

Conjoint choice models for urban tourism planning and marketing

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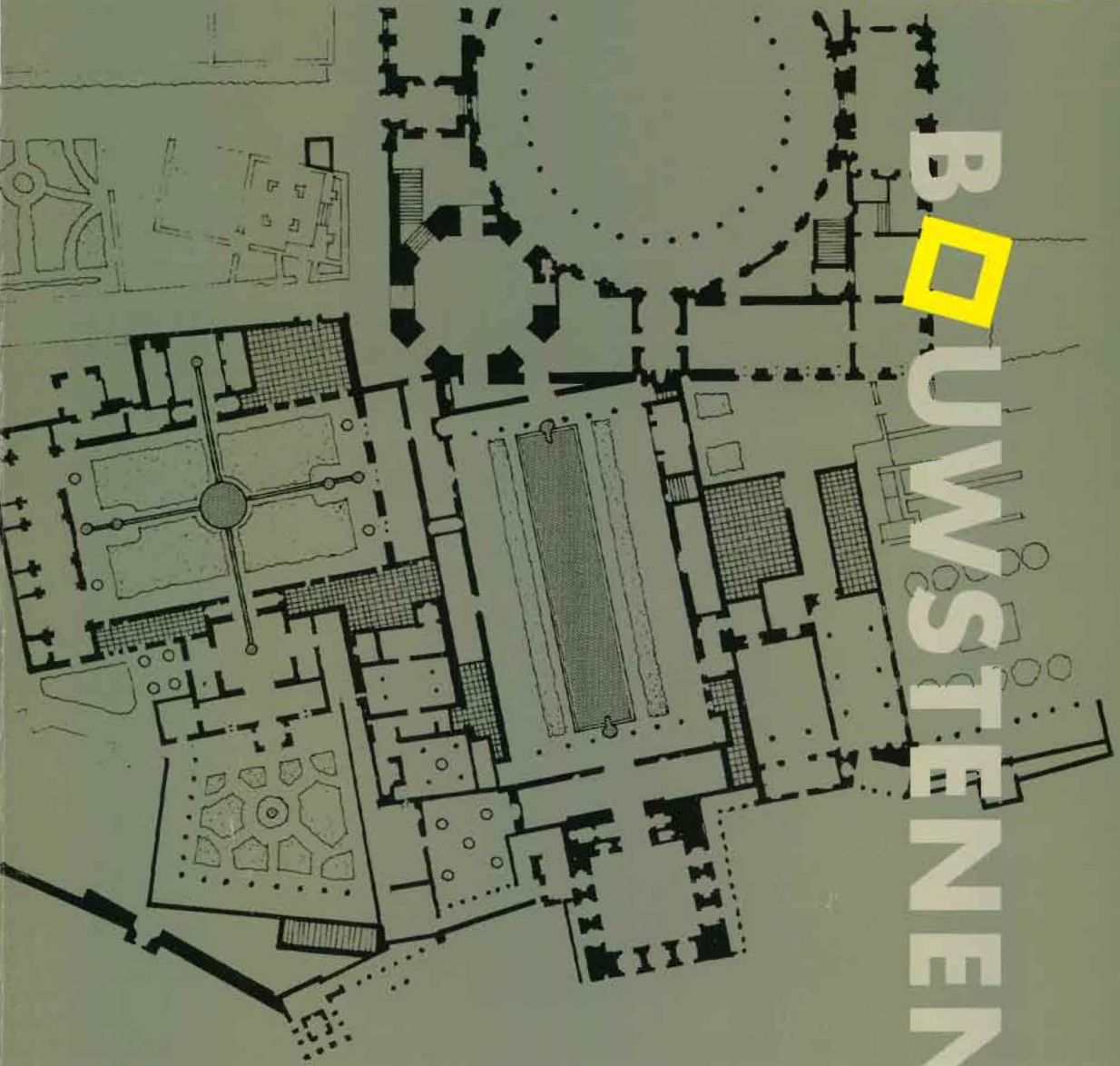
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CONJOINT CHOICE MODELS FOR URBAN TOURISM PLANNING AND MARKETING

Benedict Dellaert



BOUWSTENEN

**CONJOINT CHOICE MODELS
FOR URBAN TOURISM PLANNING AND MARKETING**

PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de
Technische Universiteit Eindhoven, op gezag van
de Rector Magnificus, prof.dr. J.H. van Lint,
voor een commissie aangewezen door het College
van Dekanen in het openbaar te verdedigen op
8 juni om 16.00 uur

door

BENEDICTUS GUSTAVUS CAROLUS DELLAERT

geboren te Nijmegen

Dit proefschrift is goedgekeurd door de promotoren:

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Granada, plan of Alhambra showing sequence of courts
within moorish palace (Wylson 1986)

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Preface

Being a PhD student in the Urban Planning Group at Eindhoven University of Technology has provided me with the unique experience of being in a real scholarly environment and has given me the possibility to study the social sciences at many different levels of aggregation. The PhD program has offered me opportunities to develop my thinking and personality that would have been very difficult to find anywhere else.

Many people and organizations have supported me in conducting the research reported in this thesis. I thank them all. There are some that I would like to mention specifically for the contributions they have made.

Harry Timmermans, my first advisor, has supported me in many ways. Not only is he a great researcher with an almost legendary capacity for multiple tasking, Harry is also a great team builder and teacher. Using his own special style of open guidance he knows how to encourage people to work independently and to develop their own special skills and areas of expertise. In a relatively short period of time Harry has been able to develop the Urban Planning Group at Eindhoven University of Technology into a true center of excellence. This, and his personal strategic insights in the world of science have helped me to learn a lot on how to do good research. Besides all that, I would like to thank Harry simply for being the nice person that he is.

I also owe much to Jordan Louviere, my second advisor. Jordan has offered me many opportunities to explore areas of research that otherwise would have been much more difficult to reach into and has been an immensely stimulating advisor from our first meetings onwards. Through his work and his personality Jordan has helped me not only in developing the line of research that I am in today, but also by offering me the wonderful opportunity to be part of the process of starting up the new department of Marketing at the University of Sydney. I look forward to working with him in the oncoming years and sharing many an evening of fine Australian wine tasting.

From my first weeks in the program onwards, Aloys Borgers has taught me many of the tricks of the trade in conjoint choice modeling that I know today. It was always a great pleasure to work with Aloys, and his continuous in depth reviews of my work have improved the quality of my research significantly.

Several organizations and people within those organizations have supported the data collection in my research. The department of Tourism of the Dutch ministry of Economic Affairs generously has funded the data collection for the second case study described in this thesis, and the faculty of Architecture, Building and Planning at Eindhoven University of Technology has made available a research grant for the data collection for the third case study. The faculty also has supported my research through travel grants to several international conferences. Travel grants from the Dutch National Science Foundation have further supported me in visiting international conferences and cooperating with researchers in other countries.

I received much practical support in the data collection from ARKE tour operators, especially from the enthusiasm of Mr John Bernaert, who was willing to distribute part of my questionnaires through the network of ARKE related travel agents. I also thank the many students that (for only a marginal fee) were willing to distribute and collect many of the

questionnaires in the Eindhoven region, especially my friends from the Tuna 'Ciudad de Luz', who will certainly love the fact that they are mentioned in this preface.

In many ways one of the most crucial aspects for success in many projects is the team in which one operates. In the past years I have been very lucky in this respect. My colleagues in the Urban Planning Group have supported me and cooperated with me in many different ways and I feel that I have learned very much from working with them. Discussions on topics inside and outside of our fields of research have helped to sharpen my mind and have made me more complete as a researcher and a human being in general (wow!). All members of the Urban Planning Group carry their own special characteristics that supplement the team and make for a very special working atmosphere in many ways.

In the final stages of preparing and defending my thesis, the support in Eindhoven of Dick Ettema, Mandy van Kasteren, Astrid Kemperman and Marcus P. Stemerding has been invaluable. Without their unique support, I simply could not have finished the final prints of my thesis in time or adequately have made the final arrangements for my formal defense.

In my present position at the department of Marketing at the University of Sydney, I again feel very fortunate to work in a group of wonderful colleagues. In the few months that I have worked in Sydney, I already have been able to learn and do many things that have enriched both my personal and professional life.

Finally, I would like to thank my parents for the continuous support that they have given me throughout my education and the unique and very dear way in which they have shaped my life.

Benedict Dellaert
Sydney, April 2 1995

1 Introduction

All through the years, the urban environment has been perceived and used, not only as an environment for necessary activities like working and housing, but also as an environment for leisure and tourism activities. The urban fabric, both in its physical and its social structure, has represented and still represents to many people one of the most enjoyable settings for recreation and tourism. Visitors to the city use many different urban facilities for their pleasure and enjoyment. They may enjoy the food in the many restaurants, admire the urban architecture and atmosphere, shop in the large variety of retail stores, or may just generally enjoy taking part in the urban life. The opportunities in the city are many and diverse.

As a consequence, many urban economies have come to depend on tourists' expenditure as an important source of income to finance their facilities (van den Berg et al. 1994). Tourists are active users of many of the most characteristic urban functions and many of these often could not be successfully operated without visitor participation. At the same time, visitors may also cause difficulties to the urban system as facilities may tend to get overused and the high investments required to sustain or enlarge the flow of tourist expenditure may not always be economically feasible (van der Borg 1991).

Surprisingly, the role of urban tourism and urban recreation has long been neglected, or at least marginalized in urban planning, and it is not until recently that urban planners have incorporated urban tourism and urban recreation explicitly in their strategies (Ashworth 1989, Inskip 1988, Jansen-Verbeke 1988, Law 1994). Only in the past decade, urban tourism and recreation facilities have been recognized as key elements in urban development, and they have been accepted as important functions in themselves, rather than derivatives or supporting functions of other urban functions such as housing and industry.

This development can be understood as part of the reaction to the deindustrialization of the urban core in the past ten to twenty years (Law 1994). In the past decades, many communities have recognized the potential of urban tourism and recreation services as a key element in revitalizing the urban environment and urban economy. As a consequence, many recent urban planning efforts have been directed towards extending and initiating urban tourism attractions in the urban core.

Urban tourism functions can only be successfully operated however if they attract sufficiently large groups of visitors. In these past years, many urban tourism planners therefore have adopted marketing oriented approaches that focus on attracting new visitors to the city (Dietvorst 1993, Gunn 1994). In these approaches it is stressed that a valid understanding of urban tourists' behavior and preferences is crucial if successful urban tourism development projects are to be created.

Marketing oriented approaches in urban tourism planning are part of a larger and more general shift in urban planning over the past decades from the use of traditional, largely supply-oriented urban planning methods to newer, more marketing oriented urban planning methods (Ashworth and Voogd 1990a, Greed 1993). Traditional planning methods were characterized by a relatively centralized and bureaucratic approach with a strong focus on constraints and physical possibilities of the existing built environment. Marketing planning in contrast is more decentralized and demand-oriented. Within certain rather generally defined social, economic and environmental limits, local governments in cooperation with local market parties set their own planning objectives. Potential changes in the urban structure are considered from the perspective of actual and potential consumers, rather than from the perspective of the available facilities. This shift in attention has led to a growing

interest of urban tourism planners in marketing research techniques that can support the evaluation of planning strategies in terms of their expected effect on urban tourists' choice behavior and the demand for urban tourism facilities.

Conjoint choice modeling is a potentially powerful method to achieve this objective. Conjoint choice modeling experiments require respondents to choose between different sets of hypothetical alternatives constructed on the basis of statistical experimental designs. The results of these choices are then used to estimate models that describe the relationship between the alternatives' characteristics and the probability that they will be selected. Thus, the impact of different planning and marketing measures on consumers' choices can be simulated.

Although conjoint choice models are commonly used to evaluate the potential consequences of management strategies on consumer behavior in marketing and transportation, they have rarely been used in urban tourism planning. There are two important reasons however why conjoint choice modeling is especially well suited to support urban tourism planning. Firstly, because it uses controlled hypothetical alternatives, conjoint choice modeling offers the possibility of measuring urban tourists' preferences for different aspects of urban tourism facilities independently. This is impossible when using modeling techniques that are based on observations of real world choice behavior, because the presence or absence of different aspects of existing urban tourism facilities are often highly correlated. Secondly, because conjoint choice modeling supports evaluations of urban tourism facilities that presently do not yet exist and can therefore be used to evaluate the very high investments that are typically required in urban tourism projects before they are actually made.

In this thesis we develop a conjoint choice modeling approach to urban tourists' choices. It is argued that urban tourists' choice processes typically involve choices between complex combinations of urban facilities, and that therefore conjoint choice models that are to support evaluation of planning strategies for urban tourism complexes should incorporate the possibility to describe choice processes that involve choices between combinations of alternatives. The term portfolio choices is used in this thesis for this type of choice processes. Traditional conjoint choice modeling techniques do however not support the modeling of portfolio choice processes.

The main *objective* of this thesis is therefore to develop a general approach to conjoint choice models for portfolio choice processes in urban tourism. Models and experimental design techniques are proposed to support the modeling of portfolio choice processes in conjoint choice models. After the theoretical discussion, the proposed approach is applied in a conceptual framework of three types of urban tourist choices. In analogy with existing marketing models that describe different types of consumers' choices (Gupta 1988, Chintagunta 1993) the proposed framework consists of three main choice types prominent in (urban) tourism research. They are: (i) participation choice, (ii) destination choice, and (iii) activity choice.

The proposed approach is tested in three empirical case studies. In these studies the choice types are operationalized for Dutch urban tourists' choices of respectively: (i) whether or not to visit different outdoor flower exhibitions, (ii) destinations and transportation modes for city trips to destinations in Belgium, Germany or The Netherlands, and (iii) activities for different periods of a weekend in Paris. The results of the studies are presented and evaluated, both on their methodological and practical planning merits. Fruitful avenues for

future research are also suggested.

To support a clear in depth discussion of the above elements, this thesis is structured as follows. Chapter 2 describes urban tourism elements in the city and introduces typical examples of urban tourism projects. It also discusses several recently proposed approaches to urban tourism planning and how they relate to marketing oriented planning techniques. The chapter defines the need for marketing research instruments that can support evaluation of planning strategies for complex urban tourism projects.

Chapter 3 reviews the literature on urban tourist behavior as well as some relevant parts of the general tourism literature. It discusses the degree to which previous tourism research results can be used to evaluate urban tourism planning strategies. It is argued that choice modeling techniques are most suitable for this purpose, and that within this category, conjoint choice models offer the most promising perspective.

Chapter 4 introduces the conjoint choice methodology and how it can be applied to urban tourists' choices. The history and background of conjoint choice modeling are discussed. It is argued that due to the complexity of urban tourism facilities and the choices that urban tourists make if they use those facilities, choice models of urban tourists' choices need to be able to capture portfolio choices. Therefore an extension of traditional conjoint choice modeling techniques is developed that can be used to study urban tourists' portfolio choice processes. A conceptual framework of three choice types is proposed to support the study of urban tourists' choice processes in a conjoint choice modeling context.

Chapter 5 presents applications and tests of the proposed conjoint choice modeling approach to urban tourists' portfolio choices. Three empirical studies on urban tourists' choice behavior are discussed. Each covers one of the choice types of the conceptual framework.

Chapter 6 summarizes the results of the empirical studies and draws conclusions. It also discusses strengths and weaknesses of the proposed approach. The chapter closes with proposals for avenues for future research.

2 Planning and Marketing for Urban Tourism

2.1 Introduction

Since urban tourism has been recognized only relatively recently as an important factor in urban planning and urban development, this chapter will first discuss recent approaches to urban tourism planning and urban tourism development projects. These approaches have mainly been developed in the past ten to twenty years as previously relatively little attention was paid to the role of tourism facilities in the city, and urban planning practice and research largely ignored the role of tourism in the urban structure (Ashworth 1989, Inskeep 1988, Jansen-Verbeke 1988, Law 1994).

The objective of this chapter is to offer an introduction to these recent developments. To achieve this objective, first elements in the urban structure are reviewed that can play a role in urban tourism planning and development, as well as examples of urban development projects in which tourism has played an important role. Secondly, recently proposed urban tourism planning methods are discussed. It will be shown that marketing techniques play a central role within these methods.

On the basis of the reviews of urban tourism development projects and urban tourism planning methods, the chapter then defines a need for marketing research techniques that can effectively support evaluation of potential urban tourism development projects.

2.2 Urban tourism facilities

Though planning for urban tourism has been somewhat neglected in the past, the design of separate urban elements to support urban tourism and recreation activities has a long tradition in the urban environment. Other urban elements that originally were not designed for tourism or recreational purposes at times also have taken on leisure functions in the urban core, or have been transformed as such. Urban design projects for urban tourism and recreation in the past have covered such various functions as theaters, cinemas, restaurants, urban greenery and water, shopping malls, tourist accommodations, bars and casinos (Wylson and Wylson, 1994). Also, in many cases cultural and monumental urban settings have been preserved to be enjoyed by residents and tourists (Ashworth 1991). The urban environment in its totality in many cities supplements the perception and use of the separate urban elements (Jansen-Verbeke 1988).

Table 2.1 summarizes the different tourism and recreation functions that the urban environment may offer. The urban market place for example is one of the oldest functions that the city offers to its visitors and residents. The market place traditionally had both a commercial and a recreational function. Nowadays, the market place function in the city is captured by a variety of retail environments, ranging from open air market places, through pedestrianized open air shopping districts to highly controlled artificial shopping mall environments.

Maitland (1990) describes how urban regional shopping centers in the U.S. and U.K. have been growing in scale for the past decades in serving as main shopping locations for their urban regions. These centers have a relatively strong functional retailing approach and often rely on so called anchor stores (stores of well known large retail chains) to draw the public. Still, their primary retailing function is always supported by other recreational facilities such as areas and places for strolling, eating and people watching.

These latter elements dominate more strongly in a category of shopping centers that can be described as specialty centers. These centers offer urban settings, richer in character and filled with more and smaller specialty shops, and further extend the traditional concept of the urban area with specialty stores and specialized market places. They also often include spaces for themed temporary retailing activities such as for example specialized clothing or food markets. A number of projects of this type has been centered around urban landmark buildings, such as old industrial sites or commercial buildings. Examples are Ghirardelli Square in San Francisco, constructed in an old chocolate factory, and the development of the Union Station in Washington, DC.

Table 2.1 Main tourism and recreation functions of the urban environment (Jansen-Verbeke 1988, Middleton 1988)

	Functions	Urban elements
1	Recreational shopping	Malls, shopping districts, pedestrian zones
2	Open air markets	Urban themes, open spaces,
3	Accommodation	Hotels, motels, apartments, conference centers
4	Restaurants and cafés	
5	Night life	Bars, nightclubs, dancing, casinos
6	Cultural facilities	Theaters, concerts, cinemas, museums, exhibitions, festivals and events
7	Greenery and water	Parks, waterfronts, urban ponds
8	Sporting facilities	
9	Public space	Open spaces
10	Cultural heritage	Urban morphology, architecture, monuments
11	Theme parks	Zoos, amusement parks, historical theme parks

In recent years, more extensive combinations of retail facilities with other urban leisure facilities have also been developed. The best known complex of this type is probably the West Edmonton Mall, which was opened in three stages in 1981, 1983, and 1985 (Maitland 1990). Due to its enormous size and its variety of functions it is often regarded as the most daring and most extraordinary shopping mall development of the eighties. It includes a wide range of retail and leisure facilities, varying from a waterpark, an ice palace, and an amusement park, to two food courts, three cinemas and a hotel with a variety of themed rooms. The more recent Mall of the Americas near Minneapolis is based on similar principles.

In general it can be seen that through the years in many cities leisure functions such as hotels, theaters, restaurants and cafés have been used as show cases of urban architecture, and have often been used to introduce new experimental architectural styles and new and imaginative design features (Bangert and Riewoldt 1993, Wenz-Gahler 1993). Many large cities have their own famous urban localities, that may carry special urban historical

memories and may have featured in books, movies and theater pieces. In many cases, the urban night life has functioned as a testing environment for avantgarde ideas in architectural design and fashion.

The urban theme park has similarly functioned as a place where people go to experience out of the ordinary surroundings and activities. Many theme parks or amusement parks have been developed in the city or at the border of the urban areas, offering physical and social settings that were very different from the normal urban life. Examples include facilities such as zoos, water amusement parks, heritage centers, and science centers (Wylson and Wylson 1994). The development of large sports facilities has also often involved large scale urban developments (John and Campbell 1993).

Similar development projects, but on an even larger scale, have been undertaken to host national or international mega events such as the olympic games or world exhibitions. For the Barcelona 1992 olympics, for example, an enormous urban development project has been undertaken, including major waterfront development, housing projects and the construction of many new sports facilities (Martorell et al. 1992). Similar developments are now taking place in Atlanta for the 1996 olympics (Mihalik 1994), and have been undertaken to host the 1992 world exhibition in Sevilla.

The above more or less independent urban elements for recreation and tourism ideally are interdependent through what is one of the most important aspects of the city in terms of tourism and recreation: the urban structure as a whole. The urban structure includes elements such as the geographical location of the city with its views, waterways and landscaping. It also includes the total composition of the built environment of the city. Some cities provide a highly aesthetical experience through the harmony of their total setting of buildings and public open spaces that greatly augments the experience of the separate elements per se. Visitors and residents can stroll along the streets, linger in the urban parks and along the water ways and can thus enjoy being in the social and physical environment of the city (Jansen-Verbeke 1988, Oosterman 1992). Historical elements in the city often contribute greatly to this experience as do social activities such as special events and festivals that may take place in the urban structure.

The urban functions in table 2.1 are often termed primary or main elements in the tourist choice process, because they constitute specific reasons for tourists and recreationists to come to the city. Several other urban functions however are also relevant to the urban tourism experience, as they represent necessary conditions for the use of the primary functions. These functions are often termed secondary functions. They are mainly related to the accessibility of primary functions. Jansen-Verbeke (1988) distinguishes three aspects in the accessibility of the urban environment as related to urban tourism and recreation: (i) transportation related functions, such as public transport, urban road systems, parking facilities, pedestrian zones, and special facilities for different user groups, (ii) usage related functions such as the timing of opening hours of different facilities, the costs of using the facilities, and the safety and atmosphere of the facilities, and (iii) information related functions, such as signage, promotion of facilities, maps of the area, the presence of tourist agencies and the tourism image of the facilities.

Not only are primary and secondary functions interrelated in the urban structure, often several primary functions are related as well. This can be the case in certain areas within the city or even within separate urban facilities. Examples of such areas and facilities include

shopping districts and shopping malls, cultural and sporting centers, and night life areas (Jansen-Verbeke 1988, Dietvorst 1993).

2.3 Examples of urban tourism development projects

In this section we will discuss typical examples of urban tourism related projects that illustrate how the different elements discussed in the previous section have been used in urban tourism development projects.

Arguably, urban waterfront development projects constitute the most interesting and most challenging category of urban development projects of the past two decades. They often represent integrated urban redevelopment projects and place a strong stress on urban tourism and recreation elements. The Baltimore Inner Harbor represents an urban waterfront development project that can be considered a real classic in its kind. It is one of the most widely discussed projects in urban design and urban planning, and has been a show case for many other urban waterfront development projects throughout the world.

Wrenn (1983) briefly introduces the history of the city of Baltimore. It is situated on the east coast in the U.S., about halfway between New York and Washington, D.C. and originally started out as a small harbor town in the eighteenth century. Its growth pattern is centered around the inner harbor area and has extended through the years because of growing industrial and transportation activities in the coastal zone. From the 1920's onwards however, the economic activities in the inner harbor area started to slow down.

This eventually led to a joint initiative of the local business community and the local government who decided in 1959 to revitalize the old urban core. At first, attention was directed towards the Charles Center, a development of part of the central business district just off the harbor. It covered more than 200,000 square meters of office space, 40,000 square meters of retailing area, a hotel, a theater and 300 apartments (Hoyle et al. 1988). The success of this development project triggered the development of an even larger scale project in 1964, which was based on the idea of creating a regional 'playground' in the inner harbor area. Tourism and recreation functions played an important role in the conception of this project, and were even further stressed in later plans that were developed in the 70's, when the development team in accordance with developments in other American cities added a conference center to the original plans. This center together with four other urban tourism functions now constitutes the core of the Inner Harbor urban development project. The other functions are: (i) Harbor place, a two storey market type shopping complex, (ii) The Baltimore Aquarium, one of the large national aquariums in the U.S., (iii) The Hyatt Regency Baltimore Hotel, a luxury hotel complex, and (iv) The Gallery, a large retailing mall. These functions are supported by several smaller urban tourism attractions such as theater and music performances, events centered around historical ships, urban parks, and several mechanical attractions. Figure 2.1 provides an aerial view of the inner harbor area.

An example of an urban waterfront development project of a different character is the Paseo del Rio project in San Antonio, Texas (Wylson 1986, Wylson and Wylson 1994). Through its historic role as a Spanish-Mexican outpost, San Antonio is one of the few cities in the U.S. with a strong historical legacy, and the project has used this legacy in its relatively strong historical orientation. The development area also differs from the Baltimore development, because it is linked to an urban riverfront, rather than a large harbor area.

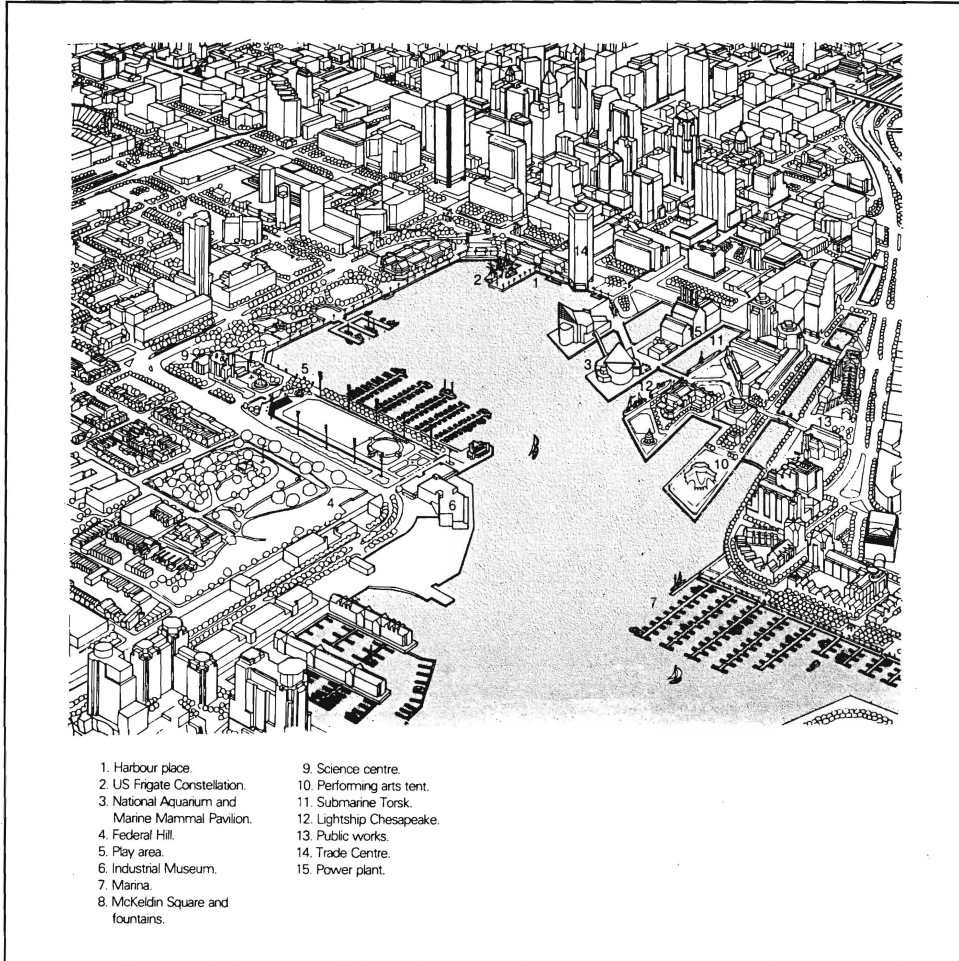


Figure 2.1 Inner Harbor Baltimore. Aerial view showing principal features enclosing water space (Wylson and Wylson 1994).

San Antonio was Texas' first city, but has later been superseded by Houston and Dallas. Especially after the first world war it has fallen behind as a business and industrial location, but it has on the other hand gained importance as a military and government center. Based on the successful conservation of its historic features and the development of new supporting tourism facilities, tourism is now its second largest industry.

The San Antonio Riverside walk is a landscaped corridor along the city's river at a lower level than the normal streets. The walk represents a place for sight-seeing, dining, socializing, listening to music and to enjoy being along the cool waterways. The area's

potential was first recognized in the 1930's when staircases were built down to the river and arched footbridges were constructed. Also, a small outdoor theater was created close to the eighteenth-century Spanish village in the city. In the 1960's legal protection from overdevelopment of the area was placed into action and a general plan was developed to support a unison in design and reconstruction of the built environment on the waterfront.

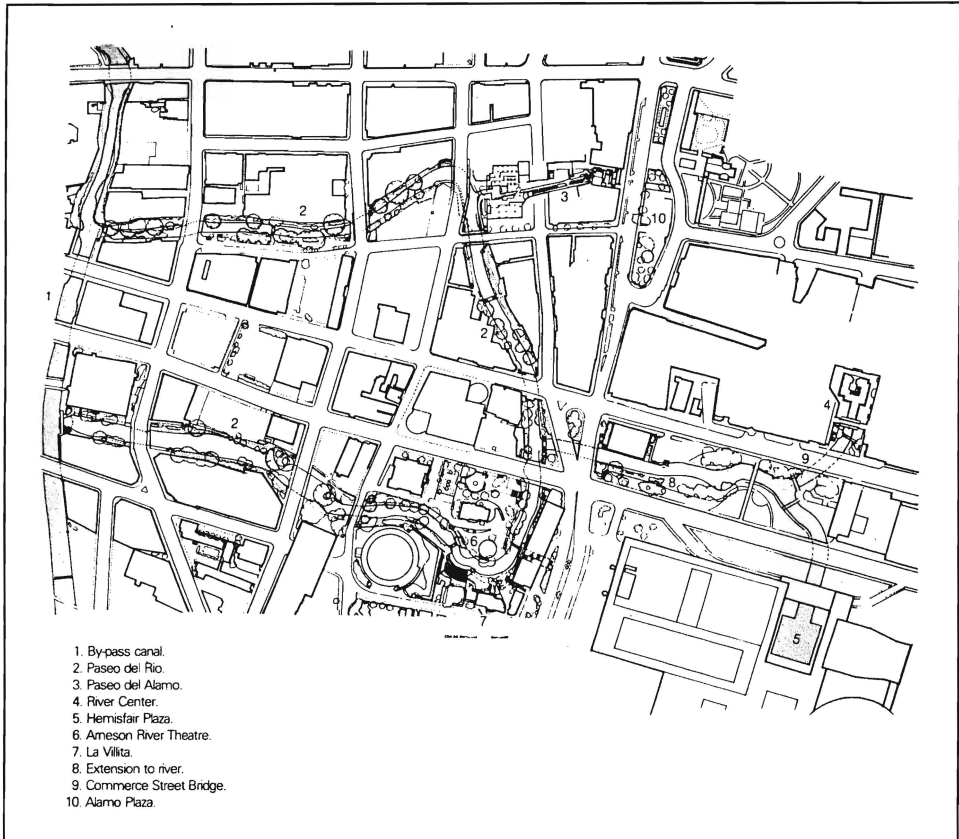


Figure 2.2 Paseo del Rio, San Antonio, Texas (Wylson and Wylson 1994).

The main Riverside walk, the Paseo del Rio, is supplemented by several smaller river branches. The Paseo del Alamo provides a link between the Paseo del Rio and the Alamo Mission Compound a major landmark in the downtown area, and the River Center is a mixed use shopping, dining, entertainment and hotel complex. The River Center was completed in 1988 and it is the first truly new branch extension to the original riverfront. Figure 2.2 provides a map of the total Riverside walk area.

As discussed, separate urban attractions have always played an important role in the

development of urban tourism and recreation. In the nineteenth century, the development of popular pleasure parks in Europe reflected the transition towards humanizing urban life in the industrial city (Wylson and Wylson 1994). The introduction of mass transportation in this period further opened up recreation and tourism to the working class.

One of the few amusement parks that still exist and operate that originate from this period is the Tivoli Gardens complex in Copenhagen, Denmark. The Tivoli Gardens represent an example of a public pleasure garden as it was originally developed in England, and that later became popular throughout Europe. The complex provides several richly landscaped garden areas and a number of specially designed buildings for dining and entertainment. Figure 2.3 offers a view of the Tivoli Gardens.

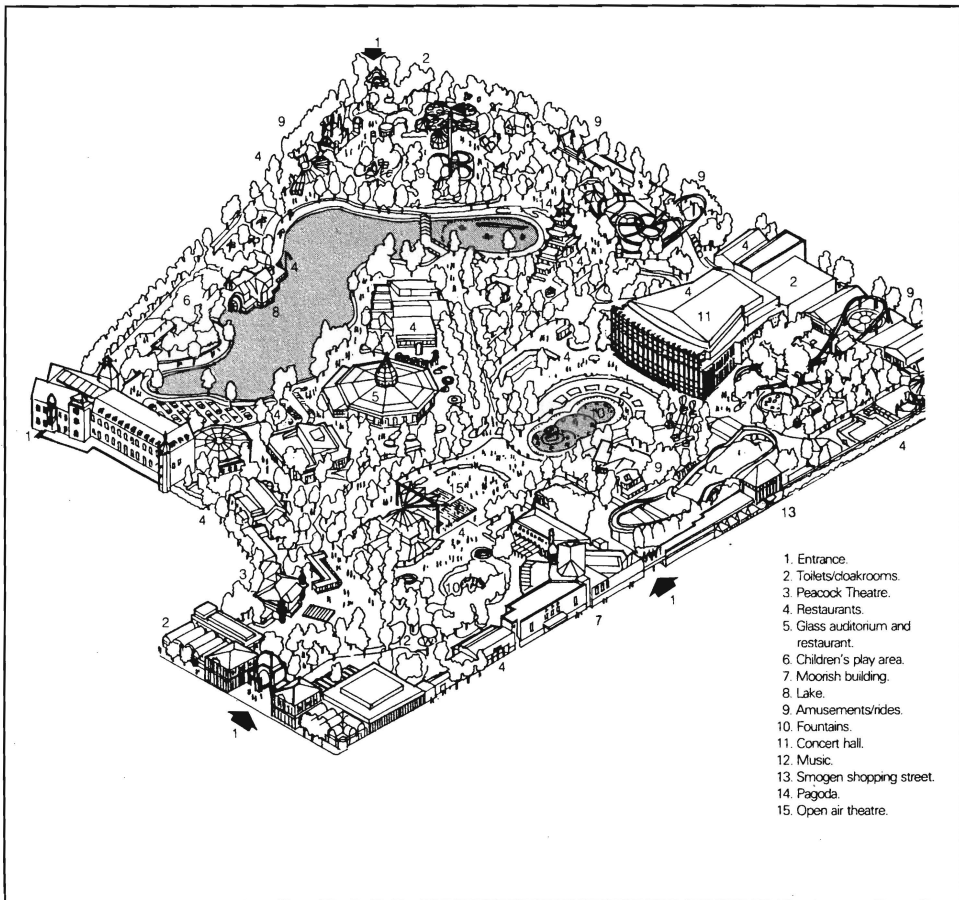


Figure 2.3 Plan of the Tivoli Gardens (Wylson and Wylson 1994).

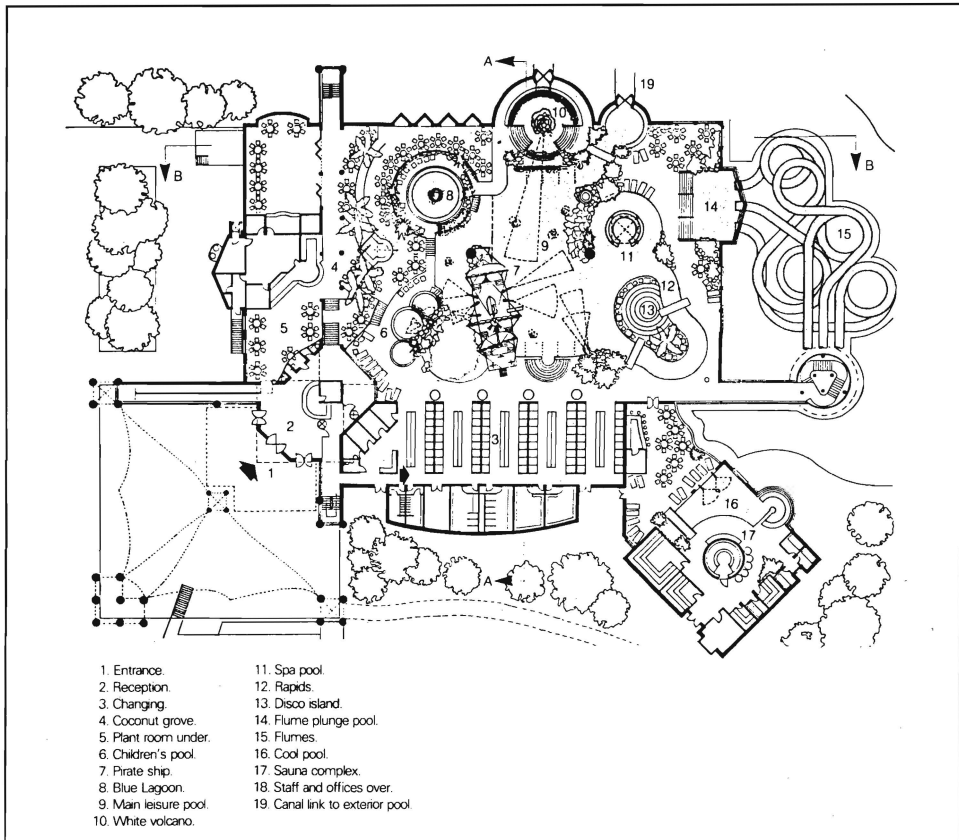


Figure 2.4 Coral Reef, Bracknell (Wylson and Wylson 1994).

Other, more recently developed urban attractions include such various facilities as water parks, amusement parks, historical heritage parks and science centers. Most of the recently developed attractions are highly diverse and complex in character and offer a number of different facilities to the visitor. Figure 2.4 presents a development of the water park Coral Reef in Bracknell near London (Wylson and Wylson 1994). It features a tropical pool, with a series of linked pools and canals, special themes and functions such as geysers, bubbles and a disco island. Other special elements include a replica of a pirate ship, an artificial tropical storm every twelve minutes, saunas, flumes, and café terraces. Figure 2.5 shows the Middle Kingdom theme park in Hong Kong. The Middle Kingdom park is an urban theme park that is based on a construction of historical heritage elements. It brings together for the visitor a reconstruction of historical Chinese buildings over a period of thirteen dynasties or 5000 years ranging from 2900 BC to 1911 AD (Wylson and Wylson 1994). The park includes buildings representing the different periods in the history of China

incorporating several tourism and recreation functions such as a theater, souvenir shops, a restaurant and tea pavilion, and an exhibition hall.

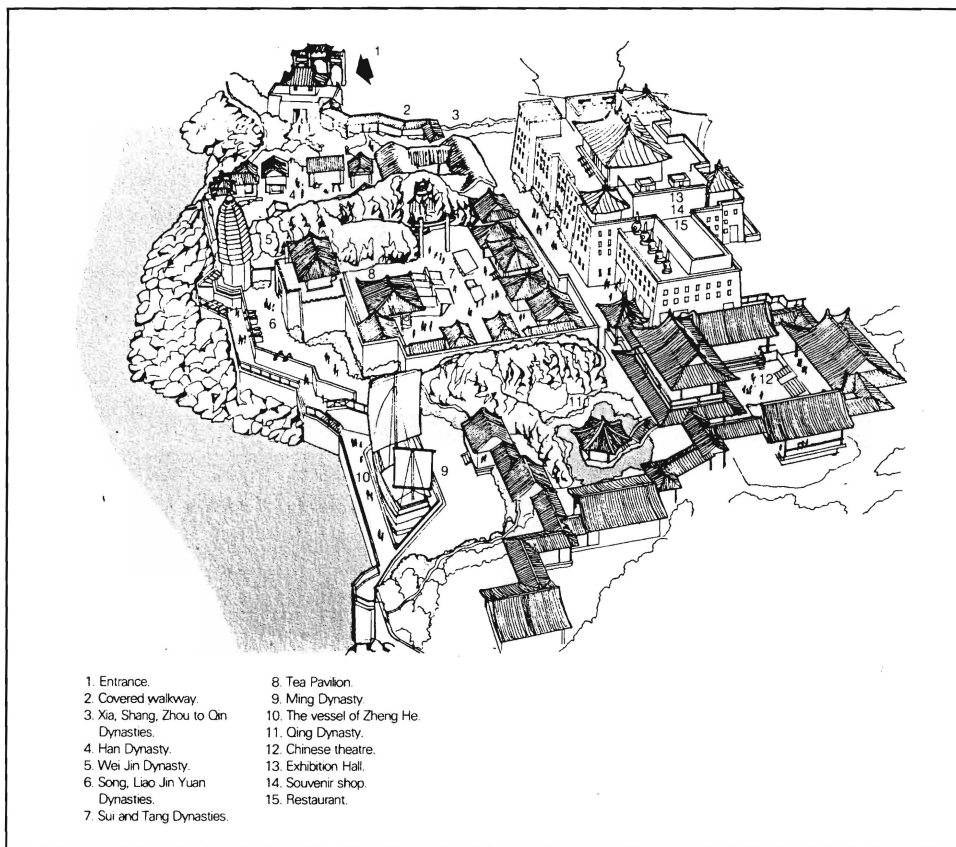


Figure 2.5 Middle Kingdom, Hong Kong (Wylson and Wylson 1994).

Retailing environments have always had a special position as attractions for urban tourism and recreation, and the design of shops and urban market places has often received extra attention in urban history. In the medieval and renaissance eras in Europe, many Italian cities had extensive systems of street arcades to support retailing and trading and transport between different areas of the city (Bednar 1990). Later, at the beginning of the nineteenth century the covered commercial arcade was invented and developed in France and England. It created a protected and undisturbed atmosphere for shopping and promenading. The twentieth century suburban and urban shopping mall, developed in the United States can be regarded as a further continuation of the concept of the shopping arcade. The urban mall has since been developed into a more general urban recreation and tourism facility, drawing in

visitors not only by offering a rich and diverse shopping environment, but also by offering a variety of other facilities, such as theaters, exhibition spaces, events, sporting facilities, cafés and restaurants and even hotels (Bednar 1990, Maitland 1990).

Figure 2.6 presents an overview of one of the classic arcades of the nineteenth century. It is the Galleria Vittorio Emanuele II, constructed in Milan from 1865 to 1877. The Galleria Vittorio Emanuele II is regarded by many as the most impressive example of the concept of the nineteenth century arcade, and its construction resulted in a true competition between other Italian cities attempting to build equally grand arcades (Bednar 1990).

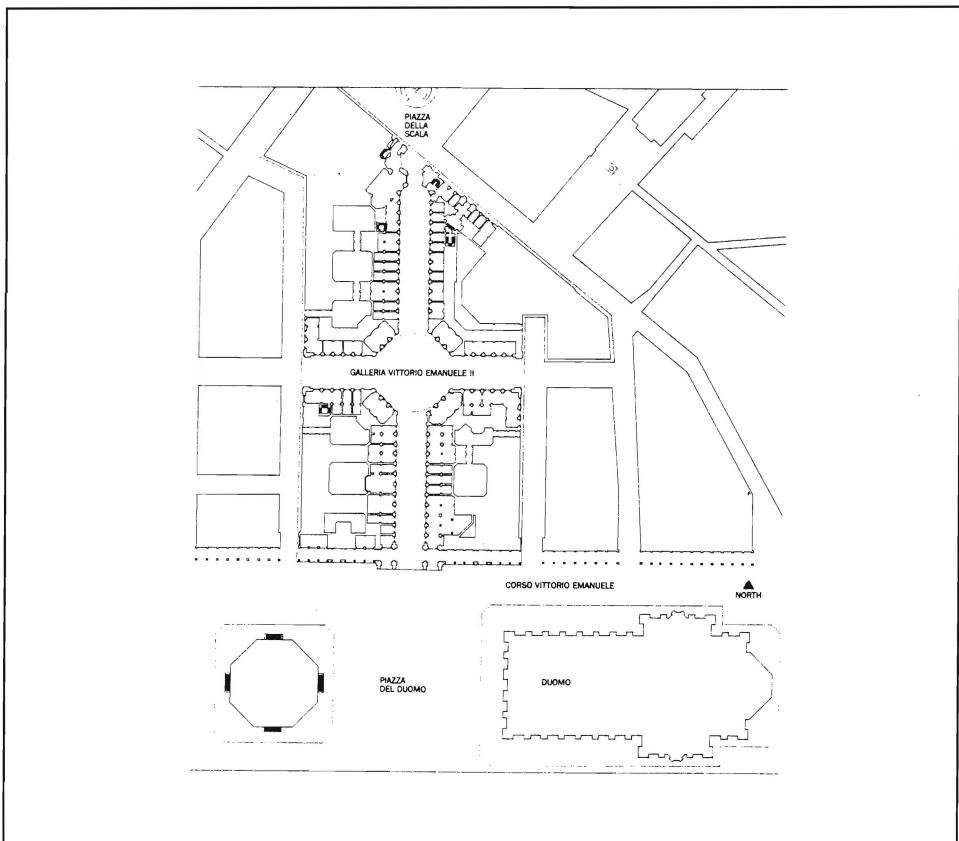


Figure 2.6 Galleria Vittorio Emanuele II, Milan (Bednar 1990).

The success of the Galleria can be explained by its important function in connecting the two most important places in the city of Milan: The Piazza del Duomo and the Piazza della Scala, which are the locations of respectively the cathedral and the opera house. Also, the Galleria functions as a meeting place in itself, where people go to promenade, shop,

meet, or dine.

An example of a contemporary shopping mall development is shown in figure 2.7. This figure shows the Horton Plaza in San Diego. This complex was opened in 1985. It was one of a number of new retail developments that at the time opened up in the centers of American cities after a long period in which new retail developments mainly took place in the suburbs. The complex houses many smaller specialty shops and represents a move away from the traditional American mall that is based on a concept in which several large department stores function as main visitor generating elements. The complex is typical for its architecture that uses a multi-levelled gallery structure and combines many visually separate elements to create a highly diverse view of the total mall structure (Maitland 1990).

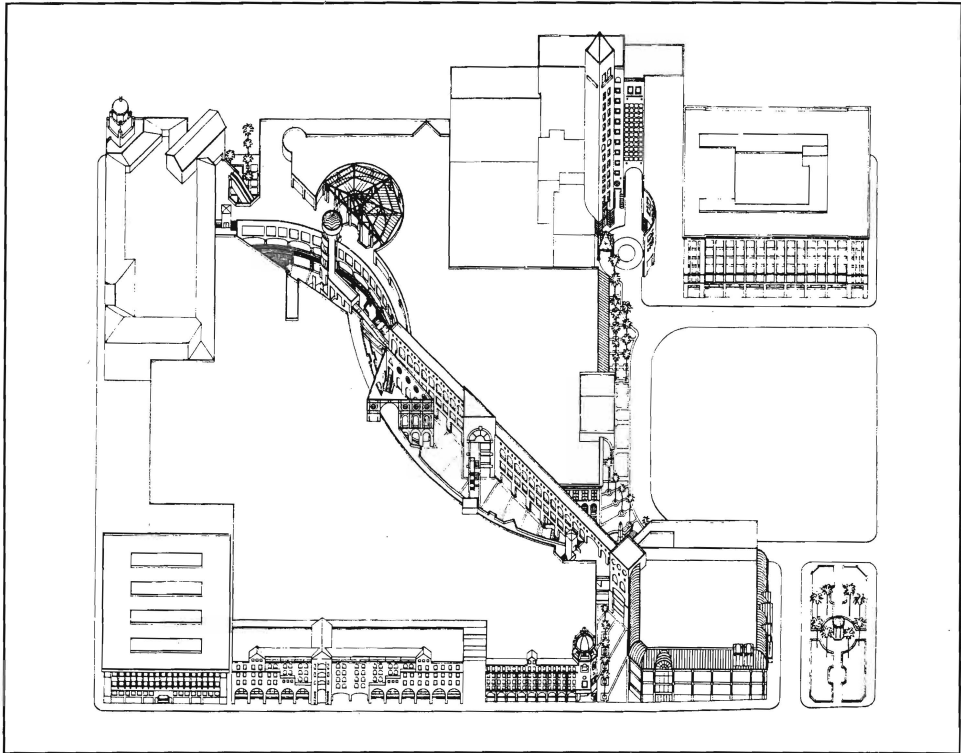


Figure 2.7 Horton Plaza, San Diego (Maitland 1990).

In reviewing the above examples, it can be seen that there are several elements that the different projects have in common. First, all projects required very high initial investments, secondly, most projects were organized as a public-private partnerships, with strong commitments from both sides, and thirdly all projects combined several urban tourism elements within the same facility or location.

2.4 Recent approaches in urban tourism planning

Two major trends can be perceived in the relationship between urban planning and urban tourism and recreation. The first trend is that tourism is increasingly being recognized as a main function of the urban environment, and that consequently, tourism elements have been incorporated in many urban development projects (Law 1994, Maitland 1990, Wylson 1986). The second trend is that tourism oriented elements are being incorporated in many non-tourism oriented planning projects (Sorkin 1992). This second trend is sometimes referred to as the Disneyfication of the urban environment, and it has been argued that the urban environment is slowly being turned into a theme park, where nothing is real and all is but an image of an imaginative utopia (Sorkin 1992, Urry 1990). Thus, it can be seen that there is a shift in attention in urban planning and design, not only in the sense that tourism is targeted more and more as a specific function, but also in the sense that tourism and recreational elements are used as an source of inspiration in the planning and design of other urban functions.

An important aspect that these two trends have in common is that they both have a strong marketing orientation and that they place a strong focus on meeting the preferences and demands of the general public (Crawford 1992, Dietvorst 1993, Jansen-Verbeke 1988, Law 1994, Veal 1993). This basic marketing orientation can be understood as part of a broader movement in planning and design that recognizes that on the one hand user needs should be met in the built environment, but that on the other hand entirely participatory planning and design strategies can seldom be successful due to information, time and budget constraints at the conception of urban planning projects (Ashworth and Voogd 1990a, Greed 1993, Hayward and McGlynn 1993, Katz 1994).

In terms of the organizational process that underlies these planning efforts it can be seen that a strong stress is generally placed on incremental, process oriented planning strategies, that also involve public-private partnerships. The public party aims to set out a relatively stable strategic framework for urban development. This covers both the overall planning objectives such as the general functional focus and the main urban areas to be developed, and the legal constraints, such as the environmental and social conditions that the projects should meet. Private parties are then stimulated to optimize their investments and activities within this framework, by leaving the actual implementation of the plan relatively open at its conception. Successful projects often involve major investments over a period of years, with a strong commitment from both the public and private sector in terms of financial and organizational input in the process.

Several studies have described and promoted this type of planning approach. In order to be able to develop projects that meet urban tourists' preferences all place strong emphasis on marketing strategies and marketing research techniques. Jansen-Verbeke (1988) describes the urban tourism planning process applied in several Dutch cities in the following four phases: (i) identification of urban tourism resources. In this phase local planners and decision-makers determine which elements, facilities and characteristics their city has to offer to tourists and recreationists. (ii) evaluation of local strengths and weaknesses, where the elements are evaluated in terms of their tourism potential. (iii) determining the relative market position of the city. In this phase the tourism resources are analyzed in terms of their relative position as compared to competing urban destinations, and (iv) developing promotion

policies, which includes the selection of a marketing and communication strategy.

Dietvorst (1993) suggests a similar, but somewhat more elaborate, approach to (urban) tourism planning. He proposes an approach in five steps that aims to stimulate tourism development while at the same time setting strategic goals for the direction of the development: (i) the first step he proposes involves mapping out the potential elements of the urban tourism product. The list of possible tourism and recreation functions of the cities presented in table 2.1 can be used as a checklist for this exercise. (ii) the second step in the process is to create spatial and functional clusters using the selected elements. Questions that need to be addressed in this stage include: (a) are different functions competing or complementary elements?, (b) what is the relationship between the public sector and private sector elements?, (c) is there any form of cooperation between different parties in terms of e.g., research and marketing efforts?, (d) which elements are mainly locally controlled, and which are mainly controlled from outside of the region (e.g., hotel chains, retailing chains)?, (e) what are the economical clusters that already exist, and can they play a role in stimulating local economic growth?, and (f) how do visitors and residents cluster the existing elements, in terms of their perception and their use of the facilities? (iii) the third step involves determining the target groups for the urban tourism planning and marketing efforts. Research for this step can be partly based on previous research and existing data, but will often also require collection of primary data, through interviews, observations or questionnaires. An important focus point in this stage is to determine the different market segments within the total group of urban tourists and recreationists in terms of temporal and spatial preferences. On the basis of the knowledge developed in the third step, (iv) the fourth step in the planning process involves a SWOT (strengths, weaknesses, opportunities and threats) analysis of the urban tourism product. This step includes an analysis of likely future social and demographic trends, a sensitivity analysis of the projected planning policy, and an analysis of likely market developments in terms of consumer preferences and competitor behavior. (v) The fifth step then determines the overall planning strategy. It selects the preferred development strategy: (a) expansion of the tourism activities, (b) consolidation of the present position in the market, or (c) restriction of the present activities, for example if overusage of historical or natural resources occurs. It also selects the tourism functions that will receive a main focus in the development strategy.

A third, somewhat more small scale oriented, but again similar process is proposed by Gunn (1994). He introduces nine planning steps in what he terms the tourism site planning concept. In his view, the site planning team consisting of designers, developers, and local public officers should go through these steps when developing a tourism project. He remarks that two important aspects distinguish the tourism planning from more general urban planning. Firstly that there is relatively little information with regard to the final users, and secondly that resource protection is often more relevant in tourism settings than in other settings. The nine steps Gunn proposes are: (i) market analysis, to develop an understanding of the potential tourist users of the site, (ii) program statement, to list and describe which elements are to be developed, (iii) site selection and program revision, in which designers and developers conduct a preliminary study of several prospective sites for the tourism development project, (iv) site analysis, which is a detailed analysis of the selected site in terms of (a) the constructed elements present at the site, (b) the available natural resources, (c) its perceptual characteristics and (d) several off-site factors such as surrounding land uses,

waterways, sounds and smells, views, utilities and accessibility, (v) synthesis, a check on the relationship between the proposed development plan and the market analysis, (vi) conceptual design, in which the design team creatively conceptualizes a plan for the site, (vii) feasibility study, when on the basis of the conceptual plan a feasibility study is conducted in terms of financial, social and environmental aspects of the plan, this then leads to (viii) the final plan, where the conceptual plan is refined into the construction drawings, the technical specifications and the legal contracts. After the plan is constructed a last step is introduced that involves (ix) evaluation of the proposed plan and its projected usage.

The dynamic character of the tourism market often requires constant adaptations of tourism development projects and improvements of earlier developed sites. All three planning approaches therefore allow for and promote the idea of feedback between the different phases in the planning process, and recognize the importance of evaluation of assumptions and implementations of earlier phases, when making decisions in later phases.

Although the above approaches vary in the emphasis that they place on the different elements in the urban tourism planning process, they share the following four general stages: (i) analysis of the present urban tourism product and its competitors, (ii) analysis of urban tourists' preferences and choice behavior, (iii) developing plans and designs for urban tourism facilities, and (iv) evaluation of these facilities in terms of their expected impact on urban tourism demand.

The four planning stages clearly differ in terms of their information needs, and consequently in their needs for specific urban planning research projects. The first stage is relatively straightforward and in most cases does not require advanced research techniques. Most data required in this stage can be collected and analyzed quite easily. The third stage also has relatively low information needs. It strongly focusses on design and development of creative planning concepts and these activities are typically based on previous experience and design skills. The second and fourth planning stages however generally require a stronger research component. The objective of the research in these stages is to develop a better understanding of urban tourists' preferences and the consequences of urban tourism projects on urban tourists' choice behavior. The two stages are strongly interrelated, and ideally marketing research of urban tourists' preferences conducted in the second stage leads to a research instrument that can be used to evaluate potential urban tourism development projects in the fourth stage. In these two stages one can recognize the strong demand orientation of the discussed urban tourism planning approaches and the key role that marketing research plays in these urban tourism planning processes.

2.5 A framework of constraints for urban tourism planning and marketing

Many authors draw attention to the relevance of defining a framework within which tourism development should take place. It has often been argued that the tourism sector is relatively sensitive to overusage of tourism resources and that it is important to determine the level at which tourism development is still sustainable.

Three aspects of sustainability are generally distinguished: (i) economical, (ii) social, and (iii) environmental sustainability (Glasson 1994, Gunn 1994). These aspects imply that in order for a tourism development project to be successful it should be (i) economically

feasible, which means that in the long run it should generate sufficient income to operate economically independently. Tourism projects should also be structured in such a way that they do not undermine or permanently damage (ii) the social and (iii) ecological systems that they operate in.

It is generally recognized that urban planning and marketing efforts should operate within this framework of sustainability and that government regulations and public-private development teams should actively impose this framework on all parties involved in urban tourism development to prevent long term economical, social and environmental damage (Gunn 1994, Kotler et al. 1993, McMahon 1993, van der Borg 1991).

In addition to these sustainability limits, several authors have argued that separate urban tourism developments within the same city should be framed within a common set of strategic goals and directions. Dietvorst (1993) for example stresses the relevance of developing an interrelated network of tourism facilities in terms of their themes and functions within regions and cities. Others (Hayword and Mc Glynn 1993, Katz 1993) have similarly stressed the importance of a common urban design code as framework within which individual projects can be designed.

2.6 Marketing urban tourism

The marketing element in urban tourism planning can further be specified on the basis of concepts developed in the marketing literature. Kotler (1994) defines marketing as a social and managerial process by which individuals and groups obtain what they need and want through creating, offering and exchanging products with others. The term products in this context covers physical products, service products and all other elements that are capable of delivering satisfaction of a persons' wants or needs. From this perspective, urban tourism marketing can be regarded as an exchange process between urban tourists enjoying urban tourism products on the one hand and deliverers and producers of urban tourism products on the other hand, where the term urban tourism product covers all physical and service products involved in the urban tourism experience.

In the same text, Kotler also introduces the societal marketing concept. This is an organizational approach that organizations should follow if they want to responsibly implement the marketing orientation in their activities. The societal marketing concept holds that the organization's task is to determine the need, wants and interests of target markets and to deliver the desired satisfaction more effectively and efficiently than competitors, and in such a way that it preserves or enhances the consumer's and society's well being. In the context of urban marketing (or place marketing in general) this concept can be operationalized in the following four core activities (Kotler et al. 1993): (i) designing the right mix of community features and services, (ii) setting attractive incentives for the current and potential buyers and users of the city's physical products and services, (iii) delivering the city's physical products and services in an efficient and accessible way, and (iv) promoting the city's values and images so that potential users are fully aware of the place's distinctive advantages.

To this aim, four broad strategic marketing approaches are generally applied in urban marketing strategies (Kotler et al. 1993). The first approach is image marketing. This often

is the least expensive element of the total marketing strategy and involves communication about the present features of the city. The second approach is to develop or exploit artificial, natural, or social elements that can attract visitors. Goodall (1990) mentions five strategies that are specifically suitable to provide a unique selling proposition in the tourism branch, i.e. strategies to provide a tourism product that can not be matched by other destinations. Each strategy optimizes one of the following five aspects: (a) the reliability of the urban tourism product which involves providing a highly predictable service to the tourist, (b) the quality of the urban tourism product, for example in terms of service or luxury, (c) the design or style of the urban tourism product, as this can be highly unique for some urban environments, (d) the price of the urban tourism product, which involves improving the degree to which the tourists perceives to get value for money, and (e) the flexibility of the urban tourism product, where some destinations may offer higher flexibility than others in terms of e.g., the activities, prices and physical environments that they offer to the tourist. The third marketing approach Kotler et al. (1993) introduce is to develop or improve the urban infrastructure in terms of the available transportation, utilities and information facilities. The fourth approach is related to social aspects of the city and may for example involve developing or promoting cultural elements, educational standards, and safety aspects of the city.

In discussing the marketing of the (urban) tourism product several authors in marketing research have pointed out specific marketing characteristics of the urban tourism product as compared to more traditional products. Middleton (1988) mentions: (i) the seasonality and fluctuations in the demand for tourism services, (ii) the interdependence between various elements of the total tourism product, such as for example between transportation and attractions, (iii) the high fixed costs and initial investments of most tourism services. He also discusses essential characteristics that the tourism product shares with other services products and that are different from those of traditional physical products. They are: (i) the inseparability of production and consumption. This implies that services are mostly hard to inspect on beforehand, and that often consumers have to move to the place where the service is delivered, (ii) the perishability of the service product due to its production process that is fixed in both time and place. This aspect also implies that there is no possibility to create or hold a stock of services products, (iii) the purchase of services does not give ownership, but is limited to a fixed time and place. Ashworth and Voogd (1990b) add to this list four other elements that are characteristic of the tourism destination product: (i) the destination is at the same time the tourism product itself, and a container of an assemblage of other tourism products, (ii) every place or destination is inevitably a component in a hierarchy of spatial scales, (iii) the total tourism product is largely assembled by the consumer rather than the producer, and (iv) the physical space and many of the facilities and attributes of that space are multi-sold: They are at the same time sold to different groups of customers and for different purposes.

Many of the above characteristics of the urban tourism product increase the risks involved when investments are made in urban tourism development projects. Not only are the initial investments and fixed costs that are required in most urban tourism projects very high, but the strong fluctuations in demand, the strong interdependence of different elements of the urban tourism product, the perishability of the product, and the relatively low level of control that the producer has over the final product that the consumer encounters, further

increase the risk in developing urban tourism projects. The strong emphasis that urban tourism planning approaches place on marketing research techniques that can be used to evaluate potential urban tourism development projects, helps to control this risk.

2.7 Conclusions and discussion

This chapter reviewed elements in the city that can have urban tourism functions and their role in past urban tourism projects. Examples of urban tourism facilities included shopping malls, cultural and sporting centers, bars and restaurants, and accommodation facilities. From the review of examples of past urban tourism projects, it was concluded that urban tourism projects generally require high initial investments, are typically based on public-private partnerships and often combine several different urban tourism elements. Examples of projects that incorporated strong urban tourism components included urban waterfront developments and mega-mall developments. These projects combined, amongst other functions, retailing, cultural, accommodation and dining facilities.

The chapter also reviewed recently proposed marketing oriented planning approaches towards urban tourism development. All reviewed approaches had a strong demand orientation and placed special emphasis on evaluating potential urban tourism projects in terms of their expected impact on urban tourism demand. The relevance of this aspect in the total planning approach was further stressed on the basis of the review of aspects specific to urban tourism marketing. It was concluded that several elements in the urban tourism product make it specifically urgent to evaluate potential urban tourism projects on their expected impact on urban tourism demand. These elements include very high initial investment and fixed costs requirements, strong fluctuations in demand, strong interdependency of urban tourism elements, perishability of the urban tourism product and a low level of control over the final product for the producers of urban tourism products.

It can therefore be concluded that urban planning research to support urban tourism planning should ideally be able to support evaluation of urban tourism projects in terms of their expected impact on urban tourism demand. This research would allow urban tourism planners to first study urban tourists' preferences for different urban tourism facilities, and then evaluate the impact of potential urban tourism projects on urban tourism demand. In the next chapter we will therefore review the urban tourism literature from this perspective.

3 Understanding Urban Tourists' Choices

3.1 Introduction

The previous chapter showed that studies of urban tourists' preferences and choice behavior comprise an essential stage in recently proposed urban tourism planning approaches. They are used to support evaluations of potential urban tourism projects in terms of their expected impact on urban tourism demand. In this chapter we will review studies in urban tourism behavior that may provide further insight in urban tourists' preferences and choice processes. We will first discuss general insights from socio-cultural research in urban tourism that are relevant to urban tourism planning. Then, more specific studies that explored and described urban tourism behavior will be reviewed.

It will be argued that though these studies provide valuable insights in urban tourism behavior and especially in urban tourists' activity patterns, their potential to support evaluations in urban tourism planning is relatively weak because they do not allow one to systematically relate and quantify the relationship between urban tourism projects and their expected impact on urban tourism demand. Therefore the general tourism literature also is reviewed on this point. First, studies that introduced conceptual models of tourists' choice processes are discussed. It can be seen, that these studies also provide relatively few tools to evaluate urban tourism projects. A more fruitful approach can be found in studies that focus on modeling tourists' choice behavior. Though these studies typically simplify the total tourist choice process or cover only part of it, they have the distinct advantage that they allow one to quantify and test the relationship between elements of competing urban tourism products and the probability that they will be selected.

Two different modeling approaches that are commonly used to model tourists' choice processes are discussed. They are the revealed preference or econometric approach and the stated preference or conjoint analysis approach. Typical examples of studies that modeled and quantified the outcome of tourists' choice processes are provided.

The chapter closes with a comparison of the strengths and weaknesses of the different modeling approaches. It is concluded that conjoint choice modeling offers the most promising perspective as a marketing research technique to support ex-ante evaluations of urban tourism projects in urban tourism planning.

3.2 A socio-cultural perspective on urban tourism

One of the most central notions in the literature that discusses tourism from a socio-cultural perspective is the observation that western societies in the present period go through a shift in their socio-economic structure from what is referred to as a system of (Fordist) mass production and consumption to a system of post-Fordist production and consumption (Urry 1990). The latter system is also sometimes described as a combined structure of postmodern consumption and flexible production (Mullins 1991).

Urry (1990) defines the ideal type of Fordist mass production and consumption with the following set of characteristics: Compared to earlier periods, there is a high and growing rate of expenditure on consumer products. This is made possible by the combination of large scale production and consumption. Consumers buy the products that are produced under the conditions of the mass production system, that at the same time provides the conditions so that they can earn enough money to do so. An important characteristic of the system is that

often only one or a few producers dominate the market for particular industrial goods. It can be seen that producers rather than consumers are dominant in the market process and that there is relatively little differentiation between goods and services. The products that are available tend to reflect the producer's interests rather than the consumer's interest. This applies for both the private and the public sector.

Several aspects distinguish the post-Fordist structure from the Fordist structure. At the most general level it can be observed that there is a shift in focus in society from the production to the consumption side of the market process. This shift takes shape in several different but related aspects (Mullins 1991, Pahl 1989, Urry 1990).

One of the most important aspects is the tendency towards greater flexibility in the production of goods and services. Producers and especially consumers obtain a greater control over the elements that they include in their commercial transactions. Consumers can for example take care of services that were formerly part of the production process, such as transportation or design, or they can construct their own product packages from goods and services modules, for example when they define their own personal tourist activity packages. In some cases the producer and consumer role can even be combined in the same individual or organization, for example in urban nightlife, where participants at the same time consume and create a certain attractive atmosphere (Oosterman 1992). In the extreme, this tendency of intermixing production and consumption aspects can be observed in the case of internal marketing strategies that organizations adopt, for example when hotel chains develop marketing strategies that not only aim to satisfy their customers but also their personnel, all to create an optimal total service product (Kotler 1994).

The greater flexibility in the production-consumption structure also opens up the possibility of a greater diversification in goods and services. Post-Fordist marketing implies a personalized relationship between producer and consumer, with a stronger emphasis on special design, made to order production and just in time logistic processes. It can also be observed that there is a tendency to decentralize professional services in small businesses, where free-lancers and specialized professionals produce goods and services both as suppliers to other producers and directly to the consumer. The role of the producer is at times redefined from a supplier per se, to that of a partner in a process in which the consumer and producer jointly define and create the service to be delivered. Sometimes the production process itself may even become an essential part of the service that is being delivered. Tourists may for example enjoy watching craftsmen work in unusual production processes, or may visit typical production sites where they can buy personalized souvenirs (Sorkin 1992).

A final shift in the production-consumption system, is a general move from the production and consumption of necessities to the production and consumption of pleasure oriented goods. It can be argued that in the western societies the system of mass production and consumption has provided the possibility to provide the necessary goods and services, and that the post-Fordist structure further extends consumption from there. Bauman (1988) for example defines the essence of postmodernity as the consumption of pleasure, and Pahl (1989) argues that if the factory chimney was the symbol of the nineteenth century in Europe and North America, the equivalent at the end of the twentieth century is the shopping mall. Mullins (1991) describes an urbanization concept based on tourism development and introduces the notion of the 'consumption compound' in the city, which refers to the large

specialized facilities that have been developed in many urban areas and that offer specific pleasure facilities, such as cultural or retailing centers that package the arts and specialized shops in large urban complexes for convenient consumption. Examples of design and planning for such facilities can be found in for example Maitland (1990), Sawicki (1989) and Wylson and Wylson (1994).

Summarizing, it can be seen that the above socio-cultural perspective supports and confirms the fact that urban planning strategies place a growing emphasis on urban tourism and urban recreation. Key trends that it distinguishes are a shift from the consumption of necessities towards pleasure-oriented consumption, a growing diversification of production, and customization of consumer-producer relationships. On the basis of these trends the following questions become relevant: What preferences do urban tourists have, especially for combinations and complexes of alternatives, and how can urban planners comply with these preferences? These questions can however not easily be answered on the basis of the discussed socio-cultural research results as they offer a general perspective rather than specific insights in urban tourists' choice behavior. In the next section we will therefore review descriptive studies in urban tourism that have studied urban tourists' preferences and choices.

3.3 Descriptive studies of urban tourists' choice behavior

There are only relatively few studies that have specifically addressed urban tourists' preferences or choice processes. One of the first and at the same time most comprehensive studies in the area has been conducted by Jansen-Verbeke (1988). In 1985, she studied urban tourists motives and activities in several smaller Dutch tourist towns. It was found that the three most frequent activities both for local visitors and for tourists from outside of the region were: (i) visiting a restaurant, café or bar, (ii) walking around in town as a recreational activity, and (iii) shopping. The elements of the urban environment that appealed most to tourists were the total physical urban setting (such as urban morphology, parks, and tourism infrastructure), and the shopping facilities. The main motives for visitors to come to town were to take a break for a day or to go shopping. Tables 3.1 to 3.3 provide a more extensive overview of the different activities, preferences and motives that tourists mentioned in the study.

Two studies on urban tourism conducted in North-America are Woodside et al. (1989) and Murphy (1992). Woodside et al. (1989) analyzed data from the 1985 Canadian 'U.S. Pleasure Travel Market Study', with a special focus on data for the city of New Orleans. They found that across different destinations the ten aspects that American urban tourists found most important in their past city trips were: (i) a variety of restaurants, (ii) the local cuisine, (iii) the fact that they were visiting a big city, (iv) walking and strolling through the city, (v) to go shopping, (vi) museums and galleries, (vii) predictable weather, (viii) elegant and sophisticated restaurants, (ix) first class hotels, and (x) budget accommodations. With regard to New Orleans, they found that the top five reasons why respondents went to New Orleans were: (i) shopping, (ii) dining and restaurants, (iii) to do something different, (iv) to get away, and (v) sightseeing. In his study of the Victoria, B.C. downtown area Murphy (1992) especially focused on urban tourists' use and appreciation of heritage elements. He

found that the dominant pattern for all visitors was to stroll around the down town area, with an occasional stop at some of the heritage stores, and that only some visitors really studied the heritage sights through plaques and notices.

Table 3.1 Urban tourists' activities in the city ($N = 375$) (Jansen-Verbeke 1988).

Activities	Tourists in percentages
Visit a restaurant, café, bar	65.6
Walk around town	55.5
Shopping	49.6
Sightseeing	26.4
Visit family or friends	11.7
Visit an open air market	10.4
Visit a museum	10.1
Business	8.3
Organized city walk	0.4
Non-response	12.0

Table 3.2 Main motives for urban tourists to visit a city ($N = 375$) (Jansen-Verbeke 1988).

Motive	Tourists in percentages
To take a break	29.4
Shopping	13.6
Business	12.7
Visit family or friends	10.4
Sightseeing	9.1
Visit a restaurant, café, bar	6.9
Walk around town	3.2
Visit an open air market	2.9
Daily purchases	2.7
Visit a museum	1.1
Other motives and non-response	9.3

Table 3.3 Elements in the city that urban tourists rate as important ($N = 1137$) (Jansen-Verbeke 1988).

Elements	Tourists in percentage (including local visitors)		
	very important	important	unimportant
Morphological features	95.5	2.9	1.6
Shopping facilities	95.5	2.5	2.0
Green areas and parks	91.4	4.5	4.1
Tourism infrastructure	91.2	3.3	5.5
Catering facilities	90.1	6.4	3.5
Historical setting	90.0	5.3	4.7
Street signs, indications of walks	89.6	4.8	5.6
Decorative elements	89.5	7.5	4.0
Organized events	75.1	8.7	16.1
Activities	65.0	14.5	20.5
Museums	59.5	10.2	30.3

Results in all three studies showed that urban tourists generally combine several activities when visiting a city. Respondents often mention several activities when asked what they have done during their visit or when their actual visiting behavior is observed. They also frequently mention more than one motive or reason for visiting the city (Jansen-Verbeke 1988, Murphy 1992, Woodside et al. 1989).

Due to the growing importance of leisure and tourism in the development of retail environments, several recent studies in the area of retailing have also included sections on urban tourism behavior. An example is a study conducted by Finn et al. (1994) on acceptance and use of the West Edmonton mega-mall. It was observed that as much as 25 percent of the visitors to the West Edmonton mall came for leisure purposes solely (e.g., recreation, entertainment or browsing without shopping) and that another 32 percent came for social purposes (e.g., to show someone around, to meet someone, or to have a meal or a snack) or for a combination of leisure and shopping purposes.

The above descriptive studies of urban tourism behavior provide valuable insights in urban tourists' activity patterns in the city. Two important aspects are that they show: (i) which activities urban tourists undertake most frequently, and (ii) that urban tourists typically combine several activities in one trip.

The studies offer relatively little support however if urban planners want to predict the expected impact of new urban tourism development projects on these activity patterns. From the research results it can be understood what urban tourists presently do and like, it is not clear however how this will change when new initiatives are taken. For this purpose, more insight in urban tourists' preference structures and choice processes is required. Within

the urban tourism field little research has however been done in this area. In the next sections we will therefore review the general tourism literature on its potential to support ex-ante evaluations of new urban tourism projects.

3.4 Exploring tourists' choice processes

Recently, Crompton (1992) and Mansfeld (1992) reviewed the tourism literature on consumer choice behavior. They suggest conceptual models of the tourist destination choice process that are both based on a process of narrowing down from a relatively large set of potential destinations to one destination that is finally selected. Earlier, Woodside and Lysonski (1989) proposed a comparable structure. They placed a relatively stronger focus however on the factors that influence the choices that tourists make and paid less attention to the actual choice process itself. These three conceptual models will now briefly be discussed.

Crompton (1992) distinguishes three main stages in the tourist choice process. First, an initial set of destinations is developed. This set has traditionally been called the awareness set. It consists of all locations that might be considered as potential destinations for a trip, before any actual decision about the trip has been made. The subjective beliefs about attributes of the destinations are based on passive information catching or incidental learning. Once the decision to go on a trip is made, the second stage is activated. This stage involves searching for information that will support evaluation of the relative utility of the potential destinations, and a selection of a small number of probable destinations. The third stage is to more thoroughly examine this smaller set and to make the final choice.

The conceptual model that Mansfeld (1992) proposes is somewhat more elaborated in that it extends the choice process both in the beginning stages and in the ending stages. The model covers a travel motivation component that initiates the choice process, and a choice evaluation stage that ends the choice processes and that provides feedback to the travel motivation stage. After the motivation stage the next step in this model of the tourist choice process is that the tourist evaluates the available information on the potential destination, and if so desired collects more information. After that, elimination of potential destinations takes place to limit the final choice set and the remaining destination alternatives are more carefully assessed. Finally, the preferred destination is selected and the trip is made. The evaluation of the choice follows after the trip and serves as an input for the travel motivation stage.

Woodside and Lysonski (1989) distinguish four basic stages in the tourist destination choice process: (i) the destination awareness stage, in which the destinations that a tourist considers are defined on the basis of whether he or she is in some way aware of them, (ii) the tourist destination preference stage, in which the evaluation that the tourist attaches to the potential destinations is defined, (iii) the travel intention stage, in which the destinations that the tourist will actually want to go to as defined, and (iv) the choice stage, in which the destinations that the tourist decides to go to are determined.

Woodside and Lysonski suggest classes of variables that may influence the outcome of the choice process in the various stages. In the awareness stage, both destination marketing variables like e.g., price, product design, communication, distribution, and traveler characteristics like e.g., experience, socio-demographics and psychographics, determine the fact whether certain destinations will be part of the awareness set or not. Traveler

characteristics and preferences determine the evaluation of the potential destinations in the second stage, and the intentions to visit in the third stage. In the fourth and final choice stage, situational variables determine which of the intentions will be finalized in the actual choice.

A common characteristic of the above conceptual models of tourists' choice processes is that they provide insightful frameworks to study tourists' choice processes, but that these frameworks are often highly complex and very difficult to operationalize. This implies that it is difficult to develop research techniques and instruments that support tourism project evaluations on the basis of these frameworks. Studies to support urban planning therefore typically operationalize only elements of the total conceptual models. Simplifying assumptions are made with regard to the rest of the elements in the conceptual model, or it is assumed that the other elements can be kept constant to the element under study.

Some of these studies have addressed the first phases in the tourist choice process and studied aspects of tourists' motivation and attitudes. Um and Crompton (1990) for example, discussed the role of attitudes and situational constraints in tourists' selection of a final choice set from the total awareness set of potential destinations. They found that attitude measurements represent significant indicators for predicting whether or not a vacation place is selected as a final destination from the alternatives in the awareness set. Witt and Wright (1993) reviewed various concepts of motivation as applied in tourism research and discussed the potential role of expectancy theory as a unifying concept in this area. They quote Lawler (1973) that the basic premise of expectancy theory is that the strength of a tendency to act depends on the strength of an expectancy that the act will be followed by a given consequence and on the value of that consequence to the actor. After reviewing some applications of expectancy theory in tourism, they conclude that it can offer a valuable framework for research, but that the theoretical concept in itself requires such a strong refinement if it needs to be of predictive value that its direct applicability is limited.

In general, the results of studies that focus on the early stages of the tourists choice process provide few tools to predict the consequences of changes in the urban tourism environment on urban tourism demand. The link between attitudes or motivation and actual choice behavior is often very weak. The only category of tourism studies in which the issue of predicting the outcome of tourists' choice processes is explicitly addressed are modeling studies (Witt and Witt 1992).

Most modeling studies have focused on the last phase in the choice process. In this stage the actual destination alternative is chosen from the set of considered alternatives and other alternatives are neglected. In estimating models of tourists' choice processes it is often assumed that the presence or absence of alternatives from earlier choice stages does not influence the parameter estimates for choices between the alternatives that are in the final set of considered alternatives. This is not as problematic as it may seem, as, contrary to other approaches, modeling studies provide the possibility to test for the validity of the overall model and the fit of the model on the observed data can be statistically evaluated.

A commonly used conceptual model that underlies many choice modeling studies consists of four choice phases that describe the process that the consumer goes through in selecting an alternative from the set of considered alternatives (Louviere 1988). These are: (i) the consumer perceives the attributes (product characteristics) of the alternatives to have a certain value, (ii) the perceived value of each attribute is evaluated in terms of its

attractiveness, (iii) the separate attribute evaluations are combined into an overall evaluation of the product, and (iv) the product with the highest overall evaluation is selected. Once the parameters in the conceptual model are estimated it is possible to directly link product characteristics to the choices that consumers make.

3.5 Modeling tourists' choice behavior

In our discussion of tourists' choice modeling we distinguish between two main approaches: (i) revealed preference or econometric modeling, and (ii) stated preference or conjoint analysis. The key difference between the two approaches is the type of data that is used as a basis in the modeling exercise. Revealed preference models are based on observations of tourist behavior in actual market situations, whereas stated preference models are based on observations of tourist behavior in controlled hypothetical settings. In this section we will review typical examples of studies applying these approaches. The next section will then discuss their strengths and weaknesses. The tourist choice modeling approaches that will be discussed are summarized in table 3.4.

Table 3.4 Reviewed approaches in tourists' choice modeling.

Data type	Dependent variable	
Revealed behavior	(i)	Tourist Participation
	(ii)	Tourist Expenditure
	(iii)	Length of stay
Stated behavior	(i)	Tourists' Rating or Ranking of alternatives
	(ii)	Tourists' Choices

Crouch and Shaw (1993) conducted an extensive meta analysis of revealed preference studies in the tourism field conducted over the past two decades. Using the dependent variable in the studies as a criteria, they differentiated between three types of revealed preference studies. They observed that in the majority of revealed preference studies tourism participation choice also referred to as tourism demand, was modeled. A second group of studies modeled tourism expenditure and a third group the tourists' length of stay. In our discussion of revealed preference approaches, we will apply this same categorization.

Witt and Witt (1992) provide a very interesting review of revealed preference studies of tourism. They compared the predictive capacity of seven different mathematical models in predicting the total tourism demand for trips for 24 origin-destination pairs from France, Germany, the U.K. and the U.S. to various other countries in Europe and the U.S.. They compared the models in terms of their forecasting performance for a one and two year horizon and on several different criteria. The models they compared ranged from a very naive model predicting tourism demand in year $t+1$ as equal to the demand in year t , through a trend curve analysis and a two-year lag autoregression model, to a full econometric model incorporating variables like the tourists' income, cost of living, the current exchange rates and dummies for several special circumstances like the 1973 and 1979 oil crises.

Surprisingly, they found that the naive 'no change' model never predicted significantly worse than the more complex models, and often (18 out of 35 times) significantly better. The autoregression model performed similarly well. It was found that the full econometric model performed worse than several other models and that transferability of the econometric model across different origin-destination pairs was particularly difficult and required changes in its parameters.

Several studies have investigated tourism demand from a somewhat different angle, by focusing more on the tourist choice process between several different destinations than on the choice of whether or not to travel to a specific destination. Stynes and Peterson (1984) provide a review of work in this area with a particular attention to predicting recreation activity and site choice. An interesting example of a more recent study in the area is Morey et al. (1991) who developed a choice model to describe recreational participation, and site and activity choice, and tested it in the context of marine recreational fishing.

One of the most comprehensive exercises in modeling tourism expenditure, the second category of revealed preference studies, is a study that was conducted by the University of Amsterdam's Foundation for Economic Research in commission of the Dutch ministry of Economic Affairs (van Dijk et al. 1991). The model developed in this study describes the demand and supply side of the Dutch tourism market in terms of tourists' and businesses' expenditure. The model is updated on a yearly basis and serves as a policy support tool for both the public and private tourism sector in the Netherlands.

An example of a recent modeling study in the third category, the modeling of tourists' length of stay, is a study by Dadgostar and Isotalo (1992). They studied factors that affect near-home tourists length of stay in city destinations in Canada and the U.S.. Key findings were that respondents with higher incomes tend to spend less time in near-home city destinations and that the destination image is relatively unimportant in explaining the tourists' length of stay.

The second main modeling approach: Stated preference modeling or conjoint analysis, also has a strong tradition in tourism research. Louviere and Timmermans (1990) provide a comprehensive review of stated preference techniques and applications in the area. In their discussion, they explicitly distinguish between studies and techniques that ask respondents to rate or rank hypothetical alternatives, and studies and techniques that ask respondents to make actual choices between hypothetical alternatives. The first group is referred to as stated preference modeling or conjoint analysis, and the second group as stated choice modeling or conjoint choice modeling.

Examples of recently conducted stated preference or conjoint analysis studies in tourism are Woodside and Carr (1988), who discussed the relevance of conjoint analysis for tourism planning and concluded that it may be especially relevant for testing new marketing strategies of competing destinations, Bojanic and Calantone (1990), who applied conjoint analysis to evaluate tourists' preference for different bundles of accommodation services, and Carmichael (1993), who studied skiers' preferences for different generically described ski-resorts.

Examples of conjoint choice analysis in tourism research are Louviere and Hensher (1983) who applied the technique to predict demand for a unique cultural event for the 1988 celebrations marking 200 years of European settlement in Australia, and Lieber and Fesenmaier (1984) who applied conjoint choice modelling in recreation research to study

tourists' preferences for hiking trails with different characteristics and services in the Chicago area. More recently, Haider and Ewing (1990) studied tourists' choices of hypothetical Caribbean destinations and Louviere and Timmermans (1992) tested the external validity of a hierarchical model of recreational destination choice.

3.6 Strengths and weaknesses of different approaches to tourist choice modeling

Our discussion of the strengths and weaknesses of revealed preference approaches as compared to stated preference approaches and after that of stated preference models as compared to stated choice models is largely based on Oppewal (1995), who thoroughly reviewed the approaches in his dissertation.

It is generally recognized that the main advantage of revealed preference models concerns their relatively close relationship to tourists' actual choice behavior. Therefore the external validity of the models can be expected to be high. However, there are also disadvantages attached to models based on revealed preference data. The most important of which are: (i) in real markets many relevant features of products and services are highly correlated. Price and quality, or facility size and variety in services for example are often correlated. These correlations lead to less efficient parameter estimates. To solve these problems, often variables are omitted from the model, but this then reduces the potential of the model to evaluate planning and marketing strategies. (ii) in collecting revealed preference data, generally only one observation per respondent can be made. This implies that revealed preference modeling requires large samples and that the costs of data collection are often high. (iii) for most respondents in a revealed preference data sample the exact specification of the choice set may be unknown to the research. This may introduce biases in parameter estimates, if alternatives are not evaluated independently of other (unknown) alternatives in the choice set. (iv) estimates can only be made on the basis of existing alternatives and attribute levels. The potential impact of new elements can never be measured from respondents revealed preferences, as these do not include new alternatives.

Stated preference modeling or conjoint analysis approaches to a large extent can deal adequately with these disadvantages, because they allow the researcher to control the hypothetical alternatives presented to the respondents (Carson et al. 1994). This implies that the attributes that describe the alternatives can be varied independently of each other, and furthermore that the choice sets can be constructed and controlled for by the researcher and then randomly assigned to respondents. Also, several observations per respondent can be made, as respondents can answer to more than one hypothetical choice task. Furthermore, new elements can be introduced in the hypothetical alternatives, allowing for parameter estimates for new planning and marketing variables that are presently not yet available in the market.

These aspects make conjoint analysis especially well suited to support ex-ante evaluations of urban tourism development projects in urban tourism planning. First, its use of controlled experiments allows urban tourism planners to measure urban tourists' preferences for different elements in the urban tourism product independently. Secondly, its use of hypothetical alternatives allows for evaluations of truly new urban tourism projects or elements. Both aspects are especially relevant in urban tourism planning, where the absence

or presence of different functions in existing urban tourism facilities often is highly correlated and where most new projects are unique in their environment.

A potential problem of stated preference approaches is that their external validity may be lower than that of revealed preference model. The reason is that the choice results in hypothetical choice tasks may differ from those in actual choices. Generally the internal validity in stated preference experiments is however higher, because the measurements can be made under experimentally controlled conditions (Louviere and Timmermans 1990).

When comparing stated preference to stated choice models it can be seen that choice models offer several advantages over preference models. First, choice task are generally perceived as closer to the respondents' real world evaluations of alternatives than ranking or rating tasks. Secondly, choice tasks support direct estimation of choice models, and do not require ad hoc choice rules that define the relationship between observed rankings or ratings and the choice probabilities.

A disadvantage of choice modeling approaches is that it is more difficult to estimate individual models, because the number of observations that is required to estimate an individual model on the basis of choice data is larger than that required for an individual model based on ratings data. This disadvantage is however more of a practical nature and can be largely circumvented by adequate segmentation of the observed data.

It is therefore concluded that choice based conjoint modeling offers the most promising approach to support ex-ante evaluations of urban tourism projects in marketing oriented urban tourism planning approaches.

3.7 Conclusions and discussion

In this chapter we reviewed studies in urban tourism on their potential to support ex-ante evaluations of urban tourism development projects in marketing oriented urban tourism planning approaches. It was observed that studies in urban tourism provide valuable insights about urban tourists' activity patterns. Important aspects included insight in activities that urban tourists undertake most frequently and the observation that urban tourists often combine several activities when visiting a city. At the same time it was however observed that most studies in the urban tourism field to date are not specifically suited to support evaluation of urban tourism development projects. Therefore, the general tourism literature was reviewed from this perspective as well.

It was concluded from this review that modeling studies and more specifically conjoint choice modeling studies offer the most promising perspective to support ex-ante project evaluations in urban tourism planning. The main advantages of conjoint choice modeling over other approaches can be summarized as: (i) like all modeling approaches it allows one to systematically quantify the relationship between urban tourism functions and urban tourism demand, (ii) it allows one to conduct controlled and independent measurements of urban tourists' preferences for different urban tourism elements, (iii) it allows one to measure urban tourists' preferences for truly new alternatives, and (iv) because of its use of choices as dependent variables, it directly relates urban tourism elements to actual choices.

4 Conjoint Choice Models for Urban Tourists' Portfolio Choices: Theory

4.1 Introduction

Recently proposed urban tourism planning approaches place a strong emphasis on marketing research techniques to support evaluation of potential urban tourism projects. In the previous chapters the urban tourism literature was reviewed from this perspective and it was argued that most research in urban tourism to date provides relatively few instruments to evaluate of urban tourism projects in terms of their expected impact on urban tourism demand. Therefore, the review was extended to incorporate the general tourism literature and it was concluded that modeling techniques, and more specifically conjoint choice modeling techniques provide the most promising opportunity to support evaluations of urban tourism projects.

In this chapter we will now further introduce conjoint choice modeling. We will argue that conjoint choice models offer a strong potential to model urban tourists' choices, but that current conjoint choice models are restricted because they do not allow one to adequately model combinations of choices that urban tourists make.

The chapter starts with a brief history of conjoint modeling after which the simple multinomial logit (MNL) model is discussed, as well as some other well known approaches to consumer choice modeling. Some classical violations of the assumptions underlying the simple MNL model in complex consumer choice processes are also discussed.

On the basis of this introduction, it is discussed how urban tourists' choices can be modeled in a conjoint choice modeling approach. It is argued that urban tourists' choices are characterized by the fact that they take place in complex urban environments and that they typically involve choice processes with evaluations of combinations of several alternatives. The term portfolio choices is used in this thesis to describe this type of choice processes and that in order to be effective for urban tourism planning conjoint choice models should support modeling of portfolio choice processes.

To facilitate the discussion, a conceptual framework is proposed that structures three main types of urban tourists' choices relevant to urban tourism research: (i) participation choice, which is the choice of whether or not to participate in urban tourism activities, (ii) destination choice, often combined with choice of transportation mode, and (iii) the choice of activities when visiting an urban destination.

Traditional conjoint choice models for these choice types however do not allow one to model portfolio choices. Therefore, a conjoint choice modeling approach is introduced that does support this type of choices. This is the main focus of the theoretical contribution of this thesis. Models are formulated that can describe portfolio choice processes of various complexity and special attention is paid to how scale differences between the separate elements in portfolio choice processes can be modeled. Design requirements for the different models of portfolio choices, and the relationship between the presented designs and the estimation of the models will also be discussed as well as the possibilities of testing the various proposed models against each other.

4.2 A brief history of conjoint choice modeling

4.2.1 Introduction

A central question in consumer choice modeling is how product and services characteristics can be related to the probability that consumers will buy these products or services. Throughout the years, different approaches have been taken to address this issue. Methodologically, all of these approaches can however be formally based in a theory of data that implies a mapping of an empirical system of behavioral observations of choices onto a numerical system of measurement scales (Luce 1959). This numerical system formally describes the relationships between the product characteristics and the choice probabilities.

Theoretical structures similar to this type have been applied in many different areas of psychological research and it can in fact be argued that many research topics in psychology can be regarded as studies of human choice behavior (Roskam 1987). In many psychological test situations such as intelligence tests or personality tests, individuals are asked to choose between various alternatives, and a theoretical structure is then applied to relate the observed choices to the presented alternatives. Likewise, what are often referred to as similarity data, consist of observations of individuals' choices between pairs of alternatives, based on a selection of pairs that are most similar to each other. In other areas in the social sciences, many topics are closely related to individual choice processes as well. Household or consumer spendings may for example be studied in economics, locational decision making may be studied in geography, and individual choices related to cultural aspects may be studied in sociology and anthropology. This diversity in backgrounds and applications of studies of individual choice behavior explains why choice modeling as it is applied in marketing and planning today draws from such a diverse area of research traditions.

In this chapter we will choose one approach as a guideline for our discussion of conjoint choice modeling. It is the random utility approach that finds its origins in psychology, in the work by L.L. Thurstone in the 1920's (Thurstone 1927a,b). It is one of the earliest systematic and formal approaches to individual choice behavior and has often been used as a bench mark for other approaches. Also, the approach offers a comprehensive theory of errors, which allows for formal statistical tests of its predictions. Other approaches also will briefly be discussed and it will be shown that many different approaches are in fact mathematically equivalent.

4.2.2 Thurstone's law of comparative judgment

Thurstone's objective was to describe a new psychophysical law that could be applied to the measurement of psychological values (Thurstone 1927a,b). He referred to this law as the law of comparative judgment because the model represented in the law supports estimation of parameters that indicate individuals' judgments of the relative size or similarity of different sets of stimuli.

The central idea in Thurstone's law is that each measurement of an individuals' judgments consists of: (i) a structural or deterministic component and (ii) an error or random component. The first component represents the mean influence that a stimulus has on the

individual's judgment and the second component represents the random variation that exists around that mean. The random variation in the model can be caused by different sources including measurement errors, variations or disturbances in perceptual functions, unobserved influences in the measurement environment and instrumental errors. In formal terms Thurstone's law of comparative judgment can be expressed as:

$$x_{ij} = \phi \left\{ \frac{(S_i - S_j)}{\sqrt{\sigma_i^2 + \sigma_j^2 - 2r\sigma_i\sigma_j}} \right\} \quad (4.1)$$

where ϕ is the normal distribution function:

$$\phi(x) = \int_{-\infty}^x \frac{1}{\sqrt{2\pi}} e^{-(1/2)t^2} dt \quad (4.2)$$

S_i and S_j are the psychological scale values of the two compared stimuli i and j , x_{ij} is the proportion of judgments where S_i is judged to be larger than S_j , σ_i and σ_j are normally distributed standard errors on the measurements of the psychological scale values and r is the correlation between the standard errors.

Originally, Thurstone proposed five different possible structures for the error terms that differed in terms of the complexity of the variance-covariance structure between the errors on the measurements of different judgments that they supported. However, in later practice the simplest version has become the most widely applied structure. This structure is known as the Thurstone Case 5 model and it assumes that the error components of all measurements are independently and identically distributed (IID).

To go from Thurstone's law of comparative judgment to a theory of choice is only a small step, and, though later more extensively discussed by others, was proposed by Thurstone himself (Manski 1973, Thurstone 1927b). In choice theory, the judgment model proposed by Thurstone can be applied to measure the overall evaluation or utility of products or services. This overall utility is taken as a measure of the value that an individual attaches to the consumption of a specific product or service, and it is assumed that each individual chooses the products or services that offer the highest utility.

Similar to the way the Thurstone model is structured, the utility of alternative i in choice modeling is assumed to consist of a structural component and a random component. The probability that alternative i is selected over alternative j is expressed as the probability that the utility of i is higher than the utility of j . Formally, this is expressed as:

$$\begin{aligned} P(i) &= P(U_i > U_j) \\ &= P(V_i + \epsilon_i > V_j + \epsilon_j) \\ &= P(\epsilon_i - \epsilon_j > V_j - V_i) \end{aligned} \quad (4.3)$$

where $P(i)$ is the probability that alternative i is chosen, U_i and U_j are the overall utilities of the compared products or services, V_i and V_j are the structural components of these overall

utilities, and ϵ_i and ϵ_j are random components. If it is assumed that ϵ_i and ϵ_j follow normal distributions, the probability can be expressed as:

$$P(i) = \phi \left\{ (V_i - V_j) / \sqrt{\sigma_i^2 + \sigma_j^2 - 2r\sigma_i\sigma_j} \right\} \quad (4.4)$$

where all elements are defined as before.

It can be seen that like the Thurstone model, this function incorporates the observed difference between two judgments or evaluations and the errors on the measurement of these judgments. The difference is that in choice models these elements are directly related to the choice process. Because it includes an error or random component in the utility model, this choice modeling approach is generally referred to as the random utility approach.

Likewise as in the Thurstone case 5 model, random utility models generally assume that the error terms are independently and identically distributed. However, contrary to the Thurstone model, the most common assumption in choice modeling with regard to the distribution of the error terms is that they follow the so called Gumbel distribution (Ben-Akiva and Lerman 1985).

This error distribution was originally developed in statistical science to describe the probability of occurrence of extreme events such as floodings of rivers or break downs of constructions (Gumbel 1958). Intuitively the usage of this distribution in choice theory can be understood if one considers the fact that choices generally deal with the selection of the most attractive alternative from a choice set rather than a selection of the most average alternative in the choice set. This implies that an extreme value distribution like the Gumbel distribution is more appropriate than an average value distribution like the normal distribution to describe the random term in the utility function (Leonardi and Papageorgiou 1992). The popularity of the Gumbel distribution is however probably mainly due to its practical properties rather than to its theoretical appropriateness. Its strong practical attraction lies in the fact that the probability function that can be derived from the Gumbel distribution is relatively simple and can be optimized relatively easily.

4.2.3 The simple multinomial logit model

The simple multinomial logit model is the most widely applied model in conjoint analysis. It is the probability model that arises from the random utility function if the error terms are IID Gumbel distributed. The model is an extension of the previous in that it can incorporate any number of alternatives. Formally, the probability that an alternative i in choice set J will be selected is the probability that the utility of alternative i ($U(i)$), is larger than the utility of the other alternatives in the choice set J (all $U(j)$, j not equal to i). In formula:

$$P(i) = P(V_i + \epsilon_i > V_j + \epsilon_j ; \forall j \in J, j \neq i) \quad (4.5)$$

If it is assumed that all ϵ are independently and identically Gumbel distributed (IID Gumbel), the differences $\epsilon_i - \epsilon_j$ follow a logistic distribution (Johnson and Kotz 1970), from which the model derives its name. The logistic distribution is very similar to a normal distribution, but has slightly wider tails. On the basis of this distribution the probability of selecting i is

expressed as:

$$P(i) = \frac{\exp(V(i))}{\sum_j \exp(V(j))} \quad (4.6)$$

4.2.4 Other approaches

Other approaches in psychology and econometrics have arrived at similar model structures. One of the best known approaches is often referred to as the Luce model (Luce 1959). This is a choice modeling approach in which constant utilities are assumed rather than random utilities and a probability rule is introduced that assigns choice probabilities to different alternatives. A strong disadvantage of the approach is that it lacks a theory of errors, so that it remains unclear how to conduct statistical tests of the choice predictions and how measurement errors on the constant utilities should be included in the choice rule.

The probability rule in the Luce model is most commonly expressed as the ratio of a mapping of the utility of the chosen alternative over the sum of the mappings of the utilities of all alternatives. In the simplest version of the model the mapping is withheld, and the utilities are directly used to calculate the probabilities, but often the mapping implies that the utilities are raised to a certain power to provide a more realistic division of choice probabilities. If the mapping implies that the exponential of the utility is taken, the Luce model is identical to the logit model. Yellot (1977) has shown that under the very weak assumption that constant choice ratios between alternatives hold under identical expansion of the choice sets, the only mapping that can be applied is the exponential, which means that under this assumption the Luce model and the random utility model with IID Gumbel distributions are identical.

Another well known approach in psychology has been introduced by Tversky (1972a,b) and is known as the Elimination by Aspects (EBA) approach. In his approach Tversky proposed a choice model that involves a sequential elimination process in which choices are made by subsequently rejecting or accepting alternatives on the basis of a sequence of desired properties. In the model different properties can have different probabilities of being at any given position in the evaluation process, so that the outcome of the choice process will be probabilistic. As has been shown, first by Tversky (1972b) and later in a more general sense by McFadden (1981), this approach is also equivalent to the random utility approach on the condition that other than IID disturbances are allowed for.

In econometrics and geography, the logit model is often approached as an extension of traditional regression models, where the traditional continuous dependent variables of regression models have been replaced by categorical dependent variables. This extension is called the logistic regression model (Wrigley 1985) and was developed in the early seventies. Normal regression procedures are inadequate to estimate models on categorical dependent variables as they provide strongly biased results if the number of response categories is low. Therefore in cases where categorical response variables are observed, a transformation of the response frequencies is performed, by taking the logarithmic of the ratio of the frequency of each of the response categories to one other category in the choice set that is selected as a

base. This transformation renders a response variable that ranges in a continuum between minus and plus infinity, and that can be analyzed in a weighted least squares or maximum likelihood procedure. Wrigley (1985) shows how the logistic regression model can be rewritten into its equivalent logit model by a simple transformation, where the frequencies are interpreted as probabilities and are then related to the exponentials of the utilities calculated from the estimated parameters.

4.2.5 The use of experiments

An important aspect of conjoint choice studies is that the parameter estimates in the model structure are based on observations in experiments. This aspect of conjoint choice analysis originates from the psychological tradition of systematically studying individuals' reactions in different experimentally controlled settings (Anderson 1981, Coombs 1964, Thurstone 1927a). Originally statistical experimental design theory was typically applied to systematically vary the different situational setting in which behavior was observed. In conjoint studies experimental designs are however used to create the hypothetical alternatives that are presented to respondents in the experiments rather than to vary the experimental settings. These hypothetical alternatives are described in terms of their main features and the design is used to vary the level at which these features occur within the alternatives.

In many conjoint studies (e.g., Green and Srinivasan 1978, 1990) respondents are asked to rate the alternatives on a common scale, such as their overall attractiveness or the probability that the respondent would buy the alternatives. This rating is then considered to be a measurement of the respondents utility for the alternative, and a random or strict utility choice rule is applied to relate the measurements to the choice probabilities of the alternatives. If ratings are applied it is not possible to statistically test the assumed choice rules, because observations are made on the respondents' utilities only and not on their actual choice behavior, and there is no theory of errors available to indicate in which case a certain choice rule should be rejected or not. Therefore extensions of conjoint ratings techniques have been developed where choices between alternatives are presented to respondents rather than rating tasks. In this way the characteristics of the choice alternatives can be related directly to choice probabilities allowing for statistical test of predicted frequencies against the observed frequencies (e.g., Louviere 1988). Double design techniques have been developed in which first a design is applied to create the hypothetical alternatives, and then a second design is used to create the choice sets in which the presence of each of the alternatives is varied (Louviere and Woodworth 1983). These double designs allow for estimates across different types of choice situations.

4.2.6 Classical assumption violations

Arguably, the one most central and most debated assumption in conjoint studies is that of independently and identically distributed (IID) disturbances over the structural utility of the alternatives. This assumption encompasses another, stronger assumption that is called the independence from irrelevant alternatives (IIA) property. This assumed property implies that the relative share of any two alternatives in the choice probability remains unchanged when other alternatives are added to or removed from the choice set.

The validity of the IID assumption and consequently that of the stronger IIA assumption, has been questioned from the very beginnings of random utility theory. Thurstone's case 5 model was only the simplest of 5 different model complexities that he proposed, and in his article it was certainly not introduced as the most realistic.

The best known counter example for the IID assumption is probably what is known as the red bus-blue bus paradox. This paradox implies that when given the choice between bus and car, an individual would not be expected to choose the bus option more often if a second bus alternative would be introduced that only differs from the first bus alternative in its color (Ben Akiva and Lerman 1985, p.109).

Any model that is based on the assumption of independent disturbances necessarily predicts that the total probability of choosing a bus option increases as the number of differently colored alternatives goes up. This shortcoming in the model's capacity can be overcome by allowing for dependencies between the error terms over the structural utilities and variations in their size. A number of models have been used to estimate parameters and variance-covariance structures given this type of error structures. Of these, the ones that are most commonly applied are: (i) the nested logit that allows for a hierarchical structure in error terms which are Gumbel distributed, and (ii) the probit model that allows for a matrix structure in relationships between error terms which are normally distributed. These models will be discussed more extensively in section 4.4. Examples of applications in econometric choice modeling include studies on transportation choice (Bunch and Kitamura 1989, McFadden 1981, Williams 1979), on consumers' choices of consumer goods (Chintagunta 1992) and on shopping center choice (Ahn and Ghosh 1989). However, the models have hardly been applied in conjoint type of studies.

Some research results have shown however that even the models that allow for dependencies and variations between the error terms in the alternatives' utility terms can sometimes be violated in observed real world choice behavior. These violations are generally referred to as violations of the regularity assumption, where the formal description of regularity is used that implies that the probability of choosing an alternative i from a choice set J cannot be enlarged by introducing more alternatives to that set (Block and Marshak 1960). In most definitions of random utility theory, violations of regularity are regarded as contrary to the principle of random utility. This is because as soon as it is accepted that the utility of an alternative only depends on the attributes of that alternative itself and not on the attributes of other alternatives in the choice set, regularity is implied.

One example of a violation of regularity is the edge aversion effect as suggested by Corbin and Marley (1974). This effect implies that respondents may have a systematic disliking of extreme alternatives. If this is the case, the probability of choosing a certain extreme alternative can be enlarged by introducing an even more extreme alternative and this then violates regularity. A second example of an effect that violates regularity is the attraction effect as discussed by Huber et al. (1982). Attraction effects occur if a very positively evaluated but unreachable alternative is added to a choice set. This highly attractive but unreachable alternative can increase the probability of choosing similar but more reachable alternatives. The introduction of an expensive new alternative in a certain brand line may for example increase the probability that other less expensive alternatives of that same brand will be chosen.

A modelling approach that can include the above effects was introduced by McFadden

et al. (1977). It is called the universal logit model, but the model is also referred to as the mother logit model. The approach is based on the multinomial logit model but adds the possibility that the utility of an alternative does not only depend on the attributes of that alternative itself, but also on the attributes of the other alternatives in the choice set, or in its simplest form the presence or absence of other alternatives in the choice set. An application of this model in conjoint analysis is a study on consumer shopping behavior by Timmermans et al. (1992).

There are some drawbacks to the mother logit approach, the most important of which is that if all possible effects are included in the choice model, this implies that a different set of parameters is estimated for every possible choice set. Therefore, in that case the model is identical in information content to using no model at all and predicting the choice probabilities directly from the observed frequencies. This implies that the model loses its function both as a theoretical construct and as a means of reducing the observed data. Also, the type of effects that can be captured in mother logit models and that cannot be captured in nested logit or probit type of models (i.e. violations of regularity) are relatively rare and can also be modeled as context effects to the choice situation, rather than as part of the choice alternatives themselves (Oppewal and Timmermans 1991). This implies that often more simple models can be used than the mother logit model, that have the advantage that they are consistent with random utility theory.

In the next section we will look at the question of how to apply conjoint choice modeling to urban tourists' choice processes and whether these processes place special requirements on choice models in terms of the effects that they should incorporate.

4.3 Conjoint choice models for urban tourism

As argued in chapters 2 and 3, a central aspect of urban tourists' choice processes is that they typically involve portfolio choices (i.e. choices between combinations of alternatives), rather than choices between single alternatives. If urban tourists select an urban tourism complex they often choose between combinations of several activities grouped together in large facilities (Wylson and Wylson 1994) and also often combine visits to several different facilities in one trip (Jansen-Verbeke 1988).

If conjoint choice models are to effectively support ex-ante evaluations of urban tourism projects, they should clearly support portfolio choice processes. Traditional conjoint choice models do not support portfolio choice models. In the next section therefore we will develop a theoretical basis for conjoint choice models of portfolio choices.

Often in marketing research, when a certain category of goods or services is studied a conceptual framework is developed to structure the discussion of the different types of consumer choices that are relevant to that product category. The most commonly used framework for traditional consumer goods consists of the following three choice types (Gupta 1988): (i) the choice of whether or not to buy from a certain category of goods at a certain time, (ii) the choice of what to buy within that category, and (iii) the choice of how much to buy. Different models have been developed to model each or combinations of these three choice types (Chintagunta 1993).

Similarly, in this thesis we propose a conceptual framework to study the different types of choices that urban tourists make. Urban tourists' choices are somewhat different from consumers' choices of more traditional products and we have therefore adapted the framework accordingly. The basis of the proposed framework is the relevance of certain tourist choice types in tourism research to date.

On the basis of the review of the tourism literature in chapter 3, three choice types were selected for a conceptual framework to structure our discussion of urban tourists' choices. They are: (i) *participation choices*, which were discussed in section 3.5 where it was discussed that Crouch and Shaw (1993) observed that tourists' participation choice is the choice process that is modeled most often in tourism research, (ii) *destination choices*, which were discussed in section 3.4 where it was shown that destination choices are the traditional research topic of most studies of tourists' choice processes (e.g., Louviere and Timmermans 1992, Haider and Ewing 1990, Um and Crompton 1990), and (iii) *activity choices*, which were discussed in section 3.3, where it was shown that urban tourists' choices of activities when visiting a city is a topic that is especially prominent in urban tourism studies (e.g., Jansen-Verbeke 1988, Woodside et al. 1989, Murphy 1992).

If we look at the choice processes underlying the three choice types in the conceptual framework, it can be seen that all are indeed portfolio choices. In making participation choices, urban tourists' compare between sets of several activities that make up the different categories of activities, and then select the category that they find most attractive. Destination choices are typically made in portfolio combinations with transportation choices, and the choice of activities to undertake when visiting an urban destination also typically involve choices between combinations of several alternatives.

This chapter will discuss the general theory underlying conjoint choice models, experimental design and estimation techniques for portfolio choice processes. Empirical applications and tests of each of the three choice types of the conceptual framework will be presented in chapter 5.

4.4 Models for urban tourists' portfolio choices

4.4.1 Introduction

The most commonly used response format in conjoint choice experiments involves a single choice task: respondents are typically requested to select the one choice alternative in each choice set they like best, or, alternatively, allocate a fixed amount of resources (dollars, trips, frequencies) among the alternatives included in the choice set. While the simple choice response format can be a valid representation of many consumer choice and decision making problems and can be a valuable marketing research tool to predict or assess the likely consequences of marketing mix decisions on single choice behavior, it is also limited in that it does not allow one to model portfolio choices between sets of several linked alternatives, as they often occur in urban tourists' choice processes. In this section we will therefore develop a theoretical basis for conjoint choice models of portfolio choices.

Methodologically, the focus on portfolio choices is consistent with a recent stream of research in planning and marketing in which new approaches have been developed to analyze

or predict combined choices with econometric choice models. This research is motivated by observations in more traditional areas of marketing, where it can also be seen that in many choice situations consumers do not evaluate single alternatives, but rather make choices between combinations of interrelated alternatives. Examples of such studies include choices among assortments of goods (e.g., Kahn and Lehman 1991), choices among sequences of alternatives, such as trip-chaining in visiting retail stores (e.g., Arentze et al. 1993), and choices of shopping centers and shops within centers (e.g., Ahn and Ghosh 1989). To our knowledge there are no examples of tourism related studies in this area.

Unlike the discussion in this thesis that focuses on conjoint choice modeling, the above studies had an econometric orientation and were based on observed choices in real world situations. Though some conjoint studies in the past used combinations of choice tasks to model different elements of complex choices (e.g., Louviere and Hensher 1983 and Oppewal et al. 1994), aside from the results presented in this thesis, only one article explicitly addressed the issue of portfolio choices in conjoint choice modeling. That is Timmermans and van der Waerden (1992) introduced a model for sequential choices to account for trip-chaining in consumer shopping behavior. They asked respondents to first choose a shopping center for convenience goods and then, given their choice of this center, to choose a second shopping center for specialty goods. In their approach, an experimental design was used that allowed them to estimate a multinomial logit model that incorporates the attribute effects of the center visited at the first stop in the shopping trip chain on subsequent choices.

Although Timmermans and van der Waerden extended traditional conjoint choice models for single choices, their approach was limited in its scope in that (i) the model structure and applied experimental design imposed an a priori ordering on the choice process, (ii) their approach did not allow for tests of scale differences between single choices and portfolio choices that may result from varying choice strategies and hence varying degrees of random error in the two types of tasks, and (iii) their approach was applied to only two alternatives and not extended to sets of multiple alternatives.

The modeling approach presented in this thesis therefore proposes a new improved experimental approach that circumvents these limitations. The proposed approach supports the estimation of a more extensive set of model structures that allows one to compare different hierarchical structures of portfolio choice processes as well as test for scale differences between single choices and portfolio choices. Thus, the approach adds to the literature a new integrated approach of conjoint choice models for portfolio choice and a new experimental choice approach. Many of the modeling elements have been reported elsewhere in the planning and marketing research literature, where they have been used to model combinations of choices in econometric choice analysis, but they have not been integrated in conjoint choice experiments.

The modeling elements that will be discussed are: (i) joint logit models, in which combinations of choices are treated as single choices but between combined alternatives (e.g., Ben-Akiva and Lerman 1985 p.278), (ii) nested logit models, in which it is assumed that the error structure over the portfolio alternatives is hierarchically structured (e.g., Ahn and Ghosh 1989, Bucklin and Lattin 1991), (iii) probit models, in which combinations of choices are allowed to have mutually interrelated error structures (e.g., Papatla and Krishnamurthi 1992), and (iv) separate models with different parameters for each of the choices in a

combination (e.g., Gupta 1988).

We especially focus on the assumptions underlying the four different models with regard to the error terms of the utility functions of combined alternatives and the resulting conditions for the experimental designs. We concentrate on the fact that the separate alternatives that make up the portfolio alternatives each may have separate disturbances and thus combined alternatives may lead to heterogeneity in the error terms across different choice situations. In the next subchapter we will specifically address the relationship between this aspect and the use of statistical experimental designs as the importance of this issue has in our view been underrated in conjoint choice modeling.

4.4.2 Portfolio choices of two alternatives

Let us first assume that the choice process of interest involves the choice of two alternatives, where the available set of alternatives for the first and second choice may or may not be identical. Later extension of the theory to portfolio choices that involve more alternatives is relatively straightforward and will be discussed in section 4.4.9.

Two extremes can be distinguished in portfolio choice processes: the *simultaneous* and the *sequential* case. The simultaneous structure involves a single choice, in which the individual takes all alternatives into consideration at the same time. In contrast, sequential structures involve choices at different moments in time, where any of the alternatives can be decided upon first. In the two alternative case two basic sequential structures arise. This is illustrated in figure 4.1, that depicts an example in which one choice is made among a first set of alternatives A_j and an other choice is made among a second set of alternatives B_k .

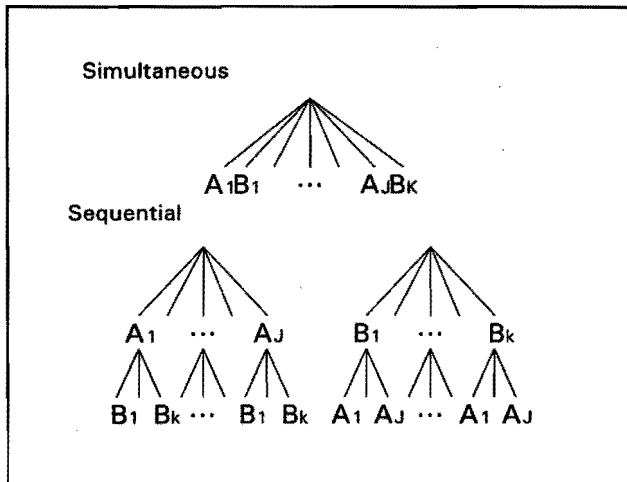


Figure 4.1 Choice structures for combinations of two choices

Although sequential portfolio choice processes involve separate choices of subsequent

alternatives, the decision maker may still take into account the utility of later sets of alternatives when choosing alternatives from earlier sets. When a tourist selects a travel destination for example, he or she may to some extent also take into account the transportation options available to reach that destination, even if the actual choice of the specific transportation mode is postponed. In the two level case, the influence of the alternatives in the second set on the choice among alternatives in the first set can vary between none at all and a full contribution. Also, the underlying parameter values of the choice alternatives may or may not be identical in the two stages of the choice process. The first choice in the sequential process will only be equal to the choice in the simultaneous process if the attributes of the second choice are fully incorporated in the first choice and the underlying parameters are identical.

The structural utility associated with a hypothetical combination of alternative A_j and alternative B_k is expressed as follows:

$$\begin{aligned}
 \text{Simultaneous: } U_{A_j B_k} &= V_{A_j,1} + V_{B_k,1} + V_{A_j B_k,1} \\
 \text{Sequence 1: } U_{A_j B_k} &= V_{A_j,1} + V_{B_k,1} + V_{A_j B_k,1} \\
 U_{B_k|A_j} &= V_{B_k,2} + V_{A_j B_k,2} \\
 \text{Sequence 2: } U_{A_j B_k} &= V_{A_j,1} + V_{B_k,1} + V_{A_j B_k,1} \\
 U_{A_j|B_k} &= V_{A_j,2} + V_{A_j B_k,2}
 \end{aligned} \tag{4.7}$$

where: $U_{A_j B_k}$ is the total utility of the combination of alternatives A_j and B_k , J is the total number of alternatives A_j , K is the total number of alternatives B_k , $U_{B_k|A_j}$ is the utility of alternative B_k given A_j , $U_{A_j|B_k}$ is the utility of alternative A_j given B_k , $V_{A_j,1}$ is the utility of A_j in the first choice, $V_{B_k,1}$ is the utility of B_k in the first choice, $V_{A_j B_k,1}$ is the utility of the interaction between A_j and B_k in the first choice, and the subscript 2 denotes the utilities of the same attributes in the second choice. In the following expressions we will only give the first of the two possible sequential functions as both sequences are derived analogously.

An intermediate structure can be derived if it is assumed that the underlying utilities in the first and second choice are not completely different, but only differ up to a sequentiality correction m_{seq} that accounts for the fact that the choices do not take place simultaneously. In that case $V_{B_k,1}$ and $V_{A_j B_k,1}$ in sequence 1 can be re-expressed as $m_{seq} V_{B_k,2}$ and $m_{seq} V_{A_j B_k,2}$, where m_{seq} is the degree to which the utility of the second level contributes to the utility of the first level. The utilities for sequence 2 can be re-expressed analogously. As will be shown in sections 4.4.6 and 4.4.7, this correction can not be separated from other scale differences that may occur between the choices in portfolio choice processes.

4.4.3 The role of disturbances

In portfolio choice models similar assumptions can be made with regard to the disturbances as those that are made in the simple multinomial logit (MNL) model for single choices. This implies that error terms over the sets of alternatives that make up the portfolio alternatives are assumed to be independently and identically distributed (IID) according to a Gumbel distribution (Ben-Akiva and Lerman 1985 p. 278).

A serious objection to the assumption of IID disturbances is that the separate alternatives that make up portfolio alternatives are likely to have separate disturbance terms. In that case portfolio alternatives which share part of their alternatives will also share part of their error terms, which leads to covariances between the overall disturbances of portfolio alternatives and therefore to violations of the IID assumption. The utilities including separate error terms are expressed in formula 4.8, and the variance-covariance structures of the utilities in formulas 4.9 to 4.11.

$$\begin{aligned}
 \text{Simultaneous: } U_{AJk} &= V_{Aj.1} + V_{Bk.1} + V_{AJBk.1} + \epsilon_{Aj.1} + \epsilon_{Bk.1} + \epsilon_{AJBk.1} \\
 \text{Sequence 1: } U_{AJk} &= V_{Aj.1} + V_{Bk.1} + V_{AJBk.1} + \epsilon_{Bj.1} + \epsilon_{Ak.1} + \epsilon_{AJBk.1} \\
 U_{Bk|Aj} &= V_{Bk.2} + V_{AJBk.2} + \epsilon_{Bk.2} + \epsilon_{AJBk.2}
 \end{aligned}
 \tag{4.8}$$

where $\epsilon_{Aj.1}$, $\epsilon_{Bk.1}$, $\epsilon_{AJBk.1}$ and $\epsilon_{Aj.2}$, $\epsilon_{Bk.2}$, $\epsilon_{AJBk.2}$ are IID Gumbel distributed disturbances over the main effects for the two dimensions and their interactions in respectively the first and the second choice, and the other elements are defined as before. The variance-covariance matrix for the simultaneous case and the first choice in the sequential case is expressed as:

$$\begin{matrix}
 U_{AIB1} & \dots & U_{AIBK} & \dots & U_{AJBK} \\
 \vdots & & \vdots & & \vdots \\
 U_{AIBK} & & & & \\
 \vdots & & & & \vdots \\
 U_{AJBK} & & & &
 \end{matrix}
 \left[
 \begin{array}{ccccc}
 \text{var}(\epsilon_{A.1} + \epsilon_{B.1} + \epsilon_{AB.1}) & \dots & \text{var}(\epsilon_{A.1}) & \dots & 0 \\
 \vdots & & \vdots & & \vdots \\
 \text{var}(\epsilon_{A.1}) & \dots & \text{var}(\epsilon_{A.1} + \epsilon_{B.1} + \epsilon_{AB.1}) & \dots & \text{var}(\epsilon_{B.1}) \\
 \vdots & & \vdots & & \vdots \\
 0 & \dots & \text{var}(\epsilon_{B.1}) & \dots & \text{var}(\epsilon_{A.1} + \epsilon_{B.1} + \epsilon_{AB.1})
 \end{array}
 \right]
 \tag{4.9}$$

where $\epsilon_{A1.1} = \epsilon_{A2.1} = \epsilon_{A.1}$, $\epsilon_{B1.1} = \epsilon_{B2.1} = \epsilon_{B.1}$, $\epsilon_{A1B1.1} = \epsilon_{A1B2.1} = \epsilon_{A1Bk.1} = \epsilon_{AB.1}$, and all other elements are defined as before. The covariance in this matrix accounts for the fact that certain combinations of alternatives share common separate alternatives. Because the disturbances within dimensions are assumed to be IID the covariances for alternatives in the matrix can be expressed as (Ben-Akiva and Lerman 1985, p.286):

$$\begin{aligned}
 \text{COV} (\epsilon_{Aj.1} + \epsilon_{Bk.1} + \epsilon_{AJBk.1}, \epsilon_{Aj'.1} + \epsilon_{Bk.1} + \epsilon_{AJ'Bk.1}) \\
 = \text{COV} (\epsilon_{Bk.1}, \epsilon_{Bk.1}) \\
 = \text{var} (\epsilon_{B.1})
 \end{aligned}
 \tag{4.10}$$

where $j' \in J$, $j' \neq j$, and all other elements are defined as before. The variance-covariance matrix for the second choice is:

$$\begin{matrix}
 & U_{BI|AI} & \dots & U_{BK|AI} \\
 U_{BI|AI} & \left[\begin{array}{ccc} \text{var}(\epsilon_{B,2} + \epsilon_{AB,2}) & \dots & 0 \\ 0 & \dots & \text{var}(\epsilon_{B,2} + \epsilon_{AB,2}) \end{array} \right. \\
 U_{BK|AI} & & &
 \end{matrix} \quad (4.11)$$

where $\epsilon_{BI,2} = \epsilon_{BK,2} = \epsilon_{B,2}$, and $\epsilon_{AIBI,2} = \epsilon_{AJBK,2} = \epsilon_{AB,2}$.

An important issue in categorical choice models like the logit model, is that differences in variance between choice situations, such as in the above variance-covariance structures, directly lead to differences in parameter estimates for these choice situations, *even if the underlying structural utilities are the same*.

This is due to the fact that there is a direct relationship between the variance of the disturbance and the scale of the parameter estimates. In logit models this relationship is expressed as: $\text{var}(\epsilon) = \pi^2/6\mu^2$, where ϵ is the error component of the utility function and μ is a parameter that determines the scale of the Gumbel distribution (Ben-Akiva and Lerman 1985, p.105). A similar relationship between variance and scale exists in all categorical choice models.

Generally in categorical choice models, the estimated parameter values for the structural utilities V are confounded with the scale parameter μ and only the product of μ and V can be estimated. In the estimation process the scale parameter μ is therefore generally set to an arbitrarily selected convenient value (e.g., 1 in the simple MNL model) and the structural parameters are estimated in relation to this value (Ben-Akiva and Lerman 1985 p.71). As a consequence, estimations made in choice situations with identical structural parameter values, but with different underlying scale parameters do not lead to identical parameter estimates. This implies that for estimations made in choice situations with different disturbances the parameter values will necessarily be different.

If for example, there exist two choice situations with disturbances ϵ_1 and ϵ_2 and scale values μ_1 and μ_2 , the assumption of equally distributed disturbances ϵ_T may lead to biases in the estimated parameter values. Swait and Louviere (1993) show that the Maximum Likelihood Estimator (MLE) will necessarily overpredict for the choice situations with the larger variance (i.e., smaller μ) and underpredict for the situations with the smaller variance (i.e., larger μ), where the degree of over- and underprediction depends on the number of observations made in each choice situation.

This observation is especially relevant to experimental design techniques used in conjoint choice modeling, which will be discussed in section 4.5.

4.4.4 Portfolio choice models

Depending on the assumptions one is willing to make with regard to the equality of the underlying parameters in the different stages of portfolio choice processes, overall or separate choice models should be applied to model the choices of the separate alternatives that make up portfolio alternatives. If the parameters of separate alternatives in the portfolio alternatives are identical for each stage in the sequential choice processes, or if simultaneous choices are

made between portfolio alternatives, overall models can be used to model the portfolio choice process. If the underlying parameters in a sequential choice process vary between different choice stages however, separate models are required for each of these choice stages. Depending on the distributional assumptions that are made with regard to either the overall choices or each of the separate choices, models of various complexity can be used to describe the portfolio choice process. We will now discuss how the joint logit model, the nested logit model and the probit model can be applied to model portfolio choices. These models increase in terms of the complexity of the effects that they incorporate in modeling portfolio choice processes. In the discussion it is assumed that the underlying parameter values for the attributes in the portfolio alternatives are identical in all stages of the portfolio choice process (i.e. $V_{Aj,1} = V_{Aj,2}$, $V_{Bk,1} = V_{Bk,2}$, $V_{AjBk,1} = V_{AjBk,2}$). In modeling terms this implies that the probabilities for the alternatives in the second choice in the sequential choice process are identical to the conditional probabilities of the simultaneous choice. Extension of the approaches to separate models for different stages of sequential choice processes and extension of the two alternative case to cases including multiple alternatives will be discussed in separate paragraphs. An overview of the modeling approaches that can be used to model the various choice structures that may underlie portfolio choice processes is presented in table 4.1.

Table 4.1 Proposed model structures

	simultaneous choice		sequential choices	
		identical parameters over choice stages		different parameters for each choice stage
Distribution of disturbances:				
IID Gumbel over portfolio alternatives	overall joint logit model	overall joint logit model	separate joint logit models	
IID Gumbel per separate alternative, hierarchically structured	overall nested logit model	overall nested logit model	separate nested logit models	
IID Normal per separate alternative, matrix structure	overall probit model	overall probit model	separate probit models	

4.4.5 Joint logit model

The joint logit model arises if it is assumed that both the error terms and the underlying parameter values are identical in all stages of the portfolio choice process. The model can be applied to the simultaneous case as well as to the sequential case if it is assumed that all disturbances are IID and that the utilities of the first choice are identical to those of the second choice. The model differs from simple multinomial choice models for single choices in that it incorporates the attributes of both choices of the portfolio choice and the interactions between attributes of different alternatives, but it is similar in that it includes

only one IID Gumbel disturbance for each choice situation. Therefore, analogously to the simple MNL model, the equations for the choice probabilities are:

$$\begin{aligned}
 U_{A_j B_k} &= V_{A_j} + V_{B_k} + V_{A_j B_k} + \epsilon_{A_j B_k} \\
 P(A_j B_k) &= P(U_{A_j B_k} > U_{A_j B_{k'}}; \forall j' \in J, j' \neq j \wedge \forall k' \in K, k' \neq k) \\
 &= \frac{\exp(V_{A_j} + V_{B_k} + V_{A_j B_k})}{\sum_{j' \in J} \sum_{k' \in K} \exp(V_{A_{j'}} + V_{B_{k'}} + V_{A_{j'} B_{k'}})} \quad (4.12)
 \end{aligned}$$

$$\begin{aligned}
 U_{B_k | A_j} &= V_{B_k} + V_{A_j B_k} + \epsilon_{A_j B_k} \\
 P(B_k | A_j) &= \frac{\exp(V_{B_k} + V_{A_j B_k})}{\sum_{k' \in K} \exp(V_{B_{k'}} + V_{A_j B_{k'}})} \quad (4.13)
 \end{aligned}$$

where V_{A_j} is the structural utility of alternative A_j , V_{B_k} is the structural utility of alternative B_k , $V_{A_j B_k}$ is the structural utility of the interaction $A_j B_k$, $\epsilon_{A_j B_k}$ is the disturbance over these utilities, and the other elements are defined as above.

4.4.6 Nested logit model

Nested logit models represent a first step towards the estimation of a full variance covariance matrix (McFadden 1981). Nested logit models still assume that the underlying parameters are identical in all choices of the portfolio choice process, but allow portfolio alternatives to be hierarchically clustered in such a way that differences in disturbances between alternatives that share certain elements are smaller than differences in disturbances between alternatives that do not share elements. The model allows for alternatives within branches of the hierarchical structure to have common disturbance elements. In comparison to the joint logit model, additional parameters that express the ratio of the scales between choices at different levels of the hierarchical structure are introduced. If the hierarchical structure adequately describes the data, these parameters take on a value between zero and one. If they equal one, the model reduces to the joint logit model.

It is assumed that disturbances in each of the branches of the hierarchical structure are identically Gumbel distributed. It is furthermore assumed that components of the disturbances specifically related to different levels in the hierarchical tree structure are independently distributed. Together, these assumptions imply that the covariances between the disturbances over the utility of one of the separate alternatives in the two alternative portfolio alternatives are zero, therefore either $COV(\epsilon_{A_j}, \epsilon_{A_j})$ or $COV(\epsilon_{B_k}, \epsilon_{B_k})$ equals zero in the nested logit model (Ben Akiva and Lerman 1985).

The overall utility of the alternatives in the nested logit model is expressed as:

$$U_{AjBk} = V_{Aj} + V_{Bk} + V_{AjBk} + \epsilon_{Aj} + \epsilon_{AjBk} \quad (4.14)$$

and the choice probability at the higher level as:

$$P(A_j) = P(\max_K (U_{AjBk}) > \max_K (U_{Aj'Bk}); \forall j' \in J; A_j \neq A_{j'}) \quad (4.15)$$

$$= P(V_{Aj} + \epsilon_{Aj} + \max_K (V_{Bk} + V_{AjBk} + \epsilon_{AjBk}) > V_{Aj'} + \epsilon_{Aj'} + \max_K (V_{Bk} + V_{Aj'Bk} + \epsilon_{Aj'Bk}))$$

Under the assumption that the error term ϵ_{AjBk} is IID Gumbel distributed with parameters $(0, \mu^{low})$, with μ^{low} as the scaling factor of the lower level, the maximum of a set of alternatives $\max_K (V_{Bk} + V_{AjBk} + \epsilon_{AjBk})$ is also Gumbel distributed, but with parameters

$(\frac{1}{\mu^{low}} \ln \sum_{k \in K} \exp((V_{Bk} + V_{AjBk})\mu^{low}), \mu^{low})$ (Johnson and Kotz 1970). The probability can then be expressed as follows:

$$P(A_j) = \frac{\exp((V_{Aj} + V_{\max\{AjBk\}})\mu^{high})}{\sum_{j' \in J} \exp((V_{Aj'} + V_{\max\{Aj'Bk\}})\mu^{high})} \quad (4.16)$$

$$= \frac{\exp((V_{Aj} + \frac{1}{\mu^{low}} \ln \sum_{k \in K} \exp((V_{Bk} + V_{AjBk})\mu^{low}))\mu^{high})}{\sum_{j' \in J} \exp((V_{Aj'} + \frac{1}{\mu^{low}} \ln \sum_{k \in K} \exp((V_{Bk} + V_{Aj'Bk})\mu^{low}))\mu^{high})} \quad (4.17)$$

$$P(B_k | A_j) = \frac{\exp((V_{Bk} + V_{AjBk})\mu^{low})}{\sum_{k' \in K} \exp((V_{Bk'} + V_{AjBk'})\mu^{low})} \quad (4.18)$$

where $P(A_j)$ is the probability that a combination including A_j is chosen from the set of all combinations A and B , $P(B_k | A_j)$ is the probability that alternative $A_j B_k$ is chosen from the K alternatives in nest A_j , μ^{high} and μ^{low} are the scaling factors for the higher and the lower level, the 'low' one of which is arbitrarily set to 1, so that the estimation of the other represents the ratio of the two scales, $V_{\max\{AjBk\}}$ is an abbreviation of $\max_K (V_{Bk} + V_{AjBk} + \epsilon_{AjBk})$, the maximum utility of the lower level attributes of the alternatives in the set $\{A_j B_1, \dots, A_j B_K\}$, often called the *inclusive value* of the nest, and the other elements are defined as above.

Although it is assumed that the underlying utilities are identical in both choices it is in principle possible to introduce the sequentiality correction m_{seq} in the utility and probability functions. This can be expressed as:

$$\begin{aligned}
 U_{AjBk} &= V_{Aj} + \epsilon_{Aj} + m_{seq}(V_{Bk} + V_{AjBk} + \epsilon_{AjBk}) \\
 P(A_j) &= \frac{\exp((V_{Aj} + \frac{m_{seq}}{\mu^{low}} \ln \sum_{k \in K} \exp((V_{Bk} + V_{AjBk})\mu^{low})))\mu^{high}}{\sum_{j' \in J} \exp((V_{Aj'} + m_{seq} V_{\max\{Aj'Bk\}})\mu^{high})} \quad (4.19)
 \end{aligned}$$

From the above, it can be seen that the sequentiality structure and the hierarchical structure in the error terms lead to identically structured corrections in the marginal probabilities. Only one parameter can be estimated that captures the combined effect of m_{seq} and μ^{high}/μ^{low} , and it is impossible to estimate the sequentiality correction m_{seq} and the scale correction μ^{high}/μ^{low} separately. We will therefore in our further discussion not distinguish between the two.

4.4.7 Probit model

To better represent the covariances in the model, it is often assumed that disturbances are normally distributed instead of Gumbel. The assumption of normally distributed disturbances leads to the probit model (e.g., Daganzo 1979). An important advantage of the normal distribution when modeling dependencies between stochastic terms is that covariances and variances between disturbances can be modelled without a need to change the model's functional expression: independent and identical disturbances are a special case of the general model in which disturbances have different dependencies and scales. As in the joint logit and nested logit model, it is assumed that the underlying parameter values in the first and second choices of the sequential choice process are identical. The utility and choice probability of an alternative $A_j B_k$ are expressed as:

$$U_{AjBk} = V_{Aj} + V_{Bk} + V_{AjBk} + \epsilon_{Aj} + \epsilon_{Bk} + \epsilon_{AjBk} \quad (4.20)$$

$$P(A_j B_k) = \int_{-\infty}^{\infty} \int_{-\infty}^{V_{AjBk} - V_{AjBk} + \epsilon_{AjBk}} \dots \int_{-\infty}^{V_{AjBk} - V_{AjBk} + \epsilon_{AjBk}} f(\epsilon_{\{AjBk\}}, \dots, \epsilon_{\{AjBk\}}) d\epsilon_{\{AjBk\}} \dots d\epsilon_{\{AjBk\}}$$

where $f(\epsilon_{\{AjBk\}}, \dots, \epsilon_{\{AjBk\}})$ is the density function of the normal distribution as expressed in formula 4.2, $\epsilon_{\{AjBk\}}$ is the sum of the three IID normally distributed error terms ϵ_{Aj} , ϵ_{Bk} and ϵ_{AjBk} over the utility of alternative $A_j B_k$ and all other elements are defined as before.

Separate estimation of sequentiality corrections in the probit model meets similar difficulties to those that were encountered in the nested logit model as the sequentiality corrections in the variance-covariance matrix are again confounded with differences in disturbances between dimensions.

It is important to note that in comparison to other probit models as they have been applied in planning and marketing (e.g., Bunch and Kitamura 1989, Chintagunta 1992, Papatla and Krishnamurthi 1992), the model we propose here represents a restricted version of the probit model. In our approach we apply it to model the specific type of covariances that occur as a result of common alternatives in different portfolio alternatives. Other possible causes of covariances are not dealt with within the model structure. In the presented approach

this is justifiable as in conjoint choice analyses, choice set composition is controlled for in the experimental design. Consequently, it can be expected that heterogeneity among respondents is not systematically related to parameter estimates as the researcher randomizes the hypothetical choice sets across respondents.

4.4.8 Separate models for different stages of portfolio choices

The above discussion of modeling approaches was based on the assumption that the parameters that drive the choice process are identical for the successive stages of the portfolio choice process. If this is not assumed, and if instead the parameters in the first choice ($V_{Aj,1}$, $V_{Bk,1}$, and $V_{Aj/Bk,1}$) are assumed to be essentially different from those in the second choice ($V_{Aj,2}$, $V_{Bk,2}$, and $V_{Aj/Bk,2}$), separate models are required to model the two choice phases.

In modeling terms, this can be done relatively straightforwardly, as identical assumptions can be made with regard to each of the choice stages to the ones that are made for the overall choices. Depending on the assumptions that are made with respect to the error distribution in each choice phase, joint logit, nested logit and probit models can be used to model the choice processes in each phase, and the identical formulas can be applied. The only difference is that there will be separate formulas with different structural utilities for the first and second choice.

4.4.9 Extension to multiple alternatives

The theory for modeling choices between two alternatives can be extended to situations where choices are made between multiple alternatives. We will now subsequently discuss the extension of the joint logit structure for two alternatives into a joint logit structure for multiple alternatives, an extension of the two alternative nested logit structure into a multi-layered nested logit structure and an extension of the two alternative probit structure into a probit structure for portfolio choices between sets of multiple alternatives. For reasons of expositional clarity we will restrain from including interaction terms in the presented formulas. They can be easily incorporated in the structural utility functions and do not lead to fundamental changes in the structure of the probability functions, but have as a disadvantage that they would lead to unnecessarily visually complex formulas.

The *joint logit model* can be extended if we describe the overall utility of the portfolio alternative as the sum of the utilities of all the alternatives present in the portfolio alternative and introduce one overall error term that describes the disturbance on the overall utility. As in the simple MNL model, it is assumed that this error term is IID Gumbel distributed.

Let $U_{\{j1, \dots, jN\}}$ be the utility of the combined set of alternatives $\{j1, \dots, jN\}$. Let N be the total set of choices involved in the portfolio choice, V_{jn} the structural utility of alternative j in choice n . Let $\epsilon_{\{j1, \dots, jN\}}$ be the error term over alternative $U_{\{j1, \dots, jN\}}$, which is assumed to be IID Gumbel. Let J_n be the total set of alternatives j in choice n , and $P(\{j1, \dots, jN\})$ the probability that the combined set of alternatives $\{j1, \dots, jN\}$ is chosen, then the joint logit model for portfolio choices of multiple alternatives is:

$$U_{\{j1, \dots, jN\}} = \sum_{n \in N} V_{jn} + \epsilon_{\{j1, \dots, jN\}} \quad (4.21)$$

$$P(\{j1, \dots, jN\}) = P(U_{\{j1, \dots, jN\}} \geq U_{\{j'1, \dots, j'N\}}; \forall n \in N; \forall j'n \in J_n; j'n \neq jn)$$

$$= \frac{\exp(\sum_{n \in N} V_{jn})}{\sum_{j'1 \in J_1} \sum_{j'2 \in J_2} \dots \sum_{j'N \in J_N} \exp(\sum_{n \in N} V_{j'n})} \quad (4.22)$$

The *nested logit model* for multiple element portfolio alternatives can be constructed as follows. Let all elements be defined as before. Let $\epsilon_{\{j1, \dots, jN-1\}}, \epsilon_{\{j1, \dots, jN-2\}}, \dots, \epsilon_{\{j1\}}$ be a set of error terms hierarchically structured in order from large to small, and related to the alternative combinations $\{j1, \dots, jN-1\}, \{j1, \dots, jN-2\}, \dots, \{j1\}$ respectively, which are all elements within the portfolio alternative $\{j1, \dots, jN\}$. Assume that: (i) each of these error terms is independently distributed of the others, and (ii) the sum of the error terms from the lowest level upward is Gumbel distributed within each hierarchical level (Ben-Akiva and Lerman 1985, p. 292). Let μ^n be the scaling factor related to the hierarchical level of $\{j1, \dots, jn\}$. Then, the utility of the alternatives is expressed as:

$$\left\{ \begin{array}{l} U_{\{j1, \dots, jN-1\}} = V_{jN} + \epsilon_{\{j1, \dots, jN\}} \\ U_{\{jN-1, jN\} | \{j1, \dots, jN-2\}} = V_{jN-1} + V_{jN} + \epsilon_{\{j1, \dots, jN-1\}} + \epsilon_{\{j1, \dots, jN\}} \\ \dots \\ U_{\{j1, \dots, jN-1, jN\}} = \sum_{n \in N} V_{jn} + \sum_{n \in N} \epsilon_{\{j1, \dots, jn\}} \end{array} \right. \quad (4.23)$$

where it can be seen that both the structural and the random component increase from the lowest conditional choice to the highest fully combined choice. The probabilities for the choices at the lowest hierarchical level are expressed as:

$$P(jN | j1, \dots, jN-1) = \frac{\exp((V_{jN})\mu^N)}{\sum_{j'N \in J_N} \exp((V_{j'N})\mu^N)} \quad (4.24)$$

For all other levels, a recursive expression is used where the utility of an alternative jn is expressed as the structural utility of that alternative V_{jn} , and the inclusive value representing the maximum utility of the alternatives at the lower hierarchical level. Given the assumption that the sums of the error terms follow IID Gumbel distributions within each hierarchical level, the probability of selecting an alternative jn at the level of $\{j1, \dots, jn\}$ is expressed as:

$$P(jn) = \frac{\exp((V_{jn} + V_{\max,jn})\mu^n)}{\sum_{jn' \in Jn} \exp((V_{jn'} + V_{\max,jn'})\mu^n)} \tag{4.25}$$

where

$$V_{\max,jn} = \frac{1}{\mu^{n+1}} \ln \sum_{jn+1 \in Jn+1} \exp(\mu^{n+1}(V_{jn+1})) \tag{4.26}$$

In the *probit model* for multiple elements, all elements are defined as before. Let $\epsilon_{\{j1, \dots, jN\}}$ now be IID normally distributed across alternatives, and ϵ_{jn} be the IID normally distributed error terms uniquely attributable to the utility of each of the separate alternatives j in choice n . Let $f(\epsilon)$ be the density function of the normal distribution. Then, the utility of the combined set of alternatives $\{j1, \dots, jN\}$ is expressed as:

$$U_{\{j1, \dots, jN\}} = \sum_{n \in N} V_{jn} + \epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn} \tag{4.27}$$

and its utility as:

$$P(\{j1, \dots, jN\}) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \dots \int_{-\infty}^{\infty} \sum_{n \in N} V_{jn} - \sum_{n \in N} V_{jn} + \epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn} \dots \int_{-\infty}^{\infty} \sum_{n \in N} V_{jn} - \sum_{n \in N} V_{jn} + \epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn} f((\epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn}), \dots, (\epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn})) d(\epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn}) \dots d(\epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn}) \tag{4.28}$$

The underlying variance-covariance matrix of the error terms in the combined choice process is expressed in formula 4.29.

In this matrix, the covariance between two multiple element portfolio alternatives is simplified to the variance over their common elements, similar to the two alternative case. This is feasible because the parts of the error terms that are different between the portfolio alternatives are assumed to be independently distributed.

	$U_{\{I_1, \dots, I_n, \dots, I_N\}}$	...	$U_{\{I_1, \dots, I_n, \dots, J_N\}}$	...	$U_{\{I_1, \dots, J_n, \dots, J_N\}}$	...	$U_{\{I_1, \dots, J_n, \dots, I_N\}}$
$U_{\{I_1, \dots, I_n, \dots, I_N\}}$	$\text{var}(\epsilon_{I_1, \dots, I_n, \dots, I_N} + \epsilon_{I_1} + \dots + \epsilon_{I_n} + \dots + \epsilon_{I_N})$	...	$\text{var}(\epsilon_{I_1} + \dots + \epsilon_{I_n} + \dots + \epsilon_{I_{N-1}})$	...	$\text{var}(\epsilon_{I_1} + \dots + \epsilon_{J_{n-1}})$	...	0
$U_{\{I_1, \dots, I_n, \dots, J_N\}}$	$\text{var}(\epsilon_{I_1} + \dots + \epsilon_{I_n} + \dots + \epsilon_{I_{N-1}})$	...	$\text{var}(\epsilon_{I_1, \dots, I_n, \dots, J_N} + \epsilon_{I_1} + \dots + \epsilon_{I_n} + \dots + \epsilon_{J_N})$	...	$\text{var}(\epsilon_{I_1} + \dots + \epsilon_{J_{n-1}} + \epsilon_{J_N})$	...	$\text{var}(\epsilon_{J_N})$
$U_{\{I_1, \dots, J_n, \dots, J_N\}}$	$\text{var}(\epsilon_{I_1} + \dots + \epsilon_{I_{n-1}})$	...	$\text{var}(\epsilon_{I_1} + \dots + \epsilon_{I_{n-1}} + \epsilon_{J_N})$	...	$\text{var}(\epsilon_{I_1, \dots, J_n, \dots, J_N} + \epsilon_{I_1} + \dots + \epsilon_{J_n} + \dots + \epsilon_{J_N})$	...	$\text{var}(\epsilon_{J_n} + \dots + \epsilon_{J_N})$
$U_{\{I_1, \dots, J_n, \dots, I_N\}}$	0	...	$\text{var}(\epsilon_{J_N})$	...	$\text{var}(\epsilon_{J_n} + \dots + \epsilon_{J_N})$	...	$\text{var}(\epsilon_{I_1, \dots, J_n, \dots, I_N} + \epsilon_{I_1} + \dots + \epsilon_{J_n} + \dots + \epsilon_{I_N})$

(4.29)

The *separate models* approach can be extended as follows. Let all elements be defined as before. Assume that the underlying structural utilities for combined choice processes and for conditional choice processes are different. Let $V_{jI.n}$ represent the structural utility of alternative j as the first alternative in the combined choice set $\{jI.n, \dots, jn.n, \dots, JN.n\}$ that is evaluated in the n^{th} choice of the combined choice process. Then the utility of the combination of alternatives regarding the choice of alternative j in the n^{th} choice is expressed as:

$$U_{\{jI.n, \dots, jn.n, \dots, jN.n\}} = \sum_{n \in N} V_{jn.n} + \epsilon_{jI.n, \dots, jn.n, \dots, jN.n} + \sum_{n \in N} \epsilon_{jn.n} \tag{4.30}$$

The probability functions for the choices at each of the choice stages can be joint logit, nested logit or probit, depending on the assumptions one is willing to make with regard to the error structure.

4.5 Experimental designs to support conjoint choice models of portfolio choices

Section 4.2.5 already briefly introduced the use of experiments in conjoint choice modeling, in this section we will now discuss the traditional experimental design approaches in conjoint choice modeling somewhat more at length and introduce a new experimental approach that supports estimation of the portfolio choice models as discussed in the previous section.

Conjoint choice experiments reported in the literature typically depend upon the simple multinomial logit model (e.g., Bates 1988, Louviere and Woodworth 1983, Louviere 1988, Timmermans 1984). A necessary and sufficient condition to estimate this model efficiently is that the experimental design used to create the choice alternatives is orthogonal. This guarantees that the attributes within the choice alternatives vary independently. A commonly applied design strategy is therefore to create an orthogonal fractional factorial design and then place the profiles into choice sets. Typically, a base alternative, coded zero, is added to each choice set to obtain orthogonality not only between the attribute levels themselves, but also between their relative differences. All estimates are then made in relation to the base alternative.

Variable or constant choice set designs may be used to create the choice sets. In the case of variable choice sets, 2^N (N is the total number of profiles), are typically applied to vary the presence or absence of the profiles in the choice sets, and the two levels indicate that an alternative can be either present or absent in the choice set. Thus, choice sets of varying size and composition are created.

In constant choice set designs, various approaches may be adopted. Two commonly applied techniques are: (i) Each alternative i in the choice set of fixed size s is described in terms of j attributes with levels l_{ij} . The attributes are placed in choice sets of size s according to a fractional factorial design in which all levels are varied independently. For example, if one wishes to conduct an experiment with two alternatives with three and four attributes, all with three levels, a 3^7 fractional factorial design is created to construct choice sets in which attributes vary independently both within and between alternatives. (ii) Alternative profiles from k identical fractional factorial designs are randomly combined to create choice sets of size k , preventing that identical alternatives are placed in the same choice set. In principle, randomization of attribute comparisons renders the marginals of the alternatives independent of each other. Independence between the attributes describing the various alternatives can be tested by calculating the correlations between the columns of the combined design profiles. If the marginals are fully independent the correlations are zero (Louviere 1988).

Recently, it has been shown that the same design strategies can be used to test more complex, non-IIA choice models. This can be done by introducing the effects of attribute levels of other alternatives from the choice set into the utility function of the alternatives. These effects are generally referred to as cross effects and availability effects (Lazari and Anderson 1993). If the design is orthogonal between attributes of different alternatives, these effects can be estimated independently of the effect of the alternatives' own attributes. For example, Anderson et al. (1992) used a fractional factorial design to create choice sets of travel mode alternatives and estimated the effect of the availability of each travel mode in the choice set on the preferences for other travel modes. Similarly, Timmermans et al. (1992) have demonstrated how fractional factorial designs that are orthogonal within and between alternatives can be used to estimate cross-effects between alternatives that depict the influence of attribute levels of one alternative on the preferences for other alternatives. Anderson and Wiley (1992) and Lazari and Anderson (1993) provide locally optimal designs for similar experiments, where alternatives are described by respectively their brand name or a single attribute. They present a catalog of designs up to a practical numbers of alternatives.

Although the above approaches extend the number and type of effects that can be estimated in multinomial logit models, they share the basic assumption with the simple

multinomial logit model that disturbances in the utility function of the alternatives follow IID distributions. This is a necessary condition for factorial experimental designs to support efficient estimation of parameter values (Dey 1985).

This assumption may give rise to bias in the model estimates, if disturbances are interdependent and/or heteroscedastic in reality. The effect of these biases on estimates in econometric choice models has been extensively discussed in the literature (e.g., Horowitz 1981, Swait and Louviere 1993). The fact that incorrect assumption of IID disturbances may also reduce the efficiency of estimations based on experimental designs has however hardly been recognized in conjoint choice applications.

As discussed in section 4.4.3, to understand the effect of these biases, it is critical to realize that the estimated parameter values for the structural utilities V are confounded with the scale parameter μ in the simple multinomial logit model, and that only the product of μ and V can be estimated. In the estimation process the scale parameter μ is therefore generally set to 1 and the structural parameters are estimated in relation to this value (Ben-Akiva and Lerman 1985 p.71). As a consequence, choice situations with identical structural parameter values, but different underlying scale parameters will not lead to identical parameter estimates. This is, estimates from choice situations with different disturbances, lead to different parameter estimates because there is a direct relationship between the variance of the disturbance and the scale parameter μ in logit and probit models.

As has been shown in the discussion of the nested logit and probit model of portfolio choices, covariances between the error terms of portfolio alternatives will typically occur if separate alternatives that make up portfolio alternatives each have separate error terms. Statistically efficient estimation of the separate influence of this effect is not possible with designs that allow estimation of cross effects, because it is confounded with corrections for other violations of IIA. We therefore propose a design approach that supports explicit estimation for various choice situations of portfolio choice processes. Whether separate models for each situation can be reduced to the less complex overall models and whether different error terms exist for different choice situations can then be tested. The objective of the proposed design approach is therefore twofold: (i) to support statistically efficient estimation of parameters in portfolio choice processes and (ii) to support tests of the model structures of joint logit, nested logit, probit models for overall and separate choice models of portfolio choice as possible explanations for differences in parameter values in portfolio choice processes.

The proposed design approach consists of a set of interrelated subdesigns. The basic principle is that it supports separate estimates for different choice situations that may occur in portfolio choice situations. The subdesigns can be distinguished in a first subdesign, that describes portfolio choices in which the portfolio alternatives vary on all separate alternatives and a set of other subdesigns that describe conditional portfolio choices in which part of the portfolio alternatives is identical. The overall design is constructed in the following two steps:

(i) A first subdesign is constructed in analogy with traditional designs for single choices, with the difference that attributes from several alternatives instead of the attributes of only one alternative are used to construct the portfolio alternatives in the design and that, within the choice sets, no common elements are allowed between portfolio alternatives. This implies that even if the separate alternatives in a portfolio choice carry separate error terms, as in

the probit model discussed before, the assumption of IID disturbances still holds within this subdesign. Statistically efficient parameter estimates are therefore supported by the subdesign. If the joint logit model applies, this design offers sufficient information to estimate all structural parameters. In the case of nested logit and probit models, independent parameter estimates of the structural parameters also can be obtained, but there is no information on the structure of the variance covariance matrix that describes the error structure in the portfolio choices.

(ii) A set of conditional subdesigns is constructed in which only one of the separate alternatives of the portfolio alternatives varies and the others are maintained as a constant condition within the choice set. The other subdesigns are introduced to allow for tests of the assumption in the joint, nested and probit models of identical underlying parameter values in the different choice situations of combined choices. They can be considered as simulations of the different phases of the portfolio choice process because they present respondents with conditional choices, in which part of the portfolio alternatives varies only across and not within choice sets.

As an example, a schematic representation of the choice sets in the overall design in the case of a two alternative portfolio choice is represented below, where $A_j, j \in J$ is an alternative from the total set of first alternatives, and $B_k, k \in K$ is an alternative from the total set of second alternatives in the portfolio alternatives:

$$\begin{bmatrix} \text{Alternatives } A_j & \text{Alternatives } B_k & \text{Interaction } A_j B_k \\ \text{Condition } & \text{Alternatives } B_k & 0 \\ \text{Alternatives } A_j & \text{Condition} & 0 \end{bmatrix}$$

If the overall joint logit model applies, the parameters estimated on choices in these subdesigns are identical to those estimated in the first subdesign, if the nested logit or probit model applies the variance of the error terms in the conditional choices will be different from that in the overall choices of the first subdesign and the parameter estimates will therefore be scaled differently. If separate models are required for different choice stages in portfolio choices the scale difference cannot account for the differences found between the estimates in different subdesigns, and therefore essentially different utility parameters will be required for different choice situations.

4.6 Estimation of conjoint choice models of portfolio choices

Traditional conjoint choice experiments are based on the assumption of identical underlying parameters and independently and identically error terms in all choice sets, in which case parameter estimation is straightforward. Generally a maximum likelihood estimation procedure is applied, though sometimes generalized weighted least squares procedures have been applied (Ben-Akiva and Lerman 1985, p.118). As the IID assumptions are incorrect if separate models for different choice stages are required or if the overall nested logit or probit

model applies the estimation procedure has to be adapted accordingly.

An important aspect in the estimation of the proposed model structures is that they are nested within each other in terms of model complexity. The separate models reduce to the probit model if the underlying model parameters of the different choice situations are identical, the probit model reduces to the nested logit model if the underlying error structure is hierarchical, and reduces to the joint logit model if the error terms are independent and identical in all choice situations. The observed reductions in model fit between the different model structures can therefore be tested using the log-likelihood ratio test statistic developed by Theil (1971). It is expressed as $2[\mathcal{L}^*(\beta_1) - \mathcal{L}^*(\beta_2)]$, where $\mathcal{L}^*(\beta_1)$ and $\mathcal{L}^*(\beta_2)$ are the adjusted log-likelihoods of the models under comparison. This statistic is asymptotically Chi-square distributed.

In the estimation procedure, first, separate models are estimated for choices in each subdesign. This is done by estimating separate simple multinomial logit models for each subdesign. This is feasible because IID disturbances exist within each subdesign as discussed. Therefore, even if the probit model is the true underlying model, parameters can be estimated consistently within each subdesign by applying models that are based on IID disturbances. Estimates based on the simple MNL model can be translated into probit parameters by applying the following transformation (Ben-Akiva and Lerman 1985, p.71):

$$\beta_{\text{logit}} = \frac{\pi}{\sqrt{6}} \beta_{\text{probit}}, \text{ assuming that } \text{var}_{\text{probit}}(\epsilon_{ij}) = 1 \text{ and } \text{var}_{\text{logit}}(\epsilon_{ij}) = \pi^2/6.$$

Next, the variance-covariance structure of the overall probit model is estimated by maximizing the log-likelihood of the observed choices across all choice sets and subjects. Again, the parameters for each of the subdesigns are optimized, however this time, a set of extra parameters μ is optimized simultaneously that expresses the difference in scale between the different subdesigns. A procedure based on an approach proposed by Swait and Louviere (1993) can be used for this purpose.

To find the optimal scale ratio, the overall log-likelihood is calculated for a sequence of scale ratios. In this procedure, the parameter values of the first subdesign are kept constant relative to the parameters of the other subdesigns and the optimum scale factor is determined between the parameters of the other subdesigns and the first. So, the second subdesign is optimized along with the first subdesign, then the third subdesign is optimized along with the first subdesign, etc..

Because the parameters of the other subdesigns are based on conditional portfolio choices that vary independently of each other, a sequential estimation procedure can be used to determine the scale factors that maximize the overall log-likelihood.

This procedure guarantees a global maximum in the log-likelihood, but does not provide estimates of the variance of the scaling values (Swait and Louviere 1993). In comparing model structures this is not a major drawback, as the log-likelihood ratio test statistic compares the total fit of the models rather than the separate parameter estimates. It is important to note that for this estimation to be effective the true underlying model in each subdesign needs to have IID disturbances.

Estimates for the covariances in the variance covariance matrix of the probit model can be derived directly from the estimated scale ratios. The covariance between conditional portfolio choices that have common elements are equal to the variance of the error term of

those common elements. The estimated scale corrections between subdesign 1 and the other subdesigns therefore equal the ratio of the variance of the overall error term in subdesign 1 to the error term in the each of the other subdesigns. If the scale of the parameters in subdesign 1 is arbitrarily set to 1 (and consequently the variance to $\pi^2/6$) the variance of the error term in subdesign i can be expressed in terms of the ratio of the scales of the two subdesigns. First, the ratio of the scales of the subdesigns (r_{1-i}) is expressed in terms of the standard deviations of the error terms of the subdesigns (σ_i and σ_1):

$$r_{1-i} = \frac{\mu^1}{\mu^i} = \frac{\sigma_i}{\sigma_1} = \frac{\sigma_i}{\pi/\sqrt{6}} \tag{4.31}$$

Then the variance in subdesign i can be expressed as:

$$var(\epsilon_i) = \frac{\pi^2}{6} r_{1-i}^2 \tag{4.32}$$

Because it is assumed that the error terms related to each of the separate elements in the portfolio alternatives are independently distributed, the variance of the error term in subdesign 1 minus the variance of the error term in subdesign i equals the $var(\epsilon_{1-i})$: the variance over the common alternatives in the portfolio choices in subdesign i . In formula this is expressed as:

$$var(\epsilon_1) - var(\epsilon_i) = var(\epsilon_{1-i}) \tag{4.33}$$

As was shown in section 4.4.3 this variance equals the covariance for the conditional choices in subdesign i if they are modeled in a probit variance-covariance structure. Therefore the covariance related to choices between alternatives i and i' in subdesign i can be expressed as:

$$\begin{aligned} cov(\epsilon_i + \epsilon_{1-i}, \epsilon_{i'} + \epsilon_{1-i}) \\ = cov(\epsilon_{1-i}, \epsilon_{1-i}) \\ = var(\epsilon_{1-i}) \end{aligned} \tag{4.34}$$

where ϵ_i and $\epsilon_{i'}$ are the sum of the error terms over the alternatives that vary in the portfolio choices in subdesign i and ϵ_{1-i} is the sum of the error terms over the alternatives that all portfolio alternatives in subdesign i have in common.

The various model structures are tested against each other in a series of log-likelihood ratio tests:

- (i) The separate models are tested against the overall probit model:

$$2[\mathcal{L}^*(\text{separate models}) - \mathcal{L}^*(\text{overall probit})].$$

(ii) If the sum of the log-likelihoods of the separate models for the subdesigns is not significantly better than that of the overall probit model, the overall probit model is tested against the different hierarchical structures of the overall nested logit model

$$2[\mathcal{L}^*(\text{overall probit}) - \mathcal{L}^*(\text{overall nested logit})],$$

(iii) If again there is no significant difference, the best fitting overall nested logit model is tested against the overall joint logit model:

$$2[\mathcal{L}^*(\text{overall nested logit}) - \mathcal{L}^*(\text{overall joint logit})].$$

4.7 Conclusions and discussion

This chapter discussed the theoretical basis of conjoint choice modeling. It then was argued that urban tourists' choices typically involve portfolio type choice processes, but that traditional conjoint choice models and experimental designs do not support this type of choice processes. Therefore an extension of traditional conjoint choice modeling was developed that allows one to estimate models of portfolio choice processes using conjoint choice experiments.

Four modeling approaches to portfolio choices were discussed: (i) overall joint logit models, (ii) overall nested logit models, (iii) overall probit models, and (iv) separate models for different elements in portfolio choices. An experimental design approach to support estimation of these models also was proposed as well as a procedure that allows one to estimate the various effects in the different models as well as to make systematic comparisons and tests of the proposed models.

To structure the discussion of urban tourists choice processes a simple conceptual framework of relevant choice types in urban tourists' choice processes was also proposed. Three main choice types were selected: (i) participation choice, (ii) destination choice, and (iii) activity choice. In the next chapter we will develop specific portfolio choice models and experimental designs for each of these three choice types.

5 Conjoint Choice Models for Urban Tourists' Portfolio Choices: Applications

5.1 Introduction

In chapter 4 a conjoint choice modeling approach was developed to model urban tourists' portfolio choices. This approach can be used as a tool to support ex-ante evaluations of urban tourism development projects. A conceptual framework of three frequently studied choice types was proposed to structure the study of urban tourists' choice processes in a conjoint choice modeling approach.

In this chapter empirical applications for each of these three choice types are introduced. Specific models and experimental designs are discussed for (i) urban tourists' participation choice, (ii) urban tourists' destination choice combined with transportation choice, and (iii) urban tourists' activity choice when visiting a city. The models and designs discussed in this chapter are based on the theoretical basis developed in chapter 4.

Each section in the chapter starts with a theoretical discussion of the models and experimental design for the specific choice type studied. This is followed by a description of the data collection in the empirical case and an exposition of results. The sections close with conclusions and a discussion of managerial implications of the study.

In the first experiment urban tourists' participation choices were studied. The study compared the choice of participating in a certain type of activity with the choice of specific activities within that type of activity, and presents a method to integrate the two choices via a nested logit structure. This structure is compared to an overall joint logit model of participation and activity choice and separate models for each of the choices. The method was applied to Dutch urban tourists' choices of visiting outdoor flower exhibitions.

In the second experiment urban tourists' destinations choice combined with transportation choice were studied. It can be expected that urban tourists' destination and transportation choices are strongly interrelated. Consequently, urban tourists' may make different choices for combinations of destinations and transportation modes than they make for each of the two topics separately. In this second study the joint logit model, the nested logit model, the probit model, and a set of separate models were compared in their ability to predict tourists' choices of combined transportation and destination portfolio alternatives. The models were applied to Dutch urban tourists' choices of short city breaks to urban destinations in Belgium, Germany and The Netherlands.

The third study presents a model to describe urban tourists' choices of activity packages. The proposed model and experiment allow for interactions and scale differences between the choices that urban tourists make for different elements of the activity packages. A probit model is used to describe choices between multiple alternatives and compared to a joint logit model for multiple alternatives as well as to separate models for each of the alternatives. In the empirical study, the models were applied to Dutch urban tourists' choices of activities for a weekend in Paris.

The chapter closes with a review of the main findings of the empirical studies. In chapter 6 we will review the results discussed in this thesis from a more general perspective and their implications for urban tourism planning and marketing.

5.2 Participation Choice

5.2.1 Introduction

As discussed in section 3.5, participation choice is one of the most widely studied topics in tourism research, especially in modeling studies (Crouch and Shaw 1993). Witt and Witt (1992) for example studied tourists' participation in each of 24 origin-destination pairs from France, Germany, the U.K. and the U.S. to various other countries. An example of a study of participation choices in a recreation context is Morey et al. (1991).

In traditional conjoint choice models the choice of participating in a given activity class is mostly treated identically to the choice of specific activities within activity classes. Usually a 'none' option is included as one of the alternatives in the designed choice sets, and it is implicitly assumed that the properties of the 'none' alternative are identical to those of specific activity alternatives. The observed proportion of 'none' choices is used to predict market penetration of an activity class in the same way as the observed proportion of choices of each activity is used to predict market shares. Moreover, as the simple multinomial logit model is commonly applied to describe the choice probabilities of both the 'none' alternative and the specific alternatives, it is assumed that independently and identically distributed (IID) Gumbel disturbances hold for the structural utility of the 'none' alternative and the specific activities.

A number of recent studies in which econometric choice models were applied to brand choice showed that the validity of this assumption may be questionable, and this choice should be treated as a combined choice of a category of products and a specific brand within that category. Bucklin and Lattin (1991), Chiang (1991) and Chintagunta (1993) for example tested model structures in which the choice of whether or not to buy goods in a certain product category was modeled in combination with the choice of what to buy within that particular product category, and Morey et al. (1991) in their study developed a similar modeling approach to describe combined recreation participation and site choice. These studies consistently found that parameters estimated on choices within product categories should be corrected when used to predict choices of whether or not to buy in a certain product category and vice versa. Though it could be argued that these studies applied econometric choice models rather than conjoint choice experiments, and that the choice processes they addressed were purchase choices rather than activity choices, the results justify a suspicion against the validity of the commonly applied assumptions underlying conjoint choice experiments.

The nested logit model is often suggested as a better way to model the joint choice of specific product alternatives and product category choice in brand choice studies in marketing (e.g., Bucklin and Lattin 1991). Another approach is to model specific product choice and product category choice as different choice processes. In that case separate parameters are estimated for the two choice models, representing the different choice processes. Gupta (1988) applied this approach in a study of purchase incidence and brand choice.

Approaches similar to these modeling techniques can be used to model joint participation and activity choice in an urban tourism context. The choice of specific urban tourism activities can either be nested under the choice of participating in a given activity class, or modeled as a separate process. In chapter 4 it was discussed how the nested logit

model and separate models can be applied in conjoint choice modeling to study combinations of choices. To the best of our knowledge however, no studies have been conducted on how to apply these models in a conjoint choice modelling framework, prior to the study described in this section. The purpose of the application discussed in this section was therefore to apply and test this extension of the traditional conjoint choice modeling approach to three basic model structures of urban tourists' joint participation and activity choice: (i) a simple multinomial logit model which included both a 'none' alternative and specific activities, (ii) a nested logit model in which activity choice was modeled conditionally on participation choice, and (iii) separate logit models of the choice of whether or not to participate in a certain activity class and the choice of specific activities.

5.2.2 Model formulation, experimental design and estimation

Urban tourists are assumed to participate in those activities that present the highest utility to them. In the present analysis we focus on the choice of participating in a single class of activities *a*, and the choice of specific activities within that class *ja*. Activities outside of class *a* are considered as a composite alternative $\neg a$. The evaluation of this alternative is assumed to be independent and identical throughout the choice process.

It is assumed that tourists base their choices on an evaluation of activity attributes, the utility of which consists of a structural part *V*, constant over time and common to all tourists, and a stochastic part ϵ that captures disturbances in utility due to taste variations between tourists and measurement errors. Different model structures can be generated depending upon the assumptions one is willing to make with regard to the stochastic part of the utility.

A simple multinomial logit model of participation and activity choice

Let J_a be the set of activities *ja* of activity class *a*. Let U_{ja} be the overall utility of alternative *ja*, V_{ja} the structural utility of alternative *ja*, and ϵ_{ja} be the disturbance on the utility of alternative *ja*. Let $U_{\neg a}$ be the overall utility of not participating in activity class *a*, $V_{\neg a}$ the structural utility of not participating in activity class *a*, and $\epsilon_{\neg a}$ the disturbance on the utility of not participating in activity class *a*. Assume that all disturbances ϵ_{ja} and $\epsilon_{\neg a}$ are independently and identically Gumbel distributed (IID) with mode 0 and scale parameter μ^{-1} . Assuming that tourists are maximizing their utility, the probability that alternative *ja* will be selected can be expressed as:

$$\begin{aligned}
 P(ja) &= P(U_{ja} \geq U_{j'a} \wedge U_{ja} \geq U_{\neg a}; \quad \forall j'a \in J_a; \quad j'a \neq ja) \\
 &= \frac{\exp(\mu^1 V_{ja})}{\exp(\mu^1 V_{\neg a}) + \sum_{j'a \in J_a} \exp(\mu^1 V_{j'a})} \tag{5.1}
 \end{aligned}$$

where $V_{ja} = \beta_{ja}'x_{ja}$, β_{ja} is the parameter vector of the attributes describing alternative *ja*, and, x_{ja} is the vector of attributes of alternative *ja*.

The probability of not participating in an activity of class a is:

$$\begin{aligned}
 P(\neg a) &= P(U_{\neg a} \geq U_{ja}; \quad \forall ja \in J_a) \\
 &= \frac{\exp(\mu^1 V_{\neg a})}{\exp(\mu^1 V_{\neg a}) + \sum_{j'a \in J_a} \exp(\mu^1 V_{j'a})} \quad (5.2)
 \end{aligned}$$

where $V_{\neg a} = \beta_{\neg a}' x_{\neg a}$,

$\beta_{\neg a}$ is the parameter associated with not participating in an activity of class a , and $x_{\neg a}$ is a dummy variable for not participating in an activity of class a . It can be easily seen that in this model structure $P(\neg a) + \sum_{ja \in J_a} P(ja) = 1$.

A nested multinomial logit model of participation and activity choice

Let all elements be defined as before. Let $V_{ja} = V_{a.gen} + V_{ja.spec}$, $\epsilon_{ja} = \epsilon_{a.gen} + \epsilon_{ja.spec}$ and $U_{ja.spec} = V_{ja.spec} + \epsilon_{ja.spec}$, where $V_{a.gen}$ is the structural utility common to all activities in class a , but not to activities outside of a , $V_{ja.spec}$ is the structural utility specific to activity ja , $\epsilon_{a.gen}$ and $\epsilon_{ja.spec}$ are disturbances on these utilities, and, $U_{ja.spec}$ is the overall utility specific to activity ja . Assume that all disturbances $\epsilon_{ja.spec}$ follow IID Gumbel distributions with mode 0 and scale parameter $\mu^{2.lo}$, that all ϵ_{ja} are independent of $\epsilon_{\neg a}$ and that all ϵ_{ja} and $\epsilon_{\neg a}$ are identically Gumbel distributed, with mode 0 and scale parameter $\mu^{2.hi}$. Then, the probability of choosing activity ja , conditional on participating in an activity of class a can be expressed as:

$$\begin{aligned}
 P(ja|a) &= P(U_{ja.spec} \geq U_{j'a.spec}; \quad \forall j'a \in J_a; \quad j'a \neq ja) \\
 &= \frac{\exp(\mu^{2.lo} V_{ja.spec})}{\sum_{j'a \in J_a} \exp(\mu^{2.lo} V_{j'a.spec})} \quad (5.3)
 \end{aligned}$$

where $V_{ja.spec} = \beta_{ja.spec}' x_{ja.spec}$,

$\beta_{ja.spec}$ is the vector of parameter values for attributes specific to alternative ja , and $x_{ja.spec}$ is the vector of attributes specific to alternative ja .

If all disturbances $\epsilon_{ja.spec}$ follow IID Gumbel distributions with parameters $(0, \mu^{2.lo})$, all $U_{ja.spec}$ follow IID Gumbel distributions with parameters $(V_{ja.spec}, \mu^{2.lo})$. This implies that $\max_{ja \in J} (U_{ja.spec})$ is Gumbel distributed with parameters $(\frac{1}{\mu^{2.lo}} \ln \sum_{ja \in J_a} (\exp(\mu^{2.lo} V_{ja.spec})), \mu^{2.lo})$ (Johnson and Kotz 1970).

Since the probability of not participating in activity class a is equal to the probability that the utility of not participating is higher than the utility of the most attractive alternative ja in class a , the probability of not participating can be expressed as:

$$\begin{aligned}
 P(\neg a) &= P(U_{\neg a} \geq \max_{ja \in J_a}(U_{ja})) \\
 &= \frac{\exp(\mu^{2,hi}V_{\neg a})}{\exp(\mu^{2,hi}V_{\neg a}) + \exp(\mu^{2,hi}(V_{a,gen} + \frac{1}{\mu^{2,lo}} \ln \sum_{ja \in J_a} \exp(\mu^{2,lo}V_{ja,spec})))} \tag{5.4}
 \end{aligned}$$

where $V_{a,gen} = \beta_{a,gen}'x_{a,gen}$,

$\beta_{a,gen}$ is parameter vector of attributes general to all alternatives $ja \in J_a$, $x_{a,gen}$ is the vector of attributes general to alternatives $ja \in J_a$, and all other elements are defined as above. In this model structure the probability of participating in activity class a , $P(a)$, equals $1 - P(\neg a)$.

The nested logit model reduces to the simple multinomial logit model if $\mu^{2,hi}$ equals $\mu^{2,lo}$, which can be seen as follows:

$$\begin{aligned}
 &\exp(\mu^{2,hi}(V_{a,gen} + \frac{1}{\mu^{2,lo}} \ln \sum_{ja \in J_a} \exp(\mu^{2,lo}V_{ja,spec}))) \quad \mu^{2,hi} = \mu^{2,lo} = \mu^2 \\
 &= \exp(\mu^2V_{a,gen}) \cdot \sum_{ja \in J_a} \exp(\mu^2V_{ja,spec}) \\
 &= \sum_{ja \in J_a} \exp(\mu^2(V_{a,gen} + V_{ja,spec})) \quad V_{ja} = V_{a,gen} + V_{ja,spec} \\
 &= \sum_{ja \in J_a} \exp(\mu^2(V_{ja})) \tag{5.5}
 \end{aligned}$$

where all elements are defined as before.

Separate logit models for participation and activity choice

Let $U_{ja,a}$ be the overall utility of alternative ja in the activity choice, $V_{ja,a}$ the structural utility of alternative ja in the activity choice, and $\epsilon_{ja,a}$ be the disturbance on the utility of alternative ja in the activity choice. Assume that all disturbances ϵ_{ja} follow IID Gumbel distributions with mode 0 and scale parameter $\mu^{3,a}$. The probability that alternative ja will be selected in the activity choice process can then be expressed as:

$$\begin{aligned}
 P(ja) &= P(U_{ja,a} \geq U_{j'a,a} ; \forall j'a \in J_a; j'a \neq ja) \\
 &= \frac{\exp(\mu^{3,a}V_{ja,a})}{\sum_{j'a \in J_a} \exp(\mu^{3,a}V_{j'a,a})} \tag{5.6}
 \end{aligned}$$

where $V_{ja,a} = \beta_{ja,a}'x_{ja,a}$,

$\beta_{ja,a}$ is the parameter vector of attributes of alternative ja in the activity choice, and $x_{ja,a}$ is the vector of attributes of alternative ja in the activity choice.

Let $U_{ja,p}$ be the overall utility of alternative ja in the participation choice, $V_{ja,p}$ the structural utility of alternative ja in the participation choice and $\epsilon_{ja,p}$ be the disturbance on the utility of alternative ja in the participation choice. Let $V_{ja,p} = V_{a,gen,p} + V_{ja,spec,p}$, $\epsilon_{ja,p} = \epsilon_{a,gen,p} + \epsilon_{ja,spec,p}$ and $U_{ja,spec,p} = V_{ja,spec,p} + \epsilon_{ja,spec,p}$, where $V_{a,gen,p}$ is the structural utility in the participation choice common to all activities in class a , but not to activities outside of a , $V_{ja,spec,p}$ is the structural utility in the participation choice specific to activity ja , $\epsilon_{a,gen,p}$ and $\epsilon_{ja,spec,p}$ are the disturbances on these utilities, and $U_{ja,spec,p}$ is the overall utility specific to activity ja in the participation choice. Let all other elements be defined as before. If we then assume that

- (i) all disturbances $\epsilon_{ja,spec,p}$ follow IID Gumbel distributions with mode 0 and scale parameter $\mu^{3,lo,p}$,
- (ii) all $\epsilon_{ja,p}$ are independent of ϵ_{-a} , and
- (iii) all $\epsilon_{ja,p}$ and ϵ_{-a} are identically Gumbel distributed, with mode 0 and scale parameter $\mu^{3,hi,p}$,

the probability of not participating in an activity of class a , equals:

$$P(\neg a) = P(U_{-a} \geq \max_{ja \in J_a}(U_{ja,p}))$$

$$= \frac{\exp(\mu^{3,hi,p}V_{-a})}{\exp(\mu^{3,hi,p}V_{-a}) + \exp(\mu^{3,hi,p}(V_{a,gen,p} + \frac{1}{\mu^{3,lo,p}} \ln \sum_{ja \in J_a} \exp(\mu^{3,lo,p}V_{ja,spec,p})))} \quad (5.7)$$

where $V_{a,gen,p} = \beta_{a,gen,p}'x_{a,gen,p}$, $\beta_{a,gen,p}$ is the parameter vector in the participation choice of attributes general to alternatives $ja \in J_a$, $x_{a,gen,p}$ is the vector of attributes in the participation choice general to alternatives $ja \in J_a$, $V_{ja,spec,p} = \beta_{ja,spec,p}'x_{ja,spec,p}$, $\beta_{ja,spec,p}$ is the parameter vector in the participation choice for attributes specific to alternative ja , $x_{ja,spec,p}$ is the vector of attributes in the participation choice specific to alternative ja , and all other elements are defined as above. As before, the nested logit structure for participation choice reduces to a simple multinomial logit model if $\mu^{3,hi,p}$ equals $\mu^{3,lo,p}$, and $P(a) = 1 - P(\neg a)$. Also the separate models reduce to one overall nested or simple multinomial logit model if $U_{ja,a}$ equals $U_{ja,p}$ up to a constant C . This is the case if the parameter vector $\beta_{ja,a}$ of the attributes of alternative ja in the activity choice equals the parameter vector $\beta_{ja,spec,p}$ of the attributes specific to alternative ja in the participation choice.

Experimental design

If we look at the proposed model structures for joint participation and activity choice, it can be seen that only the simple multinomial logit model complies with the assumption of independently and identically distributed (IID) disturbances. Both the overall nested logit model and the separate logit models have different disturbances for participation and activity choice. In the nested logit model they are $\epsilon_{ja,spec}$ for activity choice and ϵ_{ja} for participation choice, with scale values $\mu^{2,lo}$ and $\mu^{2,hi}$. In the separate models, the disturbances are $\epsilon_{ja,a}$ for activity choice and $\epsilon_{ja,p}$ for participation choice, with scale values of respectively $\mu^{3,a}$ and both $\mu^{3,hi,p}$ and $\mu^{3,lo,p}$. In both models, the disturbance on the participation choice is assumed

to be larger than the disturbance on the activity choice. Therefore, if the underlying choice structure follows one of these two models rather than the simple multinomial logit model, estimations based on a traditional experimental design that assumes IID disturbances will be biased. Estimates of parameters for activity choice will be lower than their actual value and estimates for parameters of participation choice will be higher than their actual value.

To prevent these biases, separate estimates of the parameters for activity and participation choice should be provided by the design. In the proposed model structures the IID assumption holds within the activity and participation choice models, both in the overall nested logit model and in the separate models: hence, separate designs for each of the two choice situations are a sufficient condition to support efficient estimation of the model parameters β .

A second, equally important, reason for separability, is that the underlying parameters for activity and participation choice are expected to be different, even after scale correction. Indeed the models imply that the vector of parameters for activity choices ($\beta_{ja,a}$), need not be equal to the parameters of the activity component in the participation choice ($\beta_{ja,spec,p}$).

Therefore the experimental design approach we propose consists of two subdesigns: (i) choice sets designed to represent choices within activity class. Any of the aforementioned design strategies can create such a subdesign. A base activity alternative is added to each choice set. Respondents are asked to choose the one that they favor most from the presented activities. This design supports efficient estimation of the parameters of activity choice. (ii) the second subdesign is different from the first in two respects: (a) the base alternative is changed to not participating, and (b) the choice sets are restricted to that base alternative plus only one other alternative. Respondents are asked in this subdesign to choose between either participating in the described activity or not. The parameters for participation choice can be estimated efficiently because the nested logit structure reduces to a simple multinomial logit structure if only one alternative is present in each nest. Figure 5.1 presents the basic structure of the proposed experimental design approach for a case of n alternatives clustered in N choice sets, where the number of alternatives k (other than the base) is 2.

This design approach creates two fractional factorial designs that permit one to derive separate estimates of parameters for activity and participation choice. It also allows one to estimate a simple multinomial logit model across both subdesigns efficiently because orthogonality is maintained if the two fractional factorial designs are combined. The ratio of the scales in the nested logit model, which is $\mu^{3,hi,p}/\mu^{3,lo,p}$ in the separate nested logit model for participation choice and $\mu^{2,hi}/\mu^{2,lo}$ in the overall nested logit model, can be estimated independently of the attribute levels, by combining the parameter estimates in each subdesign into one overall model. One scale ratio parameter can be estimated for the parameters of the first and second subdesign.

choice set	participation choice	activity choice
1.act	-	<div style="border-left: 1px solid black; border-right: 1px solid black; padding: 5px;"> attributes of alternative 1 attributes of alternative 1' base alternative </div>
2.act	-	<div style="border-left: 1px solid black; border-right: 1px solid black; padding: 5px;"> attributes of alternative 2 attributes of alternative 2' base alternative </div>
...	-
N.act	-	<div style="border-left: 1px solid black; border-right: 1px solid black; padding: 5px;"> attributes of alternative N attributes of alternative N' base alternative </div>
1.part	<div style="border-left: 1px solid black; border-right: 1px solid black; padding: 5px;"> participate don't participate </div>	attributes of alternative 1 -
...
N.part	<div style="border-left: 1px solid black; border-right: 1px solid black; padding: 5px;"> participate don't participate </div>	attributes of alternative N -

Figure 5.1 Experimental design structure for combined participation and activity choice models

Estimation

In terms of model complexity, the three model structures are nested within each other, which implies that differences in fit between the different model structures can be tested using the likelihood ratio test statistic (Theil 1971) as discussed in chapter 4. It is expressed as $2[\mathcal{L}^*(\beta_1) - \mathcal{L}^*(\beta_2)]$, where $\mathcal{L}^*(\beta_1)$ and $\mathcal{L}^*(\beta_2)$ are the adjusted log-likelihoods of the

models under comparison, and which is asymptotically Chi-square distributed.

The test proceeds as follows: (i) separate models are estimated for participation and activity choice, which requires estimation of separate simple multinomial logit models for each choice. The simple multinomial logit model can be estimated using available commercial software, (ii) one model is estimated by combining data from both choice tasks and estimating a nested logit model, in which activity choice is modeled conditional on participation choice. This is accomplished by estimating one model across both subdesigns under the assumption that the underlying parameters of the nested logit model are identical up to a scale correction over attributes in the participation and activity choice. This implies that the β 's estimated from activity choices only are identical to the β 's estimated from the activity related attributes in the participation choice. Or in terms of the separate logit model structure, that $\beta_{ja,a}$ equals $\beta_{ja,spec,p}$ and $\mu^{3,a}$ equals $\mu^{3,lo,p}$. A likelihood ratio test of the nested logit model against the separate MNL models can be conducted by comparing the fit of the nested logit model to the sum of the fits of the two separate models.

If the likelihood of the separate models is not significantly different from that of the nested logit model, a third test can be conducted in which the nested structure is tested against one overall simple multinomial logit model. This can be accomplished by setting $\mu^{2,hi}$ equal to $\mu^{2,lo}$ in the nested model and estimating a simple multinomial logit model; the model likelihoods can be compared with a likelihood ratio test.

5.2.3 Application to urban tourists' choices of visiting outdoor flower exhibitions

To test the viability of the proposed modeling framework, a case study on Dutch tourists' choices of large scale outdoor flower exhibitions was conducted. Parameters derived from choices made between competitive flower exhibitions only, were compared to parameters derived from choices of participating or not participating in an exhibition.

Introduction

In the Netherlands two types of large scale outdoor flower exhibitions are commonly held. The first type consists of annual exhibitions on permanent locations that represent popular day-trips. The most famous of its kind is the *Keukenhof*, located in Lisse, a small town near Amsterdam. The second type of exhibition is held less frequently at unique and varying locations. The largest in its kind is the *Floriade*, which is an official world-exhibition in gardening held once every ten years. Often, several Dutch towns compete as potential candidates for housing the *Floriade*, and it is generally used as a show case for municipal extension projects. One of the candidates for the 2002 *Floriade* was Eindhoven, a city in the southern part of the Netherlands, and used as location for the various alternatives presented to respondents.

Method

Respondents were presented with various descriptions of *Floriades*. Three attributes were used to describe the alternatives: i) *entrance fee*, ii) *presence of a special environmental issues exhibition* and iii) *introduction of a new type of public transit to the exhibition*. All three attributes represent features that have been used in the past as marketing tools in towns

where the Floriade has been held, and are real points of consideration in the organization of the 2002 Floriade.

Entrance fee was varied over three levels (*NLG 15*, *NLG 25* and *NLG 35*), and 'environmental exhibition' and 'new public transportation' were varied over two levels (*present*, *not present*). Hypothetical day trips were created by varying combinations of attribute levels according to a 3.2² full factorial design. For activity choices, choice sets were created by randomly combining alternatives drawn from two identical experimental designs that described profiles of different Floriade alternatives. Combinations of identical alternatives were not included in the choice sets and the Keukenhof with an entrance fee of NLG 15 served as the base alternative. For participation choices, profiles were randomly drawn from the full factorial design and combined with the 'don't participate' alternative. This procedure guaranteed orthogonality of attribute levels within alternatives. Respondents were asked to indicate which of the activities they were most likely to visit and whether they would or would not visit the exhibitions described in each set. The order of presentation of activity and participation choices was randomized over respondents. Data were collected in May 1994 through personal interviews. A convenience sample of 64 respondents from the Eindhoven region participated in the study. They were screened with respect to whether they had previously visited the Floriade or Keukenhof. All respondents received all alternatives.

Results

First, consider the results for the separate models estimated from the activity and participation choices (table 5.1). Table 5.2 contains parameter values estimated for the simple multinomial logit model of participation choice in the single Floriade alternatives described in the choice situations.

Table 5.1 Parameters estimated for the separate simple multinomial logit model of activity choice (three alternatives)

Attribute	Parameter estimate	Standard error	t-value
Floriade specific constant	0.839	0.164	5.105
Costs: linear	-2.128	0.171	-12.465
quadratic	0.007	0.069	0.011
Environmental exhibition	0.658	0.109	6.018
New public transportation	0.384	0.104	3.686

$\mathcal{L}(0)$: -419.6699 $\mathcal{L}(\hat{\beta})$: -225.6622 McFadden's RhoSq: 0.4623

Table 5.2 Parameters estimated for the separate simple multinomial logit model of participation choice (two alternatives)

Attribute	Parameter estimate	Standard error	t-value
Participation specific constant	0.319	0.082	3.884
Costs: linear	-1.159	0.106	-10.955
quadratic	0.017	0.055	0.305
Environmental exhibition	0.169	0.081	2.089
New public transportation	0.195	0.081	2.407

$\mathcal{L}(0)$: -532.3370 $\mathcal{L}(\hat{\beta})$: -450.0965 McFadden's RhoSq: 0.1545

The signs of the estimated parameters were as expected in both choice tasks. Choice probabilities decreased with higher costs, and increased when an environmental exhibition or a new public transport system were introduced. The positive Floriade specific constant in table 5.1 indicates that on average respondents preferred the Floriade over the Keukenhof, and the participation-specific constant in table 5.2 indicates that on average respondents also preferred visiting the Floriade to not participating.

Table 5.3 Combined parameter estimates of the overall nested logit model of participation and activity choice

Attribute	Parameter estimate	Standard error	t-value
Floriade specific constant	0.432	0.085	5.055
Participation specific constant	0.320	0.081	3.947
Costs: linear	-1.120	0.067	-16.615
quadratic	0.009	0.030	0.307
Environmental exhibition	0.290	0.046	6.365
New public transportation	0.197	0.045	4.398

Scale factor activity v.s. participation choice: 0.5220

$\mathcal{L}(0)$: -952.0069 $\mathcal{L}(\hat{\beta})$: -677.5676 McFadden's RhoSq: 0.2883

The result of the overall estimation over both choice tasks is presented in table 5.3. It was found that the separate models of the two choice tasks did not perform significantly better than one overall rescaled model. In a likelihood ratio test the loglikelihood of the overall nested logit model was tested against the two separate multinomial logit models: $2(\mathcal{L}(\text{separate}) - \mathcal{L}(\text{nested overall})) = 2(-675.7587 - -677.5676) = 3.6178$, which is not

significant at the 0.05 level for $\nu = 3$. Therefore the overall nested logit model with activity choices nested under participation choice was accepted in favor of the separate logit models of activity and participation choice.

The estimated ratio between the scales ($\mu^{3,hi,p}/\mu^{3,lo,p}$) of the separate activity and participation choice models was found to be 0.5220 which implies that the variance over the participation choices was on average $1/(0.5220^2) = 3.6703$ times that over the activity choice and that parameters estimated in the participation choice were on average 0.5220 times smaller than those estimated in the activity choices.

In a second likelihood ratio test the nested logit structure was then compared to the simple multinomial logit model: $2(\mathcal{L}(\text{nested overall}) - \mathcal{L}(\text{simple overall})) = 2(-677.5676 - -692.6054) = 30.0757$, which is highly significant at the 0.05 level for $\nu = 1$. Therefore the simple multinomial logit model was rejected. For reasons of comparison the estimates of the simple multinomial model are presented in table 5.4.

Table 5.4 Combined parameter estimates overall simple multinomial logit model

Attribute	Parameter estimate	Standard error	t-value
Floriade specific constant	0.863	0.150	5.738
Participation specific constant	0.366	0.087	4.199
Costs: linear	-1.494	0.087	-17.188
quadratic	0.010	0.041	0.237
Environmental exhibition	0.345	0.063	5.506
New public transportation	0.258	0.062	4.167

$\mathcal{L}(0)$: -952.0069 $\mathcal{L}(\hat{\beta})$: -692.6054 McFadden's RhoSq: 0.2725

Validity test

A third subdesign was presented to respondents to test the validity of the parameter estimates and the design approach. It was similar to the proposed experimental design approach, and represented a hybrid form of the subdesigns discussed earlier. Respondents were presented with two Floriade alternatives and a base of not participating, so the choice task involved choosing an activity and participating versus not-participating. The design used in the validity test is presented in Figure 5.2.

Predictions made on the basis of the simple multinomial logit model, the nested logit model and separate logit models for participation and activity choice were tested on choice data from the third subdesign. In making the predictions for the separate logit models β parameters were set at the values previously estimated for the separate activity and participation choices and the scale parameter μ in the separate participation choice was set equal to that in the overall nested logit model. Observed choice frequencies were compared with predicted frequencies. The log-likelihoods for the model structures on the hold out data were calculated and are presented in table 5.5a. Table 5.5b shows the log-likelihood ratio test

statistics of the different model structures. It can be seen that the nested logit model outperformed the simple multinomial logit model significantly, and its predictions were not significantly worse than those of the separate logit models.

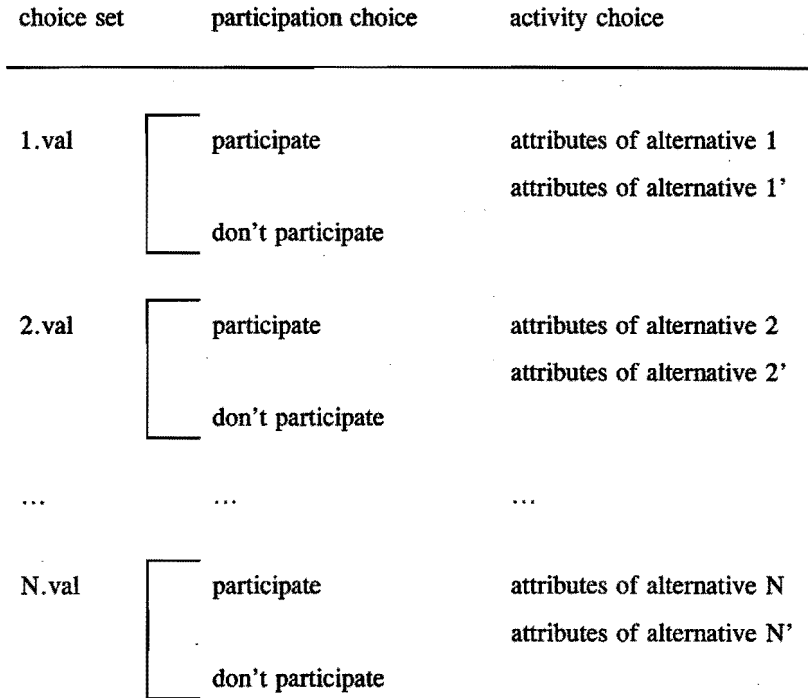


Figure 5.2 Experimental design structure of validity test for participation choice model

Table 5.5a Log-likelihoods of the models on hold-out data

Model	Log-likelihood on hold-out data
Null-model	- 419.669
Simple overall multinomial logit	- 305.262
Overall nested logit	- 292.611
Separate logit models	- 291.526

Table 5.5b Log-likelihood ratio test statistics of the models on hold-out data

Model	Null model	Simple-MNL	Nested-MNL
Simple overall multinomial logit	228.814	-	-
Overall nested logit	254.116	25.302	-
Separate logit models	256.286	27.472	2.170*

* not significant at the 0.05 reliability level

5.2.4 Conclusions and discussion

This study compared three model structures to describe participation and activity choice: (i) a simple multinomial logit model which included both a 'none' alternative and specific activities, (ii) a nested logit model in which activity choice was nested conditionally on participation choice, and (iii) separate logit models for participation and activity choice. A new experimental design approach was proposed to support tests of these models in conjoint choice analysis applications.

The results of the case study used to compare the models and test the proposed experimental approach showed that the nested logit model provided the best explanation for participation and activity choices. This finding was supported by the results of a validity task involving combined activity and participation choices.

The results showed that without scale corrections, models describing the choice process within a given class of activities cannot be used to predict participation choice and vice versa. As well it is advisable to estimate at least several parameters in both activity and participation choice situations so a scale correction can be estimated between the two choice types.

If these findings can be generalized, they would imply that assumptions commonly made in previous conjoint choice models in which a 'don't participate' base alternative was applied should be reconsidered because simple multinomial logit models are often used to model combined activity and participation choices. Results obtained in these studies may therefore require reinterpretation.

In managerial terms the results imply that the impact of marketing and planning strategies to promote certain types of activities will have a stronger impact on tourists who have already decided to participate in those types of activities than on new groups of tourists that until that time had chosen other activity types. Opening up a new tourist attraction for example will more likely draw tourists away from other attractions in the city than bring in new tourists to the city as a whole.

5.3 Combined destination and transportation choice

5.3.1 Introduction

Many studies in the urban tourism field and in tourism research in general have addressed tourists' destination choices (e.g., Crompton 1992, Mansfeld 1992, Woodside and Lysonski 1989, Woodside et al. 1989). This is also the topic of the second study of this chapter, which addresses the problem of urban tourists' destination choices in combination with their choice of transportation to get to their destination.

The study proposes and tests models for urban tourists' portfolio choices of combinations of two alternatives. From a modeling perspective the models that are described in this study fit in with a recent stream of research in planning and marketing in which new approaches were developed to analyze or predict combined choices among assortments of goods (e.g., Kahn and Lehman 1991), sequences of alternatives such as trip-chains in retail store choice (e.g., Arentze et al. 1993), and shopping centers and shops within centers choices (e.g., Ahn and Ghosh 1989). To our knowledge there are no examples of tourism related studies in this area.

In the empirical study presented in this section four different modeling approaches were compared with regard to their ability to predict tourists' portfolio choices of combined destination and transportation alternatives: a joint logit model, a nested logit model, a probit model, and a set of separate models. The models were applied to Dutch urban tourists' choices of short city breaks to urban destinations in Belgium, Germany and The Netherlands.

5.3.2 Model formulation, experimental design and estimation

Urban tourists are assumed to choose those portfolio alternatives that provide the highest utility to them. In the analysis we focus on the choice of a destination D_j from a set of destinations J and a transportation mode T_k from a set of transportation modes K .

It is assumed that tourists base their choices on an evaluation of destination and transportation attributes, the utility of which consists of a structural part V , constant over time and common to all tourists, and a stochastic part ϵ that captures disturbances in utility due to taste variations between tourists and measurement errors. Different model structures can be generated depending upon the assumptions one is willing to make about the stochastic part of the utility.

Joint logit model

Let J be a set of urban tourism destinations D_j and K a set of transportation modes T_k . Let $U_{D_j T_k}$ be the overall utility of portfolio alternative $D_j T_k$, V_{D_j} the structural utility of destination D_j , V_{T_k} the structural utility of transportation mode T_k , $V_{D_j T_k}$ the structural utility of the interaction between destination D_j and transportation mode T_k , and $\epsilon_{D_j T_k}$ the disturbance on the utility of portfolio alternative $D_j T_k$. Assume that all disturbances $\epsilon_{D_j T_k}$ are independently and identically distributed (IID) according to a Gumbel distribution with mode 0 and scale parameter μ . Assuming that tourists are maximizing their utility, the utility of portfolio alternative $D_j T_k$ and the probability that it will be selected, is expressed as:

$$\begin{aligned}
 U_{D_j T_k} &= V_{D_j} + V_{T_k} + V_{D_j T_k} + \epsilon_{D_j T_k} \\
 P(D_j T_k) &= \frac{\exp(V_{D_j} + V_{T_k} + V_{D_j T_k})}{\sum_{j' \in J} \sum_{k' \in K} \exp(V_{D_{j'}} + V_{T_{k'}} + V_{D_{j'} T_{k'}})} \quad (5.8)
 \end{aligned}$$

and the utility of transportation mode T_k given the choice of destination D_j and its probability are expressed as:

$$\begin{aligned}
 U_{T_k | D_j} &= V_{T_k} + V_{D_j T_k} + \epsilon_{D_j T_k} \\
 P(T_k | D_j) &= \frac{\exp(V_{T_k} + V_{D_j T_k})}{\sum_{k' \in K} \exp(V_{T_{k'}} + V_{D_j T_{k'}})} \quad (5.9)
 \end{aligned}$$

Nested logit model

Let all elements be defined as before. Let $P(D_j)$ be the probability that a combination including D_j is chosen from the set of all combinations D and T , $P(T_k | D_j)$ the probability that alternative $D_j T_k$ is chosen from the K alternatives in nest D_j , μ^{high} and μ^{low} the scaling factors for the higher and the lower level, the 'low' one of which is arbitrarily set to 1, so that the estimation of the other represents the ratio of the two scales. V_{nest} is the *inclusive value* of the nest, and represents the expected maximum utility of the attributes in the nest, ϵ_{D_j} and $\epsilon_{D_j T_k}$ respectively are disturbances associated with the utility of destination D_j and the unique combination $D_j T_k$. Assume that all disturbances $\epsilon_{D_j T_k}$ follow IID Gumbel distributions with mode 0 and scale parameter μ^{low} , that all ϵ_{D_j} are independent and that $\epsilon_{D_j} + \epsilon_{D_j T_k}$ is identically Gumbel distributed, with mode 0 and scale parameter μ^{high} . Then, the following equations describe a nested logit model in which destination is hierarchically structured over transportation:

$$U_{D_j T_k} = V_{D_j} + V_{T_k} + V_{D_j T_k} + \epsilon_{D_j} + \epsilon_{D_j T_k} \quad (5.10)$$

$$V_{nest} = \frac{1}{\mu^{low}} \ln \sum_{k \in K} \exp((V_{T_k} + V_{D_j T_k}) \mu^{low})$$

$$\begin{aligned}
 P(D_j) &= P(\max_K (U_{D_j T_k}) > \max_{K'} (U_{D_{j'} T_{k'}}); \quad \forall j' \in J; D_{j'} \neq D_j) \\
 &= \frac{\exp((V_{D_j} + V_{nest}) \mu^{high})}{\sum_{j' \in J} \exp((V_{D_{j'}} + V_{nest}) \mu^{high})} \quad (5.11)
 \end{aligned}$$

$$\begin{aligned}
 &= \frac{\exp((V_{Dj} + \frac{1}{\mu^{low}} \ln \sum_{k \in K} \exp((V_{Tk} + V_{DjTk})\mu^{low}))\mu^{high})}{\sum_{j' \in J} \exp((V_{Dj'} + V_{nest})\mu^{high})} \\
 P(T_k | D_j) &= \frac{\exp((V_{Tk} + V_{DjTk})\mu^{low})}{\sum_{k' \in K} \exp((V_{Tk'} + V_{DjTk'})\mu^{low})} \tag{5.12}
 \end{aligned}$$

A nested logit model in which transportation is hierarchically structured over destination is derived analogously.

Probit model

Let all elements be defined as before. Let $f(\epsilon_{DjTk}, \dots, \epsilon_{DjTk})$ be the density function of the normal distribution. Let ϵ_{Dj} , ϵ_{Tk} , ϵ_{DjTk} be the IID normally distributed disturbance over the utility of respectively the separate alternatives D_j and T_k and their interaction D_jT_k , and let $\epsilon_{\{DjTk\}}$ be the sum of these three disturbances. Then, the utility and choice probability of alternative D_jT_k are expressed as:

$$U_{DjTk} = V_{Dj} + V_{Tk} + V_{DjTk} + \epsilon_{Dj} + \epsilon_{Tk} + \epsilon_{DjTk} \tag{5.14}$$

$$P(D_jT_k) = \int_{-\infty}^{\infty} \int_{-\infty}^{V_{DjTk} - V_{DjTk} + \epsilon_{\{DjTk\}}} \dots \int_{-\infty}^{V_{DjTk} - V_{DjTk} + \epsilon_{\{DjTk\}}} f(\epsilon_{\{DjTk\}}, \dots, \epsilon_{\{DjTk\}}) d\epsilon_{\{DjTk\}} \dots d\epsilon_{\{DjTk\}}$$

The underlying variance-covariance matrix of the error terms in the combined destination transportation choice is expressed as:

$$\begin{matrix}
 & U_{DjTl} & \dots & U_{DjTk} & \dots & U_{DjTk} \\
 U_{DjTl} & \left[\begin{array}{cccccc}
 \text{var}(\epsilon_D + \epsilon_T + \epsilon_{DT}) & \dots & \text{var}(\epsilon_D) & \dots & 0 \\
 \text{var}(\epsilon_D) & \dots & \text{var}(\epsilon_D + \epsilon_T + \epsilon_{DT}) & \dots & \text{var}(\epsilon_T) \\
 0 & \dots & \text{var}(\epsilon_T) & \dots & \text{var}(\epsilon_D + \epsilon_T + \epsilon_{DT})
 \end{array} \right. \\
 U_{DjTk} & & & & & \\
 U_{DjTk} & & & & &
 \end{matrix} \tag{5.15}$$

where $\epsilon_{Dl} = \epsilon_{Dj} = \epsilon_D$, $\epsilon_{Tl} = \epsilon_{Tk} = \epsilon_T$, and $\epsilon_{DjTl} = \epsilon_{DjTk} = \epsilon_{DjTk} = \epsilon_{DT}$, and the variance-covariance matrix for the conditional choice is:

$$\begin{matrix}
 U_{TI|DI} \\
 \vdots \\
 U_{TK|DI}
 \end{matrix}
 \begin{bmatrix}
 U_{TI|DI} & \dots & U_{TK|DI} \\
 \text{var}(\epsilon_T + \epsilon_{DT}) & \dots & 0 \\
 \vdots & \ddots & \vdots \\
 0 & \dots & \text{var}(\epsilon_T + \epsilon_{DT})
 \end{bmatrix}
 \quad (5.16)$$

Separate models

Let $V_{Dj,1}$, $V_{Tk,1}$, and $V_{DjTk,1}$ respectively be the structural utilities specific to destination D_j , to transportation mode T_k and their interaction in the first choice of either destination or transportation choice and let $V_{Dj,2}$, $V_{Tk,2}$, and $V_{DjTk,2}$ be the structural utilities for those same elements, but with different parameters for the second choice involving the other alternative in the choice set. Let $\epsilon_{Dj,1}$, $\epsilon_{Tk,1}$, $\epsilon_{DjTk,1}$ be the error terms for these structural utilities in the first choice and $\epsilon_{Dj,2}$, $\epsilon_{Tk,2}$, $\epsilon_{DjTk,2}$ the error terms for the structural utilities in the second choice. Then the utility functions can be expressed as:

$$\begin{aligned}
 \text{Sequence 1: } U_{DjTk} &= V_{Dj,1} + V_{Tk,1} + V_{DjTk,1} + \epsilon_{Dj,1} + \epsilon_{Tk,1} + \epsilon_{DjTk,1} \\
 U_{Tk|Dj} &= V_{Tk,2} + V_{DjTk,2} + \epsilon_{Tk,2} + \epsilon_{DjTk,2}
 \end{aligned}
 \quad (5.17)$$

$$\begin{aligned}
 \text{Sequence 2: } U_{DjTk} &= V_{Dj,1} + V_{Tk,1} + V_{DjTk,1} + \epsilon_{Dj,1} + \epsilon_{Tk,1} + \epsilon_{DjTk,1} \\
 U_{Dj|Tk} &= V_{Dj,2} + V_{DjTk,2} + \epsilon_{Dj,2} + \epsilon_{DjTk,2}
 \end{aligned}
 \quad (5.18)$$

Depending on assumptions made with respect to the error distribution in each choice phase, joint logit models, nested logit models and probit models can be used to model the choice process in each phase.

Experimental design

As has been shown in the discussion of the nested logit and probit model of portfolio choices covariances between the error terms of portfolio alternatives will typically occur if the separate alternatives that make up portfolio alternatives each have separate error terms. We therefore apply a design approach that allows for separate estimation of each of various choice situations of the portfolio choice process. The overall design is constructed as follows: (i) First, a subdesign is constructed in analogy with traditional designs for single choices, except that attributes from the two alternatives instead of attributes of only one alternative are used to construct the portfolio alternatives in the design. As well, no common elements are allowed between portfolio alternatives within the choice sets,

(ii) Two other conditional subdesigns are constructed in which only the destination or the transportation mode varies, and the other is maintained as a constant condition within the choice set. A schematic representation of the design strategy is given below.

$$\begin{bmatrix} \text{Alternatives } D_j & \text{Alternatives } T_k & \text{Interactions } D_j T_k \\ \text{Condition} & \text{Alternatives } T_k & 0 \\ \text{Alternatives } D_j & \text{Condition} & 0 \end{bmatrix}$$

If the overall joint logit model applies, the parameters estimated from choices in the second and third subdesign are identical to those estimated in the first subdesign. If the nested logit or probit model apply, the variance of the error terms in the conditional choices will differ from those in the overall choices of the first subdesign, and the parameter estimates will be scaled differently. If separate models are required for different stages in portfolio choices, the scale difference cannot account for the differences found between the estimates in different subdesigns and essentially different utility parameters will be required for different choice situations.

Estimation

As described in chapter 4, the first step in the estimation procedure is to estimate separate models for the choices in each of the subdesigns. This is done by estimating separate simple multinomial logit models for each subdesign. Next, the variance covariance structure of the overall probit model is estimated such as to maximize the log-likelihood of the observed choices across all choice sets and all subjects. Again, the structural parameters for each of the subdesigns are optimized. This time however a set of extra parameters μ is optimized simultaneously that express the differences in scale between the different subdesigns. Estimates for the covariances in the variance-covariance matrix of the probit model are derived directly from the estimated scale ratios, as indicated in chapter 4.

The various model structures are tested against each other in a series of log-likelihood ratio tests:

(i) The separate models are tested against the overall probit model:

$$2[\mathcal{L}^*(\text{separate models}) - \mathcal{L}^*(\text{overall probit})],$$

(ii) If the sum of the log-likelihoods of the separate models for the subdesigns is not significantly better than that of the overall probit model, the overall probit model is tested against the two hierarchical structures of the overall nested logit model

$$2[\mathcal{L}^*(\text{overall probit}) - \mathcal{L}^*(\text{overall nested logit})],$$

(iii) If again there is no significant difference the best fitting overall nested logit model is tested against the overall joint logit model:

$$2[\mathcal{L}^*(\text{overall nested logit}) - \mathcal{L}^*(\text{overall joint logit})].$$

5.3.3 Application to urban tourists' choices of destination and transportation mode for short city breaks in Belgium, Germany or The Netherlands

The modeling and design strategy discussed above will now be illustrated in an empirical application to Dutch tourists' choices of short city breaks in Belgium, Germany or the Netherlands. These three countries are the most popular destinations for Dutch tourists' short breaks, and although Paris and London are the two major city destinations for Dutch tourists, the cities in Belgium and Germany are generally regarded as more direct competitors to Dutch cities. This is because they are similar to Dutch urban destinations in terms of the travel time required, costs involved and number of tourist attractions.

Method

Choice data for this study were collected in June and July 1993 in the Eindhoven region the Netherlands. Questionnaires were mail delivered to 2040 randomly selected households and later personally collected at the door. This sample was combined with a sample of 480 respondents that were contacted through travel organizations and received a questionnaire along with their tickets. Response rates were 30.5% and 10.9% respectively. Of the respondents, only those that had made a city trip in the past three years were selected. These respondents represented 97% of the total response.

A first identification of the attributes that influence individuals' vacation behavior was based on a literature survey. These attributes were then discussed with a group of experts in Dutch tourism marketing, which led to a final list of attributes included in the experiment. Cities in the choice experiment could be located in three different countries (*The Netherlands, Belgium and Germany*) and at three different distances (*75 km, 100 km and 125 km*). Three types of urban tourist facilities were included: restaurants and bars, shopping facilities and special sights, each of which was presented at three different levels of availability (*few, many or very many*). Hotel facilities were described in terms of price (*NLG 50, NLG 75 or NLG 100*), quality (*two star, three star or four star accommodation*) and location (*city center, near center or at city border*). Transportation was described in terms of transportation mode (*bus, train or car*), price (*NLG 30, NLG 45 and NLG 60 for bus, and NLG 45, NLG 60 and NLG 75 for train*) and travel time (*1.5 hours, 2 hours and 2.5 hours*). Interactions between the country of destination and the availability of special sights and between travel distance to the destination and required travel time were included. The list of attributes and their levels is given in table 5.6. *Car* was presented as a base alternative in the choice task and is therefore not included in this table.

The experimental design was constructed according to the design strategy explained in the previous section: (i) First, a subdesign was constructed to support estimation of main effects and interaction effects for choices between portfolio alternatives that differed on their separate alternatives. For each transportation mode (bus and train), a 3^{10} design in 81 profiles was used to generate the alternatives (3^2 for transportation attributes and 3^8 for destination attributes). Profiles from these two designs were then randomly combined to create choice sets of two alternatives, restricting the possible combinations to those that did not share the same destination. This procedure guarantees orthogonality within but not between choice alternatives. (ii) A second subdesign was constructed for portfolio choices of destination alternatives conditional on transportation. It consisted of two parts: a first part in which

destinations varied on a given bus as transportation mode, and a second part in which destinations varied on a given train as transportation mode. For these parts two $3^2 \cdot 3^8$ designs in 32 profiles were used. To create choice sets, profiles with identical transportation mode descriptions were randomly combined into sets of two. This procedure guarantees orthogonality within main effects of each alternatives, but not between alternatives and no interactions could be estimated. (iii) A third subdesign was constructed for portfolio choices of transportation, conditional on destination. In this design transportation alternatives were varied for a given destination in a $3^8 \cdot 3^2 \cdot 3^2$ design of 64 profiles. Destinations varied over different choice sets, but were conditional within each choice set. This design guaranteed orthogonality both within and between main effects of the alternatives. Main effects could be estimated independently from second order interactions, but the interaction effects themselves were confounded.

Table 5.6 Attributes in combined destination and transportation choice experiment

Destination	Levels		
Area	Netherlands	Germany	Belgium
Distance	75 km	100 km	125 km
Restaurants and bars	few	many	very many
Shopping facilities	few	many	very many
Special sights	few	many	very many
Hotel price	NLG 50.-	NLG 75.-	NLG 100.-
Hotel quality	**	***	****
Hotel location	city center	near center	city border
Interaction area and sights	-	-	-

Transportation	Levels		
Price (bus)	NLG 30.-	NLG 45.-	NLG 60.-
Price (train)	NLG 45.-	NLG 60.-	NLG 75.-
Travel time (bus)	1.5 hours	2 hours	2.5 hours
Travel time (train)	1.5 hours	2 hours	2.5 hours
Interaction distance and time (bus)	-	-	-
Interaction distance and time (train)	-	-	-

Thus, the total design consisted of 209 ($81 + 2 \cdot 32 + 64$) different two alternative choice sets. A base alternative was added to each choice set. It described a city trip by car to an unattractive combination of destination attributes. For the conditional choices in the design

(e.g., choosing a destination for a given mode of transportation), the base was changed to the given condition (i.e. the given mode of transportation or destination). The experimental design can be summarized as follows:

	$Dest_1$	Bus_1	$Dest_2$	$Train_1$	$Dest_{base}$	Car_{base}
	3^8	3^2	3^8	3^2	1	1
	3^8	3^2	3^8	0	1	0
	3^8	0	3^8	3^2	1	0
	3^8	3^2	0	3^2	0	1

Please divide 100 points over the following three city breaks to indicate your preference for each trip

CHOICE 1 (a0)	Trip 1	Trip 2	Trip 3	
Destination				
the city is in	Germany	Belgium	Netherlands	
travel distance	125 km	75 km	75 km	
restaurants and bars	very many	few	few	
shopping facilities	many	many	few	
special sights	many	few	few	
hotel price	NLG 100	NLG 50	NLG 100	
hotel quality	**	***	**	
hotel location	near center	city center	city border	
Transportation				
mode	bus	train	car	
price	NLG 60	NLG 45	NLG 30	
travel time	2,5 hours	1,5 hours	2 hours	
Your points: pnts	+	+	= 100

Figure 5.3 Example of a combined destination transportation choice task presented to respondents

Respondents in the experimental task were asked to imagine that they were planning a weekend city break in the near future. In each choice set they were asked to allocate one hundred points over the trip options to reflect their preferences. The hundred points for each choice set were rescaled to one point in the estimation to reflect the fact that they represented one single observation rather than hundred different observations. An example of a choice set given to respondents is presented in figure 5.3. Each respondent was offered 12 choice sets, which were randomly drawn from the different subdesigns such that the expected number of responses per choice set was identical for all choice sets. Responses were aggregated across respondents in the analyses.

Results

In line with the estimation procedure described earlier, separate logit models were estimated first for the various subdesigns representing overall and conditional portfolio choices. These models then were compared to the overall probit, nested and joint logit models.

Separate models

The results of separate model estimations for the three subdesigns are presented in tables 5.7a to 5.7d. The parameters represent first and second order orthogonal polynomial code for the three level attributes. Thus the first parameter represents a contrast between the first and the third level and the second parameter represents a contrast between the second and the other two levels. More readily interpretable attribute level utilities also were calculated (tables 5.9a and 5.9b).

Tables 5.7a and 5.7b contain estimates for the combined transportation and destination choices. Parameter values generally had the expected signs, i.e. utility increased with more shopping facilities and decreased with less facilities and was a monotonic decreasing function of price. The most important attributes were presence of special city sights and shopping facilities. Although significant, hotel characteristics generally were somewhat less important as was presence of restaurants and bars. Insignificant in this choice process were geographical area, travel distance, travel time, travel costs and all observable interactions. The difference between bus and train also was not significant.

Some insignificant parameters in the models for overall choices in the first subdesign had unexpected values which disappeared in the conditional choice models, where they also were more significant. This result may be due to the fact that respondents in the combined choice condition did not systematically evaluate attributes considered to be less important. Such attributes however were evaluated more consistently when attention was more focused in the conditional choices.

Tables 5.7c and 5.7d contain the results for the conditional portfolio choices of destination and transportation. The estimated model parameters in 5.7c represent the selection of destination given transportation mode. The sign of the parameters was as expected, and consistent with estimates for the combined portfolio choices. Table 5.7d shows that in choice sets of transportation choices only, bus and train attributes were considerably more significant than in choice sets for combined choices and also had the expected signs. The difference between bus and train alternatives again was not significant. In general, parameters in conditional portfolio choices were more significant than those in combined portfolio choices.

Table 5.7a Estimates for subdesign 1: combined portfolio choice of destination and transportation, destination parameters

Attribute		Parameter estimate	Standard error	t-value
Intercept		0.78044	0.05740	13.597
Area		-0.00626	0.04414	- 0.142
		-0.04135	0.02438	- 1.696
Distance		-0.01634	0.04263	- 0.383
		-0.01373	0.02458	- 0.559
Restaurants and bars		0.09084	0.04199	2.163
		0.01655	0.02636	0.628
Shopping facilities		0.16188	0.04456	3.561
		0.04172	0.02524	1.623
Special sights		0.23900	0.04219	5.579
		0.04891	0.02233	2.146
Hotel price		-0.08420	0.04214	- 1.964
		-0.00511	0.02372	- 0.211
Hotel quality		0.10531	0.04747	2.172
		0.00224	0.02429	0.090
Hotel location		0.08845	0.03940	2.200
		0.00801	0.02397	0.396
Interaction	A ₁ ,S ₁	0.00812	0.05451	0.149
Area and Sights	A ₁ ,S ₂	-0.00840	0.02982	- 0.282
	A ₂ ,S ₁	0.02285	0.03124	0.732
	A ₂ ,S ₂	0.00553	0.01829	0.302

McFadden's RhoSq: 0.35134

Table 5.7b Estimates for subdesign 1: combined portfolio choice of destination and transportation, transportation parameters

Attribute		Parameter estimate	Standard error	t-value
General difference between bus and train		-0.02222	0.02513	- 0.884
Price (bus)		-0.01442	0.06075	- 0.237
		-0.00661	0.03440	- 0.192
Travel time (bus)		-0.05906	0.06006	- 0.983
		-0.01938	0.03484	- 0.556
Price (train)		-0.04117	0.05804	- 0.709
		0.01823	0.03429	0.534
Travel time (train)		-0.00936	0.05959	- 0.157
		-0.01275	0.03412	- 0.372
Interaction	D ₁ .Tb ₁	0.06792	0.07347	0.924
Distance and	D ₁ .Tb ₂	0.00545	0.04301	0.127
Travel time (bus)	D ₂ .Tb ₁	0.00464	0.04310	0.108
	D ₂ .Tb ₂	0.00040	0.02503	0.016
Interaction	D ₁ .Tt ₁	0.03205	0.07069	0.453
Distance and	D ₁ .Tt ₂	-0.00504	0.04256	- 0.118
Travel time (train)	D ₂ .Tt ₁	-0.03989	0.04264	- 0.936
	D ₂ .Tt ₂	0.01230	0.02519	0.488

McFadden's RhoSq: 0.35134

Table 5.7.c Estimates for subdesign 2: conditional destination choice

Attribute	Parameter estimate	Standard error	t-value
Intercept choices conditional on train	0.78316	0.10618	7.376
Intercept choices conditional on bus	0.91772	0.10724	8.558
Area	0.01010	0.05503	0.183
	-0.02295	0.03055	-0.751
Distance	0.00117	0.04326	0.027
	0.02278	0.02655	0.858
Restaurants and bars	0.10205	0.04374	2.333
	-0.00928	0.03259	-0.285
Shopping facilities	0.14753	0.04272	3.454
	0.00626	0.03182	0.197
Special sights	0.30100	0.04403	6.836
	0.03550	0.02763	1.285
Hotel price	-0.14566	0.04532	-3.214
	0.00248	0.03234	0.077
Hotel quality	0.10765	0.04338	2.482
	0.00128	0.03139	0.041
Hotel location	0.07632	0.04327	1.764
	0.01119	0.03165	0.353

McFadden's RhoSq: 0.47766

Table 5.7.d Estimates for subdesign 3: conditional transportation choice

Attribute	Parameter estimate	Standard error	t-value
Intercept	-0.85706	0.05438	-15.762
General difference between bus and train	-0.02563	0.04247	-0.604
Price (bus)	-0.14974	0.07352	-2.036
	-0.00988	0.04783	-0.207
Travel time (bus)	-0.10775	0.07263	-1.484
	-0.03306	0.04499	-0.735
Price (train)	-0.12693	0.07006	-1.812
	0.03929	0.04654	0.844
Travel time (train)	-0.10948	0.07166	-1.528
	0.01296	0.04514	0.287

McFadden's RhoSq: 0.37475

Overall probit model

To test whether a probit model structure was statistically superior to the three separate models described previously, parameters estimated from conditional choices were constrained to be equal up to a scale correction to the parameters estimated from the combined choices. In the tests the scale of the combined choices was arbitrarily set to one. Alternative specific constants were not rescaled, because their values depend on the average utility level of the alternatives in the respective subdesigns. The estimated scale ratio between the conditional destination choices and the combined choices was 0.8502. This implies that parameter estimates for combinations of transportation and destination choice on average were 0.8502 times those estimated from conditional destination choices. Hence, smaller errors were associated to choices of destination only when compared to choices of both transportation and destination. The scale ratio between the conditional transportation choices and the combined choices also was estimated. It was 0.3194, which again supports the expected model structure and implies that smaller errors were associated with conditional transportation choices.

The results of the overall estimation are in table 5.8. Insignificant interaction effects were omitted from this table, because they were not part of the rescaling tests. The corresponding utilities are in tables 5.9a and 5.9b. Probit parameters can be calculated from

these parameters by multiplying them by the correction $\beta_{logit} = \frac{\pi}{\sqrt{6}}\beta_{probit}$, as was discussed

in section 4.6. Covariances can be calculated from the ratio of the scales as discussed in 4.6, and equal 0.4559 for choices between alternatives with equal transportation modes and 1.4771 for choices between alternatives with equal destinations.

Testing the models

To test the explanatory power of the scale ratios, likelihood ratio tests were performed for (i) separate model structures against the probit model with covariances for both transportation and destination components, (ii) the probit model against two possible nested logit models in which one covariance was set equal to zero, and (iii) the nested logit model with the highest log-likelihood against the joint logit structure in which both covariances were set equal to zero. If the log-likelihood of the probit model is not significantly lower than that of the separate models, that implies that the hypothesis of identical underlying parameter values can not be rejected. The probit model is compared to two possible nested logit models with corrections on only one conditional choice to test whether scale ratio corrections were a better approximation of the underlying choice structure than no scale corrections. If the nested logit model is more appropriate, the scale correction between combined choices and one conditional choice should not significantly improve model fit, and if the joint logit model is more appropriate, neither of the scale ratios should be significant.

Table 5.8 Overall estimates

Attribute	Parameter estimate	Standard error	t-value
Intercept subdesign 1	0.78044	0.05740	13.597
Intercept subdesign 2 (conditional on train)	0.67651	0.08776	7.708
Intercept subdesign 2 (conditional on bus)	0.79182	0.08891	8.906
Intercept subdesign 3	-0.27308	0.01716	-15.913
Area	-0.00703	0.03077	-0.229
	-0.03174	0.01714	-1.852
Distance	-0.01256	0.02746	-0.458
	0.00450	0.01637	0.275
Restaurants and bars	0.09064	0.02734	3.315
	0.00739	0.01848	0.400
Shopping facilities	0.14452	0.02735	5.285
	0.02587	0.01825	1.417
Special sights	0.25492	0.02778	9.177
	0.04038	0.01595	2.532
Hotel price	-0.10452	0.02812	-3.717
	0.00178	0.01769	0.010
Hotel quality	0.09886	0.02848	3.471
	0.00377	0.01770	0.213
Hotel location	0.07211	0.02666	2.705
	0.01162	0.01764	0.659
General difference between bus and train	-0.02222	0.02513	-0.884
Price (bus)	-0.04537	0.02170	-2.090
	-0.00287	0.01392	-0.206
Travel time (bus)	-0.03859	0.02151	-1.794
	-0.01144	0.01323	-0.865
Price (train)	-0.03931	0.02067	-1.902
	0.01300	0.01355	0.959
Travel time (train)	-0.03194	0.02113	-1.511
	0.00202	0.01317	0.153

Scalefactors: Subdesign 2 versus 1: 0.8502 Subdesign 3 versus 1: 0.3194

McFadden's RhoSq: 0.3998

Table 5.9a Utility values of attribute levels, destination attributes

Attribute		Destination-transportation choice	Conditional destination choice	Conditional transportation choice	Overall
Area	Belgium	0.03510	0.03305	-	0.02471
	Germany	-0.08270	-0.04590	-	-0.06348
	Netherlands	0.04761	0.01286	-	0.03877
Distance	125 km	-0.00260	-0.02160	-	-0.01706
	100 km	-0.02746	0.04556	-	0.00900
	75 km	0.03007	-0.02395	-	0.00806
Restaurants and bars	very many	0.07430	0.11133	-	0.08325
	many	0.03309	-0.01856	-	0.01478
	few	-0.10739	-0.09276	-	-0.09802
Shopping facilities	very many	0.12016	0.14127	-	0.11866
	many	0.08345	0.01251	-	0.05173
	few	-0.20360	-0.15378	-	-0.17039
Special sights	very many	0.19010	0.26550	-	0.21454
	many	0.09781	0.07099	-	0.08076
	few	-0.28790	-0.33649	-	-0.29529
Hotel price	NLG 50	0.07909	0.14317	-	0.10470
	NLG 75	0.01023	0.00497	-	-0.00035
	NLG 100	-0.08931	-0.14813	-	-0.10434
Hotel quality	****	0.10308	0.10636	-	0.09509
	***	0.00447	0.00257	-	0.00754
	**	-0.10755	-0.10893	-	-0.10262
Hotel location	city center	0.08045	0.06514	-	0.06049
	near center	0.01601	0.02237	-	0.02324
	city border	-0.09645	-0.08750	-	-0.08373

The results were as follows: (i) the log-likelihood of the three separate models was -754.63 and that of the overall probit model was -757.28. The log-likelihood ratio test statistic:

$$2[\mathcal{L}^*(\text{separate models}) - \mathcal{L}^*(\text{overall probit})]$$

had a value of 5.30 which is not significant at the 0.05 level in a Chi-square test at 25 degrees of freedom (i.e. the number of extra parameters in the separate models). This implies that the separate models did not describe the observations significantly better than the overall probit models, (ii) log-likelihood results for the nested logit models were calculated as

follows: (a) destination choices were rescaled relative to combined choices, and (b) transportation choices were rescaled relative to combined choices. The log-likelihoods were respectively -759.29 and -757.83. The log-likelihood ratio test statistics against the overall probit model:

$$2[\mathcal{L}^*(\text{overall probit}) - \mathcal{L}^*(\text{overall nested logit})]$$

were respectively 4.02 for the first model and 1.10 for the second. Only the first fitted significantly worse than the probit model (log-likelihood ratio test at 1 degree of freedom for one omitted scale parameter). The second model did not fit significantly worse. This implies that a model with transportation choice nested under destination choice was appropriate for this application because the nested logit model typically requires only one conditional choice to be rescaled, (iii) the overall joint logit model was rejected in favor of the nested logit model because one of the scale corrections produced a significant improvement in model fit.

Table 5.9b Utility values of attribute levels, transportation attributes

Attribute		Destination- transportation choice	Conditional destination choice	Conditional transportation choice	Overall
General bus		-0.02222	-	-0.02563	-0.02222
General train		0.02222	-	0.02563	0.02222
Price (bus)	NLG 30	0.00781	-	0.13983	0.04250
	NLG 45	0.01323	-	0.01976	0.00573
	NLG 60	-0.02103	-	-0.15958	-0.04823
Travel time (bus)	1.5 hours	0.03968	-	0.07470	0.02715
	2 hours	0.03876	-	0.06612	0.02287
	2.5 hours	-0.07843	-	-0.14081	-0.05002
Price (train)	NLG 45	0.05950	-	0.16622	0.05231
	NLG 60	-0.03665	-	-0.07857	-0.02600
	NLG 75	-0.02284	-	-0.08764	-0.02630
Travel time	1.5 hours	-0.00338	-	0.12244	0.03396
	2 hours	0.02550	-	-0.02592	-0.00403
	2.5 hours	-0.02211	-	-0.09651	-0.02992

Validity Test

A further test of predictive validity was conducted on data from a holdout choice task answered by all respondents. This task consisted of three transportation-destination combinations: in which two alternatives shared the same destination D_1 , and two other alternatives shared the same transportation mode T_2 . The choice set was D_1T_1 , D_2T_2 and D_1T_2 . In this case covariances between alternatives should play an important role. The observed results and predicted model choices are shown in table 5.10. The joint logit and nested logit models predictions were made analytically. Probit model predictions were made by taking

15,000 random drawings from a normal distribution based on the estimated parameters and variance-covariance matrix, including (i) a model with both rescalings and (ii) a model with only the significant rescaling. Chi-square values for predicted versus observed choices are shown in table 5.11. Results indicate that only the predictions of the probit model with the one significant covariance and the nested logit model with rescaled transportation choices did not differ significantly from the observed hold out choices. The predictions of the probit model with both covariances, the nested logit model with rescaled destination choices and the joint logit model differed significantly from the observed choices. These results supported the previous analysis.

Extension to predictions for choice situations with more than three alternatives is straightforward, because predictions on the basis of the probit, nested logit and joint logit models can be made in a similar way for cases with more alternatives.

Table 5.10 Observed and predicted frequencies on hold out choice task

	Observed	Probit (both cov.)	Probit (one cov.)	Nested Transport. rescaled	Nested Destination rescaled	Joint logit
<i>alt D₁T₁</i>	139	189	143	145	203	183
<i>alt D₂T₂</i>	333	323	318	318	231	242
<i>alt D₁T₂</i>	141	101	152	150	179	188

Table 5.11 Chi-square values for observed and predicted frequencies for the different models

	Observed	Probit 2	Probit 1	Nested T	Nested D
Probit model (2 cov.)	29.6334	-	-	-	-
Probit model (1 cov.)	1.6489	31.9877	-	-	-
Nested logit model (rescaled transportation choices)	1.5091	34.0931	0.0543	-	-
Nested logit model (rescaled destination choices)	70.9520	87.4790	54.5729	52.6086	-
Joint logit model	54.4626	95.4438	39.5046	37.7488	2.9468

The critical value Chi-square for two degrees of freedom at the 0.95 level is 5.99

5.3.4 Conclusions and discussion

This study discussed four model structures for urban tourists' portfolio choices of destination and transportation alternatives: a joint logit model, two nested logit models, a probit model with covariances between partly identical portfolio alternatives, and separate models for different choices of the portfolio choice. The models were tested in a conjoint choice application of Dutch tourists' choices of short city breaks to destinations in Belgium, Germany and The Netherlands. The application provided support for the theoretical assumption that destination and transportation choices are differently scaled, but that the underlying attribute values in combined and conditional portfolio choices are not significantly different after rescaling. It was shown that the suggested experimental approach supported parameter estimations for models of varying complexity for two alternative portfolio choices. It also was shown that the approach allows for tests of complex model structures of separate models for different choices in portfolio choices to more parsimonious overall models with covariances between error terms over different portfolio choices such as the probit model and the nested logit model, and to a joint logit model without covariances.

As expected, covariances did exist between the error terms over utilities of choices between combined alternatives with common elements. The covariance between portfolio alternatives that shared the same transportation component did not significantly improve the model fit, the covariance between portfolio alternatives that shared the destination component however did improve the model fit significantly. This finding implies that models estimated for urban tourists' separate transportation choices should not be used to predict transportation choices in combined destination transportation portfolio choices unless scale corrections are estimated as well.

Contrary to our expectations, interactions between the separate alternatives that made up the portfolio alternatives were not significant in the case study. If this result can be generalized to other choice situations, it can reduce the required number of profiles in experimental designs for destination-transportation portfolio choices. This is because including interactions in experimental approaches generally increases the size of the applied design considerably.

The main managerial implication of our research results is that strategic urban planning decisions on urban tourists' destination and especially transportation choices should not be based on research of those choices separately. In general, strategies based on models of tourists' purchases of separate services may seriously overestimate the influence of planning and marketing strategies on urban tourists' usage of these services if the services are in fact purchased in a portfolio combination with other services. To be most effective, planning and marketing strategies that aim to influence urban tourists' portfolio choices should address the most relevant choice alternatives in their portfolio choices and should be accustomed to the specific choice stage in which the tourists' choices are made. With regard to the choice process studied in this chapter that implies that urban tourists' combined destination-transportation choices can be targeted most effectively through the destination component of their choices.

5.4 Activity choice

5.4.1 Introduction

One of the main attractions of the city as a tourist destination is its diversity and complexity, its large array of cultural activities, shopping facilities, historic sights etc. (Woodside et al. 1989, Wylson and Wylson 1994). Though several studies in urban tourism have addressed urban tourists' activity choices (Jansen-Verbeke 1988, Murphy 1992) and some have specifically addressed tourists' usage and creation of complexes or combinations of attractions (Dietvorst 1993), little research is available on urban tourists' evaluations and choices of combinations of activities. Also, little is known about how tourists' preferences for different activities will change when combined with other activities and undertaken in different periods of the day.

The answers to these questions may have important managerial consequences however in planning and marketing urban tourist destinations. Marketing and planning strategies that focus on tourists' evaluations of separate activities, when combinations of activities determine tourists' choices, may lead to erroneous decisions about marketing and urban development strategies (Dietvorst 1993, Morey et al. 1991). For example it has been observed that unless extremely high investments are made, stand-alone urban attractions are seldom enough to draw in substantial numbers of new visitors or increase the number of repeat visits to urban areas (Law 1994). Therefore, clustering of urban attractions potentially can open up new avenues for planning and marketing strategies that will be more successful in attracting urban tourism.

To support the evaluation of planning and marketing strategies of packages of urban attractions this study addresses the issue of how to model urban tourists' choices of activity packages in cities. It introduces a conjoint choice experiment approach that allows one to estimate parameters in choice situations where respondents choose between different activity packages. The results of an empirical study on Dutch tourists' choices of activity packages for a weekend in Paris are the focus of this section.

5.4.2 Model formulation, experimental design and estimation

Urban tourists are assumed to choose those activity patterns that represent the highest utility to them. It is assumed that tourists base their activity pattern choices on an evaluation of the activities that they can undertake during different parts of the day. The utility of the competing activities for each part of the day consists of a structural part V_i and a stochastic part ϵ_i that captures disturbances in utility due to taste variations between tourists and measurement errors. Different model structures can be generated depending upon the assumptions one is willing to make about the stochastic part of the utility.

Joint logit model

The joint logit model arises if the overall utility of a package is described as the sum of the utilities of all the alternatives present in the package, and a single error term is associated with the overall utility, which is assumed to be IID Gumbel distributed. Let $U_{\{j1, \dots, jN\}}$ be the utility of the combined set of alternatives $\{j1, \dots, jN\}$, N the total set of choices in the

combined choice, and V_{jn} the structural utility of alternative j in choice n . Let $\epsilon_{\{j1, \dots, jN\}}$ be the error term, which is assumed to be IID Gumbel, J_n is the total set of alternatives j in choice n , and $P(\{j1, \dots, jN\})$ is the probability that the combined set of alternatives $\{j1, \dots, jN\}$ is chosen, then:

$$U_{\{j1, \dots, jN\}} = \sum_{n \in N} V_{jn} + \epsilon_{\{j1, \dots, jN\}} \tag{5.18}$$

$$\begin{aligned} P(\{j1, \dots, jN\}) &= P(U_{\{j1, \dots, jN\}} \geq U_{\{j'1, \dots, j'N\}}; \forall n \in N; \forall j'n \in J_n; j'n \neq jn) \\ &= \frac{\exp(\sum_{n \in N} V_{jn})}{\sum_{j'1 \in J_1} \sum_{j'2 \in J_2} \dots \sum_{j'N \in J_n} \exp(\sum_{n \in N} V_{j'n})} \end{aligned} \tag{5.19}$$

Probit model

Let all elements be defined as before. Let $f(\epsilon)$ be the density function of the normal distribution. Let $\epsilon_{\{j1, \dots, jN\}}$ be the overall component of the error term over the set of alternatives, assumed to be IID normal, and let ϵ_{jn} be the IID normally distributed disturbance uniquely attributable to the utility of each of the separate alternatives j in choice n . Then, the utility of the combined set of alternatives $\{j1, \dots, jN\}$ is expressed as:

$$U_{\{j1, \dots, jN\}} = \sum_{n \in N} V_{jn} + \epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn} \tag{5.20}$$

and its utility as:

$$\begin{aligned} P(\{j1, \dots, jN\}) &= \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \dots \int_{-\infty}^{\infty} \exp(\sum_{n \in N} V_{jn} - \sum_{n \in N} V_{jn} + \epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn}) \dots \int_{-\infty}^{\infty} \exp(\sum_{n \in N} V_{jn} - \sum_{n \in N} V_{jn} + \epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn}) \\ &\quad f((\epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn}), \dots, (\epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn})) \\ &\quad d(\epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn}) \dots d(\epsilon_{\{j1, \dots, jN\}} + \sum_{n \in N} \epsilon_{jn}) \end{aligned} \tag{5.21}$$

and the underlying variance-covariance matrix of the error terms in the combined choice process is expressed as:

$$\begin{array}{c}
 U_{\{1, \dots, j_n, \dots, j_N\}} \quad \dots \quad U_{\{1, \dots, j_n, \dots, j_N\}} \quad \dots \quad U_{\{1, \dots, j_n, \dots, j_N\}} \quad \dots \quad U_{\{1, \dots, j_n, \dots, j_N\}} \\
 \left. \begin{array}{l}
 U_{\{1, \dots, j_n, \dots, j_N\}} \\
 \cdot \\
 U_{\{1, \dots, j_n, \dots, j_N\}} \\
 \cdot \\
 U_{\{1, \dots, j_n, \dots, j_N\}} \\
 \cdot \\
 U_{\{1, \dots, j_n, \dots, j_N\}}
 \end{array} \right\} \begin{array}{l}
 \text{var}(\epsilon_{11, \dots, 1n, \dots, 1N} \\
 + \epsilon_{11} + \dots + \epsilon_{1n} \\
 + \dots + \epsilon_{1N}) \quad \dots \quad \text{var}(\epsilon_{11} + \dots + \epsilon_{1n} \\
 + \dots + \epsilon_{1N-1}) \quad \dots \quad \text{var}(\epsilon_{11} + \dots \\
 + \epsilon_{1n-1}) \quad \dots \quad 0 \\
 \\
 \text{var}(\epsilon_{11} + \dots + \epsilon_{1n} \\
 + \dots + \epsilon_{1N-1}) \quad \dots \quad \text{var}(\epsilon_{11, \dots, 1n, \dots, j_N} \\
 + \epsilon_{11} + \dots + \epsilon_{1n} \\
 + \dots + \epsilon_{j_N}) \quad \dots \quad \text{var}(\epsilon_{11} + \dots \\
 + \epsilon_{1n-1} + \epsilon_{j_N}) \\
 \\
 \text{var}(\epsilon_{11} + \dots \\
 + \epsilon_{1n-1}) \quad \dots \quad \text{var}(\epsilon_{11} + \dots \\
 + \epsilon_{1n-1} + \epsilon_{j_N}) \quad \dots \quad \text{var}(\epsilon_{11, \dots, j_n, \dots, j_N} \\
 + \epsilon_{11} + \dots + \epsilon_{j_n} \\
 + \dots + \epsilon_{j_N}) \quad \dots \quad \text{var}(\epsilon_{j_n} + \dots \\
 + \epsilon_{j_N}) \\
 \\
 0 \quad \dots \quad \text{var}(\epsilon_{j_N}) \quad \dots \quad \text{var}(\epsilon_{j_n} + \dots \\
 + \epsilon_{j_N}) \quad \dots \quad \text{var}(\epsilon_{j_1, \dots, j_n, \dots, j_N} \\
 + \epsilon_{j_1} + \dots + \epsilon_{j_n} \\
 + \dots + \epsilon_{j_N})
 \end{array} \right.
 \end{array} \tag{5.22}$$

where the covariance between two combined alternatives is simplified to the variance over their common elements because the other parts are assumed to be independently distributed.

Separate models

Let all elements be defined as before. Assume that the underlying structural utilities for combined choice and conditional choice processes are different. Let $V_{j1,n}$ represent the structural utility of alternative j as the first alternative in combined choice set $\{j1,n, \dots, jn,n, \dots, jN,n\}$ evaluated in the n^{th} choice of the combined choice process. Then the utility of the combination of activities regarding the choice of alternative j in the n^{th} choice is expressed as:

$$U_{\{j1,n, \dots, jn,n, \dots, jN,n\}} = \sum_{n \in N} V_{jn,n} + \epsilon_{j1,n, \dots, jn,n, \dots, jN,n} + \sum_{n \in N} \epsilon_{jn,n} \tag{5.23}$$

The probability functions for the choices at each stage can be joint logit or probit, depending on the assumptions one is willing to make with regard to the error structure.

Experimental design

Covariances between the error terms of portfolio alternatives will typically occur if separate alternatives that make up portfolio alternatives each have separate error terms, as would be the case for the probit model. Also, different parameter values for choices in different

conditional choice situations could be required if separate models apply. The results of the other case studies discussed in this chapter (sections 5.3 and 5.4), and results from other studies (e.g., Swait and Louviere 1993) suggest that rescaling often adequately explains the difference between conditional and combined choices and between choices in different contexts, hence one would expect separate models not to be required.

We therefore used a design approach that permits explicit estimation and testing of the covariance structure between single conditional choices of one alternative, but does not allow estimation of parameter values in all possible conditional choice conditions. Under the assumption of IID disturbances within single activity choices the above variance-covariance matrix can be estimated by calculating scale corrections between the parameter estimates of the single conditional and combined choices. This approach also allows one to test the assumption that the underlying parameter values in different choice situations are identical. Thus, one can test whether separate models for each situation can be reduced to less complex overall models and whether different error terms are required for different choice situations.

The proposed design approach consists of a set of interrelated subdesigns. The basic idea is to make the choice sets such that separate estimates for subsets of different choice situations that may occur in portfolio choice situations can be obtained. The subdesigns are: (i) a subdesign that describes portfolio choices such that the portfolio alternatives vary on all separate alternatives, and (ii) a set of subdesigns that describe conditional portfolio choices in which portfolio alternatives are identical except for one activity.

The overall design is constructed in the following two steps: (i) A first subdesign is constructed like traditional designs for single choices, except that attributes from several alternatives instead of attributes of only one alternative are used to construct the portfolio alternatives in the design, and within choice sets no common elements are allowed between portfolio alternatives. This implies that the assumption of IID disturbances holds within each subdesign even if separate alternatives in a portfolio choice have separate error terms, as in the case of the probit model. Therefore within each subdesign, statistically efficient parameter estimates are supported. If the joint logit model applies, this design offers sufficient information to estimate all β 's. In case of the probit model, independent estimates of the β 's can be obtained, but no information can be derived about the structure of the variance-covariance matrix for the errors in the portfolio choices, (ii) A multiple set of other conditional subdesigns is constructed. In this set are only the activities of one time period in the full activity set of combined activities, while others are kept constant condition within choice sets. These subdesigns are introduced to allow tests of the assumption in the joint logit and probit model of identical underlying parameter values in the different choice situations of combined choices.

If the overall joint logit model applies parameters estimated from choices in these subdesigns are identical to those estimated in the first subdesign. If the probit model applies the variance of the error terms in the conditional choices will differ from that in the first subdesign, and therefore the parameter estimates will be scaled differently. If separate models are required for different choice stages in portfolio choices the scale difference cannot account for the differences between the estimates in different subdesigns, and therefore different utility parameters will be required for different choice situations. A schematic representation of a design for activity choices regarding N different periods of time is given below:

$$\begin{bmatrix}
 \textit{period 1} & \textit{period 2} & \dots & \textit{period N} & \textit{interactions} \\
 \textit{period 1} & \textit{constant} & \dots & \textit{constant} & 0 \\
 \textit{constant} & \textit{period 2} & \dots & \textit{constant} & 0 \\
 \dots & \dots & \dots & \dots & 0 \\
 \textit{constant} & \textit{constant} & \dots & \textit{period N} & 0
 \end{bmatrix}$$

Estimation

First, separate models are estimated for the choices in each of the subdesigns by estimating a separate simple multinomial logit model for each subdesign. This is feasible because disturbances within each subdesign will be IID, as shown before. Therefore, even if the probit model is the true model, parameters can be estimated consistently within each subdesign by applying models that are based on IID Gumbel disturbances. Estimates of the simple MNL model can be translated into probit parameters by applying the transformation discussed in chapter 4 (Ben-Akiva and Lerman 1985, p.71).

Next, the variance covariance structure of the overall probit model is estimated. To find the optimal model, the log-likelihood is calculated for a sequence of scale ratios. To do this the parameter values of the first subdesign are kept constant relative to parameters of the other subdesigns, and a scale ratio is determined between the parameters of the other subdesigns and the first. Because the parameters of the second to *N*th subdesigns are based on conditional portfolio choices that vary independently of each other, a sequential estimation procedure can be used to determine the scale ratios that maximize the overall log-likelihood. This procedure guarantees a global maximum in the log-likelihood, but does not provide estimates of the variance of the scale ratios. In comparing models this is not a major drawback, as the log-likelihood ratio test statistic compares the total fit of the models rather than the separate parameter estimates. It is important to note that this estimation is efficient only if the true underlying model in each subdesign has IID disturbances. Estimates for the covariances in the variance-covariance matrix of the probit model can be derived directly from the estimated scale ratios as discussed in chapter 4.

The various model structures are tested against each other in a series of log-likelihood ratio tests. First the separate models are tested against the overall probit model, and if the sum of the log-likelihoods of the separate models for the subdesigns is not significantly better than that of the overall probit model, the overall probit model is then tested against the overall joint logit model.

5.4.3 Application to urban tourists' choices of activity packages for a weekend in Paris

The proposed modeling approach was implemented and tested in a case study on Dutch urban tourists' choices of activity packages for a weekend in Paris. Paris represents the most popular urban tourism destination for Dutch tourists, and many travel organizations offer several types of trips to Paris, including various optional activity packages.

Method

Data for this study were collected in May 1994 in the Eindhoven region, the Netherlands. A random sample of 60 streets was drawn from the map of the region and in each street a convenience sample of 10 households was selected who agreed to participate in the survey. Questionnaires were delivered and later collected at the household address. Households also were given the possibility to send the questionnaire back by mail. Thus, 510 completed questionnaires were collected. For the analysis presented in this study only data was used from respondents that indicated that they had visited Paris in the past three years. This group represents 221 respondents of the total response, which is 43 percent.

Alternatives were presented to the respondents in an experimental choice task which described a weekend in Paris in four time periods: *saturday morning*, *saturday afternoon* and *saturday evening*, and *sunday morning*. These are the most common time periods in Dutch tourists' weekend trips to Paris. A three level attribute described the possible activities for each time period. The activities used to describe the hypothetical activity packages were selected on the basis of results of previous research on urban tourism, where they were found to be the activities that were undertaken most frequently by urban tourists (Woodside et al. 1989, Jansen-Verbeke 1988). Attribute levels were varied in part over different time periods, to make choice alternatives more realistic and permit estimation of parameter values for a larger number of different activities. The levels used to describe the saturday morning activity were: *Shopping*, *make a bus tour* and *sightseeing*, for saturday afternoon they were: *Shopping*, *a non-guided walk in the city* and *sightseeing*, for saturday evening: *Visit a show*, *make a bus tour by night* and *have a drink in a café*, and for sunday morning: *Visit a museum*, *a non-guided walk in the city* and *sightseeing*. A base alternative was added to all choice sets. It was described as a *non-guided walk in the city* on saturday morning, a *visit to a museum* on saturday afternoon, *stay in the hotel* on saturday evening, and *make a bus tour* on sunday morning. An overview of the attribute levels is provided in table 5.12 that also presents the estimates for the main effects.

A 3^4 fractional factorial design in 81 profiles was used to construct the profiles in the experimental choice tasks for the first subdesign. This design supported the estimation of main effects and all two way interactions between main effects. Choice sets were created by randomly combining alternatives from two identical 3^4 designs, with the restriction that the alternatives of each choice set should have different descriptions for all attributes. The base alternative was added to each choice set. For the four other subdesigns the three level variable describing one of the four activities was varied independently of the other activities which were conditional to the choice.

The choice tasks were presented to the respondents as part of a larger questionnaire. Each respondent was presented with 6 or 5 choice sets drawn from a randomization of all choice sets in the first subdesign and 2 choice sets systematically drawn from the other subdesigns, so that 15 respondents represented one complete replication of the full design including the first and all four other subdesigns. For each choice set, respondents were asked to choose the activity package that they found most attractive. An example of a choice set is presented in figure 5.4. In the analysis, observations were aggregated across all respondents.

Please select the alternative you prefer.

Choice 1	Program 1	Program 2	Program 3
saturday morning	sight seeing	make a bus tour	non-guided walk around the city
saturday afternoon	shopping	sight seeing	visit a museum
saturday evening	visit a show	have a drink in a café	stay in the hotel
sunday morning	non-guided walk around the city	sight seeing	make a bus tour

Choice: [] [] []

Figure 5.4 Example of a portfolio activity choice task as presented to respondents in the first subdesign.

Results

Table 5.12 presents the results for the first subdesign. Estimates represent utility values of the main effects of the first and second level of each attribute estimated relative to the intercept. The intercept represents the utility of the combination of the third levels of all attributes. The significance of the estimates also is indicated. Estimates for interaction effects and their significance are presented in table 5.13, which describes the additional utility attached to combinations of attribute levels on top of their main effects. The results presented in table 5.12 are based on the model structure including interactions. This is relevant because the estimates involved dummy codes, and interaction effects are not independent of main effects. The overall fit of the model was satisfactory both with and without interactions, with McFadden's rho square values of 0.5454 and 0.4672 respectively.

The parameter estimates in table 5.12 show that the combination of sightseeing in different periods of the day and having a drink in a café at night was highly positively evaluated compared to the base alternative, as revealed by the intercept. Shopping, making a bus tour and making a non-guided walking tour also were positively evaluated. Visiting a museum was evaluated somewhat less positively and its observed parameter was not significantly different from that for sightseeing. Of the activities on a saturday evening, visiting a show had a parameter very close to zero, which implies that it was evaluated nearly identically to having a drink in a café. Making a nightly bus tour was evaluated negatively, but neither of the parameters for the saturday evening was significant.

It can be seen in table 5.13 that approximately one third of the interaction effects between activities were significant. As expected, combinations of identical activities for different parts of the weekend were evaluated negatively. Shopping on both saturday morning and afternoon was evaluated negatively, as was making a non-guided walk around town on

both saturday afternoon and sunday morning. An exception was the combination of making a bus tour by day and making a tour by night, which were seen as essentially different activities. It can be observed that none of the interactions between activities in the evening and day time activities were significant. This indicates that choices on evening activities generally did not interact with choices on day time activities. Some significant interactions occurred between activities that perhaps would seem to have a less clear relationship: for example, a combination of shopping and making a non-guided tour around town, had a significant negative parameter. In part, these parameters in part can be interpreted as a consequence of a less obvious commonality between the activities such as the fact that both involve a lot of walking, but also can be explained from the fact that these combinations were considered less attractive than combinations that included sightseeing. Sightseeing was part of the intercept and therefore was not included separately in the interaction estimates.

Table 5.12 Utility values of the attribute levels and their significance for the combined portfolio choices

Attributes	Levels	Utility over intercept	standard error	t-statistic
intercept		1.52720	0.31864	4.793
saturday morning	1 shopping	0.95542	0.34967	2.732
	2 make a bus tour	0.52042	0.35427	1.469
	3 sightseeing	-	-	-
saturday afternoon	1 shopping	0.90504	0.33304	2.718
	2 non-guided walk	0.51074	0.37596	1.359
	3 sightseeing	-	-	-
saturday evening	1 visit a show	0.09241	0.32656	0.283
	2 a bus tour by night	-0.49884	0.34145	-1.461
	3 a drink in a café	-	-	-
sunday morning	1 visit a museum	0.36280	0.35012	1.036
	2 non-guided walk	0.83095	0.38600	2.153
	3 sightseeing	-	-	-

McFadden's rho-square without interactions: 0.4672

Two tests for differences in attribute evaluations in different periods of the weekend were conducted as part of the first subdesign: (i) between shopping on saturday morning and saturday afternoon, and (ii) between a non-guided walk on saturday afternoon and sunday morning. Log-likelihood ratio tests were conducted to test the difference between the models with different and identical parameter estimates on these attribute levels for the different parts of the weekend. Results are presented in Table 5.14 and reveal that the model in which both the compared attribute levels were identical was not significantly different from the model in which they were allowed to be different. Hence, for these attributes there is no difference in utility between the periods of the weekend in which they would be undertaken.

Table 5.13 Utility values and significance for interaction effects

Interaction effects	Utility over intercept	standard error	t-statistic
sat.morn.shop * sat.aft.shop	-2.19908	0.35007	-6.282
sat.morn.shop * sat.aft.walk	-1.27562	0.34343	-3.714
sat.morn.shop * sat.eve.show	0.39081	0.33299	1.174
sat.morn.shop * sat.eve.tour	0.45489	0.35739	1.273
sat.morn.shop * sun.morn.museum	-1.02010	0.38141	-2.675
sat.morn.shop * sun.morn.walk	-0.87580	0.33518	-2.613
sat.morn.tour * sat.aft.shop	-0.63581	0.33363	-1.906
sat.morn.tour * sat.aft.walk	-0.81755	0.40655	-2.011
sat.morn.tour * sat.eve.show	0.50117	0.34167	1.467
sat.morn.tour * sat.eve.tour	0.21225	0.31598	0.672
sat.morn.tour * sun.morn.museum	-0.89438	0.37420	-2.390
sat.morn.tour * sun.morn.walk	-1.42174	0.38719	-3.672
sat.aft.shop * sat.eve.show	-0.21843	0.33825	-0.646
sat.aft.shop * sat.eve.tour	-0.01884	0.32991	-0.057
sat.aft.shop * sun.morn.museum	-0.14842	0.40831	-0.363
sat.aft.shop * sun.morn.walk	-0.75597	0.37102	-2.038
sat.aft.walk * sat.eve.show	0.20316	0.34034	0.597
sat.aft.walk * sat.eve.tour	0.13854	0.34582	0.401
sat.aft.walk * sun.morn.museum	0.29294	0.36909	0.794
sat.aft.walk * sun.morn.walk	-0.62911	0.37569	-1.675
sat.eve.show * sun.morn.museum	-0.51885	0.34403	-1.508
sat.eve.show * sun.morn.walk	-0.17918	0.35833	-0.500
sat.eve.tour * sun.morn.museum	0.27828	0.33988	0.819
sat.eve.tour * sun.morn.walk	0.48198	0.32976	1.480

McFadden's rho-square including interactions: 0.5454

As mentioned, the estimates in tables 5.12 and 5.13 are based on dummy codes and therefore main effects are not fully independent of interactions. The advantage is that both main effects and interaction estimates can be interpreted very straightforwardly. When comparing parameters between different subdesigns, however dependencies between parameter estimates can cause difficulties as interaction effects may vary between subdesigns. Therefore to compare the different subdesigns, effect coding was used. The estimates for the conditional choices for different parts of the weekend in the second to fifth subdesign are presented in table 5.15a to 5.15d. For reasons of comparison, table 5.15e is also included which presents the estimates for the first subdesign based on effects coding.

Table 5.14 Test of differences in parameter values for identical attributes in different periods

Model	Log-likelihood	Chi-square value of difference	
different parameter values for all periods of the weekend	-241.46	-	-
identical parameter values for shopping on saturday morning and afternoon	-241.47	0.02	-
identical parameter values for shopping and the non-guided tour on saturday afternoon and sunday morning	-241.71	0.48	0.46

The critical Chi-square value for one degree of freedom at the 0.95 level is 3.84.

Table 5.15a Utility values of the attribute levels and their significance for the conditional portfolio choices for saturday morning only

Attributes	Levels	Utility over intercept	standard error	t-statistic
intercept		0.51367	0.27522	1.866
saturday morning	1 shopping	-1.40464	0.33557	-4.186
	2 make a bus tour	-0.61173	0.39945	-1.531
	3 sightseeing	-	-	-

Table 5.15b Utility values of the attribute levels and their significance for the conditional portfolio choices for saturday afternoon only

Attributes	Levels	Utility over intercept	standard error	t-statistic
intercept		0.23687	0.28748	0.824
saturday afternoon	1 shopping	-0.49281	0.30341	-1.624
	2 non-guided walk	0.86710	0.38469	2.254
	3 sightseeing	-	-	-

Table 5.15c Utility values of the attribute levels and their significance for the conditional portfolio choices for saturday evening only

Attributes	Levels	Utility over intercept	standard error	t-statistic
intercept		2.46209	0.45781	5.378
saturday evening	1 visit a show	-0.60134	0.29826	-2.016
	2 a bus tour by night	-0.77212	0.39741	-1.951
	3 a drink in a café	-	-	-

Table 5.15d Utility values of the attribute levels and their significance for the conditional portfolio choices for sunday morning only

Attributes	Levels	Utility over intercept	standard error	t-statistic
intercept		0.25428	0.33474	0.760
sunday morning	1 visit a museum	0.41782	0.30275	1.380
	2 non-guided walk	0.76581	0.38607	1.984
	3 sightseeing	-	-	-

Table 5.15e Utility values of the attribute levels and their significance: overall estimates for the combined portfolio choices, main effects only.

Attributes	Levels	Utility over intercept	standard error	t-statistic
intercept		2.40466	0.15440	15.574
saturday morning	1 shopping	-0.52083	0.09127	-5.706
	2 make a bus tour	-0.53699	0.09085	-5.911
	3 sightseeing	-	-	-
saturday afternoon	1 shopping	-0.37003	0.09100	-4.067
	2 non-guided walk	-0.08130	0.09029	-0.901
	3 sightseeing	-	-	-
saturday evening	1 visit a show	0.14524	0.08939	1.625
	2 a bus tour by night	0.06464	0.09071	0.713
	3 a drink in a café	-	-	-
sunday morning	1 visit a museum	-0.34379	0.09162	-3.752
	2 non-guided walk	-0.27744	0.09148	-3.033
	3 sightseeing	-	-	-

To test the validity of rescaling separate compared to combined choices, one overall model was estimated with scale corrections between the estimates for the separate choices and combined choices. The scale correction for all subdesigns as significantly different from 1, but only the scale corrections for the first two subdesigns were within the range of 0 to 1. They were respectively 0.4321 and 0.3351. The other two scale parameters took on negative values. Therefore the rescaling hypothesis was rejected for the last two subdesigns.

This finding implies that the overall probit model should perform significantly worse than a set of separate models for each of the subdesigns. This was tested in a log-likelihood ratio test where a probit model with rescalings for the first two subdesigns and no rescaling for the last two subdesigns was compared to separate models for all five subdesigns. The covariances of the variance-covariance matrix of this probit model were calculated on the basis of the discussion in the section 4.6, where first the ratios of the scales of the subdesigns ($r_{1,i}$) are expressed in terms of the standard deviations of the error terms of the subdesigns (σ_i and σ_j) and then the variance in subdesign i can be expressed as:

$$\text{var}(\epsilon_i) = \frac{\pi^2}{6} r_{1,i}^2 \quad (5.24)$$

As it is assumed that the error terms for each of the separate elements in the portfolio alternatives are independently distributed, the variance of the error term in subdesign j minus the variance of the error term in subdesign i equals $\text{var}(\epsilon_{j,i})$: the variance over the common alternatives in the portfolio choices in subdesign i .

As shown in section 4.4.3, this variance equals the covariance for the conditional choices in subdesign i if they are modeled in a probit variance-covariance structure. Therefore the covariances in the proposed probit model for portfolio alternatives with common activities except for the first period of the weekend are: 1.3378, and for portfolio alternatives with common activities except for the second period of the weekend they are: 1.4602. These values should be viewed in relationship to the variance of the combined portfolio choices in the first subdesign, which is 1.6449 if its scale is set to 1 as commonly is done in logit estimates.

To compare the validity of the two models, the log-likelihood of the overall probit model was compared to the sum of the log-likelihoods of the separate models using the log-likelihood ratio test statistic:

$$2[\mathcal{L}^*(\text{separate models}) - \mathcal{L}^*(\text{overall probit})],$$

which had a value of 23.75. This was significant at the 0.05 level in a Chi-square test at 12 degrees of freedom (the number of extra parameters in the separate models). Therefore the previous conclusion that separate models are required was confirmed.

5.4.4 Conclusions and discussion

The main purpose of this study was to introduce and test a conjoint choice approach to model urban tourists' choice of activity packages. The joint logit model, the probit model and a set of separate logit models were introduced to model choices between combinations of activities. An experimental design approach including attributes from multiple alternatives and interactions between attributes of different alternatives was also proposed. The approach

allowed for tests of possible differences in parameter values for identical attributes when introduced in different periods of the weekend.

The approach was implemented in a case study on Dutch urban tourists' choices of activity packages for a weekend in Paris. Respondents were asked to choose from different hypothetical descriptions of activity packages describing a saturday morning, saturday afternoon, saturday evening and sunday morning in Paris. It was found that interactions between activities in different periods of the weekend did indeed occur. The combination of shopping on both saturday morning and saturday afternoon, was evaluated negatively for example, whereas shopping in itself was evaluated positively as a weekend activity. It was also observed that evening activities did not interact with day time activities, so that it was concluded that choices on evening activities were made relatively independently of choices for day time activities. The tests for possible differences in evaluations of identical activities in different parts of the weekend showed that in this case study respondents did not evaluate activities differently depending on the period of the weekend.

Significant differences were observed between the choices for combined portfolio packages of activities for all periods of the weekend and conditional portfolio choices for just one period of the weekend. For two out of four conditional choice situations (saturday morning and saturday afternoon) scale differences could explain the observed differences in parameter values. For the other two conditional choice situations (saturday evening and sunday morning) however, separate models were required.

This result was somewhat unexpected because rescaling explained observed parameter differences in similarly different situations in the studies described in previous sections. Therefore it would be worthwhile to conduct further research in this area. It would be especially interesting to conduct a similar study using a larger sample of respondents, because that would allow one to address potential differences in preferences between urban tourists that could partly explain the observed results.

In managerial terms several implications for the planning and marketing of urban tourism facilities can be drawn from the results obtained in this study. First, it was observed that sightseeing and shopping were the most popular components in urban tourists' choices of day time activity packages, so that it can be concluded that these can be used as major motivators to attract urban tourism. Secondly it was observed that, as expected, tourists will often combine several different activities in their activity packages. This implies that in marketing a specific city, the possibility of combining tourism activities should be communicated to potential urban tourists and where possible facilitated. Interrelationships between urban areas and urban activities can be planned in networks and complexes of facilities and can be marketed as pre-set packages or as 'self created' tourist opportunities. Thirdly, it was observed that night time activities were selected largely independent of day time activities. This implies that they can also be marketed more or less independently and that there may be potential benefits in planning for night time activities separately from planning for day time activities. Fourthly, it can be concluded that planning and marketing strategies that address single choices may need to be different from those that address combined portfolio choices, because preferences may vary between choice situations where combinations of choices are made and those where separate choices are made.

5.5 Conclusions and discussion

This chapter presented choice models and empirical applications for the three choice types of the simple conceptual framework introduced in chapter 4. In each of the applications the modeling principles were tailored to the specific needs of the problem addressed. It has been shown that the proposed approach can adequately capture several essential effects in portfolio choice processes in urban tourism. It has also become clear from the case studies that different choice situations may require choice models of different complexity, ranging from overall nested logit models to separate models for combined and conditional portfolio choices. Chapter 6 will further discuss the empirical results described in this chapter and discuss strengths and weaknesses of the proposed approach. It will also propose fruitful avenues for future research.

6 Conclusions and discussion

6.1 Introduction

Developing and marketing urban tourism projects is probably one of the most complex and challenging tasks in recent urban planning efforts that have taken place in many western cities. Urban tourism projects often require high initial investments to be successful, but at the same time offer little guarantees that the investments can be turned into profit.

In this thesis a modeling approach was developed that can assist urban tourism planners and marketers in evaluating the potential impact of urban tourism projects on urban tourism demand before those projects are actually implemented. Thus, the approach can help prevent unnecessary losses in urban tourism development projects.

Methodologically, the proposed approach represents an extension of traditional conjoint choice modeling techniques that captures urban tourists' choices between combinations of alternatives. This type of choices is referred to as portfolio choices in this thesis.

The proposed approach is based on a general review of the urban tourism literature in chapters 2 and 3. Chapter 2 presented several examples of urban tourism projects. It was shown that urban tourism development projects typically involve investments in large complexes that combine multiple tourism and retailing functions. It was argued that marketing research techniques play a central role in recent urban tourism planning approaches, especially as tools for ex-ante evaluations of urban tourism development projects.

Chapter 3 reviewed the literature on urban tourism behavior. Previous studies were discussed that showed activities that urban tourists frequently undertake and also that urban tourists often combine several different activities when visiting a city. It was concluded that most research in urban tourism to date provides relatively few tools to support evaluations of complex urban tourism development projects in terms of their expected impact on urban tourists' behavior. Therefore, more general studies on tourists' choice processes also were reviewed from this perspective. On the basis of this review, it was argued that conjoint choice modeling offers the most promising approach to develop suitable ex-ante evaluation techniques of urban tourism development projects.

Chapter 4 introduced the theoretical basis of conjoint choice modeling and argued that traditional conjoint choice techniques need to be extended to models and experimental techniques that allow one to model portfolio choices in order to adequately model urban tourists' choice processes. Models and experimental designs were developed to support this extension and a conceptual framework of three choice types to support the study of urban tourists' choice processes was proposed. It included three choice types often studied in (urban) tourism behavior research: (i) participation choice, (ii) destination choice, and (iii) activity choice.

Chapter 5 tested the proposed approach. For each of these three choice types empirical applications were discussed. It was shown that the proposed approach can adequately capture important effects in urban tourists' portfolio choice processes.

This chapter will review the most important findings of the empirical studies discussed in chapter 5 and discuss strengths and weaknesses of the proposed approach. Also, avenues for future research will be proposed that represent especially promising areas to extend the research discussed in this thesis.

6.2 Discussion of empirical results

Arguably, the most important conclusion that can be drawn from the research reported in this thesis is that urban tourists' portfolio choices should be modeled differently from urban tourists' single choices. The empirical studies showed that scale differences existed between combined and single conditional portfolio choices in several urban tourism choice situations, as well as interactions between different alternatives within portfolio alternatives.

Therefore, models that do not take into account these effects and that simply combine several single choice models to model combined choice processes therefore perform significantly worse than models that do incorporate these effects related to portfolio choices. The findings also imply that ex-ante evaluations of urban tourism development projects based on the proposed approach lead to significantly better predictions of changes in urban tourism demand due to new project investments than traditional models.

The results in the first case study showed that urban tourists' participation choices are significantly differently scaled (i.e. smaller) than their activity choices. This implies that urban tourism planning strategies that change characteristics of urban tourism activities or facilities generally will have a smaller impact on total urban tourism demand than they have on the spread of demand over different comparable activities.

In the second case study it was observed that in combined destination-transportation choices, destination alternatives are much more influential to urban tourists' choices than transportation alternatives. Consequently, parameters for the choice model of transportation choices needed to be rescaled when used in models for choices between combined destination-transportation alternatives. Parameters for choices of destination alternatives however hardly required any rescaling when transportation alternatives also were incorporated in the choice task. In this empirical study no significant interactions were found between the attributes of destination and transportation alternatives.

This type of interaction between different alternatives within portfolio alternatives was observed however in the third empirical test that covered urban tourists' choices of activities for different periods of a short city break. Shopping for example, was considered an attractive activity for each separate period of the weekend, but not if it was undertaken in more than one period. Similar relationships existed between other activities. When choices for different parts of the weekend were compared to choices between portfolio alternatives, again two out of four conditional choices were found to be scaled significantly different from combined choices.

The main managerial implication of our research is that strategic urban tourism planning and marketing decisions should not be based on research of tourists' choices of single facilities or services. Strategies based on models for choices of separate facilities or services may overestimate the influence of planning and marketing strategies on the probability of urban tourists using those specific facilities or services if these facilities or services are in fact part of a portfolio choice including other facilities or services.

Planning and marketing strategies aimed at influencing urban tourists' portfolio choices should address the most relevant choice elements in portfolio choice processes and be accustomed to the specific choice stage in which the consumer portfolio choice is made to be most effective. For different choices in the portfolio choice process different alternatives may be more relevant than others and it is therefore important that planning and

marketing strategies manipulate the alternatives that are relevant to the particular choice aspect of interest.

6.3 Strengths and weaknesses of the proposed approach

As a general conclusion it can be argued that the research results presented in this thesis justify the conclusion that conjoint modeling offers a suitable tool to measure and model urban tourists' choice processes. More specifically, the empirical results show that the proposed extension of traditional conjoint choice modeling effectively supports estimation of scale differences between choices of separate elements in portfolio alternatives and combinations of these elements. Also, it can capture interaction effects specific to combinations of alternatives that cannot be measured if separate choice models are used for each of the single choices. This implies that urban tourism demand can be predicted more effectively.

This extra information can be acquired in a relatively straightforward extension of traditional conjoint choice models. A disadvantage however is that this extension requires larger experimental designs and consequently larger surveys than more traditional approaches. This is an aspect that can be especially burdensome if models are estimated that involve choices between portfolio alternatives that include many different elements. In those cases experimental designs have to be extended to include a large number of subdesigns, which increases the required total number of choice tasks.

It could also be argued that although the proposed approach captures the main elements in portfolio choice processes, it does not allow one to simulate dynamic choice situations in which urban tourists' make several sequential choices from a set of portfolio alternatives. The proposed approach mimics different stages of the dynamic choice process by presenting respondents with different types of conditional choice situations. It does not offer respondents an open structure however in which they themselves can determine the order and structure of their choice process. To do so would either lead to violations of the experimental design principles used in this thesis or require designs of a much larger size.

This is because presently, the design structure determines the absence or presence of variation in the alternatives and attributes in the choice sets. If the respondents themselves are allowed to determine how alternatives are combined, the control that the design exercises over the choice task is lost and the orthogonality of the original design may be violated in the actual choice sets that respondents construct. To maintain orthogonality, respondents would have to answer to multiple combinations of portfolio choice tasks similar to those used in the presently proposed approach.

6.4 Fruitful avenues for future research

Some possibilities for future research have already been mentioned in the previous section. This section extends that discussion and offers a more general perspective on the opportunities for further research in conjoint choice modeling of urban tourists' choice processes. Three main areas for future research are suggested. All three are concerned with

extending conjoint choice modeling towards more realistic measurements and models of dynamic consumer choice processes. The three areas are: (i) modeling strategies, (ii) experimental strategies, and (iii) forecasting strategies.

With regard to modeling strategies, several areas of interest can be distinguished. First, the proposed models can be extended to include parameters that describe the way in which urban tourists' choice processes are structured over time (e.g., Fisher et al. 1990). Recent studies in the areas of transportation (Hensher and Mannering 1994, Ettema et al. 1995) and retailing research (Popkowski Leszczyc and Timmermans 1994) have estimated such parameters using subsequent observations of respondents' choices at different moments in time. The models that are applied in these studies are known as hazard or duration models. Though the predictions of hazard models for the actual choice outcome at each specific moment in time are essentially the same for simultaneous and sequential portfolio choices (also, section 4.4.6 of this thesis), hazard models allow one to capture relevant extra information on the structure of the sequential choice process. More specifically, they allow one to estimate parameters that indicate the probability that tourists make certain choices at different moments in time, and also parameters that describe the way in which urban tourists' preferences evolve over time.

A second modeling approach that provides promising opportunities for future research is to further develop segmentation techniques on the basis of the variance in respondents' stated choice data. Many applications of conjoint choice modeling approaches are based on aggregate data. Although this will often lead to stable aggregate models, more insight can be gained if respondents can be grouped together in segments with similar preference structures. Sometimes, interaction effects observed in aggregate models can be explained by the fact that different underlying preference segments exist within the population. Also, the value of main effects may differ between segments, which may lead to erroneous predictions when aggregate models are used in situations where significant shifts occur between the number of people in different preference segments. This may be the case for example if demographic characteristics of the population change. The estimated parameter values within each segment may remain the same, but the aggregate parameter value will change as the size of the segments changes. An example of recent work in this area is a study by Swait (1994) who introduced an application of latent-class segmentation to revealed choice data.

A third potentially fruitful future line of analysis is to test whether differences that exist between the way in which urban tourists evaluate separate activities and the way in which they evaluate combinations of activities are in some way systematic. If they are, a structural system could be developed that allows one to develop more general guidelines to combine estimates based on tourists' evaluations of single alternatives with estimates based on evaluations of combinations of alternatives.

A similar approach could be taken to compare stated choice models and revealed choice based models (Carson et al. 1994). A systematic meta-analysis of stated and revealed choice models estimated in comparable settings would be valuable to test for systematic relationships that may exist between stated and revealed choice parameter estimates. This analysis could be especially fruitful from the point of view of establishing a further understanding of the external validity of models estimated on the basis of stated choice data. Stated choice models typically have a high internal validity and construct validity (i.e. a strong relationship between the intended theoretical construct and the measured variables)

when compared to revealed choice models, but sometimes perform less well on certain aspects of external validity. More specifically the variance of the data in stated choice experiments will typically be lower than the variance of revealed choice data. Consequently, stated choice models may overpredict the effect of planning and marketing strategies in real world situations. Testing for variance related scale differences between revealed and stated choice models is therefore a fruitful hypothesis to test in a meta-analysis.

There are several difficulties in comparing revealed and stated choice models. These are related to the fact that models based on revealed choice data are in certain respects also limited in their external validity. This is because parameters estimated in revealed choice models are typically confounded with characteristics of the respondents' physical and social environment (Oppewal 1995). Thus, the estimated parameter values not only capture the respondents' preferences but also the various limitations in choice opportunities that the respondents encounter. Therefore, as estimates vary between contexts, systematic differences between revealed and stated choice models may be hard to observe and explain.

With regard to experimental design strategies, it would be fruitful to develop more flexible choice tasks that better simulate sequential portfolio choices and still maintain independence between observations. The presently proposed design structures do not allow one to estimate the temporal effects in sequential choice processes discussed above. In order to support estimation of these models, more flexible designs are required in which respondents can select different elements of portfolio alternatives at different moments in time.

This objective is especially challenging as mathematical experimental design theory is typically based on the assumption of independent error terms over observations and hardly any work has been done on design optimization for measurements in situations where the error terms are expected to be dependent. This would however necessarily be the case if sequential choices are observed. In those situations it can be expected that certain random variations in the measurement will be constant between several subsequent choices. If dependencies exist between error terms over different observations, this biases the estimates made on the basis of the design. The reason is that due to scale differences between different choice situations the fully independent observations will have a lower impact on the overall estimates than those that are partly dependent.

Also, it would be worthwhile to test the proposed approach in experiments that apply more extensive and more realistic descriptions of urban tourism packages to further specify the relationships that exist between various urban activities and the way in which tourists plan their activity patterns. These choice tasks could include the use of modern computer hard- and software that allows for more realistic simulations of urban tourists' choice environments. Developments like this are taking place in marketing and retailing research, where consumers are presented with video or virtual reality representations of new consumer choice situations to evaluate the market potential of new product developments (Urban et al. 1990, Burke et al. 1992)

Similarly, in transportation research, interactive data collection tools have recently been proposed and tested as a way to more realistically measure respondents' planning of daily activities and travel patterns (Gärling et al. 1994, Ettema et al. 1994). It would be interesting to extend those environments to include controlled or semi-controlled experimental choice tasks in which respondents could be asked how they would change their choices under

certain hypothetical planning or marketing scenarios.

Interactive computer supported data collection also offers advantages in terms of its potential to develop more individualized and flexible choice tasks. Attribute levels can be adjusted to the individual respondent, and potentially, on line evaluations of respondents' answers can help develop a more efficient data collection. The reason is that computerized questionnaires can focus on those attributes and attribute levels where most information is required. Traditional experimental designs in conjoint analysis are based on the assumption that all choice outcomes have an equal a priori probability of occurrence. It is theoretically possible however to reduce the size of the required design if the experimenter already has information on the probability of different observations before the measurements are made. Computer supported data collection in combination with an interactive design generator, can potentially increase the efficiency of data collection in conjoint choice experiments, because the design can be re-optimized after each observation.

In terms of forecasting strategy an interesting extension would be to capture some of the complexity of the portfolio choice process in a micro-simulation approach in which choices for different types of urban tourists' choice processes and for different individuals are estimated separately at first, and then combined in a simulation to determine the overall choice probabilities for portfolio alternatives across choice processes and individuals. The advantage of this approach would be that relatively simple models and experimental designs could be used, but that the approach would still allow for a greater flexibility in the overall forecast. Aspects that could be captured are: (i) the modelling of possible interrelationships between the various choice stages that may occur in portfolio choice processes, (ii) the modeling of different preferences in different contextual situations for each tourist, and (iii) the modeling of interrelationships between the behavior of different tourists (Merz 1991, Goulias and Kitamura 1992).

To simulate these dynamic effects in complex choice behavior both within and between urban tourists, Monte Carlo simulations can be used that draw from a set of distributions for each of the separate models. These models would be used to maintain dynamic databases representing the current state for each individual urban tourist and the state of the urban tourism environment. To predict a situation at a certain point in time, subsequent draws would be made from each of the models for the requested period of time. The variation in end-states of the system if observed over a sufficiently high number of simulations indicates the probability for each end-state to occur. By varying the level of the variables in the system, the consequences of different marketing and planning strategies can be evaluated.

Finally, the practicality of the proposed models in terms of their forecasting capacity can potentially be improved by incorporating them in a decision support system that assists urban tourism planners and marketers in systematically evaluating different planning and marketing strategies. Recent work by Arentze et al. (1994, 1995) offers interesting insights in the possibilities for future research along this line.

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Conjuncte keuzemodellen voor planning en marketing van stedelijk toerisme

De stedelijk omgeving is door de jaren heen niet alleen gebruikt als een omgeving om in te werken en te wonen, maar ook als een omgeving voor ontspanning en vermaak. De sociale en fysieke structuren van de stad bieden aan veel mensen aantrekkelijke mogelijkheden voor recreatieve en toeristische activiteiten. Bezoekers van de stad kunnen dan ook vele verschillende voorzieningen benutten. Ze kunnen de vele restaurants en cafés bezoeken, winkelen in de winkelstraten, en genieten van de sfeer in de stad en de stedelijke architectuur. De stad biedt veel variatie en mogelijkheden.

De uitgaven van stedelijk toeristen en recreanten zijn door de groeiende populariteit van stedelijk toerisme en recreatie voor veel stedelijke economieën een belangrijke bron van inkomsten geworden (van den Berg et al. 1994). Toeristen en recreanten behoren tot de meest actieve gebruikers van veel stedelijke voorzieningen zoals de horeca en culturele evenementen. Veel van deze voorzieningen zouden niet rendabel zijn als ze geen bezoekers van buiten de stad konden aantrekken. Tegelijkertijd kan het aantal bezoekers aan de stad echter problemen veroorzaken in het stedelijk beheer. Sommige voorzieningen kunnen wellicht de vraag niet aan en stedelijke structuren kunnen daardoor overbenut worden. Ook zijn vaak hoge investeringen vereist om stedelijk toeristen aan te trekken of om de stroom van toeristen op gang te houden. De economische haalbaarheid van deze investeringen is echter veelal moeilijk te voorspellen en achteraf blijkt dat projecten niet altijd zo rendabel zijn als gehoopt (van der Borg 1991).

Verrassend genoeg is de rol van stedelijk toerisme en stedelijk vermaak in de stede­bouw­kundige planologie lange tijd relatief ondergewaardeerd en in feite is er pas de laatste tien jaar sprake van een duidelijke aandacht voor stedelijk toerisme binnen de stede­bouw­kundige planologie (Ashworth 1989, Inskeep 1988, Jansen-Verbeke 1988, Law 1994). Pas in de laatste tien jaar worden voorzieningen voor stedelijk toerisme en stedelijk vermaak expliciet in stede­bouw­kundige projecten opgenomen als belangrijke functies op zichzelf en niet als afgeleide van andere stedelijke functies zoals volkshuisvesting en bedrijvigheid.

Deze ontwikkeling kan gedeeltelijk worden beschouwd als een reactie op de de­industrialisatie van het stadscentrum zoals die in veel steden heeft plaatsgevonden (Law 1994). Veel gemeenten hebben zich in de afgelopen decennia gerealiseerd dat stedelijk toerisme en vermaak een belangrijke rol kunnen spelen bij het ontwikkelen en herstructureren van de stedelijke omgeving en de stedelijke economie. Dit heeft als gevolg gehad dat veel recente stede­bouw­kundige plannen voor stadscentra gericht zijn geweest op het ontwikkelen en uitbreiden van stedelijk toeristische attracties.

Voorzieningen voor stedelijk toerisme kunnen echter alleen succesvol zijn als ze voldoende bezoekers trekken. Marktonderzoek speelt dan ook een belangrijke rol in veel planningsprojecten die er op zijn gericht om extra stedelijk toerisme te genereren. In deze marktgerichte planningsbenadering wordt benadrukt dat het begrijpen van de voorkeuren van stedelijk toeristen van essentieel belang is voor het ontwikkelen van succesvolle stedelijke ontwikkelingsprojecten met een sterke toeristische inslag.

Marktgerichte benaderingen in stede­bouw­kundige plannen voor stedelijk toerisme passen binnen een meer algemene trend in stede­bouw­kundige planologie die zich in de laatste

decennia heeft ontwikkeld. Er is een verschuiving opgetreden van meer traditionele aanbodgeoriënteerde planningsmethoden naar nieuwe methoden die meer nadruk leggen op de vraagzijde van de markt (Asworth en Voogd 1990, Greed 1993). De traditionele planningsmethoden kenmerkten zich door een relatief gecentraliseerde en bureaucratische benadering, met een sterke aandacht voor de fysieke mogelijkheden en onmogelijkheden van de bestaande gebouwde omgeving. Marktgerichte planningsbenaderingen daarentegen stellen de vraagzijde centraal en zijn in het algemeen meer gedecentraliseerd. Binnen zekere vrij algemeen omschreven sociale, economische en milieutechnische randvoorwaarden stellen lokale overheden in overleg met lokale marktpartijen hun eigen planningsdoelen vast. Mogelijke veranderingen in de gebouwde omgeving worden beschouwd vanuit het oogpunt van de huidige en potentiële gebruikers en niet zozeer vanuit de mogelijkheden die bestaande voorzieningen en structuren bieden. Deze verschuiving in planningsbenaderingen is de voornaamste reden voor de groeiende aandacht bij planners van stedelijk toeristische voorzieningen voor marktonderzoek dat ondersteuning kan bieden bij de evaluatie van stedenbouwkundige plannen met betrekking tot hun impact op de vraag naar stedelijk toerisme.

Conjuncte keuzemodellen en experimenten vormen een veelbelovende methode om dit type evaluaties uit te voeren. In conjuncte keuze-experimenten wordt respondenten gevraagd om in verschillende hypothetische keuzesets het alternatief te selecteren dat zij het meest aantrekkelijk vinden. De keuzeresultaten worden vervolgens gebruikt om modellen te schatten die de relatie weergeven tussen de kenmerken van de verschillende hypothetische alternatieven en de kans dat ze worden gekozen. Op deze wijze kunnen modellen worden ontwikkeld die kunnen worden gebruikt om de impact te voorspellen die verschillende plannings- en marketingstrategieën hebben op de keuzes die stedelijk toeristen maken.

Conjuncte keuzemodellen worden binnen vakgebieden als marketing en verkeer en vervoer veelvuldig toegepast. Binnen het onderzoek naar stedelijk toerisme worden ze echter nog maar relatief weinig benut. Conjuncte keuzemodellen bieden echter ook uitstekende mogelijkheden voor succesvolle toepassingen binnen stedelijk toerisme. Ten eerste, omdat door het gebruik van statistische experimentele designs de invloed van verschillende effecten op het keuzegedrag van stedelijk toeristen onderling onafhankelijk kan worden gemeten, terwijl dit in veel werkelijke keuzesituaties binnen stedelijk toerisme niet mogelijk is omdat de aanwezigheid van verschillende kenmerken van stedelijk toeristische voorzieningen veelal sterk met elkaar zijn gecorreleerd. Ten tweede, omdat conjuncte keuzemodellen het mogelijk maken om ook de invloed van nieuwe, nog niet bestaande voorzieningen op het keuzegedrag van toeristen te voorspellen. In de hypothetische keuzesituaties kunnen ook nog niet bestaande kenmerken worden voorgelegd aan respondenten en worden geëvalueerd op de invloed die zij hebben op het keuzeproces. Dit is extra aantrekkelijk voor stedelijk toerisme projecten omdat zij vaak grote investeringen vergen voor het ontwikkelen van grotendeels nog onbekende voorzieningen.

In dit proefschrift is daarom een conjuncte keuzebenadering ontwikkeld die keuzes die stedelijk toeristen maken te meten en te modelleren. Omdat stedelijk toeristen in hun keuzeproces veelal geconfronteerd worden met complexe voorzieningen die meerdere verschillende functies huisvesten is hierbij bijzondere aandacht besteed aan combinaties van keuzes die stedelijk toeristen maken. Bovendien is uit eerder onderzoek gebleken (Jansen-Verbeke 1988, Murphy 1992) dat stedelijk toeristen graag meerdere activiteiten combineren bij hun bezoek aan de stad. Conjuncte keuzemodellen die de gevolgen van nieuwe plannings-

en marketingstrategieën in stedelijk toerisme moeten evalueren, moeten daarom dit type keuzeprocessen kunnen beschrijven. De keuzeprocessen waarbij stedelijk toeristen keuzes maken tussen combinaties van alternatieven wordt in dit proefschrift portfolio keuzes genoemd.

Traditionele conjuncte keuzemodellen zijn echter niet geschikt om portfolio keuzes te modelleren. Het voornaamste *doel* van het onderzoek beschreven in dit proefschrift is daarom om conjuncte keuzemodellen en experimenten te ontwikkelen die portfolio keuzes van stedelijk toeristen kunnen beschrijven. Er zijn modellen en experimentele designs ontwikkeld om verschillend aspecten van portfolio keuzes te meten en modelleren. Hierbij is met name aandacht besteed aan mogelijke schaalverschillen tussen parameters die worden geschat voor keuzes tussen portfolio alternatieven en parameters voor keuzes tussen afzonderlijke alternatieven. Ook is aandacht besteed aan mogelijke interacties tussen de verschillende afzonderlijke alternatieven in een portfolio set.

Na de theoretische bespreking van de voorgestelde benadering, wordt deze toegepast in een conceptueel kader van drie type keuzeprocessen die stedelijk toeristen doorlopen. Deze drie keuzeprocessen zijn geselecteerd in analogie met de marketing literatuur (Gupta 1988) en gebaseerd op eerdere besprekingen van toeristenkeuzes in de literatuur op het terrein van stedelijk toerisme. De drie onderzochte keuzeprocessen zijn: (i) de keuze om wel of niet aan bepaalde typen activiteiten deel te nemen, (ii) een bestemmingskeuze in combinatie met vervoermiddelkeuze, en (iii) de keuze van activiteiten in de stad.

De voorgestelde benadering is getoetst in drie empirische case studies. In deze studies zijn de keuzes van Nederlandse stedelijk toeristen uitgewerkt voor respectievelijk: (i) het wel of niet bezoeken van verschillende typen parken, (ii) bestemming en vervoermiddel voor stedentrips in België, Duitsland en Nederland, en (iii) activiteiten voor verschillende perioden van een weekend in Parijs. De resultaten van deze empirische studies laten zien dat er significante verschillen bestaan tussen de keuzes tussen afzonderlijke alternatieven en tussen portfolio alternatieven. In sommige situaties kon herschaling de waargenomen verschillen verklaren, maar in enkele situaties waren werkelijk verschillende modellen noodzakelijk. In een van de drie studies bestonden er significante interacties tussen de verschillende alternatieven binnen de portfolio sets.

Het proefschrift sluit af met een analyse van de sterke en zwakke punten van de voorgestelde benadering en enkele mogelijkheden voor verder onderzoek. Het voornaamste voordeel van de voorgestelde modellen en experimenten is dat significant betere voorspellingen kunnen worden gemaakt van portfolio keuzes die stedelijk toeristen maken en dat zo plannings- en marketingstrategieën preciezer kunnen worden geëvalueerd. Hoewel dit gebeurt met behulp van een relatief eenvoudige uitbreiding van traditionele conjuncte keuzemodellen en experimenten, is het voornaamste nadeel van de methode dat er om deze extra informatie te verkrijgen meer keuzetaken benodigd zijn dan in de traditionele conjuncte keuzebenadering. Dit kan met name een probleem vormen als de portfolio alternatieven die worden bestudeerd zijn opgebouwd uit zeer veel verschillende afzonderlijke alternatieven.

Abstract

In this thesis a methodology is developed to measure and model urban tourists' preferences for combinations of alternatives. Models and experimental designs are introduced that allow researchers to measure the influence that various attributes of urban tourism activities have on the probability that these activities will be undertaken.

The method applied in the studies reported in this thesis is based on an extension of traditional conjoint choice modeling techniques. It proposes models and experimental designs that allow one to incorporate urban tourists' choices between combinations of several activities.

It is especially relevant to know urban tourists' preferences for different possible combinations of alternatives in urban tourism planning and marketing, because previous research has shown that urban tourists' typically like to combine several activities when visiting a city. Also, urban tourism behavior often takes place in highly complex urban environments that incorporate multiple tourism facilities and services. Therefore, models that allow one to model between combinations of alternatives can significantly improve the precision of predicted changes in tourism demand, in ex-ante evaluations of the impact of new urban tourism project developments.

The proposed approach was applied and tested for three important types of choices in urban tourism research: (i) participation choice, (ii) destination choice, and (iii) activity choice. The results of the empirical studies show that the proposed methodology effectively supports measuring and modeling effects that are specifically related to choices between combinations of alternatives. They also show that the proposed models lead to significantly better predictions of urban tourists' choices than the traditional models for single choices. Therefore, it can be concluded that the proposed approach offers a way to more precisely evaluate the potential impact of urban tourism planning and marketing strategies on urban tourism demand.

Curriculum vitae

Benedict Dellaert (1967, Nijmegen) is a senior lecturer at the department of Marketing, faculty of Economics, the University of Sydney. Previously, he was a PhD-student with the Urban Planning Group at Eindhoven University of Technology from 1992 to 1995. In 1990 and 1991 he worked at the Dutch ministry of Economic Affairs, department of Regional Economic Policy and at the Urban Planning Group, Eindhoven University of Technology to fulfill the requirements to replace his military service.

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Conjoint Choice Models for Urban Tourism Planning and Marketing

In this thesis a methodology is developed to measure and model urban tourists' preferences for combinations of alternatives. Models and experimental designs are introduced that allow researchers to measure the influence that various attributes of urban tourism activities have on the probability that these activities will be undertaken.

The method that was applied in the studies that are reported in this thesis is based on an extension of traditional conjoint choice modeling techniques. It proposes models and experimental designs that allow one to incorporate urban tourists' choices between combinations of several activities.

In urban tourism planning and marketing, it is especially relevant to know urban tourists' preferences for different possible combinations of alternatives, because previous research has shown that urban tourists' typically like to combine several activities when visiting a city. Also, urban tourism behavior often takes place in highly complex urban environments that incorporate multiple tourism facilities and services. Therefore, if ex-ante evaluations of the impact of new urban tourism project developments are made, models that allow one to model between combinations of alternatives can significantly improve the precision of predicted changes in tourism demand.

The proposed approach was applied and tested on three important types of choices in urban tourism research: (i) participation choice, (ii) destination choice, and (iii) activity choice. The results of the empirical studies show that the proposed methodology effectively supports measuring and modeling the effects that are specifically related to choices between combinations of alternatives. They also show that the proposed models lead to significantly better predictions of urban tourists' choices than the traditional models for single choices. Therefore, it can be concluded that the proposed approach offers a way to more precisely evaluate the potential impact of urban tourism planning and marketing strategies on urban tourism demand.

