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Towards the measurement of regional inequities through patterns of ideally generated socio-economic indicators

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TOWARDS THE MEASUREMENT OF REGIONAL INEQUITIES THROUGH PATTERNS OF IDEALLY GENERATED SOCIO-ECONOMIC INDICATORS

BY

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ABSTRACT

Regional disparities are commonly described in terms of only one criterion when in fact they can be characterized by a number of social and economic variables. The objective of this study is to define regional data according to specific socio-economic indicators, and measure the disparities associated with them in comparison to those from ideally generated groupings. Socio-economic data from the Federal Republic of Germany was obtained from the West German Federal Institute for Regional Analysis and Planning. The variables will be grouped by factor analysis to create the indicators, and variation will be measured using analysis of variance. The ideal regional groupings are to be generated from both a grouping algorithm, and discriminant analysis techniques.

ACKNOWLEDGEMENTS

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I would also like to express my gratitude to Dr. Alfred Hecht for his constant guidance through this academic endeavour, as well as to committee members Dr. Barry Boots and Dr. Bruce Young. The significant contributions made to this thesis by Dr. John Radke, Jon Fujii and Linda Norman are also greatly appreciated.

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CHAPTER ONE

INTRODUCTION

Spatial polarizations in the general welfare of a nation occur naturally with the operation of a free-enterprise economy (Friedmann & Alonso, 1964). Yet in many developed nations, it is considered desirable that there should be an interregional balance within the country. However, achieving an interregional balance without jeopardizing sustained national growth presents a problem that has yet to be successfully overcome in practice (Clark, 1980; Hewings, 1978; Kluczka, 1980). Despite this, the national objective of reducing regional disparities has been common to many regional policies.

Regional disparities have been measured by a selection of various indicators (Pinder, 1983; Molle et al., 1980). In many developed countries, the concern in regional policies has been placed primarily on income and unemployment conditions and the measurement of these conditions used similar variables (Courbis, 1982; Blunden et al., 1973). Yet this practice may be too restrictive since regional well-being can be measured by a number of aspects, both social and economic. Frequently regional disparities are analyzed from the point of view of unemployment and the economy, although such disparities include demographic, social and cultural aspects, infrastructure, etc., and their importance is self-evident (Roura, 1982). The need for greater improvements in regional statistics in general has been suggested previously (McCrone, 1973). In this sense, the focus of regional planners may be biased towards a selected number of indices.

The comparison of existing variation in a region to some derived measure of potential variation can identify and describe regional inequities in a new manner. Such a comparison would allow the regional scientist the opportunity to evaluate a region's disparities based on its own potential for variation.

The objective of this thesis is to describe regional disparities by comparing existing variation in a region to some derived measure of maximum potential variation. In order to do this a set of socio-economic data, in this case of West Germany, is factor analyzed to identify interrelated variables (socio-economic indicators). For each set of interrelated variables the observations are grouped according to a grouping algorithm developed. These grouped observations can than be compared to the groups formed by the political groupings found in reality. The number of groups in the ideal groupings must naturally be identical to the number found in the empirical political data to make a meaningful comparison.

The set of observations will be grouped according to the principle that variation within groups is to be minimized. This means regions are grouped together according to their similarity in "poorness" or "richness" of a particular variable. The resulting groups of observations will have variation within groups minimized, and variation between groups maximized. One can label this a "worst solution" for it would maximize the regional disparity that could exist within a particular data set. This will be operating under the assumption that there are no spatial limitations associated with the placement of a specific region in any group.

Detailed socio-economic data for 328 areal units has been obtained from the West German Federal Institute for Regional Analysis and Planning (Bonn). This data refers to 1980 conditions at the municipal level in the Federal Republic of Germany, and was published in 1983. This thesis utilizes the 1980 socio-economic data from the Federal Republic of Germany, although regional data from other nations could have been used.

The variation inherent in the socio-economic indicators from the existing West German regional structure will first be measured using analysis of variance techniques. Using the respective set of generated ideal groupings, ideal measures of variation will then be calculated for the same socio-economic indicators. Such ideal measures will enable the researcher to compare and contrast levels of regional variation over space and time, by socio-economic indicator. Similarly, the variation that is present in the selected variables of each socio-economic indicator will also be tested using both the existing regional structure and the sets of ideal groupings which represent the maximum potential variation. This will permit an internal analysis of the selected variables from each socio-economic indicator.

The evaluation of the data's socio-economic indicators may occur in a number of ways. The first method will be to compare the amount of variance in the selected variables of each indicator from the existing regional structure, with the values derived from the set of ideally generated groupings for those same variables. Since the ideal groupings represent a "worst solution", any levels of variation that are present in the existing structure that approach the ideal level will therefore represent a problem situation. This will enable the researcher to make descriptive statements about the comparative levels of regional inequities involved with the various sets of socio-economic variables. Further, some level of understanding may be achieved as to the nature of regional problems, such as where a region may exhibit relatively high indications of disparities over specific sets of interrelated variables.

In the attempt to assess the effects of regional policies, a wide variety of approaches have been used ranging from questionnaire studies through single and multi-equation regression models to comprehensive cost-benefit analysis. Bartels (1982) claims that often, in attempting to overcome the limitations or drawbacks associated with these approaches, a different and technically more sophisticated approach is adopted, only to find a new set of problems specific to that approach.

The second level of comparison that can be achieved by comparing existing variation in a region to some ideal measure pertains to the measurement of the effects of regional policies over time. Such a comparison will allow a region to monitor the relative success of its policy decisions by testing collected data over a suitable time frame. For example, if a region develops specific policies to improve the status of a group of interrelated health variables, its success can be tested by comparing them to the ideally generated potential variation for that group over time. If the variation found for the health variables approaches those values, then the policies may have little or even detrimental effects, all other things being equal.

Finally, it is possible to map separately the ideally generated groupings and visually compare them to the existing spatial groupings. This will be done to identify the spatial characteristics inherent in the data that are not clearly evident without such an analysis.

In summary, the comparison of existing variation in a region to some derived measure of potential maximum variation can aid the researcher in the analysis and recognition of regional inequities in a given data set. In that it is not constrained by time or space, the methodology's versatility may establish it as a valuable tool for the regional scientist. The next chapter will briefly describe the present state of the West German regional well-being structure, followed by a more detailed description of the methodology to be employed on the data.

CHAPTER TWO

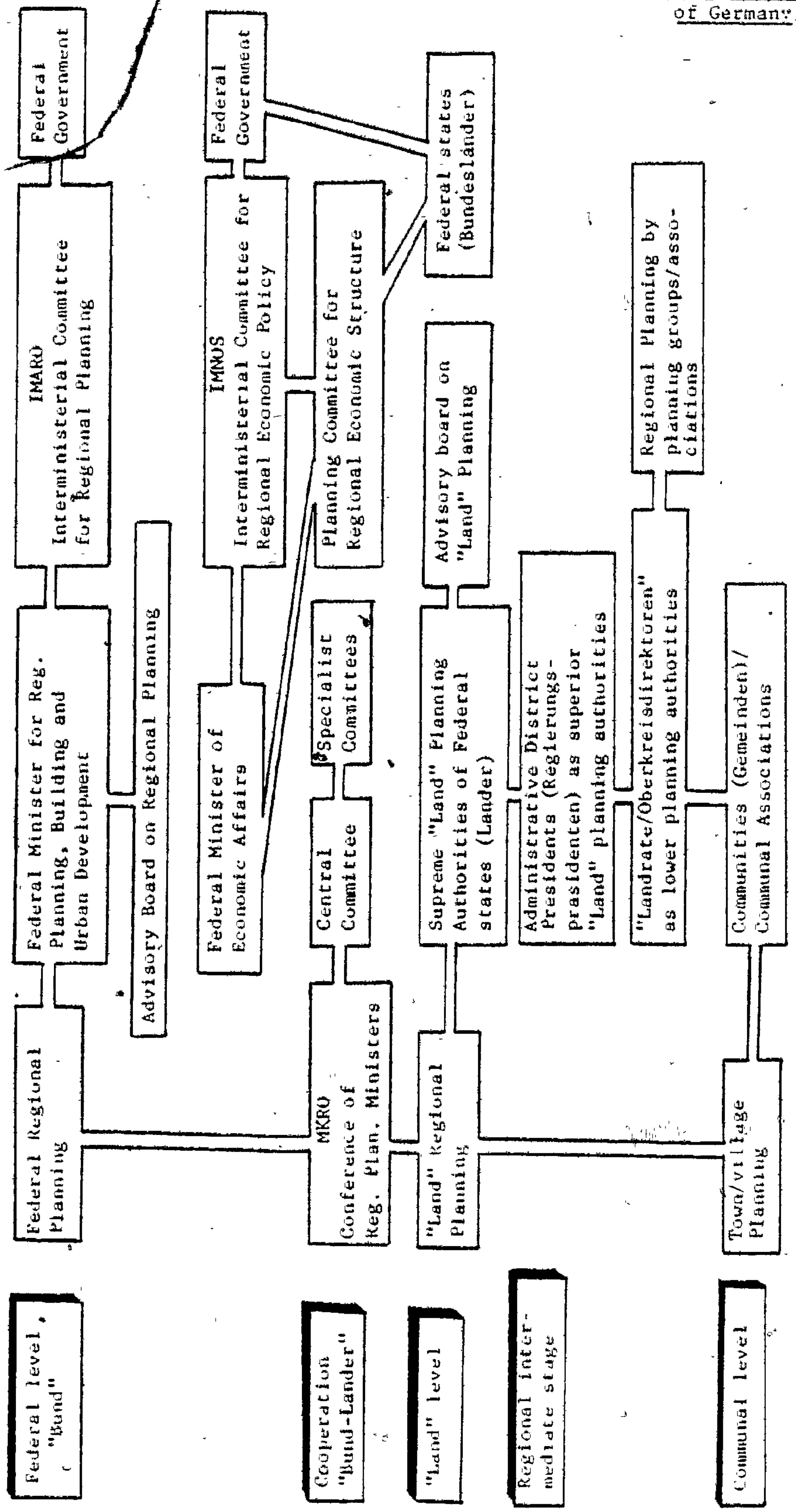
POST 1945 REGIONAL STRUCTURE OF WEST GERMANY

Since data has been obtained from the Federal Republic of Germany, a brief summary of the post World War II regional structure will be presented. This will provide an understanding of the unique spatial developments that can be associated with a country that has experienced serious political and economic re-organization.

In the Federal Republic of Germany, there are four levels of regional organization: the Federal level (IMARO), the joint Federal-Länder level (MKRO), the Länder level of regional planning and the Communal level which encompasses the town or village planning. However, the Federal Government has legislative competence when it is necessary to maintain the same level of living conditions beyond the boundaries of each Länder. As such, joint resolutions on regional planning and co-ordination of decisions affecting the spatial structure of the federal territory is maintained through the federal IMARO committee (Kluczka, 1980). The present organization of spatial development and regional planning is outlined in Figure 2-A.

In the modern history of Germany, their defeat, destruction and division at the end of the Second World War directly affected the East-German population as they had to leave their homelands. In 1945, one quarter of the German territory was annexed by Poland and the Soviet Union, the capital Berlin was divided and administered by the Allies, and the remainder of Germany was divided into four separate zones of occupation which led to the foundation of two German states in the West and in the East in 1949 (Scholler, 1980). Two major stages of development can be recognized in West Germany after the war which closely coincided with first the Christian-Democrat Government (CDU.-FDP.) and later with the Social-Liberal-Coalition (SPD.-FDP.). The first phase (1949-1969) initiated the fast recovery of the economy and an increased Western oriented foreign policy. At the same time, an increased social welfare program was necessary to provide for the integration of over ten million

Figure 1-A Organization of spatial development and regional planning in the Federal Republic of Germany.



Source: (Kluczka, 1980, p. 12)

refugees and migrants from East and Middle Germany into the West German Society. After 1969, the Brandt-Scheel government initiated the acceptance of the border between the two German states. Further democratization in industry, society and social services also occurred at this time in West Germany (Scholler, 1980).

Regional problems in West Germany were recognized and policy developments were made later than in most other western European countries. During the late 1940's and 1950's there was a distinct preoccupation with total economic recovery and revitalization policies in the wake of the Second World War. This changed in the 1960's as West Germany began to attain significant economic growth, such that by the end of the decade it ranked among the world's greatest economic powers (Casper, 1978).

In general, all of the West German Lander (the ten states of the West German Federation, excluding West Berlin) were able to benefit from this renewed economic growth, although certain regions benefitted more than others. The German regional well-being problem is perhaps best described as "sub-regional", one where isolated pockets of territory tend to lag behind in their level of economic development, and are scattered over the country as a whole (Casper, 1978). A further distinguishing feature is that the regional problem is not characterized in terms of a single criterion. Rather, problem areas have inherent structural inequities over a number of features such as rural depopulation or deficiencies in infrastructure. The methodology to be employed on the West German data will prove useful in the measurement of these regional inequities over various socio-economic criterion.

West German post-war regional development policy has been divided into three separate phases of initiatives by Ullrich Casper (1978). The first phase covered the initial decade at the end of the Second World War, while the second phase began in the late 1950's. The third and most recent phase covered the period from the late 1960's to the present.

In the first decade following the Second World War, the development policy was primarily designed to compensate for the disruption caused by the devastation of the war. Its main objectives were the reconstruction of areas with damaged industrial production capacities, agricultural production and the alleviation of high local unemployment levels (Casper, 1978). These unemployment levels were further irritated by the high volume of refugees and evacuees from other parts of the country and East Germany. Although this large inflow of refugees was a burden at first on the West, it also represented a significant "brain drain" of highly qualified workers and academics from the German Democratic Republic to the Federal Republic of Germany. The flow was so intense that by the end of the 1950's one-fifth of the workforce in the West was of East German origin (Abelshauser, 1982).

From 1951 on, economically deprived areas of two types were annually designated using different sophisticated unemployment indicators. The two types included areas of general economic depression, and regions of agricultural destruction. Also, a 40-50 kilometre wide belt of territory along the Baltic Sea, East German, and Czechoslovakian borders was delineated as the "Zonal Border Area", following the division of Germany in 1953. This Zonal Border Area was granted generous economic assistance in an effort to provide compensation for the disruption and loss of natural economic hinterland areas. (Casper, 1978)

The policy, initiated in this first period was largely administered by an Interministerial Committee for Regional Economic Policy (IMNOS: see Figure 2-A) and assistance was primarily in the form of loans paid from the Federal Regional Promotion Programme to industry and local government.

In the late 1950's, the second phase of a regional economic development policy in West Germany began. By this time, full employment had been reached and the manufacturing industry was experiencing labour shortages. In the rural areas unemployment and emigration occurred as a result of structural change in agriculture. For these reasons the prime objective of the regional development policy swung towards assisting those areas considered likely candidates for economic growth and the recipients of this rural out-migration. These areas were characterized by the possession of large labour markets; a minimum of sanitary, social and educational infrastructure; and an existing core of industry. During this second phase, these <u>Federal Growth Centres</u> (Bundesausbauorte) were granted better incentives than other assisted areas. By 1968, eighty-one of these areas had been designated in the Federal Republic of Germany. (Casper, 1978)

In 1963, the criteria for area delineation were forced to change in order to alleviate a new emerging regional problem. Areas, particularily in the Ruhr, were adversely affected by structural changes in the iron, steel and coal mining industries. As a result, the new indicators were changed to include gross regional product, industrial activity rates, unemployment rates and net emigration rates, in declining order of importance. (Casper, 1978.) Such changes further exemplify the need to develop a consistent system for the measurement of regional disparities.

As a result of the 1966-1967 recession, a shift in policy emphasis away from incentive instruments towards the promotion of infrastructure investment occurred. (Casper, 1978) Since industry was less likely to invest, the Federal government decided that incentives to promote the development of specific locations were no longer appropriate.

The third policy phase of development had its beginnings in the late 1960's. In this phase, the primary direction remains the attempt to achieve a greater cooperation and coordination of regional policy efforts pursued independently by both the Federal government and each of the Länder. According to Casper (1978), there was no systematic overlap in the areas assisted by the Federal and Länder governments, nor was there any harmonization of the types and amount of assistance given to those areas by the two levels of government. Finally, an increasing recognition of the existence of unequal living conditions across West Germany was essential to ensure a greater coordination between the Federal government and Länder.

Prior to 1969, the individual Länder operated their own regional policies to assist problem areas, while at the same time the Federal government also aimed policies at what it considered problem areas in West Germany. The result was a definite lack of regional promotion in any nationally meaningful sense, since areas could be assisted by the individual Länder, the Federal government or by both. (Casper, 1978). Furthermore, increasing expenditures by the Federal government caused the Länder to feel as if their powers were being constrained. In contrast, the Federal government was becoming increasingly frustrated by Länder policies which contradicted the national federal policies. Indeed, constitutional lawyers managed to argue that Federal interventions in state administration and spending were not illegal since they took place in policy areas where the national interest required Federal action. (Reissert, 1978) Therefore, the 1969 Act Concerning the Programme for the Improvement of Regional Economic Structures emerged providing the institutional basis for a more coordinated regional policy effort between the levels of government. This Act was passed with considerable difficulty, and a change of constitution was first required to allow for a joint Federal/Länder initiative, in the place of the Länder's original constitutionally reserved policy areas. The Act provided for the establishment of a planning committee consisting of both Federal and Länder representatives. The concerns of the committee, other than finance, long-term planning and objective formulation; were the delineation of assisted areas and the harmonization of Federal/Länder incentives. (Casper, 1978) After lengthy political discussion, the assisted areas that were finally designated under this program were termed the GA areas.

According to Bernd Reissert (1978), the problem-solving capacity of joint Federal/Länder initiatives has fallen well short of expectations. Although the advantages of joint tasks have been largely limited to the harmonization of problem perceptions among Federal and Länder specialists and a stabilization of expenditure levels in those policy areas; more complicated problem-solving actions have met with considerable difficulty within the joint task policy mandate (Reissert, 1978).

In West Germany, regional policy is not limited to financial incentives. In fact, the non-incentive regional policies that are pursued have their main thrust directed at infrastructure policy. The GA Programme provides a framework for joint Federal/Länder infrastructure policy, as well as incentive assistance. The major kinds of infrastructure that qualify for assistance under this program include the preparation of industrial sites, the improvement of communication networks, the production and supply of energy and water, sewage and drainage, and infrastructure to promote tourism (Casper, 1978).

Although there are many minor incentive schemes in the

Federal Republic of Germany, the four major regional incentives offered in the late 1970's consisted of:

1. The Investment Allowance: the cornerstone of the German regional incentive system and a fairly automatic project-related capital grant on a fixed 7.5 percent of eligible investment.

2. The Investment Grant: a discretionary project-related capital grant with rates of up to 25 percent of eligible investment depending on a matrix of location and project-type criteria.

3. The ERP Regional Soft Loan: a project-related and largely automatic loan which can be awarded to small or medium-sized firms for projects that are not eligible for an investment allowance or an investment grant. Loan duration is up to fifteen years for buildings and up to ten years for plant, depending upon the life-time of the particular asset. A payment holiday of between 18 and 24 months, depending on the starting date of the loan, is available but no interest-free period can be obtained. In the Zonal Border Area interest rates are lower than elsewhere. The loan covers up to two-thirds of eligible investment with the actual proportion covered being determined by a set formula based on project size.

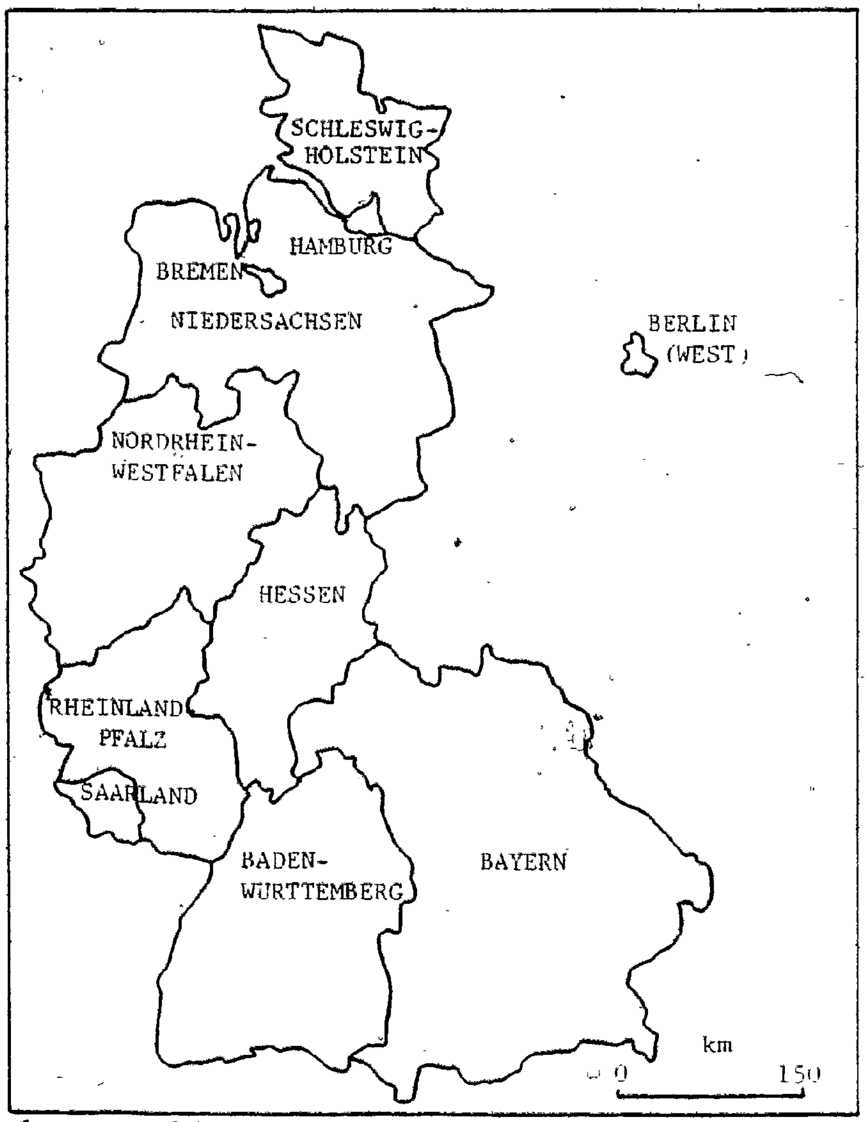
4. The Special Depreciation Allowance: available only in the Zonal Border Area, it is an item-related concession involving a high initial depreciation allowance of up to 50 percent of eligible costs for plant and machinery and up to 30 percent for buildings. Although, in principle, the decision whether or not to award and what rate to

> award is discretionary. in practice little discretion is exercised. The allowance can be used only on condition that it does not give rise to corporate losses or exacerbate existing losses. (Casper, 1978, p.12)

The improvement of regional disparities could theoretically be achieved by restructuring the geographical boundaries of each Länder. However, although there have been several regional referenda concerning regional boundary changes in the Länder system, no federal government has seriously pursued a political and geographical reorganization. In both 1955 and 1972, committees of experts appointed by the central government submitted proposals for reorganization. but the consistency of the status quo proved stronger in both cases (Schöller, 1980). The aim to create states of optimal efficiency and balanced size is demonstrated in Figures 2-B and 2-C, where the 1972 revised Bundesländer demonstrates a political solution for North Germany and the Middle West. This effort to compensate for large disparities in the size and capacities of the German states was abandoned in 1974.

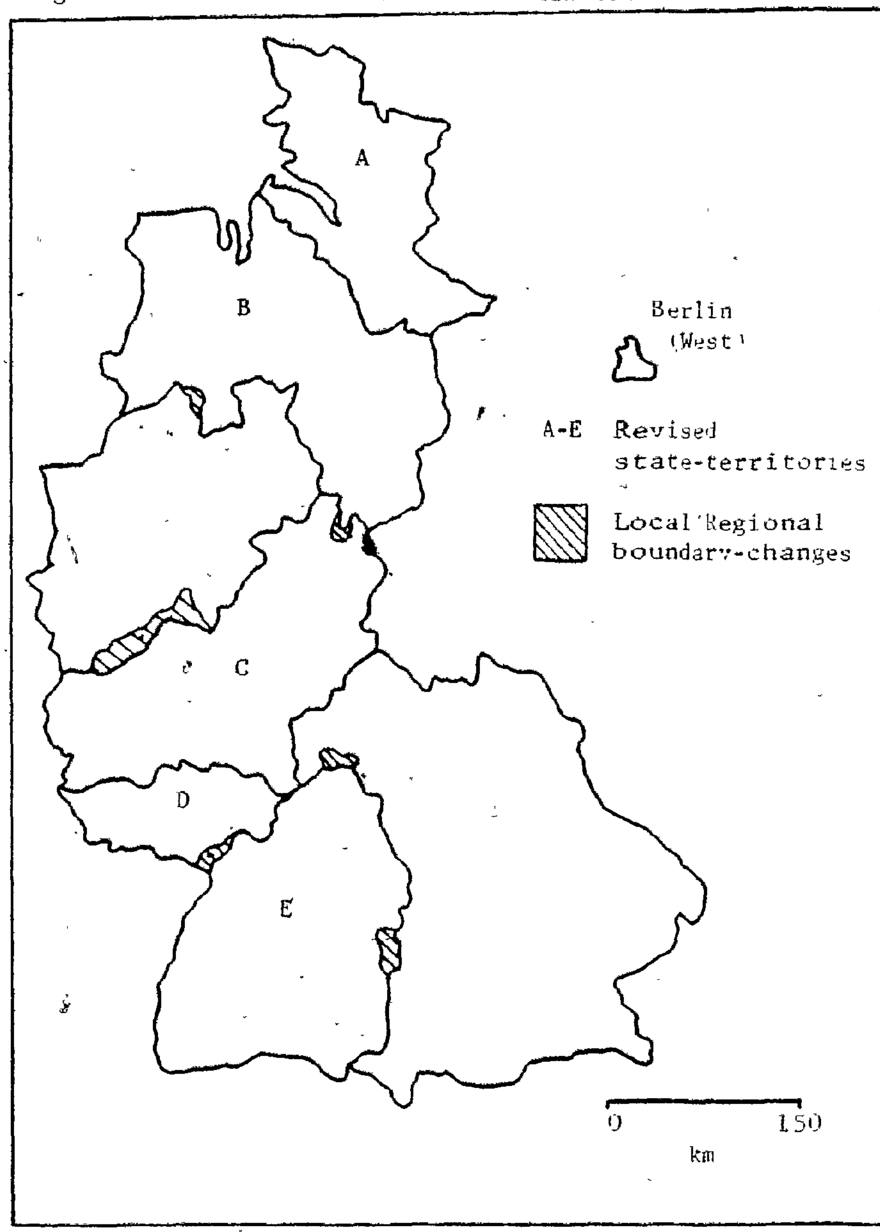
The state of West Berlin's poorly defined political status has remained an important issue throughout the last

Figure 2-B Existing Bundesländer



Source: (Schöller, 1980, p. 8)

Figure 2-C Revised Bundeslander (Plan 1972)



Source: (Schöller, 1980, p. 8)

decade (Schöller, 1980). It has not acquired the legal status of a Bundesland, and heavy economic disadvantages have resulted from its geographical isolation and loss of the capital function. West Berlin is not part of the Federal Republic, nor is it governed by it. Until the East accepts the reality of the Berlin case, the responsibility of Berlin will remain with the four occupying powers (Schöller, 1980).

In 1965, the Federal Law on Regional Planning (ROG) was established by the Federal Government in agreement with the Länder. It attempted to regulate all important aspects of spatial development in the Federal Republic of Germany, including legislative and organizational competence, the material objectives and substance of regional planning. The essential component of the ROG was that;

> all parts of the Federal Republic have to be developed so that their spatial structure is as conducive as possible to the free unfolding of the individual personality in society. (Kluczka, 1980, p. 13)

The aim stated here of equalizing the living conditions was to be attained with specific consideration for the environment and spatial structure of the Federal Republic of

Germany (Kluczka, 1980). According to D. Bartels (1982), this attempt at large scale regional planning failed somewhat at both the federal and state level for many reasons. The weakness of the young departments versus the previously established, well-financed sectoral planning authorities presented significant set-backs. Also, the individual states would generally not go along with the Federal programs if they could better enhance their general welfare with the instruments at their own disposal.

In 1975, the federal government first presented the regional well-being status of the different areas of the country in the Federal Regional Planning Programme (BROP) paper. It was the first attempt to classify the entire federal territory according to available infrastructure and employment structure. This information was provided to the states to aid them in reducing deficiencies within their regions (Kluczka, 1980). Bartels (1982) identified problems that occurred in many areas of the BROP such as the creation of an interregional "quality of life", although no definition of this term or how to operationalize it was found in the BROP. Furthermore, there was a conflict in the definition of higher population densities for priority functions, and the BROP relied on 38 areal units that were not consistent with the set of 69 state planning regions embodied by law.

In conclusion, the existing national regional planning and policies in West Germany has not been a comparatively strong theme in federal politics. It has possessed relatively limited influence, particularly in relation to its objectives, which are very broad but still quite vaguely defined (Bartels, 1982).[3] In the next chapter, a detailed description of the methodology used to determine the ideal variation in the West German socio-economic data and how it will be compared to the actual variation will be presented.

CHAPTER THREE

METHODOLOGY

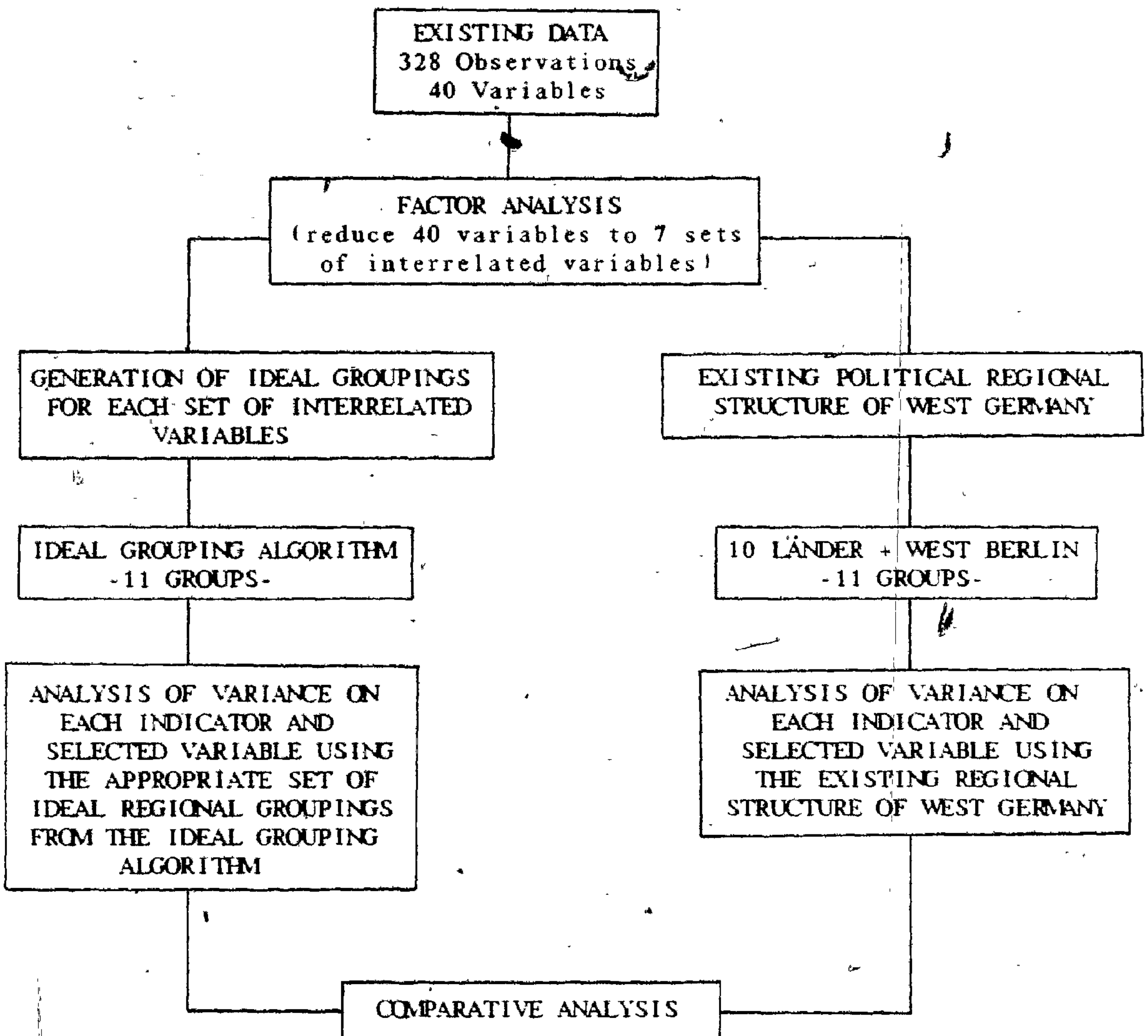
3.1 GROUPING OF VARIABLES

It is possible to categorize and group West German municipalities using the detailed socio-economic data provided by the Federal Institute for Regional Analysis and Planning (Bonn). Through the use of an ideal grouping procedure, it will become possible to make descriptive statements about the actual levels of disparities found in a region compared to its potential for variation. This will be done over sets of interrelated socio-economic variables. As a result, it may be appropriate to pin-point general welfare trouble spots according to a country's specific socio-economic structure. The outline for the procedure followed in this research is found in table 3.1.

The first step was to determine sets of interrelated

TABLE 3.1

FLOW CHART OF ANALYSIS

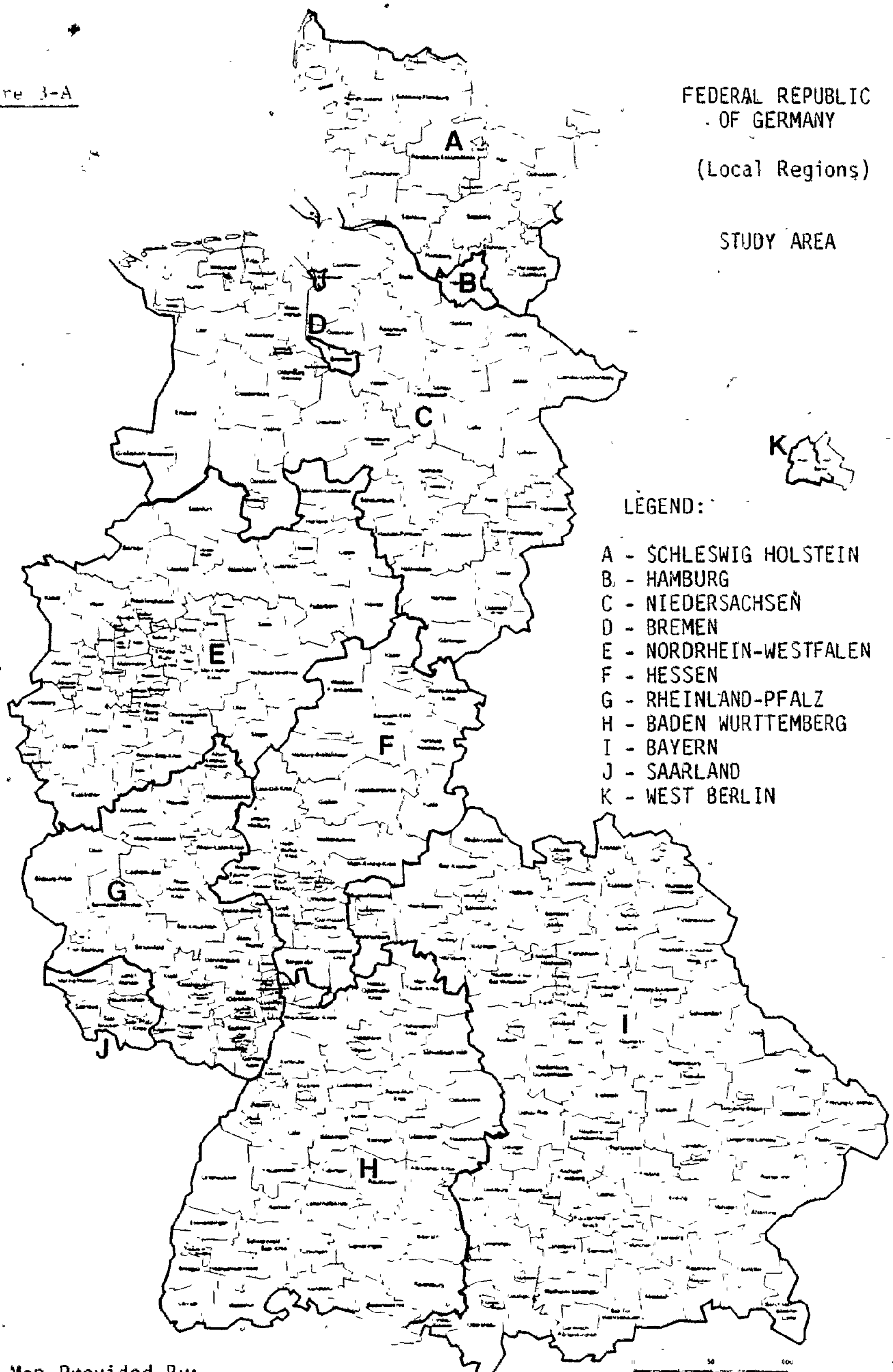


variables from the original raw data. Such groups of interrelated variables should display fundamental or underlying regional disparities in the data set. For example, they may describe regional disparities in terms of groups of variables which relate to either housing, health, employment, or some other socio-economic criterion.

Figure 3-A displays the 328 lower level government municipalities and city-states in the Federal Republic of Germany. (A list of the municipalities and city-states is presented in Appendix "A"). The variables used in this study are listed in table 3.2, and their definitions can be found in table 3.3. (For a detailed description, see Appendix "B")

To determine these underlying ties between the individual variables, a factor analysis was performed on the data. A factor analysis was chosen to determine the groupings of variables since it possesses the capacity to reduce a complex data bank to a smaller number of independent factors. Grouping research has been especially attractive in such areas as education, urbanism, economics, geography, regional development, and intergroup conflict

Figure 3-A



Base Map Provided By:
Bundesforschungsanstalt fur
Landeskunde und Raumordnung

TABLE 3.2

Variable List

x2	DENSITY
x3	NATURAL INCREASE RATE
x4	NET MIGRATION RATE
x5	DEPENDENCY RATIO
x6	FOREIGN RATIO
x7	PERCENT POPULATION 15-65
x8	EMPLOYMENT RATIO
x9	INDUSTRIAL WORKERS
x10	OPPORTUNITY RATIO
x11	PERCENT EMPLOYED IN GROWTH SECTOR
x12	PERCENT SKILLED WORKERS
x13	AVERAGE WAGES AND SALARIES IN INDUSTRY
x14	TOTAL UNEMPLOYMENT RATE
x15	LONG-TERM UNEMPLOYMENT RATE
x16	NET MIGRATION OF WORKERS
x17	NET MIGRATION RATE 25-30
x18	GROSS DOMESTIC PRODUCT PER CAPITA
x19	INCOME TAX PER CAPITA
x20	VALUE ADDED TAX -NET-
x21	"KEY" CONTRIBUTION PER CAPITA
x22	INVESTMENT ALLOCATION RATE
x23	PERCENT WITH HIGHER EDUCATION
x24	PERCENT WITH UNIVERSITY EDUCATION
x25	APPRENTICESHIP OPPORTUNITY RATE
x26	YOUTH UNEMPLOYMENT
x27	NET MIGRATION RATE 18-25
x28	PERCENT NEW HOUSING
x29	PERCENT BUILDINGS WITH 1-2 APARTMENTS
x30	PERCENT BUILDINGS WITH MORE THAN 2 APARTMENTS
x31	PURCHASE PRICE PER SQUARE METRE (LAND)
x32	NET MIGRATION RATE -FAMILIES-
x33	# RESIDENTS PER DOCTOR
x34	# RESIDENTS PER MEDICAL SPECIALIST
x35	# HOSPITAL BEDS PER RESIDENT
x36	# HOSPITAL BEDS PER DOCTOR
x37	RESIDENTIAL DENSITY
x38	BUILT-UP AREA RATIO
x39	UNBUILT-UP AREA PER RESIDENT
x40	ENVIRONMENTAL CONDITIONS
x41	NET MIGRATION OVER 50 RATE

TABLE 3.3

Variable List

Variable	Definition
x2	Population per square km
x3	$\frac{\text{Births - Deaths}}{\text{Population}} \times 1000$
x4	$\frac{\text{Total Immigration - Total Emigration}}{\text{Total Population}} \times 1000$
x5	$\frac{\text{Population Under 15 + Population Over 65}}{\text{Population Between 15 and 65}} \times 100$
x6	$\frac{\text{Foreign Population}}{\text{Total Population}} \times 100$
x7	$\frac{\text{Population Between 15 and 65}}{\text{Total Population}} \times 100$
x8	$\frac{\text{Employees}}{\text{Population Between 15 and 65}} \times 1000$
x9	$\frac{\text{Industrial Sector Workers}}{\text{Population Between 15 and 65}} \times 1000$
x10	$\frac{\text{Number of Open Job Places}}{\text{Number of Unemployed}} \times 1000$
x11	$\frac{\text{Numbers Employed in Growth Sector}}{\text{Number of Employees Between 15 and 65}} \times 1000$
x12	$\frac{\text{Numbers Employed With Completed Training Program}}{\text{Total Employed}} \times 100$
x13	$\frac{\text{Wages and Salaries (DM)}}{\text{Number of People Working in Industry}}$
x14	$\frac{\text{Number of Unemployed}}{\text{Number of Employers}} \times 100$

x15 Number of Unemployed for at Least a Year x 1000
Number of Employers

x16 Immigration - Emigration of Workers x 1000
Population Between 15 and 65

x17 Immigration - Emigration (25 - 30) x 1000
Population Between 25 and 30

x18 Gross National Domestic Product per Resident (DM)

x19 Personal Income Tax per Resident

x20 Value Added Tax from Business - (Net)

x21 "Key" Contribution in DM's per Resident

x22 Investment Allocation in DM's per Resident

x23 Students in the 7th Grade of Middle, Gesamt & High Schools x 1000
Total Number of Students in the 7th Grade

x24 Students in the First Year of University x 1000
Population Between 20 and 25

x25 Number of Apprenticeship Places x 100
Number of Students Leaving School Without Completing High-school

x26 Unemployment Rate (Under 25) x 1000
Population Between 15 and 25

x27 Immigration - Emigration (18 - 25) x 1000
Population Between 18 and 25

x28 Number of New Housing Units x 1000
Total Number of Housing Units

x29 Number of New Buildings With 1 and 2 Apartments x 100
Total Number of New Buildings

x30 Number of New Buildings With 3 or More Apartments x 100
Total Number of New Buildings

x31 Land Purchasing Price (DM)
Total Area Sold in Square Metres

x32 $\frac{\text{Immigration - Emigration (30-50) (Under 18)}}{\text{Population Between 30 and 50; and Under 18}} \times 1000$

x33 $\frac{\text{Number of Residents}}{\text{Number of Free-Practicing Doctors}}$

x34 $\frac{\text{Number of Residents}}{\text{Number of Medical Specialists}}$

x35 $\frac{\text{Number of Hospital Beds}}{\text{Number of Residents}} \times 1000$

x36 $\frac{\text{Number of Hospital Beds}}{\text{Number of Doctors in Hospitals}}$

x37 $\frac{\text{Population}}{\text{Residential Area in Square KMs}}$

x38 $\frac{\text{Built Up Area (Hectares)}}{\text{Un-Built Up Area (Hectares)}}$

x39 $\frac{\text{Un-Built Up Area (Square Metres)}}{\text{Population}}$

x40 $\frac{\text{Natural Area Close By (Square Metres)}}{\text{Population}}$

x41 $\frac{\text{Immigration - Emigration (Over 50)}}{\text{Population Over 50}} \times 1000$

behaviour, which tend to have large amounts of readily accessible data (C.S.R.D., 1974).

The most commonly used factor analysis in such research has been the varimax, orthogonal rotation procedure. This option extracts independent factors, each of which has a few strongly related variables associated with them. These groups of interrelated variables provide good information on the composition of each socio-economic factor to be used in the further analysis. An orthogonal rotation specifies a zero correlation between the factors. In this way, the factors are independent of each other, allowing for easier analysis of results. For example, it allows for a clear distinction between housing, employment and other factors.

In this thesis, factor analysis was used to first derive underlying components of interrelated variables. These variables that identified most with these components were used to analyze regional variation in West Germany. The selection of the variables was based on the magnitude of loadings of the variables on the independent factors. A loading value of +/- 0.7 was used, which means the factor captured at least forty-nine percent of the variation of the original variable. This cut-off is somewhat arbitrary, but since the variable is to be a surrogate of the underlying factor, it was felt that a high correlation (loading) value was needed. It should be pointed out that changing the cut-off value would result in different ideal groups of municipalities.

Table 3.4 exhibits the seven sets of interrelated variables that emerged from the factor analysis with the varimax, orthogonal rotation. As stated above, only those variables that possessed factor loadings greater than +/- 0.7 were accepted as surrogate variables for the factor. These seven groups of interrelated variables represent separate socio-economic dimensions. Each is given a name corresponding to the variables that are characteristic of the dimension.

The first factor that emerged from the factor analysis was termed the "Population Structure Indicator". This factor had an eigen value of 15.45. Eigen values associated with each factor represent the amount of total variance accounted for by that factor. Relative importance of a factor therefore may be evaluated in terms of the proportion

TABLE 3.4

RESULTS FROM FACTOR ANALYSIS PROCEDURE
(Factor Loadings From Varimax Rotation)

Factor #1

-(.833) Dependency Ratio (X5)
(.829) % Population 15-65 (X7)

"POPULATION STRUCTURE" INDICATOR

Factor #2

(.810) Employment Ratio (X8)
(.798) % Employed In Growth Sector (X11)
(.795) Industrial Workers (X9)
(.759) Value Added Tax -Net- (X20)
(.755) G.D.P. per Capita (X18)

"GENERAL ECONOMIC" INDICATOR

Factor #3

-(.851) % Housing GT. 2 Apts. (X30)
(.851) % Housing LE. 2 Apts. (X29)
(.722) Density (X2)

"URBAN/HOUSING" INDICATOR

Factor #4

-(.935) Youth Unemployment Rate (X26)
-(.828) Total Unemployment Rate (X14)
(.808) Opportunity Ratio (X10)
-(.779) Long-Term Unemployment Rate (X15)

"UNEMPLOYMENT" INDICATOR

Factor #5

(.833) Net Migration of Workers (X16)
(.830) Net Migration Rate 25-30 (X17)
(.775) Net Migration of Families (x32)

"GENERAL MIGRATION" INDICATOR

Factor #6

-(.774) # Residents per Medical Specialist (X34)
-(.706) # Residents per Doctor (X33)

"HEALTH" INDICATOR

Factor #7

(.767) Net Migration Rate 18-25 (X27)

"YOUTH MIGRATION" INDICATOR

of total variance that it accounts for. The percent of variance captured by this factor was 38.6. Two selected variables had factor loadings greater than +/- 0.7 as exhibited in table 3.4. The two variables were X5 "Dependency Ratio" and X7 "% Population 15-65".

A "General Economic Indicator" was the second factor with an eigen value of 5.13. This factor captured 12.8 percent of variance and five variables had factor loadings greater than +/- 0.7. This indicator was characterized by X8 "Employment Ratio", X9 "Industrial Workers", X11 "% Employed in Growth Sector", X18 "G.D.P. per capita", and X20 "Value Added Tax -Net-".

The third factor was an "Urban/Housing Indicator" with an eigen value of 2.96. The percent of variance captured by this factor was 7.4 percent. The three significant selected variables included X2 "Density", X29 "% Housing With 1 or 2 Apartments", and X30 "% Housing With Greater Than 2 Apartments".

The fourth factor that emerged from the factor analysis was termed an "Unemployment Indicator". It possessed an eigen value of 2.39, and captured 6.0 percent of variance.

This indicator selected X10 "Opportunity Ratio", X14 "Total Unemployment Rate", X15 "Long-Term Unemployment Rate", and X26 "Youth Unemployment Rate".

A "General Migration Indicator" was the fifth factor that arose from the factor analysis. It had an eigen value of 1.76 and captured 4.4 percent of the variance. This indicator consisted of three selected variables including X16 "Net Migration of Workers", X17 "Net Migration Rate 25-30", and X32 "Net Migration of Families".

The "Health Indicator" was derived from the sixth factor. The factor had an eigen value of 1.65 and captured 4.1 percent of the variance. Two variables were selected that had factor loading scores greater than +/- 0.7. These included X33 "# Residents per Doctor" and X34 "# of Residents per Medical Specialist".

The seventh factor produced what will be termed a "Youth Migration Indicator". It had an eigen value of 1.40 and captured 3.5 percent of variance. Only one variable displayed a factor loading over the predetermined cut-off value from this factor. This selected variable was X27 "Net Migration Rate 18-25".

3.2 IDEAL GROUPINGS OF MUNICIPALITIES

Once the seven sets of interrelated variables had been derived from the original 40 variables, they were used to determine the ideal maximum variation in the 328 municipalities in the Federal Republic of Germany. But before discussing the formation of groups with minimum internal variation, it is necessary to recognize the continuum of approaches that exist in regional model construction. They range from "soft models" such as cluster analysis which require little or no prior information, to a variety of techniques such as discriminant analysis which requires an increasing use of prior information (Hampton & Rayner, 1977).

According to Hampton & Rayner (1977), four traditional multivariate methods of analysis have proved particularly useful in the study of regional economics. These include multiple regression analysis, factor analysis, discriminant analysis and canonical correlation. Of these, two were considered for use in this study. An initial attempt to form the ideal groupings was based on the application of discriminant analysis. It classifies each observation in a group based on the combination of group means for the predictor variables from each set of interrelated variables. In this way, each observation is classified according to the original group that it best resembled. A separate discriminant analysis was performed on each socio-economic indicator using the variables from table 3.4. This output of grouped municipalities was then compared to the groups of municipalities found in the existing political regions of the Federal Republic of Germany.

Discriminant analysis however possesses shortcomings which rendered it less than an optimal tool for the purpose of this study. One is that the ideal groups that are derived are based on the original existing group means. For Germany, this meant that the municipality means of the Länder were used. Therefore the observations in each "new" group resembled the existing Länder structure. In other words, group membership was biased by the existing regional structure.

The stating of probabilities associated with group membership used in discriminant analysis also presented a problem. Initially the assignment of observations to groups were given proportionate probabilities according to the number of observations in the original Länder. Bayern has 96 municipalities in the Federal Republic of Germany, and the results from the discriminant analysis showed group memberships in this Länder in largely disproportionate amounts. Secondly, each Länder was given equal probabilities of group membership. However, this biased the results in favour of the smaller Länder.

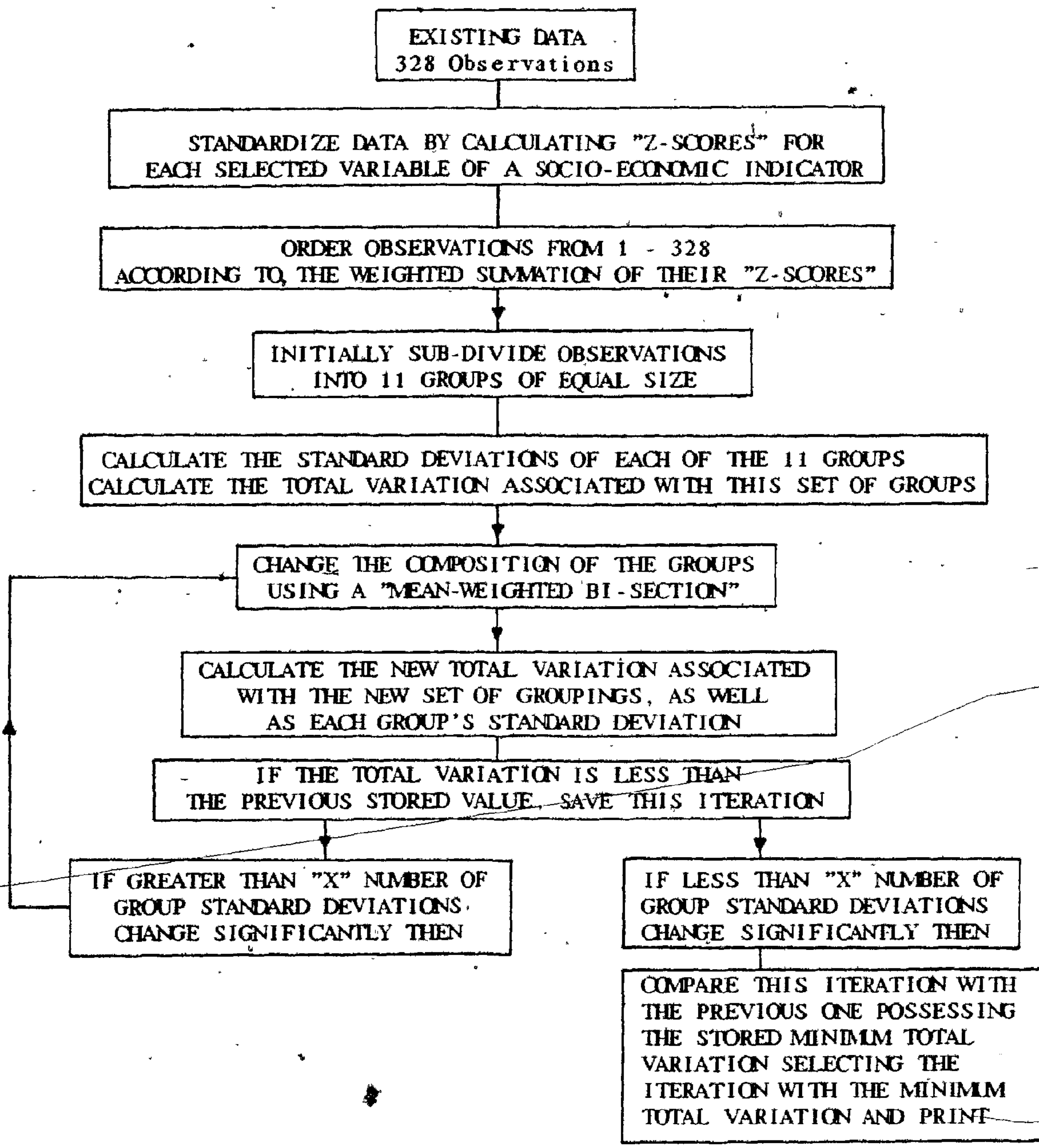
Unless arbitrarily forced on the data, discriminant analysis does not necessarily generate an output that consists of the same number of groupings for each indicator. Although there were eleven starting groups in the existing regional structure, it was possible to obtain results that had less than eleven groups, especially in cases where no individual observations resembled an original group mean. (Results of the discriminant analysis technique as applied to the German data can be seen in Appendix "C")

As noted above, limitations inherent in discriminant analysis encouraged the formation of a simple but effective grouping procedure. This new procedure was primarily designed to compensate for the areas in which the discriminant analysis method was weak. The format for the new grouping procedure is outlined in table 3.5, and the detailed computer program can be found in Appendix "D". The basic aim of this grouping procedure was to ensure that municipalities were grouped so that their internal variation was minimized. For example, all "poor" municipalities were put in one category and all "rich" in another. In all, eleven groups corresponding to the eleven political groups in the Federal Republic of Germany were created.

The first step in the ideal grouping procedure was to rank the 328 individual areal units in magnitude according to their scores on the variables from a particular socio-economic indicator. The computer program sorted the observations in this manner in order to run more efficiently. This was done by initially standardizing the observations for each selected variable of the indicator using the "z-score" variable transformation. For example, each observation for the selected "X5" and "X7" variables from table 3.4 were standardized for the "Population Structure Indicator".

TABLE 3.5

FLOW CHART OF COMPUTER PROGRAM



$$Z(i) = \frac{X(i) - \overline{X}}{SD}$$

Note: Z(i) = "ith" Z-score

X(i) = "ith" observation

$\overline{X}$ = Mean of variable "X"

SD = Standard Deviation ("X")

The "z-score" variable transformation is the most common method for standardizing the scale of a variable of interval-level measurement. This procedure generates a new variable with a mean of 0.0 and a standard deviation of 1.0. Each observation is characterized by a value equivalent to the number of standard deviation units that it is above or below the mean (Nie et. al.; 1975). The "z-scores" allow the investigator to accurately compare data that was initially measured in different units.

Before the summation of the individual "z-scores" from the component variables were calculated, it was necessary to weight the individual observations. The observations were weighted according to the relative importance that each selected variable possessed in the composition of an individual socio-economic indicator. In multiplying the initial standardized observation by the variable's squared loading, the values were weighted according to their degree of representation of the original factor.

After the summation of weighted "z-scores" for the variables belonging to a particular component had been calculated, the observations were then ordered from highest to lowest and initially sub-divided into eleven groups of equal size. (9 groups of 30; 2 groups of 29). This was used only as a starting point for the procedure. The standard deviations of each group, as well as the total variation was then calculated and stored. In order to reduce the total variation within the eleven groups, they were then partitioned using a "mean-weighted bi-section". This method searched for clusters within the data over a finite number of groups and represented a simplistic approach to the grouping of the data. The observations of Group One and Group Two were added together and were divided by the total number of observations in the two groups. This calculated the combined mean for those groups, and the new partition between Group One and Two was placed there. This procedure continued through Group "n" and Group "n + 1", until the ten new dividing points were determined for the eleven groups. The eleven groups were no longer constrained in terms of group size, as the program searched for the optimal breaks in the data. The program then calculated the new standard deviations of each group, and compared them with those that were stored in the previous step. The total variation associated with this iteration was also calculated. If this value was less than the previous minimum stored variation, the new value was stored and the output of the iteration was saved.

In determining the termination of iterations, a dual combination approach was used to optimize the groupings within the data. First, if a predetermined number of group's standard deviations changed significantly from those that were previously stored, the algorithm would repeat the process and re-partition the groups again. In this thesis, the range of acceptance was arbitrarily set at +/- one-sixteenth of the previous standard deviation. Any new values that were higher or lower than this acceptable range were registered as significant changes. If five or more group's standard deviations changed significantly over the previous iteration the program would continue. Secondly, the program also calculated the total variation associated with each iteration. This re-partitioning continued until less than the predetermined number of groups had significant changes in their standard deviations. When this occurred, the program printed the output corresponding to the ideal grouping of observations that had the reduced total variation within all groups, as well as the output from the iteration possessing the minimum total variation. The purpose of providing two separate outputs was to ensure that a sub-optimal case was not accepted. By incorporating the dual combination approach, the case possessing the lower level of total variation among all iterations was always accepted as the optimal solution. The grouping procedure was used with each of the twenty variables resulting in seven distinct sets of ideal groups of municipalities. At this stage, the groups had no requirement of being spatially contiguous. (For a simplified example using the computer program, see Appendix "E")

3.3 THE ACTUAL REGION

The existing political structure of West Germany represents the actual region in this study and the boundaries are consistent with those of the ten Länder and their collective municipalities: plus the addition of West Berlin. This political structure forms the basis for the comparison of the characteristics of the ideal sets of regional groupings generated in the previous section. The boundaries of the political Länder and a more detailed view of the municipalities in West Germany can be found in Figure 3-A.

3.4 MEASUREMENT AND COMPARISON OF ACTUAL REGION TO IDEAL REGIONAL GROUPINGS

In order to explore the amount of variation present in the data for each of the socio-economic indicators, analysis of variance (Anova) was used. Anova was applied to regional problems by Weeden (1974), and has since been used by a host of regional scientists including Buck & Atkins (1983), and Hecht (1983).

Anova was used to measure the levels of disparities that exist for each indicator in the existing political regional structure and the ideal regional groupings. Through the application of the analysis of variance technique, it was possible to compare the variance within Länder and between Länder groupings for each of the seven derived socio-economic indicators. The ratio of mean squares (F test) can be used to test an hypothesis concerning the parameters of the Anova model, and conditions of normally distributed sub-populations and equal variances must be assumed (Afifi & Azen, 1979).

In testing the indicators by Anova from the actual political structure of West Germany, the groupings (Länder) remained consistent for each indicator. A set of F-ratios was calculated which represented the existing variation present in the data within and between Lander for each indicator. The summation of z-scores for the component variables of each indicator was used to characterize each municipality in the testing of variation within and between groups. These variables were previously used by the grouping algorithm in order to account for the effects of each variable in the generation of the ideal groupings. When testing the indicators by Anova from the ideal groupings, each indicator was tested using the set of ideal groupings that were generated by the grouping algorithm.

After the external comparison of the socio-economic indicators was completed, it was then possible to analyze each of the indicators from an internal viewpoint. Here, analysis of variance (Anova) was again used to test the amount of variation present in each of the selected variables that characterize each indicator. The groupings remained the same for each variable when testing the variation present in the actual region and represented the existing political structuring of the Länder in the Federal Republic of Germany. A set of F-ratios was calculated representing the existing variation within and between Länder for each variable. However, when testing the variables by anova from the ideal groupings, each variable was examined using the hypothetical set of ideal groupings with which that variable helped to generate. For example, a "youth unemployment" variable was measured using the ideal groupings that was derived from the set of unemployment variables characterizing the Unemployment Indicator.

In this chapter a detailed description of the methodology has been presented. In the next chapter, the analysis of variance results are examined for the existing regional structure and the ideal groups for each set of interrelated socio-economic variables. This is first performed at an external level, followed by a more detailed internal analysis of the selected variables. Finally, the distribution of ideal groups for each socio-economic indicator will be mapped in an effort to discover any recognizable patterns between the existing regional structure and the ideal groups.

CHAPTER FOUR

COMPARISON OF IDEAL AND ACTUAL GROUPS OF MUNICIPALITIES

The results from the analysis of variance (F-ratios) are found in Table 4.1 for both the existing regional structure of the Federal Republic of Germany and each ideal grouping corresponding to the seven socio-economic indicators. These values were generated by comparing the variance associated with the summation of z-scores on the selected variables of each indicator. These z-scores were also used as the values that characterized each municipality in the generation of the ideal groupings.

The values associated with each indicator as a whole were essential for the comparative analysis of the indicators. It allowed the investigator the luxury of comparing the relative levels of variation between indicators on a similar scale. However, for any internal investigation of the indicators, it is necessary to analyze the F-ratios associated with the selected variables of each indicator which are exhibited in table 4.2.

From table 4.1, it is evident that the set of Unemployment variables exhibit the highest F-ratio (30.427) from the existing regional structure of the Federal Republic of Germany, followed by the Urban/Housing variables (7.308) and the Population Structure variables (6.441). Higher F-ratios represent stronger regional concentrations of similar values, or greater levels of regional inequity over a particular socio-economic indicator. The second column in table 4.1 depicts the F-ratios associated with the ideal groupings for each indicator. These values are much higher than those in column one, and represent a "worst solution". (i.e. a grouping of all the "poor" regions into one group and all the "good" regions in another group) In this sense, they represent the maximum amount of regional inequity that could occur in reality with the empirical set of data for each socio-economic indicator. Here, the Urban/Housing variables (1879.462) exhibit the highest ideal F-ratio, followed by the Unemployment variables (1352.868), the Population Structure variables (1204.907) and the Youth

TABLE 4.1

RESULTS FROM ANALYSIS OF VARIANCE (F-RATIOS)

EXISTING REGIONAL STRUCTURE VS. IDEAL STRUCTURE (BY SOCIO-ECONOMIC INDICATOR)

	EXISTING F-RATIO	IDEAL F-RATIO	EXISTING / IDEAL F-RATIO x100
1. POPULATION STRUCTURE INDICATOR	6.441*	1204.907*	0.535
x5 "Dependency Ratio"			
x7 "% Population 15-65"			
2. GENERAL ECONOMIC INDICATOR	1.926*	573.624*	0.336
x8 "Employment Ratio"			
x11 "% Employed In Growth Sector"			
x9 "Industrial Workers"			
x20 "Business Tax" -Net-			
x18 "G.D.P. per Capita"			
3. URBAN/HOUSING INDICATOR	7.308*	1879.462*	0.389
x2 "Density"			
x30 "% Housing With G.T. 2 Apts."			
x29 "% Housing With 1-2 Apts."			
4. UNEMPLOYMENT INDICATOR	30.427*	1352.868*	2.249
x26 "Youth Unemployment"			
x14 "Total Umenployment"			
x10 "Opportunity Ratio"			
x15 "Long-Term Unemployment"			
5. GENERAL MIGRATION INDICATOR	2.388*	312.766*	0.764
x16 "Net Migration -Workers-"			
x17 "Net Migration -25-30-"			
x32 "Net Migration -Families-"			
6. HEALTH INDICATOR	2.400*	379.398*	0.633
x34 "# Residents/Medical Specialist"			
x33 "# Residents/Doctor"			
7. YOUTH MIGRATION INDICATOR	1.165	840.206*	0.139
x27 "Net Migration -18-25-"			

* SIGNIFICANT AT $\alpha = .05$ DEGREES OF FREEDOM = 10, 327.

Migration variable (840.206).

It is the third column in table 4.1 of which one must take particular notice. Here, the ratio of F-ratios (Existing/Ideal x 100) represents how close each indicator is to its own ideal "worst solution". Therefore, larger values in this column represent a more serious case of regional inequity over a particular socio- economic indicator in the Federal Republic of Germany. The Unemployment variables (2.249) exhibits the highest ratio by a large margin, followed by the General Migration variables (0.764), the Health variables (0.633) and the Population Structure variables (0.535). The Youth Migration variable produces the best score at (0.139), accompanied by the General Economic variables (0.336) and the Urban/Housing variables (0.389). These values enable the investigator to compare the amount of variation associated with each indicator according to its respective ideal "worst solution". It is interesting to note that the General Migration variables possessed the third lowest F-ratio from the existing regional structure, but when compared to its ideal solution it had the second highest ratio of F-ratios. This demonstrates the danger involved with an analysis of the empirical situation without first assessing how close the disparities may be to the worst possible situation.

Not only is a comparative analysis of the variation associated with the sets of socio-economic variables important, but also an internal analysis of the variation associated with the individual selected variables. The external comparison of indicators identifies the groups of interrelated variables that are closest to their worst solution, thus indicating higher levels of regional inequity. Once these have been identified, it can be useful to examine the F-ratios of the selected variables to pin-point problem areas within each socio-economic indicator.

Table 4.2 displays the individual variable's F-ratios for both the existing regional structure in column one, and the ideal structures in column two. Again, column three exhibits the ratio of F-ratios (Existing /Ideal x 100) as a percentage of how close the existing variation is to the ideal "worst solution" for each variable. The ideal F-ratios in column two are calculated using the ideal grouping structure of the socio-economic indicator to which

TABLE 4.2

RESULTS FROM ANALYSIS OF VARIANCE (F-RATIOS)

EXISTING REGIONAL STRUCTURE VS. IDEAL STRUCTURE (BY VARIABLE)

VARIABLE	EXISTING F-RATIO	IDEAL F-RATIO	EXISTING / IDEAL F-RATIO x100
1. POPULATION STRUCTURE INDICATOR			
X5 Dependency Ratio	6.563*	1243.802*	0.528
X7 % Population 15-65	6.314*	1161.901*	0.543
2. GENERAL ECONOMIC INDICATOR			
X8 Employment Ratio	1.755	254.475*	0.690
X11 % Employed in Growth Sector	1.744	195.376*	0.893
X9 Industrial Workers	3.125*	55.402*	5.641
X20 Business Tax -Net-	2.207*	112.515*	1.962
X18 G.D.P. per Capita	1.573	190.810*	0.824
3. URBAN/HOUSING INDICATOR			
X30 % Housing With G.T. 2 Apts.	6.473*	700.822*	0.924
X29 % Housing With 1-2 Apts.	6.473*	700.822*	0.924
X2 Density	8.564*	105.983*	8.081
4. UNEMPLOYMENT INDICATOR			
X26 Youth Unemployment	33.099*	313.716*	10.551
X14 Total Unemployment	19.509*	136.181*	14.326
X10 Opportunity Ratio	14.715*	159.079*	9.250
X15 Long-term Unemployment	33.837*	102.189*	33.112
5. GENERAL MIGRATION INDICATOR			
X16 Net Migration-Workers-	2.540*	98.042*	2.591
X17 Net Migration- 25-30 -	2.108*	184.658*	1.142
X32 Net Migration-Families-	2.168*	102.584*	2.113
6. HEALTH INDICATOR			
X34 # Residents/Medical Specialist	3.489*	150.751*	2.314
X33 # Residents/Doctor	1.756	390.748*	0.449
7. YOUTH MIGRATION INDICATOR			
X27 Net Migration- 18-25 -	1.165	840.206*	0.139

* SIGNIFICANT AT α = .05 DEGREES OF FREEDOM = 10, 327.

it belongs.

The following section will analyze the socio-economic indicators according to their proximity to their respective ideal "worst solutions". The spatial distribution of the ideal groupings for each socio-economic indicator are found in Figures 4-A to 4-G. Each map represents the distribution of the 11 ideal groups that were derived using the ideal grouping procedure.

Concentrations of ideal groups were discovered in various regions of the Federal Republic of Germany, which suggests the locations of areas that exhibited strong regional disparities over certain socio-economic indicators. However, quite similar values of variation could be achieved between the ideal set of groupings and reality without a visual correlation between maps.

The set of Population Structure variables registered as the middle indicator in terms of the proximity to its ideal "worst solution" with a ratio of F-ratios of 0.535. Interestingly, the two selected variables behaved in similar fashion to the variables in the aggregate form. Here, (x5) the "Dependency Ratio" variable and (x7) "% of Population between 15 and 65" had ratios of F-ratios of 0.528 and 0.543 respectively. Not only were these values similar, but also their existing F-ratios and ideal F-ratios were almost identical.

In Figure 4-A, the distribution of ideal groups from the set of Population Structure variables display some interesting characteristics. Areas that scored particularly well on this indicator were located in the Munchen area of Bayern, the Rhein-Main and Rhein-Ruhr regions, and also the Stuttgart area of Baden-Wurttemberg. These areas all exhibited more favourable population structures according to the (x5) Dependency Ratio and (x7) % Population Between 15-65 variables. In contrast, areas that were characterized by the worst scores on this indicator were found in the Emsland area of Niedersachsen and much of the eastern border zone along Czechoslovakia and East Germany. This region stretched through Bayern, Hessen and much of eastern Niedersachsen. Also, the southwest portion of Bayern and adjoining Baden-Wurttemberg reflected lower scores near the Austrian/Switzerland borders. One further observation is that there were disparities evident between urban and rural areas on this socio-economic indicator. Urban areas were

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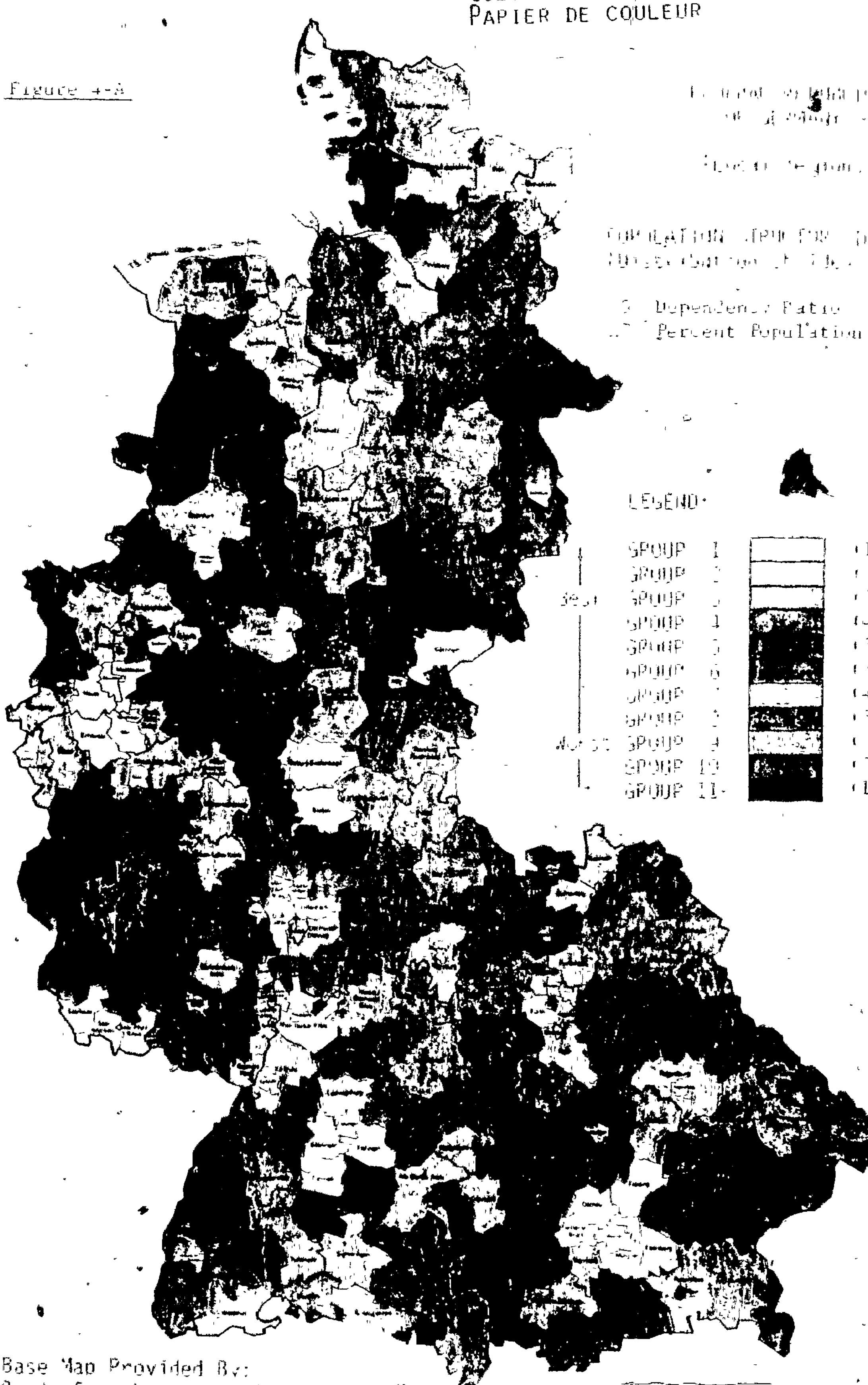
Figure 4-A



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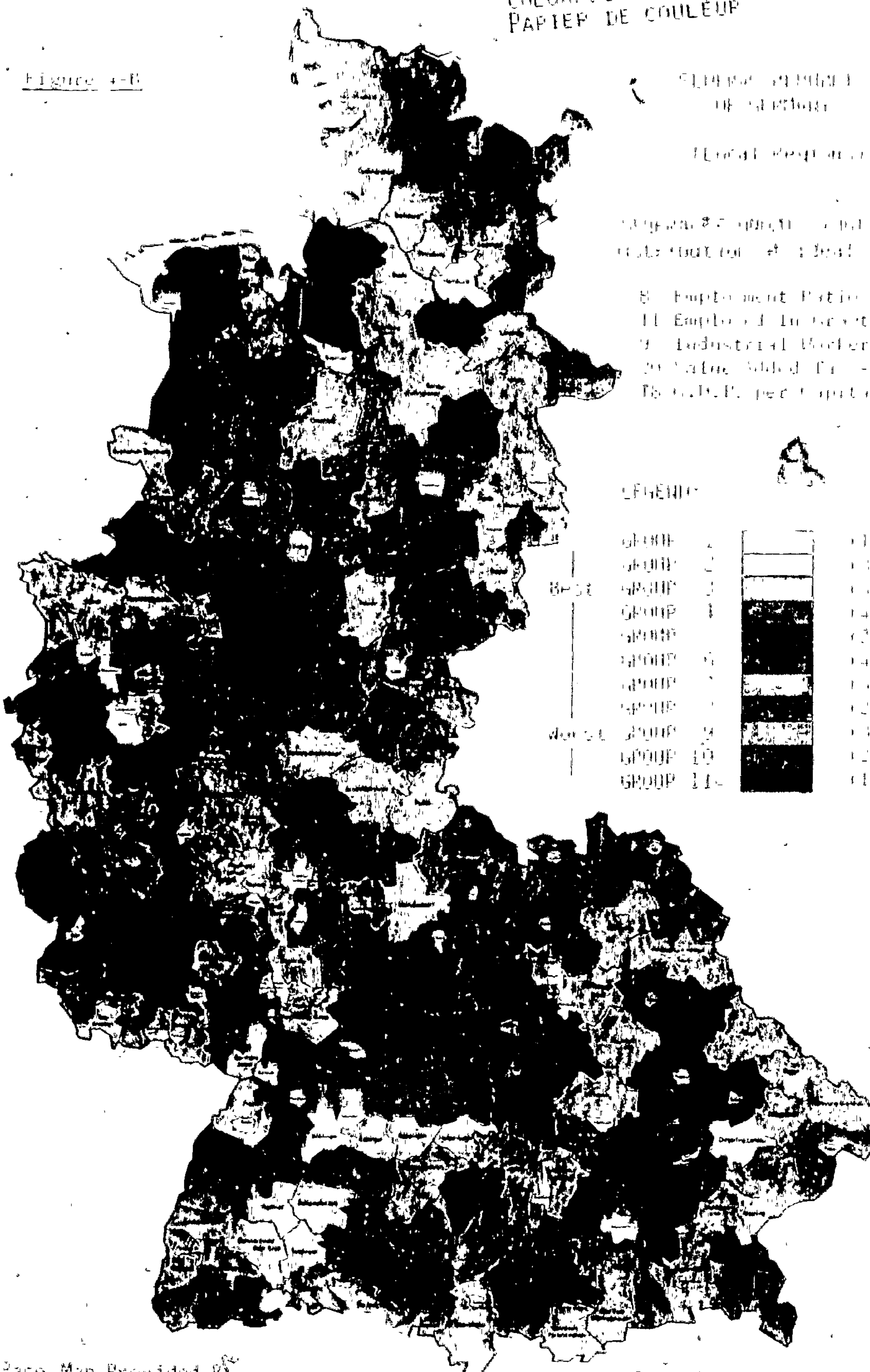
generally characterized by one of the best three groups, while many rural areas exhibited more deficient population structures.

The second socio-economic indicator was the set of General Economic variables with an overall ratio of F-ratios of 0.336. Here, the (x9) "Industrial Workers" and (x20) "Net Business Tax" variables possessed higher ratio of F-ratios of 5.641 and 1.962. These values suggested higher levels of regional inequity over these variables in the Federal Republic of Germany. In contrast, the "Employment Ratio" (x8) had the best score at 0.690 of the five selected variables, followed by the (x18) "Gross Domestic Product per Capita" and (x11) "% Employed in the Growth Sector" variables. An interesting note here is that although the best score of any selected variable was only 0.690, the ratio of F-ratios was even further from the ideal "worst solution" at 0.336 for the indicator as a whole.

A plotting of the ideal groups derived for the set of General Economic variables can be found in Figure 4-B. Here, areas that exhibited higher scores were concentrated through much of Baden-Wurttemberg and the Rhein-Ruhr

Figure 4-B



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regions. These areas were characterized by municipalities belonging to the upper categories of the ideal groups for the variables in this indicator. The worst areas of the Federal Republic of Germany according to the General Economic variables could be found in northwest Niedersachsen and northern Schleswig-Holstein. Much of Rheinland Pfalz and North-central Bayern also had lower group memberships. Again, there was a significant urban-rural bias on this indicator as urban areas tended to display group memberships in the higher categories in comparison to many rural regions. Many urban areas had higher group memberships at the expense of their immediate surrounding regions. In general, the surrounding regions appeared worse off than other poor areas of the country.

The third lowest indicator in terms of proximity to its ideal "worst solution" was the set of Urban/Housing variables with a corresponding ratio of F-ratios of 0.389. In this case, the "Density" (x2) variable had a higher existing F-ratio and much lower ideal F-ratio than either (x30) "% Housing with Greater Than 2 Apartments" or (x29) "% Housing with 1 or 2 Apartments". This resulted in the Density variable's higher ratio of F-ratio, which was very close to that of the "Opportunity Ratio" (x10) from the Unemployment variables. As such, both x29 and x30 had much lower ratios of F-ratios (0.924) than that for the density variable (8.081).

Figure 4-C shows the distribution of ideal groups that were generated for the Urban/Housing socio-economic indicator. The major concentration of municipalities that exhibited higher group memberships were found mainly in the densely populated Rhein-Ruhr region. There were also minor concentrations in the Rhein-Main region, the Stuttgart area and the southern portion of Baden-Wurttemberg and Bayern along the Austrian and Swiss borders. In contrast, north and central Bayern were the most notable areas of lower group membership, particularly along the Czechoslovakian border. Northwest Niedersachsen and the interior of Hessen and Rheinland Pfalz also displayed lower scores on this socio-economic indicator. As one might expect with a set of Urban/Housing variables, there was a substantial urban-rural distinction. Here, predominately urban areas displayed much higher scores on this indicator than the more sparsely populated rural areas. Many urban core areas again had more favourable scores in comparison to their immediate

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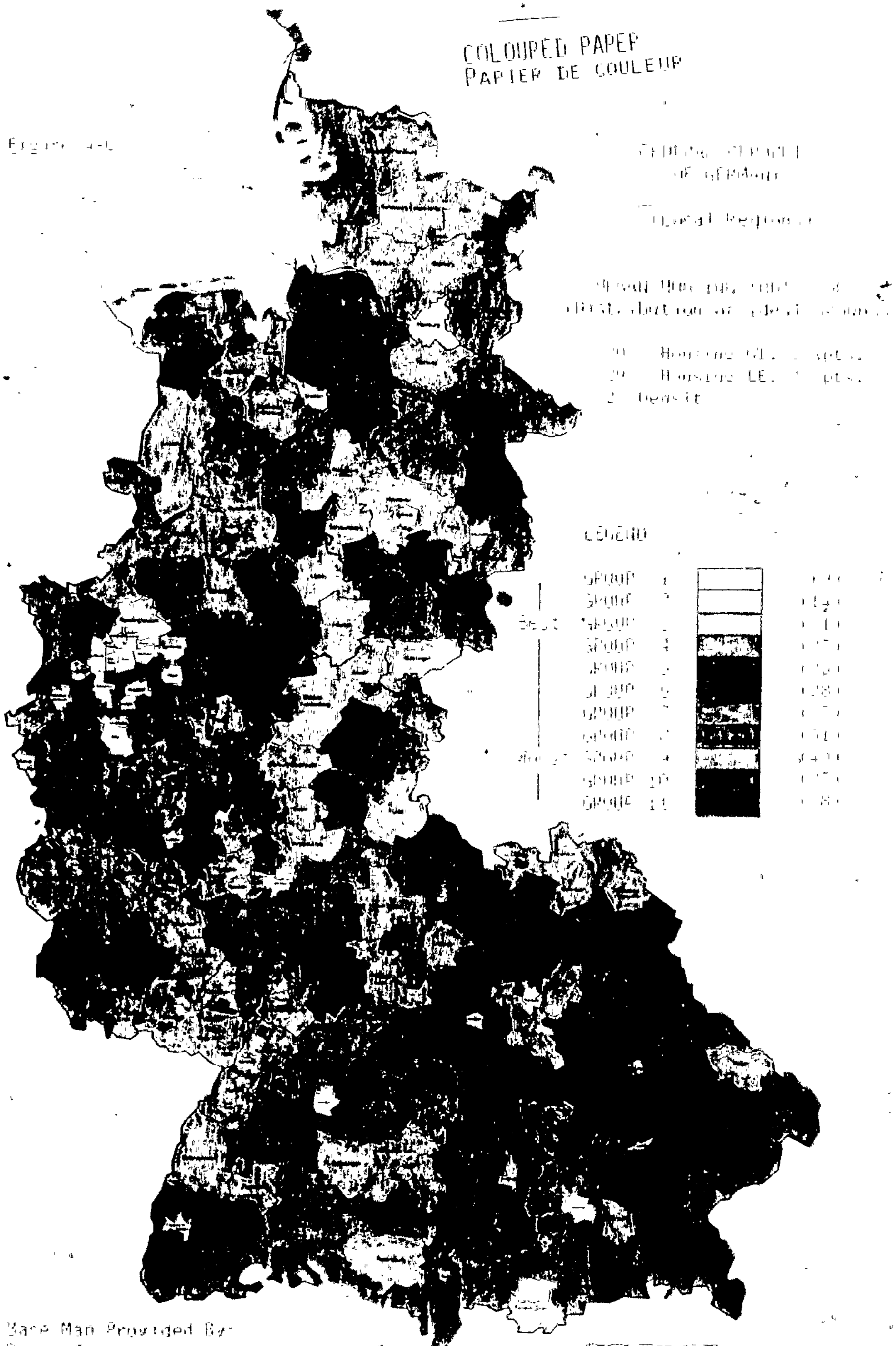

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surrounding regions.

The set of Unemployment variables possessed the highest ratio of F-ratios of the seven socio-economic indicators with a value of 2.249. From an internal study of the indicator it can be observed that higher existing F-ratios were evident, as well as higher ratios of F-ratios in column three for its selected variables. The "Long-term Unemployment" (x15) variable appeared to be closest to the ideal "worst solution" in terms of regional inequities (33.112), followed by "Total Unemployment" (x14, 14.326), "Youth Unemployment" (x26, 10.551) and the "Opportunity Ratio" (x10, 9.250). All four selected variables exhibited higher ratios of F-ratios than any other selected variable from all indicators. This illustrates the seriousness of the regional concentrations associated with this indicator in the Federal Republic of Germany.

The set of ideal groups from the Unemployment variables are displayed in Figure 4-D. Perhaps the most striking group concentrations could be found in this map compared to those for the other six indicators. Here, all of Baden-Wurttemberg, southern Bayern and the Rhein-Main areas

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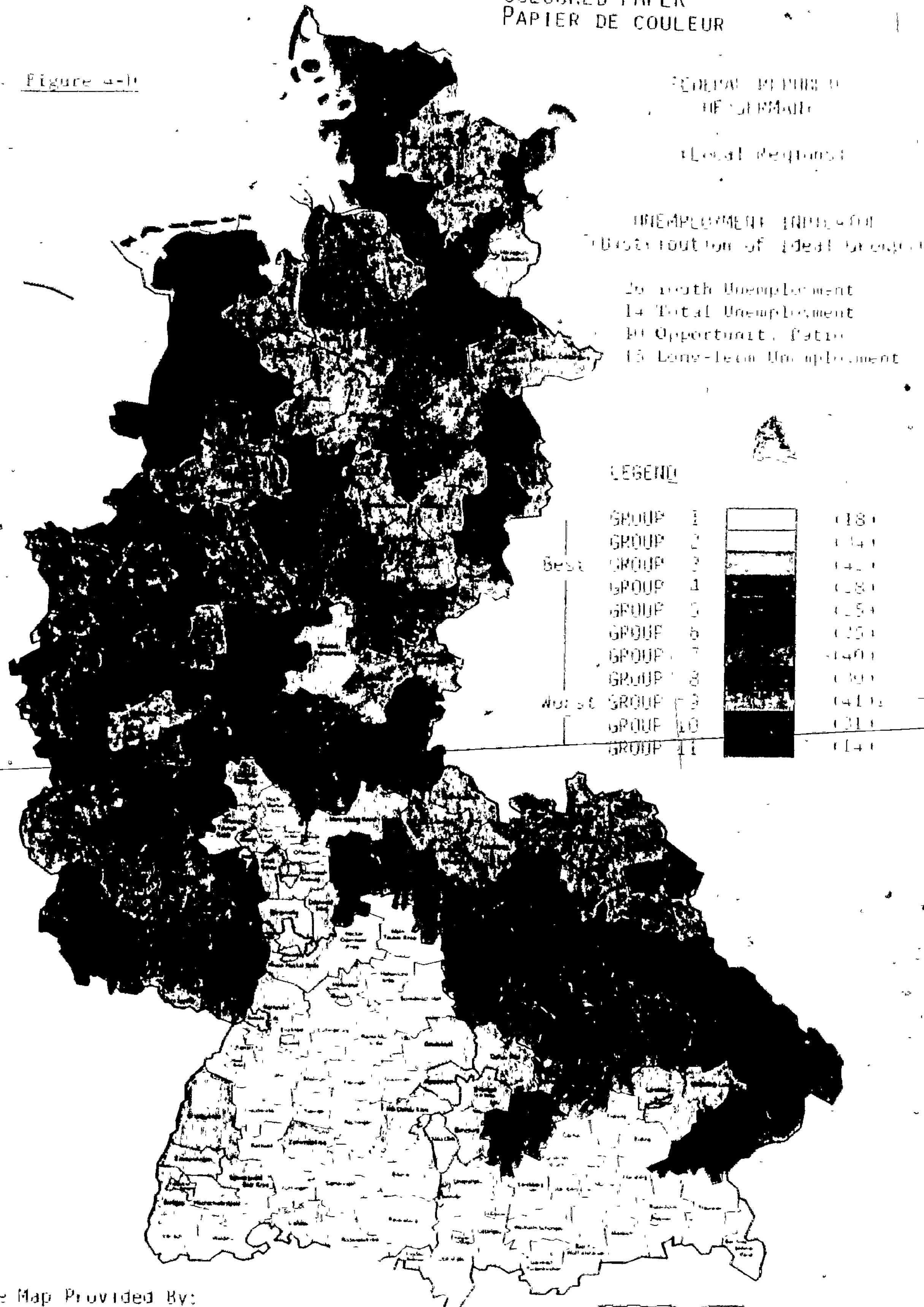
Figure 4-1



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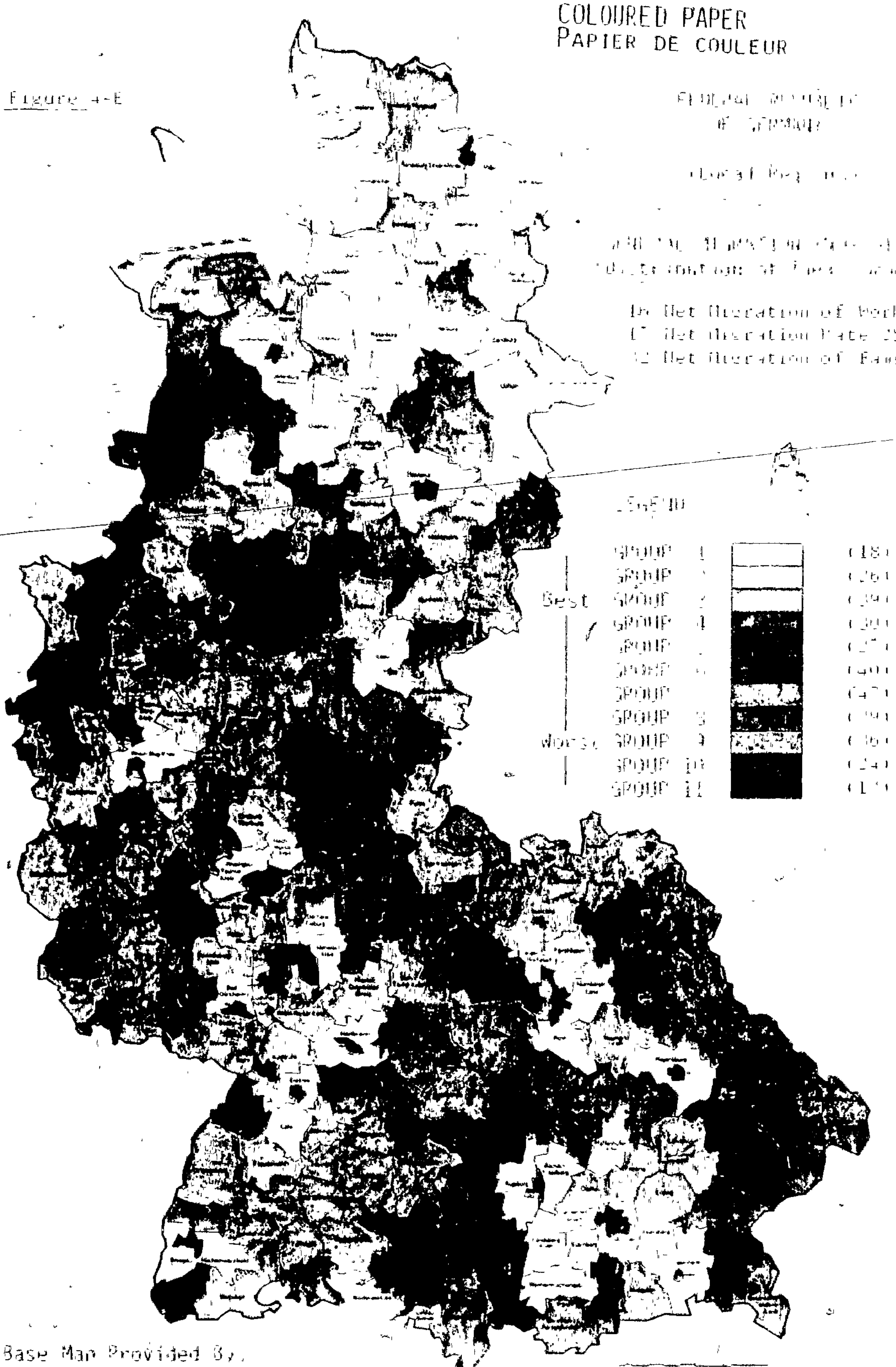
exhibited higher group memberships. The unemployment rates were the most favourable in these regions and there appeared to be a distance-decay function that originated in the Stuttgart and Munchen areas spreading in a north-central direction. In contrast, the northern states of Niedersachsen and Schleswig-Holstein exhibited higher unemployment rates, as well as the Czechoslovakian and East German border areas of Bayern. Furthermore, the Saarbrucken region and much of the Rhein-Ruhr also exhibited lower group memberships. In summary, a core of lower unemployment rates were found primarily in the south, stretching from Munchen to Stuttgart and Frankfurt. The areas with predominately higher rates of unemployment were found in the northern states and along border regions.

The second worst socio-economic indicator in terms of the proximity to its ideal "worst solution" was the set of General Migration variables with an overall ratio of F-ratios of 0.764. Internally, the variables all exhibited similar existing F-ratios although the "Net Migration of Age 25-30" (x17) variable had a much higher ideal F-ratio. This resulted in it being close to twice as good on its ratio of F-ratios than the "Net Migration of Workers" (x16) and "Net

Migration of Families" (x32) variables which possessed lower ideal F-ratios. Since the "worst solution" for x16 and x32 was not as severe as that for x17, the "Age 25-30 Net Migration" variable appeared to be further from a problem situation than the first two.

The ideal groups from the General Migration variables are exhibited in Figure 4-E. Areas of greatest out-migration correspond to those with lower ideal group memberships. With this in mind, the Rhein-Ruhr region and the area of southeast Niedersachsen along the East German border appeared as the localities beset with significant out-migration. The Saarbrucken region and the northeast portion of Bayern along the Czechoslovakian border also exhibited lower group memberships. In contrast, southern Bayern, Schleswig-Flensburg and northern Niedersachsen displayed the heaviest concentrations of in-migration. In Bayern, much of this region centred around Munchen, while in the northern Länder it appeared as though much of the immigration was at the expense of northern urban settlements such as Hamburg, Kiel, Flensburg and Lubeck. As this indicator does not denote any movement of young people (x27 "Net Migration Aged 18-25"), it can be observed that many of

Figure 4-E



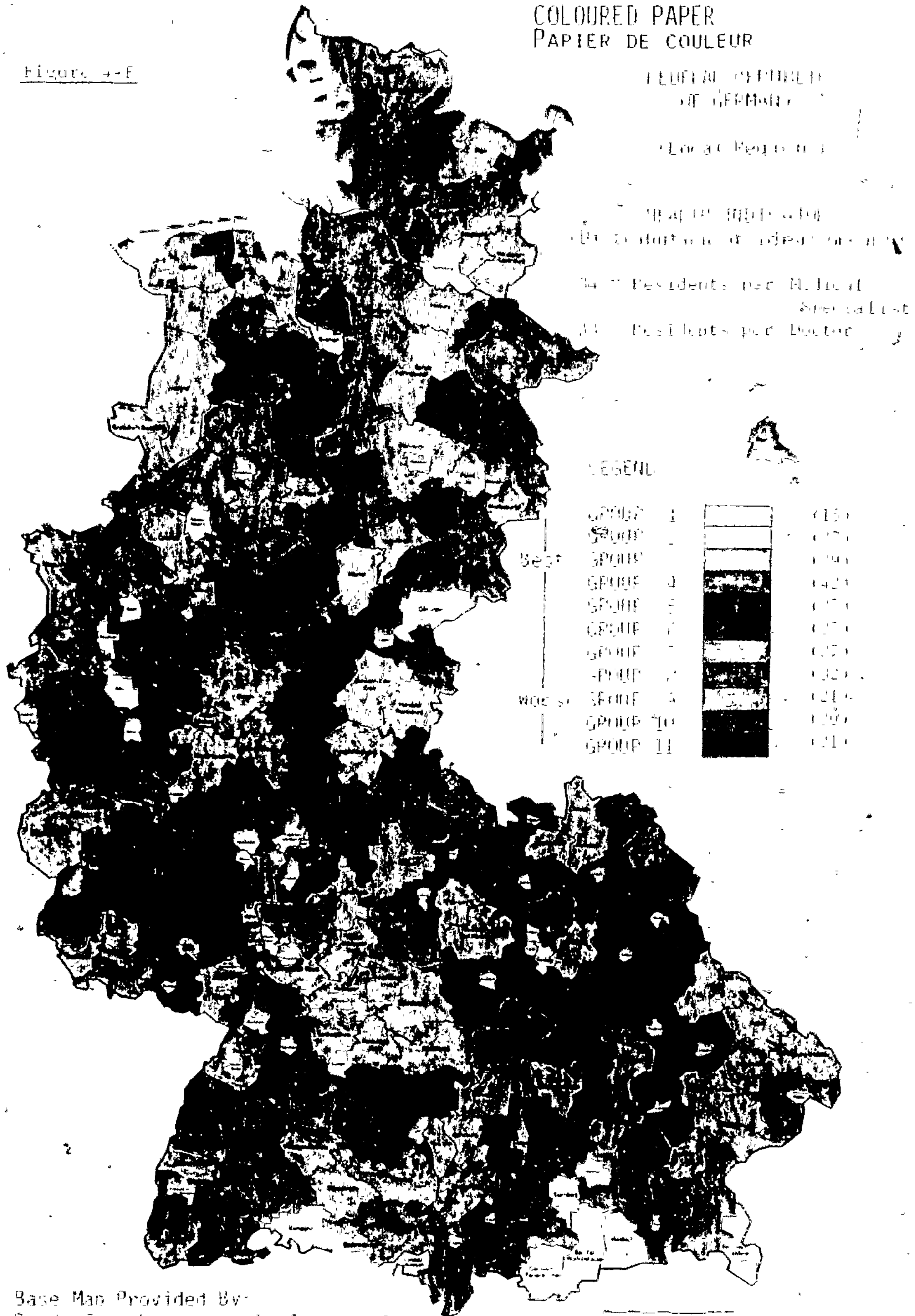
Base Map Provided By,
Bundesforschungsanstalt für
Landeskunde und Raumordnung

the municipalities with universities generally displayed out-migration for this indicator. This may reflect the students migrating to the area at a younger age and leaving after they have acquired their education. Therefore this indicator would account for the loss of those people, but not their gain at an earlier age.

The set of interrelated Health variables registered a ratio of F-ratios of 0.633, which placed it as the third highest indicator in terms of its proximity to its ideal "worst solution". Here, the two selected variables showed strikingly different results. The "# Residents per Medical Specialist" (x34) exhibited both a higher existing F-ratio and a lower ideal F-ratio than its counterpart "# of Residents per Doctor" (x33). This resulted in ratios of F-ratios that were highly dissimilar as x34 had 2.314 compared with x33's value of 0.449. Therefore, although the Health variables ranked fourth in terms of the proximity to its ideal "worst solution", the variation in (x34) # of Residents per Medical Specialist was close to five times worse than that for (x33) # of Residents per Doctor, outlining a possible problem area within this socio-economic indicator.

Figure 4-F shows the distribution of ideal groups that were generated for the Health variables. Here, higher group memberships were found primarily along the southern borders of Baden-Wurttemberg and Bayern, running parallel to the Austrian and Switzerland borders. A secondary region of better health care was located in the Rhein-Ruhr region. possibly corresponding to the large urban population. These areas all exhibited more favourable ratios of "Residents to Doctors" (x33) and "Residents to Medical Specialists" (x34). The worst areas according to this Health Indicator were found through most of Bayern to the north of the narrow strip in the south that exhibited more favourable scores. Also, the Saarbrucken region and much of western Rheinland Pfalz displayed worse scores on this indicator. A third region covering most of Niedersachsen and northern Nordrhein Westfalen also reflected predominately lower group memberships. These areas which had lower group memberships had higher ratios of residents to doctors and medical specialists. As alluded to previously, there appeared to be a large variation between urban and rural regions, as medical care appeared to be significantly better in most urban areas of the Federal Republic of Germany. This

Figure 4-F



Base Map Provided By:
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indicator also showed the substantial difference between urban areas and their surrounding regions. Many of the surrounding areas scored very poorly on this indicator, showing the concentration of medical care in the large centres at the expense of the immediate surrounding zones.

Finally, the socio-economic indicator that was furthest from its ideal "worst solution" was Youth Migration with a ratio of F-ratios of 0.139. Since there was only one selected variable in this indicator (x27 "Net Migration Aged 18-25"), its set of ratios represented the aggregate scores for the indicator as a whole.

The seventh distribution of ideal groups can be found in Figure 4-G, corresponding to those characteristic of the Youth Migration variable. Areas of highest in-migration or those with higher group memberships could be found particularly in the Munchen, Rhein-Main, Hamburg and Stuttgart areas. The area surrounding Munchen in Bayern stretched up the interior to include the Nurnberg region. In contrast, much of the peripheral areas of Bayern including the Czechoslovakian and East German border-areas appeared to have higher levels of out-migration or lower

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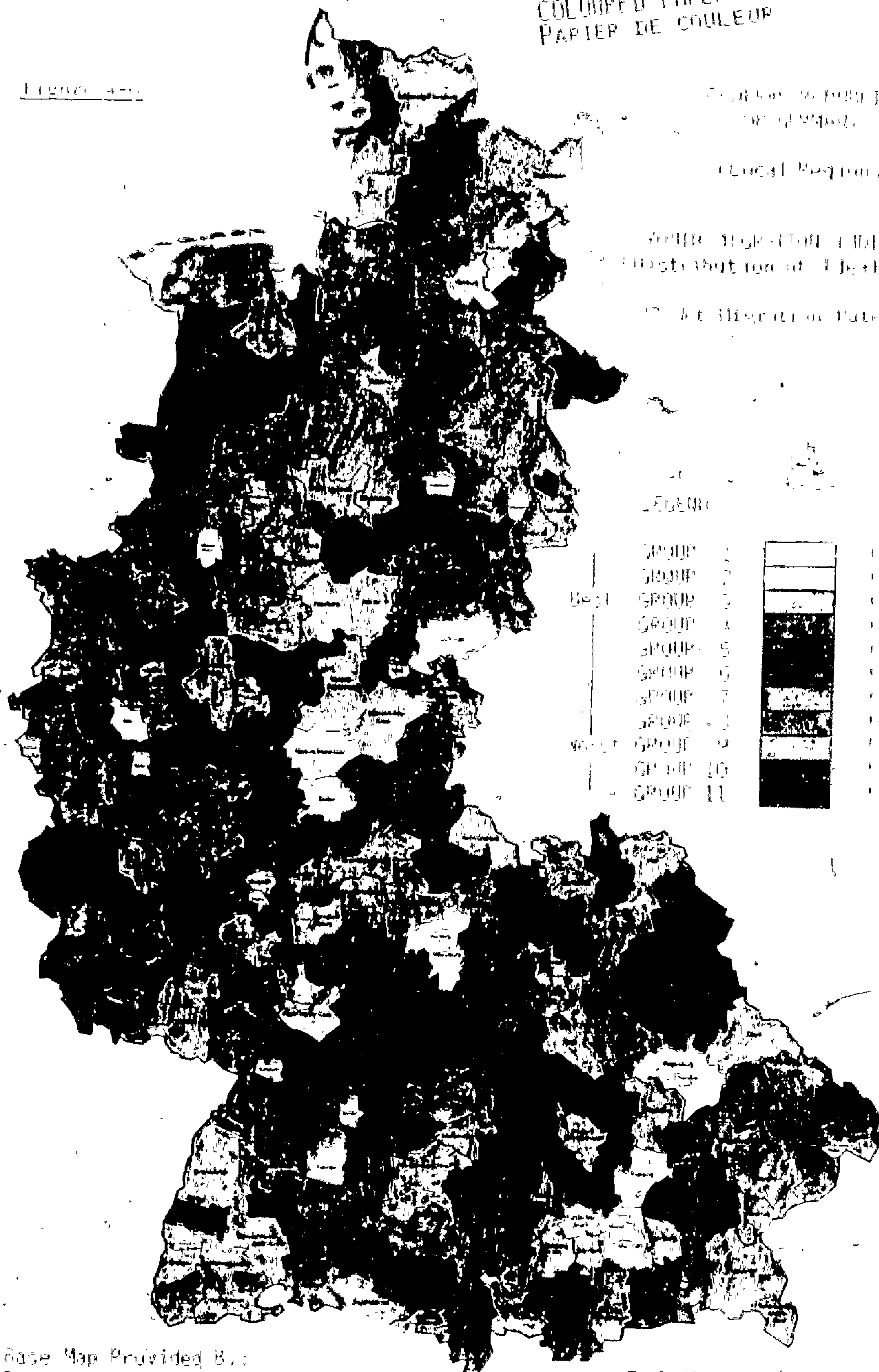

Base Map Provided B.:
Bundesforschungsanstalt fur
Landeskunde und Raumordnung

group memberships. In addition much of Rheinland Pfalz, northern Hessen, and areas bordering the Netherlands to the northwest of Niedersachsen and Nordrhein-Westfalen all exhibited significant levels of out-migration corresponding to the 18-25 age group. There also appeared to be a slight urban-rural bias on this indicator, as many urban areas displayed predominately higher ideal group memberships than the rural areas. Furthermore, urban areas that possess universities generally exhibited significantly higher scores on this socio-economic indicator.

In summary, the analysis of the ideal groupings has occurred in three separate and distinct phases. First, a comparison of the variation associated with the sets of interrelated variables was performed. Secondly, a comparison of the variation in the selected variables of each socio-economic indicator was also made between the ideal groups and the existing political structure of the Federal Republic of Germany. Finally, a visual comparison and correlation of the spatial distribution of ideal groupings was undertaken in order to identify any concentrations of specific groups in the Federal Republic of Germany. The substantial urban-rural bias was the most

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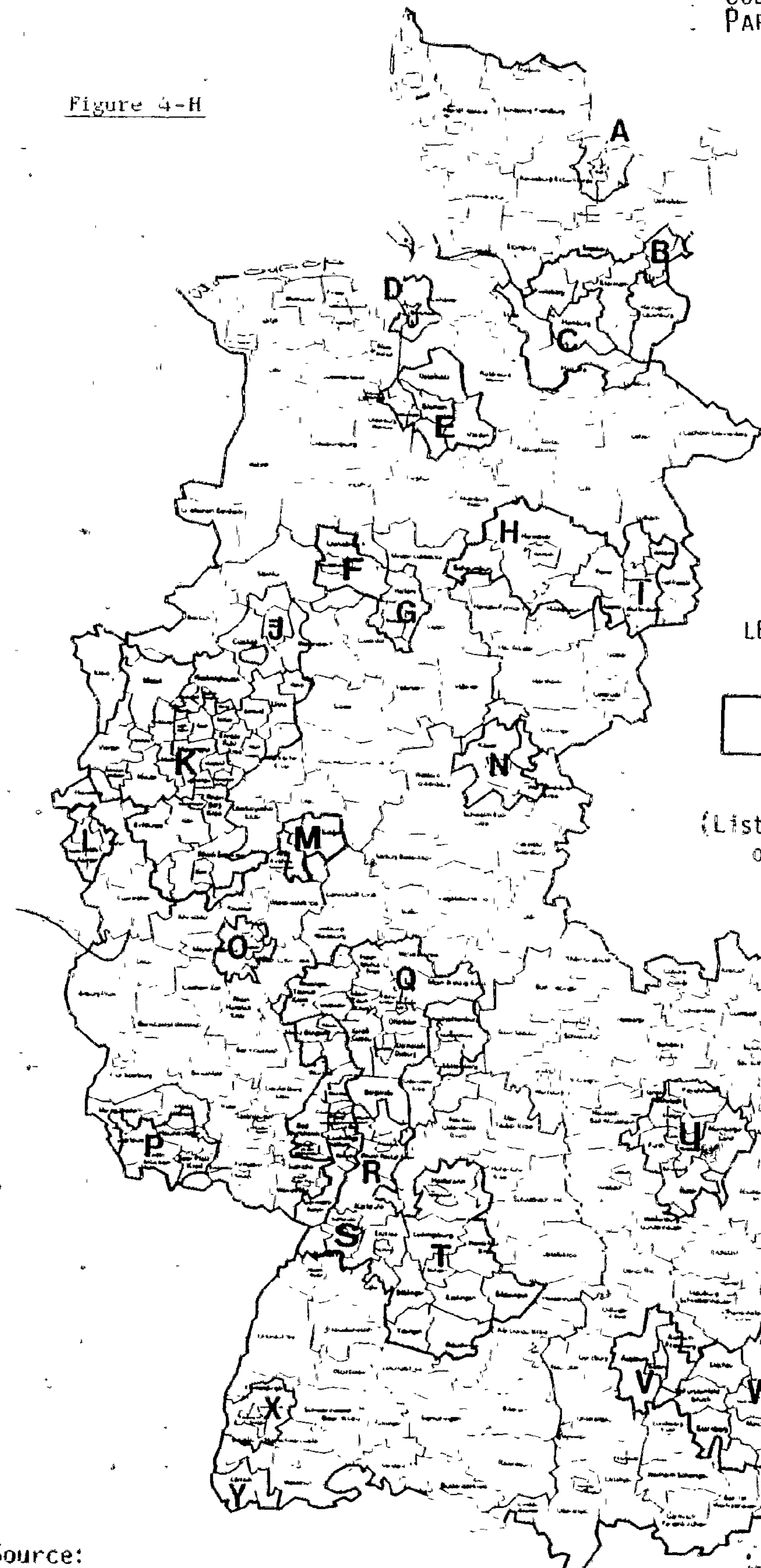
Figure 4-H

FEDERAL REPUBLIC
OF GERMANY

(Local Regions)

MAJOR URBAN AREAS



LEGEND:

STRUCTURED BUILT-UP URBAN AREAS

(List of Urban Areas is found on the following page)

Source:
Bundesforschungsanstalt fur
Landeskunde und Raumordnung; 1978.

TABLE 4.3

LIST OF URBAN AREAS FROM FIGURE 4-H

A - Kiel
B - Lubeck
C - Hamburg
D - Bremerhaven
E - Bremen
F - Osnabruck
G - Bielefeld/Herford
H - Hannover
I - Braunschweig
J - Munster
K - Rhein-Ruhr
L - Aachen
M - Siegen
N - Kassel
O - Koblenz/Neuwied
P - Saar
Q - Rhein-Main
R - Rhein-Neckar
S - Karlsruhe
T - Stuttgart
U - Nurnberg
V - Augsburg
W - Munchen
X - Freiburg
Y - Basel/Lorrach
Z - Berlin (West)

notable observation from the visual comparison of the seven sets of ideal groupings. Five of the seven independent socio-economic indicators displayed this bias. Figure 4-H displays the major urban areas in the Federal Republic of Germany to which a visual comparison can be made. The urban-rural bias was also evident in terms of the effects of the urban areas on their immediate surrounding regions. These surrounding regions had predominately lower scores on many of the indicators than other areas in the Federal Republic of Germany.

The peripheral border areas of Bayern and Hessen, and much of the north including Niedersachsen and Schleswig-Holstein displayed significantly lower values on many of the socio-economic indicators. This further demonstrates the necessity of the adequate provision of incentives for growth and prosperity in these regions to offset the inequities. In the next chapter, there will be a discussion of the relevancy of results and further applications for the methodology.

CHAPTER FIVE

SUMMARY AND CONCLUSION

The preceeding chapters, have introduced a new approach to describe regional variation by comparing actual variation to some generated measure of potential maximum variation. This approach however, is not restricted to the data from the Federal Republic of Germany; indeed it may be used to measure and compare levels of regional inequities over a host of regions.

Factor analysis was used to reduce the original forty variables to seven sets of interrelated variables or "socio-economic indicators" representing the independent factors. To achieve this, a varimax, orthogonal rotation was used resulting in indicators that were largely independent of each other. This allowed for a clearer distinction between the various socio-economic criterion.

The seven sets of variables were then used to define seven distinct ideal groupings of municipalities. Each set of ideal groupings represented a "worst solution" in that variation was minimized within groups and maximized between them.

The resulting variation within and between groupings was measured by analysis of variance for the socio-economic indicators in both the existing regional structure of the Federal Republic of Germany and the sets of ideal groupings. Since each set of ideal groupings represent a "worst solution" for a socio-economic indicator, any levels of variation in the existing structure that approach those values for the ideal groupings constitute high levels of regional inequities. Similarly, statements can be made about the comparative levels of inequity associated with each indicator's proximity to its own ideal "worst solution".

The analysis between these sets of interrelated variables indicated the levels of disparity associated with them (table 4.1). Variation within each socio-economic indicator was also measured by analysis of variance (table

4.2). The variables for the existing regional structure of the Federal Republic of Germany were all measured using the boundaries of the existing political Länder. For the ideal measures, each variable in a set of interrelated variables was assessed using the ideal groups that were derived for that set of interrelated variables. This allowed the investigator the luxury of an internal analysis of each variable within the sets of interrelated variables. This was especially valuable in the identification of disparities within specific features of socio-economic indicators.

In the Federal Republic of Germany, the set of Unemployment variables emerged as being closest to its ideal "worst solution". Although all of the selected variables within this indicator scored poorly in comparison to the variables from other indicators, it was the Long-Term Unemployment variable that was the most distinct. It was two times closer to the ideal situation than any other selected variable from this socio-economic indicator. This demonstrates the serious effects of unemployment in the Federal Republic of Germany: particularly in relation to long-term unemployment.

The set of General Migration variables and the Health variables followed the Unemployment Indicator in terms of proximity to their ideal "worst solutions". However, they were both only one-third as close to their ideal situations as the set of Unemployment variables. The Population Structure variables were ranked fourth, followed by the Urban/Housing variables, the General Economic variables and the Youth Migration variable in respect to the resemblance of the levels of variation in their ideal "worst solutions". Table 4.1 reflected the ratios associated with the levels of variation in the existing regional structure and the ideal groupings for each socio-economic indicator.

From an internal view of the selected variables from each socio-economic indicator, the four unemployment-related variables registered as being closest to their ideal "worst solutions". These consisted of the Long-Term Unemployment, Total Unemployment, Youth Unemployment and the Opportunity Ratio variables. The Density variable from the set of Urban/Housing variables was the next closest to its ideal solution, followed by the Number of Industrial Workers variable from the set of General Economic variables. Finally, the selected variables comprising the Health

Indicator displayed interesting results as the Number of Residents per Medical Specialist was over five times closer to the ideal "worst solution" than its counterpart the Number of Residents per Doctor. This illustrates the value of looking internally within a socio-economic indicator. Although the Health Indicator was ranked fourth in terms of its proximity to its ideal solution, its selected variables had quite different levels of inequity associated with them.

Figures 4-A to 4-G displayed the distribution of ideal groups for each socio-economic indicator. A significant urban/rural bias was evident in many of the distributions, as predominately urban areas generally exhibited more favourable scores over five of the seven sets of interrelated socio-economic variables. A further observation of this bias was evident at the expense of regions that immediately surrounded urban areas. These substantial urban/rural discrepancies raise the possibility of employing the methodology in two separate and distinct phases. By subdividing the municipalities according to their urban or rural status, a comparison could be made between each Länder's urban or rural areas. This would make allowances for the extent of urbanization in each Länder.

The methodology that has been performed on the data in this thesis has not taken the urban/rural distinction into consideration. In so doing, an unbiased view of the municipalities within each Länder is presented.

Of the eleven political groups in the Federal Republic of Germany, three were in the form of city-states. These included Hamburg, West Berlin, and the cities of Bremen and Bremerhaven. With such a unique grouping structure, levels of variation within and between groups could be adversely weighted in the direction of these urban areas. For example, comparing these groups to any of those with a combination of rural and urban municipalities would bias the results in the direction of the urbanized city-states. In this thesis, the city-states were left in the study since this was a demonstration of the methodology. However, an alternative course of action would be to ignore the city-states and compare the levels of variation between and within the remaining eight Länder. This practice would remove the effects of the urbanized Länder, and maintain the comparison at the level of the more heterogenous Länder. In so doing, the assumptions of the Anova model that were outlined in Chapter Three could be more readily met. The results in the analysis in this thesis reflect the unique political structure that exists in the Federal Republic of Germany. For the methodology to be used as a tool for the regional scientist, its flexibility allows it to be adjusted to fit the objectives of the investigator.

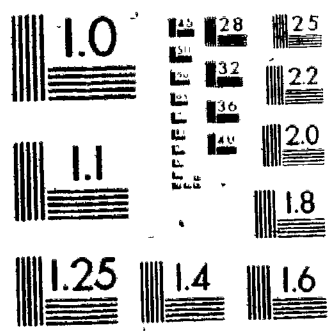
The selected variables from each socio-economic indicator were weighted according to their squared factor loading scores from the factor analysis procedure. The selected variables were weighted by the amount of explained variance that the original factor captured. This was done on the premise that each selected variable should be given different amounts of emphasis in the construction of an indicator. As the cut-off loading value was set at +/- 0.7, selected variables within a socio-economic indicator could still possess significant differences in the amount of variance that was captured. A variable with a factor loading of 0.9 would have 81 percent of its variance captured, where as a second selected variable at 0.7 would have only 49 percent captured. Certainly, these differences warrant consideration for a suitable weighting system. A second alternative would be to weight each variable according to their communalities from the factor analysis.

The communalities indicate how well each variable was explained by the entire set of factors. In this method, a variable will be weighted not only according to its own factor from which it was selected, but also from the effects of the other factors in the analysis. However, since the investigator is primarily concerned with the internal structure of each socio-economic indicator, this method of weighting may be inappropriate. A third alternative would be to leave each variable unweighted. This would therefore assume that all selected variables over the significant cut-off value of +/- 0.7 were equal in terms of their importance to any set of interrelated variables. As the purpose of the factor analysis was to find groups of interrelated variables, the question of their subsequent weighting remains an important issue.

The methodology employed on the data from the Federal Republic of Germany has allowed for the measurement and description of regional inequities over a set of independent socio-economic indicators. By comparing the amount of variation that exists in the Federal Republic of Germany with the variation associated with the sets of ideally generated "worst solutions", it has been possible to evaluate regional inequities on a scaled system. The closer that the levels of variation in the Federal Republic of Germany are to those values from the ideal solutions, the higher the level of regional disparity. Of course, the regional planner will be more concerned with those indicators that are of critical importance to the objectives of regional policy within the host country. For example, higher levels of regional inequity may be acceptable over a set of Population Structure variables compared with those for the Unemployment Indicator. Clearly this would be a case of policy priorities.

This comparative approach can also be utilized by the regional scientist to test changing levels of regional inequity over time. In securing a similar set of socio-economic data after a suitable time frame, one can monitor the change. Consequently, it will be possible to measure accurately changes in the levels of variation over this time period. If the existing levels of variation approach the ideal "worst solution", then it will be evident that the levels of regional inequity will have increased over that socio-economic indicator. Similarly, levels of variation that depart from the ideal situation will

2 OF/DE 2



represent an improvement in the regional well-being structure.

The method of comparing existing variation to some derived measure of extreme potential variation can aid the researcher in the analysis of regional inequities that exist within the data set. A greater level of description can be achieved by assessing a region's disparities according to its deviation from an ideally generated "worst solution". Since there are no time or spatial constraints within the methodology, it may serve as a useful tool in the recognition of regional problems.

APPENDIX

APPENDIX "A"

LIST OF MUNICIPALITIES

AREA	CODE #	MUNICIPALITY	URBAN-AREA (*)
SCHLESWIG - HOLSTEIN			
1	1001	FLENSBURG	
2	1002	KIEL	*
3	1003	LUBECK	*
4	1004	NEUMUNSTER	*
5	1051	DITHMARSCHEN	
6	1053	HERZOGTUM LAUENBURG	
7	1054	NORDFRIESLAND	
8	1055	OSTHOLSTEIN	
9	1056	PINNEBERG	*
10	1057	PLON	
11	1058	RENDSBURG-ECKERNFORDE	
12	1059	SCHLESWIG-FLENSBURG	
13	1060	SEGEBERG	
14	1061	STEINBURG	
15	1062	STORMARN	
HAMBURG			
16	2000	HAMBURG	*
NIEDERSACHSEN			
17	3101	BRAUNSCHWEIG	*
18	3102	SALZGITTER	*
19	3103	WOLFSBURG	*
20	3151	GIFHORN	
21	3152	GOTTINGEN	
22	3153	GOSLAR	
23	3154	HELMSTEDT	
24	3155	NORTHEIM	
25	3156	OSTERODE am HARZ	
26	3157	PEINE	
27	3158	WOLFENBUTTEL	

AREA	CODE #	MUNICIPALITY	URBAN-AREA (*)
28	3201	HANNOVER (City)	*
29	3251	DIEPHOLZ	
30	3252	HAMELN-PYRMONT	
31	3253	HANNOVER	
32	3254	HILDESHEIM	
33	3255	HOLZMINDEN	
34	3256	NIENBURG (Weser)	
35	3257	SCHAUMBURG	
36	3351	CELLE	
37	3352	CUXHAVEN	
38	3353	HARBURG	
39	3354	LUCHOW-DANNENBERG	
40	3355	LUNEBURG	
41	3356	OSTERHOLZ	
42	3357	ROTENBURG (Wumme)	
43	3358	SOLTAU-FALLINGBOSTEL	
44	3359	STADE	
45	3360	UELZEN	
46	3361	VERDEN	
47	3401	DELMENHORST	*
48	3402	EMDEN	
49	3403	OLDENBURG (Oldenburg) (City)	*
50	3404	OSNABRUCK (City)	*
51	3405	WILHELMSHAVEN	*
52	3451	AMMERLAND	
53	3452	AURICH	
54	3453	CLOPPENBURG	
55	3454	EMSLAND	
56	3455	FRIESLAND	
57	3456	GRAFSCHAFT BENTHEIM	
58	3457	LEER	
59	3458	OLDENBURG (Oldenburg)	
60	3459	OSNABRUCK	
61	3460	VECHTA	
62	3461	WESERMARSCH	
63	3462	WITTMUND	

BREMEN

AREA	CODE #	MUNICIPALITY	URBAN-AREA (*)
64	4011	BREMEN	*
65	4012	BREMERHAVEN	*

AREA	CODE #	MUNICIPALITY	URBAN-AREA (*)
NORDRHEIN - WESTFALEN			
66	5111	DUSSELDORF	*
67	5112	DUISBURG	*
68	5113	ESSEN	*
69	5114	KREFELD	*
70	5116	MONCHENGLADBACH	*
71	5117	MULHEIM a.d. RUHR	*
72	5119	OBERHAUSEN	*
73	5120	REMSCHEID	*
74	5122	SOLINGEN	*
75	5124	WUPPERTAL	*
76	5154	KLEVE	
77	5158	METTMANN	*
78	5162	NEUSS	*
79	5166	VIERSEN	*
80	5170	WESEL	*
81	5313	AACHEN (City)	*
82	5314	BONN	*
83	5315	KOLN	*
84	5316	LEVERKUSEN	*
85	5354	AACHEN	*
86	5358	DUREN	
87	5362	ERFTKREIS	*
88	5366	EUSKIRCHEN	
89	5370	HEINSBERG	
90	5374	OBERBERGISCHER KREIS	
91	5378	RHEIN.-BERG. KREIS	*
92	5382	RHEIN-SIEG-KREIS	*
93	5512	BOTTROP	*
94	5513	GELSENKIRCHEN	*
95	5515	MUNSTER (Westf.)	*
96	5554	BORKEN	
97	5558	COESFELD	
98	5562	RECKLINGHAUSEN	*
99	5566	STEINFURT	
100	5570	WARENDORF	
101	5711	BIELEFELD	*
102	5754	GUTERSLOH	
103	5758	HERFORD	*
104	5762	HOXTER	

AREA	CODE #	MUNICIPALITY	URBAN-AREA (*)
105	5766	LIPPE	*
106	5770	MINDEN-LUBBECKE	
107	5774	PADERBORN	
108	5911	BOCHUM	*
109	5913	DORTMUND	*
110	5914	HAGEN	*
111	5915	HAMM	*
112	5916	HERNE	*
113	5954	ENNEPE-RUHR-KREIS	*
114	5958	HOCHSAUERLANDKREIS	
115	5962	MARKISCHER KREIS	*
116	5966	OLPE	
117	5970	SIEGEN	
118	5974	SOEST	
119	5978	UNNA	*

HESSEN

AREA	CODE #	MUNICIPALITY	URBAN-AREA (*)
120	6111	DARMSTADT	*
121	6112	FRANKFURT am MAIN	*
122	6115	OFFENBACH am MAIN	*
123	6116	WIESBADEN	*
124	6171	BERGSTRASSE	*
125	6172	DARMSTADT-DIEBURG	*
126	6173	GROSS-GERAU	*
127	6176	HOCHTAUNUSKREIS	*
128	6178	LIMBURG-WEILBURG	
129	6179	MAIN-KINZIG-KREIS	*
130	6180	MAIN-TAUNUS-KREIS	*
131	6181	ODENWALDKREIS	
132	6182	OFFENBACH	*
133	6183	RHEINGAU-TAUNUS-KREIS	
134	6184	VOGELSBERGKREIS	
135	6185	WETTERAUKREIS	
136	6188	GIESSEN	
137	6189	LAHN-DILL-KREIS	
138	6212	KASSEL (City)	*
139	6272	FULDA	
140	6273	HERSFELD-ROTENBURG	
141	6274	KASSEL	
142	6275	MARBURG-BIEDENKOPF	
143	6276	SCHWALM-EDER-KREIS	

AREA	CODE #	MUNICIPALITY	URBAN-AREA (*)
144	6277	WALDECK-FRANKENBERG	
145	6278	WERRA-MEISSNER-KREIS	

RHEINLAND - PFALZ

AREA	CODE #	MUNICIPALITY	URBAN-AREA (*)
146	7111	KOBLENZ	*
147	7131	AHRWEILER	
148	7132	ALTENKIRCHEN (Westerwald)	
149	7133	BAD KREUZNACH	
150	7134	BIRKENFELD	
151	7135	COCHEM-ZELL	
152	7137	MAYEN-KOBLENZ	
153	7138	NEUWIED	
154	7140	RHEIN-HUNSRUCK-KREIS	
155	7141	RHEIN-LAHN-KREIS	
156	7143	WESTERWALDKREIS	
157	7211	TRIER	
158	7231	BERNKASTEL-WITTLICH	
159	7232	BITBURG-PRUM	
160	7233	DAUN	
161	7235	TRIER-SAARBURG	
162	7311	FRANKENTHAL (Pfalz)	*
163	7312	KAISERSLAUTERN (City)	*
164	7313	LANDAU i.d. PFALZ	
165	7314	LUDWIGSHAFEN a. Rh.	*
166	7315	MAINZ	*
167	7316	NEUSTADT an der WEINSTRASSE	*
168	7317	PIRMASENS (Town)	
169	7318	SPEYER	*
170	7319	WORMS	
171	7320	ZWEIBRUCKEN	
172	7331	ALZEY-WORMS	
173	7332	BAD DURKHEIM	*
174	7333	DONNERSBERGKREIS	
175	7334	GERMERSHEIM	
176	7335	KAISERSLAUTERN	
177	7336	KUSEL	
178	7337	SUDLICHE WEINSTRASSE	
179	7338	LUDWIGSHAFEN	*
180	7339	MAINZ-BINGEN	
181	7340	PIRMASENS	

AREA	CODE #	MUNICIPALITY	URBAN-AREA (*)
BADEN - WURTTEMBERG			
182	8111	STUTTGART	*
183	8115	BOBLINGEN	*
184	8116	ESSLINGEN	*
185	8117	GOPPINGEN	*
186	8118	LUDWIGSBURG	*
187	8119	REMS-MURR-KREIS	*
188	8121	HEILBRONN (City)	*
189	8125	HEILBRONN	
190	8126	HOHENLOHEKREIS	
191	8127	SCHWABISCH HALL	
192	8128	MAIN-TAUBER-KREIS	
193	8135	HEIDENHEIM	
194	8136	OSTALBKREIS	
195	8211	BADEN-BADEN	*
196	8212	KARLSRUHE (City)	*
197	8215	KARLSRUHE	*
198	8216	RASTATT	*
199	8221	HEIDELBERG	*
200	8222	MANNHEIM	*
201	8225	NECKAR-ODENWALD-KREIS	
202	8226	RHEIN-NECKAR-KREIS	*
203	8231	PFORZHEIM	*
204	8235	CALW	
205	8236	ENZKREIS	
206	8237	FREUDENSTADT	
207	8311	FREIBURG im BREISGAU	*
208	8315	BREISGAU HOCHSCHWARZWALD	
209	8316	EMMENDINGEN	
210	8317	ORTENAUKREIS	
211	8325	ROTTWEIL	
212	8326	SCHWARZWALD-BAAR-KREIS	
213	8327	TUTTLINGEN	
214	8335	KONSTANZ	
215	8336	LORRACH	
216	8337	WALDSHUT	
217	8415	REUTLINGEN	
218	8416	TUBINGEN	
219	8417	ZOLLERNALBKREIS	
220	8421	ULM	*

AREA	CODE #	MUNICIPALITY	URBAN-AREA (*)
221	8425	ALB-DONAU-KREIS	
222	8426	BIBERACH	
223	8435	BODENSEEKREIS	
224	8436	RAVENSBURG	
225	8437	SIGMARINGEN	

BAYERN

AREA	CODE #	MUNICIPALITY	URBAN-AREA (*)
226	9161	INGOLSTADT	
227	9162	MUNCHEN (City)	*
228	9163	ROSENHEIM	
229	9171	ALTOTTING	
230	9172	BERCHTESGADENER LAND	
231	9173	BAD TOLZ-WOLFRATSHAUSEN	
232	9174	DACHAU	
233	9175	EBERSBERG	*
234	9176	EICHSTATT	
235	9177	ERDING	
236	9178	FREISING	*
237	9179	FURSTENFELDBRUCK	*
238	9180	GARMISCH-PARTENKIRCHEN	
239	9181	LANDSBERG a. LECH	
240	9182	MIESBACH	
241	9183	MUHLDORF a. INN	
242	9184	MUNCHEN	*
243	9185	NEUBURG-SCHROBENHAUSEN	
244	9186	PFAFFENHOFEN a.d. ILM	
245	9187	ROSENHEIM	
246	9188	STARNBERG	*
247	9189	TRAUNSTEIN	
248	9190	WEILHEIM-SCHONGAU	
249	9261	LANDSHUT (Town)	
250	9262	PASSAU (Town)	
251	9263	STRAUBING	
252	9271	DEGGENDORF	
253	9272	FREYUNG-GRAFENAU	
254	9273	KELHEIM	
255	9274	LANDSHUT	
256	9275	PASSAU	
257	9276	REGEN	

AREA	CODE #	MUNICIPALITY	URBAN-AREA (*)
258	9277	ROTTAL-INN	
259	9278	STRAUBING-BOGEN	
260	9279	DINGOLFING-LANDAU	
261	9361	AMBERG (Town)	
262	9362	REGENSBURG (City)	*
263	9363	WEIDEN i.d. OPf.	
264	9371	AMBERG-SULZBACH	
265	9372	CHAM	
266	9373	NEUMARKT i.d. OPf.	
267	9374	NEUSTADT a.d. WALDNAAB	
268	9375	REGENSBURG	
269	9376	SCHWANDORF	
270	9377	TIRSCHENREUTH	
271	9461	BAMBERG (Town)	
272	9462	BAYREUTH (Town)	
273	9463	COBURG (Town)	
274	9464	HOF (Town)	
275	9471	BAMBERG	
276	9472	BAYREUTH	
277	9473	COBURG	
278	9474	FORCHHEIM	
279	9475	HOF	
280	9476	KRONACH	
281	9477	KULMBACH	
282	9478	LICHTENFELS	
283	9479	WUNSIEDEL i. FICHTELGEBIRGE	
284	9561	ANSBACH (Town)	
285	9562	ERLANGEN	*
286	9563	FURTH (City)	*
287	9564	NURNBERG	*
288	9565	SCHWABACH	*
289	9571	ANSBACH	
290	9572	ERLANGEN-HOCHSTADT	*
291	9573	FURTH	*
292	9574	NURNBERGER LAND	*
293	9575	NEUSTADT a.d. Aisch-BAD WINDSHEIM	
294	9576	ROTH	
295	9577	WEISSENBURG-GUNZENHAUSEN	
296	9661	ASCHAFFENBURG (Town)	
297	9662	SCHWEINFURT (Town)	
298	9663	WURZBURG (City)	*
299	9671	ASCHAFFENBURG	

AREA	CODE #	MUNICIPALITY	URBAN-AREA (*)
300	9672	BAD KISSINGEN	
301	9673	RHÖN-GRABFELD	
302	9674	HASSBERGE	
303	9675	KITZINGEN	
304	9676	MILTENBERG	
305	9677	MAIN-SPESSART	
306	9678	SCHWEINFURT	
307	9679	WURZBURG	
308	9761	AUGSBURG (City)	*
309	9762	KAUFBEUREN	
310	9763	KEMPTON (Allgau)	
311	9764	MEMMINGEN	
312	9771	AICHACH-FRIEDBERG	
313	9772	AUGSBURG	
314	9773	DILLINGEN a.d. DONAU	
315	9774	GUNZBURG	
316	9775	NEU-ULM	
317	9776	LINDAU (Bodensee)	
318	9777	OSTALLGAU	
319	9778	UNTERALLGAU	
320	9779	DONAU-RIES	
321	9780	OBERALLGAU	

SAARLAND

322	10041	SAARBRUCKEN	*
323	10042	MERZIG-WADERN	
324	10043	NEUNKIRCHEN	*
325	10044	SAARLOUIS	*
326	10045	SAAR-PFALZ-KREIS	*
327	10046	SANKT WENDEL	

WEST BERLIN

328	11000	BERLIN (West)	*

Note: Urban Areas (*) include all Core Areas of Metropolitan Centres, Suburbs of those Core Areas, and Independent Centres.

(Bundesforschungsanstalt fur Landeskunde und Raumordnung, 1982, p.14-15)

APPENDIX "B"

TRANSLATION OF VARIABLES

The following English translations correspond to the German descriptions provided by the Federal Institute for Regional Analysis and Planning (Bonn). (Bundesforschungsanstalt fur Landeskunde und Raumordnung, 1982, p. 17-25)

X2 DENSITY

Population density is the most highly used density measure to describe the regional population distribution. Also, population density is an indicator of large regional job markets and the regional capacity (or productivity) for highly valued infrastructures, as well as the ecological strain of an area.

X5 DEPENDENCY RATIO

The goal of political area regulations is a balanced population structure (i.e. the sections of the population which are employable and those which are non-employable should stand in a balanced proportion to each other and so enable a tolerable distribution of social burdens). The Dependency Ratio relates the youthful population and the population of 65+ to the productive population. The indicator values show the extent to which demographic conditional social burdens appear.

X7 PERCENT POPULATION 15-65

This indicator describes the demographic employment potential in that it relates the population at the employable age to the total population. From a political, economic and job market point of view, the indicator shows the potential availability factors of work.

X8 EMPLOYMENT RATIO

A sufficient availability of job positions is part of the foundational development of political goals of area regulations. Here, the employed are representative of job positions. High value indicators show a large supply of job positions, indicating good employment opportunities for the dependently employed. The dependently employed account for approximately 75% of all employed in the Federal Republic of Germany.

X9 INDUSTRIAL WORKERS

From a political area regulation point of view, this indicator is ambivalent to put a value to. On one side a high value points to good employment opportunities in the production sector. On the other side, there are many job positions endangered by advancing economic structural change (old industrialized and single structured areas). High values can in this respect indicate a latent structural unemployment potential.

X10 OPPORTUNITY RATIO

This indicator shows the possibilities for the unemployed to find a new job in the labour market. The larger the supply of available jobs, the more favourable the chances are of the unemployed finding a job. A high supply of vacant jobs during high unemployment shows great differences between the supply and demand structure of job positions. (Structural Unemployment).

X11 PERCENT EMPLOYED IN GROWTH SECTOR

The following industries belong to the Growth Sector Industries:

a) chemical industries
b) mechanical engineering
c) automobile industries
d) air vehicle industries
e) fine mechanical and optical industry
f) synthetic material (plastic) processing
g) portions of service performance sectors

Despite economic recession and structural change, these trades show a significant growth in job positions during the last few years. A mid-term continuation of this trend is expected. A high supply of job positions in these trades is therefore stabilized in the job market because the job positions are relatively secure and are also highly valued qualitatively. Indicators with high values are judged positively.

X14 TOTAL UNEMPLOYMENT RATE

High unemployment impairs both social and economic political goal setting equally. The complete extent of this impairment is best expressed by the yearly average unemployment quota. It measures both middle and short term forthcoming economic structural problems which arise from layoffs in the workforce. Those regions especially affected by such structural problems are those with small job markets, a small diversification of trades and an unfavourable location factor.

X15 LONG-TERM UNEMPLOYMENT RATE

The extent of unemployment is determined above all by 2 components: the economic unemployment situation and structural unemployment. The long-term unemployment quota is an indicator of the extent of structural unemployment. It can be traced back to differences in the quality profiles between the supply and demand of work production factors. The risk of being unemployed for a long period of time is even greater for a single person who has few job qualifications and whose line of business is affected by structural change. Indicators with high values thus show friction which results from economic-structural changes in the job market.

X16 NET MIGRATION OF WORKERS

For employable people, economically secure living such as a qualified professional position or work place, stands in the foreground of all considerations in choosing a place to live. A deficiency in secure job positions, as well as a deficiency in professional and social chances of "moving up" lead to the migration of employable people. A high negative balance therefore almost always explains insufficient employment opportunities.

X17 NET MIGRATION RATE 25-30

This is an indicator of insufficient employment possibilities for young employable people. A high negative balance means there is an inadequate and unattractive supply of job positions. It strongly contributes to the migration of young people, by which the development possibilities of the regions in question are are fundamentally diminished as long as it is a question of rural regions or structurally weak regions).

X18 GROSS DOMESTIC PRODUCT PER CAPITA

Economic growth and economic efficiency results from the availability of both production factors--work and capital. Deficient availability of both factors restricts positive economic development. Gross domestic product is a central indicator to the measurement of economic strength and economic growth. It measures those from domestic economic units bringing economic achievement in DM. Indicators with low values show a limited strength in economic performance.

X20 VALUE ADDED TAX -NET-

Besides the revenues from income tax, the revenues from industrial tax for communal task planning are also significant. The industrial tax revenues are dependent on the degree of industrialization and the production structure. High industrial tax revenues are valued positively, as they contribute to the widening of the investment scope in the municipality.

X26 YOUTH UNEMPLOYMENT

Approximately 1/4 of the unemployed are young potential employees under 25 years old. This is especially a social-political problem. A deficiency of training and working places and a subsequent failure to enter into profitable living, causes high individual and social costs. It is to be feared that the young unemployed will increase in the coming years because the strong age group in their late 50's and early 60's will be demanding strengthened training and working places. The indicator makes clear the regional extent of this problem situation. However, one should bear in mind that the actual number of young unemployed could essentially be higher since the indicator considers only those which labour management report as being unemployment cases.

X27 NET MIGRATION RATE 18-25

Interregional migration of people aged 18-25 is mainly comprised of the so-called "education wanderers". The scholastic and professional development is the dominant migration motive for this group. Unsatisfactory professional education possibilities are a decisive causation factor for the migration in this age group. The widespread wish for qualified scholastic and professional education and vocational training causes many young people to migrate out of regions with unsatisfactory education possibilities. High migration losses of those in this age group are negatively valued since they lead to a considerable decrease of human-capital in the region.

X29 PERCENT BUILDINGS WITH 1-2 APARTMENTS

The wish for housing property is widespread. The next most desired individual housing wish is for one or two family housing as it corresponds to intellectual demands with regard to larger living surfaces, better quality housing and friendly living surroundings. The height of these indicators is expressed by the extent to which the housing wishes will be realized, or are able to be realized.

X30 PERCENT BUILDINGS WITH MORE THAN 2 APARTMENTS

Even if the owner-occupied homes represent the favourite type of housing, it is necessary that there is at least a minimal supply of rental-apartments available in order to secure a balanced supply, especially in high density areas. Building good-quality well-equipped apartments in low rise buildings on favourable locations helps to ease the desire of low wage earners presently living in less expensive older homes, to live in new apartments. The interpretation of the indicator values depends on the current apartment-market situation. During a scarcity in housing, high values could lead to a relaxation of the situation in the rental apartment sector. (In a balanced provision, a share of approximately 12-25% is sufficient.)

X32 NET MIGRATION RATE -FAMILIES-

This indicator examines the movement of young grown households with children. Factors such as the location, size, facilities, and price of an apartment, as well as factors such as clean air, little noise, low prices of building construction land and construction costs and light traffic, play an important role in the migration decision of these households.

X33 NUMBER OF RESIDENTS PER DOCTOR

This indicator measures the primary medical care of the population. The primary medical care is best expressed by the function of the family doctor. The more inhabitants a doctor has to care for, the less an intensive medical treatment is guaranteed. Indicators with high values therefore show an insufficient caring situation.

X34 NUMBER OF RESIDENTS PER MEDICAL SPECIALIST

Medical specialists support the degree of primary medical care--both diagnostic and theraputic. This is therefore a question of specialized medical care provision (secondary medical care). The indicator gives an explanation for the care situation in each area. Here, indicators with high values show an insufficient medical care situation.

APPENDIX "C"

As outlined in Chapter Three, a discriminant analysis was first performed on the data, prior to the development of an alternative grouping mechanism. This procedure would classify each observation to a group based on the combination of group means for the predictor variables from each set of interrelated variables. Therefore, each municipality was classified according to the average score of the Länder that it best resembled.

A measure of regional concentration could be derived by analyzing the number of correctly classified observations over each socio-economic indicator. For example, if the municipality of Giessen was found to best resemble the average score for the Länder of Hessen, then it would be considered as a correctly classified case for that particular set of predictor variables. A greater number of correctly classified cases would coincide with stronger levels of regional concentration.

Table C-1 exhibits the number of correctly classified cases for each of the seven socio-economic indicators. The discriminant analysis was first applied with prior proportionate probabilities of group membership. However, this resulted in the majority of groups being classified into the group resembling Bayern. Although Bayern contains 96 of the 328 observations in the data, it was found that there were disproportionate numbers of observations being classified into this category. In fact, all 328 observations from the Youth Migration variable were classified into Bayern because of the weighted probabilities.

In the second procedure, the groups were given equal prior probabilities of group membership. This biased the results in the direction of the smaller Länder. Here, the set of Unemployment variables were found to contain the highest percentage (42.99), followed by the sets of General Economic, Urban/Housing, General Migration and the Health variables. The set of Population Structure variables and the Youth Migration variables showed the least number of correctly classified cases at 8.23 percent respectively. These findings suggested that the greatest regional concentrations still occurred over the set of interrelated unemployment variables. Similarly, the Youth Migration and Population Structure variables reflected higher levels of regional dispersion.

The ideal groups that were derived from the discriminant analysis were based on the original existing group means for the Länder in the Federal Republic of Germany. The observations in each new group resembled the existing previous Länder structure. In this way, the group memberships were biased by the existing regional structure.

Unless arbitrarily forced on the data, the discriminant analysis would not necessarily generate an output that consisted of the equivalent number of groupings for each indicator. Although there were eleven groups in the existing regional structure of West Germany, it was possible to obtain results that had less than eleven groups, if there were no individual observations resembling an original group mean. This occurred in the output for the Population Structure variables. In this case, there were no individual observations resembling the original Länder of Nordrhein - Westfalen, Hessen, Rheinland - Pfalz, or Baden - Wurttemberg.

Table C-2 exhibits the F-ratios that were derived using ANOVA with the output from the discriminant analysis. The ideal F-ratios were found to be consistently lower than those in table 4.1 for the alternate grouping procedure. However, many of the trends were still evident such as the unemployment variable's higher ratio of existing to ideal F-ratios. The lower ideal F-ratios in table C-2 reflected less than optimal results compared with those in table 4.2, as higher F-ratios distinguished groups that possessed lower internal variation and greater external variations between groups.

APPENDIX "C"

TABLE C-1

SOCIO-ECONOMIC INDICATOR	% OF CORRECTLY CLASSIFIED CASES	
	PRIOR EQUAL PROBABILITIES	PRIOR PROPORTIONATE PROBABILITIES
POPULATION STRUCTURE INDICATOR	8.23	31.10
GENERAL ECONOMIC INDICATOR	22.26	32.01
URBAN/HOUSING INDICATOR	20.43	33.84
UNEMPLOYMENT INDICATOR	42.99	53.66
GENERAL MIGRATION INDICATOR	17.07	28.35
HEALTH INDICATOR	16.16	35.06
YOUTH MIGRATION INDICATOR	8.23	29.96

TABLE C-2 APPENDIX "C"

RESULTS FROM DISCRIMINANT ANALYSIS IDEAL GROUPINGS

EXISTING REGIONAL STRUCTURE VS. IDEAL STRUCTURE (BY VARIABLE)

VARIABLE	EXISTING F-RATIO	IDEAL F-RATIO	EXISTING / IDEAL F-RATIO x100
1. POPULATION STRUCTURE INDICATOR			
X5 Dependency Ratio	6.563*	511.568*	1.28
X7 % Population 15-65	6.314*	449.081*	1.41
2. GENERAL ECONOMIC INDICATOR			
X8 Employment Ratio	1.755	52.189*	3.36
X11 % Employed in Growth Sector	1.744	49.800*	3.50
X9 Industrial Workers	3.125*	29.753*	10.50
X20 Business Tax -Net-	2.207*	37.171*	5.94
X18 G.D.P. per Capita	1.573	50.146*	3.14
3. URBAN/HOUSING INDICATOR			
X30 % Housing With G.T. 2 Apts.	6.473*	92.089*	7.03
X29 % Housing With 1-2 Apts.	6.473*	92.089*	7.03
X2 Density	8.564*	233.706*	3.66
4. UNEMPLOYMENT INDICATOR			
X26 Youth Unemployment Rate	33.099*	82.542*	40.10
X14 Total Unemployment Rate	19.509*	51.085*	38.19
X10 Opportunity Ratio	14.715*	48.143*	30.57
X15 Long-term Unemployment Rate	33.837*	118.491*	28.56
5. GENERAL MIGRATION INDICATOR			
X16 Net Migration-Workers-	2.540*	43.346*	5.86
X17 Net Migration- 25-30 -	2.108*	33.206*	6.35
X32 Net Migration-Families-	2.168*	55.154*	3.93
6. HEALTH INDICATOR			
X34 # Residents/Medical Specialist	3.489*	39.140*	8.91
X33 # Residents/Doctor	1.756	125.417*	1.40
7. YOUTH MIGRATION INDICATOR			
X27 Net Migration- 18-25 -	1.165	168.540*	0.69

* SIGNIFICANT AT $\alpha = .05$ DEGREES OF FREEDOM = 10, 327.

APPENDIX "D"

COMPUTER PROGRAM

```
      REAL DATA(328,20),SAVE(328)
      INTEGER I,J,POS(328,2),STORE(328),DIM,OPT(11),
     *               ABMIN(11),TPOS(328,2)
      DO 50 I=1,328
      READ (5,10)STORE(I),(DATA(I,J),J=1,20)
10    FORMAT(I8,2X,F14.4,28X,F14.4,14X/
     *10X,5F14.4/38X,3F14.4/10X,2F14.4,14X,F14.4,14X/
     *66X,F14.4/10X,F14.4,14X,2F14.4,14X/10X,3F14.4,28X/
     *80X)
50    CONTINUE
      DO 55 DIM=1,7
      DO 60 I=1,328
      POS(I,1)=STORE(I)
      POS(I,2)=I
*     POPULATION STRUCTURE INDICATOR
      IF (DIM.EQ.1) THEN
      SAVE(I)=(((DATA(I,3)-66.1115)/2.0005)*.6865)-
     *        (((DATA(I,2)-51.3950)/4.5183)*.6936)
      WRITE(6,15)POS(I,1),SAVE(I)
      ENDIF
*     ECONOMIC INDICATOR
      IF (DIM.EQ.2) THEN
      SAVE(I)=(((DATA(I,4)-485.8843)/170.5170)*.6569)+
     *        (((DATA(I,5)-180.0505)/95.7183)*.6315)+
     *        (((DATA(I,7)-251.4834)/135.4046)*.6372)+
     *        (((DATA(I,12)-19082.3943)/7428.9858)*.5698)+
     *        (((DATA(I,13)-295.7112)/158.3661)*.5765)
      WRITE(6,15)POS(I,1),SAVE(I)
      ENDIF
*     HOUSING INDICATOR
      IF (DIM.EQ.3) THEN
      SAVE(I)=(((DATA(I,1)-563.0021)/735.9389)*.5216)-
     *        (((DATA(I,16)-92.3852)/6.5334)*.7241)+
     *        (((DATA(I,17)-7.6146)/6.5333)*.7241)
      WRITE(6,15)POS(I,1),SAVE(I)
      ENDIF
*     UNEMPLOYMENT INDICATOR
      IF (DIM.EQ.4) THEN
      SAVE(I)=(((DATA(I,6)-57.3426)/37.5029)*.6531)-
```

```
     *          (((DATA(I,14)-38.4211)/11.5292)*.8744)-
     *          (((DATA(I,8)-8.9059)/2.8168)*.6852)-
     *          (((DATA(I,9)-8.6837)/4.5172)*.6061)
      WRITE(6,15)POS(I,1),SAVE(I)
      ENDIF
*     GENERAL MIGRATION INDICATOR
      IF (DIM.EQ.5) THEN
      SAVE(I)=(((DATA(I,10)-.2566)/4.7235)*.7799)+
     *          (((DATA(I,11)-3.0170)/15.4430)*.6885)+
     *          (((DATA(I,18)-1.5234)/6.6821)*.6000)
      WRITE(6,15)POS(I,1),SAVE(I)
      ENDIF
*     HEALTH INDICATOR
      IF (DIM.EQ.6) THEN
      SAVE(I)=(((DATA(I,19)-1183.7449)/371.9313)*.4981)+
     *          (((DATA(I,20)-1655.1755)/1563.8920)*.5986)
      WRITE(6,15)POS(I,1),SAVE(I)
      ENDIF
*     YOUTH MIGRATION INDICATOR
      IF (DIM.EQ.7) THEN
          SAVE(I)=(((DATA(I,15)+6.0292)/25.3857)*.5879)
          WRITE(6,15)POS(I,1),SAVE(I)
          ENDIF
60        CONTINUE
15        FORMAT(I12,F10.4)
          CALL SORT(SAVE,POS)
          CALL IDEAL(SAVE,OPT,ABMIN)
          WRITE(6,20)(OPT(J),J=1,11)
20        FORMAT(11I5)
          DO 21 I=1,328
          TPOS(I,1)=POS(I,1)
          TPOS(I,2)=POS(I,2)
21        CONTINUE
          CALL PRINT(POS,SAVE,DATA,OPT,DIM)
          WRITE(6,20)(ABMIN(J),J=1,11)
          CALL PRINT(TPOS,SAVE,DATA,ABMIN,DIM)
55        CONTINUE
          END
*
*
*
*
          SUBROUTINE SORT(SAVE,POS)                        1
          REAL TEMP,SAVE(328)
          INTEGER K,KK,L,LL,POS(328,2),T(2)
```

```
      DO 100 L=1,164
      LL=165-L
      CALL HEAPIFY(LL,328,SAVE,POS)
100   CONTINUE
      DO 110 K=1,327
      KK=329-K
      TEMP=SAVE(1)
      T(1)=POS(1,1)
      T(2)=POS(1,2)
      SAVE(1)=SAVE(KK)
      POS(1,1)=POS(KK,1)
      POS(1,2)=POS(KK,2)
      SAVE(KK)=TEMP
      POS(KK,1)=T(1)
      POS(KK,2)=T(2)
      CALL HEAPIFY(1,KK-1,SAVE,POS)
110   CONTINUE
      TEMP=SAVE(1)
      T(1)=POS(1,1)
      T(2)=POS(1,2)
      SAVE(1)=SAVE(2)
      POS(1,1)=POS(2,1)
      POS(1,2)=POS(2,2)
      SAVE(2)=TEMP
      POS(2,1)=T(1)
      POS(2,2)=T(2)
      RETURN
      END
*
*
*
*
      SUBROUTINE HEAPIFY(A,B,SAVE,POS)                         1
      REAL TEMP, SAVE(328)
      INTEGER A,B,V,M,C,POS(328,2),T(2)
      C=INT(B/2)
      DO 200 V=A,C
      M=2*V
      IF (M.LT.B) THEN
      IF (SAVE(M).GT.SAVE(M+1)) THEN
      M=M+1
      ENDIF
      ENDIF
      IF (SAVE(V).GT.SAVE(M)) THEN
      TEMP=SAVE(V)
```

```
      T(1)=POS(V,1)
      T(2)=POS(V,2)
      SAVE(V)=SAVE(M)
      POS(V,1)=POS(M,1)
      POS(V,2)=POS(M,2)
      SAVE(M)=TEMP
      POS(M,1)=T(1)
      POS(M,2)=T(2)
      V=M-1
      ELSE
      V=C
      ENDIF
      IF (V.GE.C) GO TO 300
200   CONTINUE
300   RETURN
      END
*
*
*
*
      SUBROUTINE IDEAL(SAVE,OPT,ABMIN)
      INTEGER FLAG,NUM(11),RANGE(11,2),I,OPT(11),MAJ,J,ABMIN(11)
      REAL SAVE(328),SUM(11,2),SSD,SD(11),TV,LAST,MIN
      FLAG=0
      LAST=999999.99
      MIN=LAST
      CALL INIT(SUM,NUM,RANGE,OPT,SD,ABMIN)
850   MAJ=0
      CALL STAT(SAVE,SUM,RANGE,NUM,SSD,MAJ,SD,TV)
      WRITE(6,805)LAST,TV
805   FORMAT(2F10.3)
      IF (MAJ.GE.5.OR.LAST.GE.TV) THEN
      CALL SAVER(RANGE,TV,MIN,ABMIN)
      DO 900 I=1,11
      OPT(I)=RANGE(I,2)
900   CONTINUE
      CALL PARTITION(SUM,RANGE,SAVE,NUM)
      DO 910 J=1,11
      SUM(J,1)=0.0
      SUM(J,2)=0.0
910   CONTINUE
      LAST=TV
      ELSE
      FLAG=1
      ENDIF
```

```
      IF (FLAG.EQ.0) GO TO 850
      RETURN
      END
*
*
*
*
      SUBROUTINE PARTITION(SUM,RANGE,SAVE,NUM)
      INTEGER TEMP,MID,I,RANGE(11,2),NUM(11)
      REAL SUM(11,2),MEAN,SAVE(328)
      TEMP=1
      MID=0
      DO 800 I=1,10
      MEAN=(SUM(I,1)+SUM(I+1,1))/(NUM(I)+NUM(I+1))
      CALL SEARCH(RANGE(I,1),RANGE(I+1,2),MID,MEAN,SAVE)
      RANGE(I,1)=TEMP
      RANGE(I,2)=MID
      NUM(I)=RANGE(I,2)-RANGE(I,1)+1
      TEMP=MID+1
800   CONTINUE
      RANGE(11,1)=TEMP
      RANGE(11,2)=328
      NUM(11)=RANGE(11,2)-RANGE(11,1)+1
      RETURN
      END
*
*
*
*
      SUBROUTINE SEARCH(HIGH,LOW,MID,MEAN,SAVE)              2
      INTEGER FOUND,TEMP1,TEMP2,HIGH,LOW,MID
      REAL SAVE(328),MEAN
      FOUND=0
      TEMP1=HIGH
      TEMP2=LOW
750   MID=INT(((HIGH+LOW)/2))
      IF (SAVE(HIGH).EQ.MEAN) THEN
      MID=HIGH
      FOUND=1
      ELSE
      IF (SAVE(LOW).EQ.MEAN) THEN
      MID=LOW
      FOUND=1
      ELSE
      IF (SAVE(MID).EQ.MEAN) THEN
```

```
      FOUND=1
      ELSE
      IF (SAVE(MID).GT.MEAN) THEN
      HIGH=MID+1
      LOW=LOW-1
      ELSE
      HIGH=HIGH+1
      LOW=MID-1
      ENDIF
      ENDIF
      ENDIF
      ENDIF
      IF (HIGH.GT.LOW) THEN
      FOUND=1
      ENDIF
      IF (FOUND.NE.1) GO TO 750
      HIGH=TEMP1
      LOW=TEMP2
      RETURN
      END
*
*
*
*
      SUBROUTINE INIT(SUM,NUM,RANGE,OPT,SD,ABMIN)
      REAL SUM(11,2),SD(11)
      INTEGER NUM(11),RANGE(11,2),L,U,Y,OPT(11),ABMIN(11)
      U=1
      L=0
      DO 500 Y=1,9
      L=L+30
      NUM(Y)=30
      SD(Y)=99999.99
      SUM(Y,1)=0.0
      SUM(Y,2)=0.0
      RANGE(Y,1)=U
      RANGE(Y,2)=L
      OPT(Y)=L
      ABMIN(Y)=L
      U=U+30
500   CONTINUE
      DO 510 Y=10,11
      L=L+29
      NUM(Y)=29
      SD(Y)=99999.99
```

```
      SUM(Y,1)=0.0
      SUM(Y,2)=0.0
      RANGE(Y,1)=U
      RANGE(Y,2)=L
      OPT(Y)=L
      ABMIN(Y)=L
      U=U+29
510   CONTINUE
      RETURN
      END
*
*
*
*
      SUBROUTINE STAT(SAVE,SUM,RANGE,NUM,SSD,MAJ,SD,TV)
      REAL SAVE(328),SUM(11,2),SSD,SD(11),A,B,C,D,TV
      INTEGER I,RANGE(11,2),Y,NUM(11),MAJ
      DO 600 I=RANGE(1,1),RANGE(1,2)
      SUM(1,1)=SUM(1,1)+SAVE(I)
      SUM(1,2)=SUM(1,2)+(SAVE(I)**2)
600   CONTINUE
      DO 610 I=RANGE(2,1),RANGE(2,2)
      SUM(2,1)=SUM(2,1)+SAVE(I)
      SUM(2,2)=SUM(2,2)+(SAVE(I)**2)
610   CONTINUE
      DO 620 I=RANGE(3,1),RANGE(3,2)
      SUM(3,1)=SUM(3,1)+SAVE(I)
      SUM(3,2)=SUM(3,2)+(SAVE(I)**2)
620   CONTINUE
      DO 630 I=RANGE(4,1),RANGE(4,2)
      SUM(4,1)=SUM(4,1)+SAVE(I)
      SUM(4,2)=SUM(4,2)+(SAVE(I)**2)
630   CONTINUE
      DO 640 I=RANGE(5,1),RANGE(5,2)
      SUM(5,1)=SUM(5,1)+SAVE(I)
      SUM(5,2)=SUM(5,2)+(SAVE(I)**2)
640   CONTINUE
      DO 650 I=RANGE(6,1),RANGE(6,2)
      SUM(6,1)=SUM(6,1)+SAVE(I)
      SUM(6,2)=SUM(6,2)+(SAVE(I)**2)
650   CONTINUE
      DO 660 I=RANGE(7,1),RANGE(7,2)
      SUM(7,1)=SUM(7,1)+SAVE(I)
      SUM(7,2)=SUM(7,2)+(SAVE(I)**2)
660   CONTINUE
```

```
      DO 670  I=RANGE(8,1),RANGE(8,2)
      SUM(8,1)=SUM(8,1)+SAVE(I)
      SUM(8,2)=SUM(8,2)+(SAVE(I)**2)
670   CONTINUE
      DO 680  I=RANGE(9,1),RANGE(9,2)
      SUM(9,1)=SUM(9,1)+SAVE(I)
      SUM(9,2)=SUM(9,2)+(SAVE(I)**2)
680   CONTINUE
      DO 690  I=RANGE(10,1),RANGE(10,2)
      SUM(10,1)=SUM(10,1)+SAVE(I)
      SUM(10,2)=SUM(10,2)+(SAVE(I)**2)
690   CONTINUE
      DO 700  I=RANGE(11,1),RANGE(11,2)
      SUM(11,1)=SUM(11,1)+SAVE(I)
      SUM(11,2)=SUM(11,2)+(SAVE(I)**2)
700   CONTINUE
      SSD=0.0
      TV=0.0
      DO 710  Y=1,11
      A=(SUM(Y,1)**2)/(FLOAT(NUM(Y)))
      B=SUM(Y,2)-A
      C=B/(FLOAT(NUM(Y)-1))
      D=SQRT(C)
      IF (D.LE.SD(Y)*0.9375) THEN
      MAJ=MAJ+1
      ENDIF
      IF (D.GE.SD(Y)*1.0625) THEN
      MAJ=MAJ+1
      ENDIF
      SD(Y)=D
      SSD=SSD+SD(Y)
      TV=TV+((SD(Y)**2)*(NUM(Y)-1))
710   CONTINUE
      WRITE(6,720)(SD(Y),Y=1,11),TV
720   FORMAT(11F6.3,2X,F9.2)
      RETURN
      END
*
*
*
*
      SUBROUTINE PRINT(POS,SAVE,DATA,OPT,DIM)
      INTEGER POS(328,2),I,J,K,DIM,OPT(11)
      REAL DATA(328,20),SAVE(328)
      J=1
```

```
      DO 950 I=1,328
      POS(I,1)=POS(I,1)*100
      IF (I.GT.OPT(J)) THEN
      J=J+1
      ENDIF
      POS(I,1)=POS(I,1)+J
      K=POS(I,2)
      IF (DIM.EQ.1) THEN
      WRITE(6,970)POS(I,1),DATA(K,2),DATA(K,3),SAVE(I)
      ELSE
      IF (DIM.EQ.2) THEN
      WRITE(6,971)POS(I,1),DATA(K,4),DATA(K,5),DATA(K,7),DATA(K,12)
     *                    ,DATA(K,13),SAVE(I)
      ELSE
      IF (DIM.EQ.3) THEN
      WRITE(6,972)POS(I,1),DATA(K,1),DATA(K,16),DATA(K,17),SAVE(I)
      ELSE
      IF (DIM.EQ.4) THEN
      WRITE(6,973)POS(I,1),DATA(K,6),DATA(K,8),DATA(K,9),DATA(K,14)
     *                    ,SAVE(I)
      ELSE
      IF (DIM.EQ.5) THEN
      WRITE(6,972)POS(I,1),DATA(K,10),DATA(K,11),DATA(K,18),SAVE(I)
      ELSE
      IF (DIM.EQ.6) THEN
      WRITE(6,970)POS(I,1),DATA(K,19),DATA(K,20),SAVE(I)
      ELSE
      IF (DIM.EQ.7) THEN
      WRITE(6,974)POS(I,1),DATA(K,15),SAVE(I)
      ENDIF
      ENDIF
      ENDIF
      ENDIF
      ENDIF
      ENDIF
      ENDIF
950   CONTINUE
970   FORMAT(I12,3X,2F12.4,F10.4)
971   FORMAT(I12,3X,5F11.4,F10.4)
972   FORMAT(I12,3X,3F12.4,F10.4)
973   FORMAT(I12,3X,4F12.4,F10.4)
974   FORMAT(I12,3X,F12.4,F10.4)
      RETURN
      END
*
```

```
*
*
*
      SUBROUTINE SAVER(RANGE,TV,MIN,ABMIN)
      REAL MIN,TV
      INTEGER I,ABMIN(11),RANGE(11,2)
      IF (TV.LE.MIN) THEN
      DO 920 I=1,11
      ABMIN(I)=RANGE(I,2)
920   CONTINUE
      MIN=TV
      ENDIF
      RETURN
      END
```

SOURCE:

1. Aho, V. and Hopcroft, J. and Ullman, J; <u>Data Structures and Algorithms</u>: Addison Wesley; Don Mills, Ontario; 1983. pp. 273-274.

2. Dytk, V. and Lawson, J. and Smith, J.; <u>Introduction to Computing: Structured Problem Solving Using WATFIV-S</u>; Reston Publishing (Prentice Hall); Virginia; 1979. pp. 239.

APPENDIX "E"

RESULTS FROM THE GROUPING PROCEDURE (BY MUNICIPALITY)

NOTE: A - Population Structure Indicator
B - General Economic Indicator
C - Urban/Housing Indicator
D - Unemployment Indicator
E - General Migration Indicator
F - Health Indicator
G - Youth Migration Indicator

The results for each municipality are displayed according to the group that they were classified in by each set of socio-economic variables. They are numbered from 1 to 11, where Group 1 represents the best conditions for the variables through to Group 11 representing the worst conditions.

LIST OF MUNICIPALITIES — SOCIO-ECONOMIC INDICATORS

CENSUS	MUNICIPALITY	A	B	C	D	E	F	G
	SCHLESWIG - HOLSTEIN							
1	FLENSBURG	7	3	4	11	10	2	2
2	KIEL (*)	5	3	3	8	11	2	1
3	LUBECK (*)	9	4	4	8	9	2	4
4	NEUMUNSTER (*)	10	4	4	10	9	3	4
5	DITHMARSCHEN	11	7	8	10	2	5	8
6	HERZOGTUM LAUENBURG	8	10	8	3	2	7	5
7	NORDFRIESLAND	6	9	6	10	3	5	5
8	OSTHOLSTEIN	7	10	6	8	1	5	7
9	PINNEBERG (*)	3	7	8	6	3	6	4
10	PLON	7	11	9	9	3	7	8
11	RENDSBURG-ECKERNFORDE	7	10	9	9	3	6	5
12	SCHLESWIG-FLENSBURG	9	10	8	11	4	8	7
13	SEGEBERG	4	8	9	9	1	8	4
14	STEINBURG	10	7	9	6	4	8	6
15	STORMARN	4	7	8	4	1	7	3

CENSUS	MUNICIPALITY	A	B	C	D	E	F	G
HAMBURG								
16	HAMBURG (*)	5	2	3	5	10	1	3
NIEDERSACHSEN								
17	BRAUNSCHWEIG (*)	5	3	2	10	10	3	2
18	SALZGITTER (*)	6	2	7	10	10	6	11
19	WOLFSBURG (*)	1	1	5	5	10	6	11
20	GIFHORN	6	9	11	5	1	10	8
21	GOTTINGEN	2	6	7	8	10	3	1
22	GOSLAR	8	7	5	6	9	4	4
23	HELMSTEDT	10	9	10	7	5	8	8
24	NORTHEIM	11	6	8	9	7	6	10
25	OSTERODE am HARZ	11	5	6	9	8	6	10
26	PEINE	9	7	9	9	3	9	8
27	WOLFENBUTTEL	8	10	8	10	6	7	8
28	HANNOVER (City) (*)	4	1	3	8	11	2	2
29	DIEPHOLZ	7	9	8	7	2	10	8
30	HAMELN-PYRMONT	11	4	6	9	8	4	10
31	HANNOVER	4	10	7	8	3	9	5
32	HILDESHEIM	8	5	6	9	7	5	5
33	HOLZMINDEN	11	5	10	9	6	9	8
34	NIENBURG (Weser)	9	8	9	7	7	8	8
35	SCHAUMBURG	9	9	7	9	3	5	7
36	CELLE	9	5	8	7	4	5	8
37	CUXHAVEN	8	11	10	8	3	8	8
38	HARBURG	4	11	9	6	1	9	4
39	LUCHOW-DANNENBERG	11	10	10	9	1	8	11
40	LUNEBURG	6	7	8	6	3	6	4
41	OSTERHOLZ	4	11	11	8	2	10	6
42	ROTENBURG (Wumme)	8	9	10	8	2	8	5
43	SOLTAU-FALLINGBOSTEL	8	7	8	8	6	9	5
44	STADE	7	7	10	9	1	8	4
45	UELZEN	11	9	10	9	3	4	8
46	VERDEN	7	8	10	7	2	8	7
47	DELMENHORST (*)	6	7	6	9	8	4	3
48	EMDEN	7	1	8	11	10	5	6
49	OLDENBURG (Obg) (City) (*)	5	3	4	9	6	3	2
50	OSNABRUCK (*)	5	2	3	7	9	1	2
51	WILHELMSHAVEN (*)	6	4	4	11	7	4	2
52	AMMERLAND	7	9	7	9	1	8	8
53	AURICH	9	10	8	11	3	9	7

CENSUS MUNICIPALITY	A	B	C	D	E	F	G
54 CLOPPENBURG	11	8	8	10	6	10	11
55 EMSLAND	11	6	9	11	5	9	10
56 FRIESLAND	7	7	8	11	4	9	8
57 GRAFSCHAFT BENTHEIM	10	7	8	10	6	7	10
58 LEER	10	10	11	11	4	9	6
59 OLDENBURG (Oldenburg)	7	10	9	9	1	10	5
60 OSNABRUCK	10	8	7	7	3	8	8
61 VECHTA	10	6	8	10	6	8	8
62 WESERMARSCH	7	4	9	9	7	9	10
63 WITTMUND	8	10	9	11	4	10	6
BREMEN							
64 BREMEN(*)	5	2	3	9	8	3	4
65 BREMERHAVEN (*)	5	5	4	8	9	5	4
NORDRHEIN - WESTFALEN							
66 DUSSELDORF (*)	2	1	1	4	9	1	3
67 DUISBURG (*)	3	3	1	10	10	6	7
68 ESSEN (*)	4	4	1	8	9	2	5
69 KREFELD (*)	5	2	3	9	4	4	4
70 MONCHENGLADBACH (*)	3	4	2	6	5	4	3
71 MULHEIM a.d. RUHR (*)	3	4	2	8	9	5	8
72 OBERHAUSEN (*)	2	5	2	7	8	6	6
73 REMSCHEID (*)	5	3	4	6	8	5	8
74 SOLINGEN (*)	6	4	2	5	8	4	7
75 WUPPERTAL (*)	5	3	3	7	7	4	3
76 KLEVE	5	9	7	7	3	7	8
77 METTMANN (*)	2	6	5	5	3	6	6
78 NEUSS (*)	2	6	5	7	6	7	6
79 VIERSEN (*)	4	8	6	9	6	7	9
80 WESEL (*)	3	7	5	7	5	8	10
81 AACHEN (City) (*)	1	4	3	9	11	2	1
82 BONN (*)	1	4	4	3	9	1	1
83 KOLN (*)	2	2	2	11	10	2	2
84 LEVERKUSEN (*)	2	1	3	5	9	4	7
85 AACHEN (*)	3	9	5	10	7	8	5
86 DUREN	3	6	8	9	5	6	7
87 ERFTKREIS (*)	2	6	8	6	3	8	5
88 EUSKIRCHEN	4	9	8	6	3	6	9
89 HEINSBERG	3	10	9	10	5	9	8
90 OBERBERGISCHER KREIS	6	5	8	6	3	4	6

CENSUS	MUNICIPALITY	A	B	C	D	E	F	G
91	RHEIN.-BERG. KREIS (*)	3	9	6	6	3	6	7
92	RHEIN-SIEG-KREIS (*)	3	10	7	3	1	6	4
93	BOTTROP (*)	3	9	2	10	8	8	8
94	GELSENKIRCHEN (*)	4	4	1	10	10	7	7
95	MUNSTER (Westf.) (*)	1	4	5	4	10	2	1
96	BORKEN	8	6	9	8	5	8	8
97	COESFELD	5	10	8	8	3	9	5
98	RECKLINGHAUSEN (*)	3	7	3	9	7	8	7
99	STEINFURT	7	8	7	9	7	8	8
100	WARENDORF	5	6	7	7	6	8	8
101	BIELEFELD (*)	5	3	4	6	9	4	3
102	GUTERSLOH	6	4	5	5	5	8	7
103	HERFORD (*)	8	4	6	6	7	7	6
104	HOXTER	10	9	7	8	7	7	9
105	LIPPE (*)	9	6	7	8	6	5	5
106	MINDEN-LUBBECKE	9	5	6	6	6	6	9
107	PADERBORN	6	6	6	8	6	6	3
108	BOCHUM (*)	2	4	1	10	9	6	4
109	DORTMUND (*)	3	4	3	10	9	4	4
110	HAGEN (*)	4	4	2	8	10	4	7
111	HAMM (*)	5	6	5	9	9	6	8
112	HERNE (*)	4	7	1	10	9	7	6
113	ENNEPE-RUHR-KREIS (*)	4	4	4	8	6	6	6
114	HOCHSAUERLANDKREIS	8	6	5	6	8	8	11
115	MARKISCHER KREIS (*)	6	4	4	9	7	6	9
116	OLPE	6	6	9	6	7	9	9
117	SIEGEN	5	4	8	6	9	7	6
118	SOEST	7	6	6	7	6	6	9
119	UNNA (*)	4	7	5	10	11	9	11
	HESSEN							
120	DARMSTADT (*)	3	1	4	3	9	1	1
121	FRANKFURT am MAIN (*)	2	1	1	1	9	2	3
122	OFFENBACH am MAIN (*)	4	2	4	3	9	3	4
123	WIESBADEN (*)	4	3	3	3	4	2	3
124	BERGSTRASSE (*)	4	9	8	3	4	8	6
125	DARMSTADT-DIEBURG (*)	3	10	8	3	2	10	3
126	GROSS-GERAU (*)	1	3	8	3	9	7	5
127	HOCHTAUNUSKREIS (*)	4	6	6	2	1	4	5
128	LIMBURG-WEILBURG	8	9	9	3	3	6	6
129	MAIN-KINZIG-KREIS (*)	4	6	8	3	4	6	7
130	MAIN-TAUNUS-KREIS (*)	1	7	7	1	5	6	5

CENSUS	MUNICIPALITY	A	B	C	D	E	F	G
131	ODENWALDKREIS	8	6	11	3	2	8	5
132	OFFENBACH (*)	1	5	5	2	6	8	5
133	RHEINGAU-TAUNUS-KREIS	4	9	7	3	2	6	4
134	VOGELSBERGKREIS	9	9	10	5	6	7	10
135	WETTERAUKREIS	5	10	9	4	5	6	5
136	GIESSEN	2	5	9	4	10	5	2
137	LAHN-DILL-KREIS	6	4	10	6	7	7	6
138	KASSEL (City) (*)	7	2	4	8	9	2	3
139	FULDA	9	7	7	6	7	5	6
140	HERSFELD-ROTENBURG	9	6	10	6	6	7	10
141	KASSEL	5	8	9	8	1	10	5
142	MARBURG-BIEDENKOPF	3	7	9	4	10	5	2
143	SCHWALM-EDER-KREIS	8	10	11	7	4	9	9
144	WALDECK-FRANKENBERG	9	6	7	3	4	5	7
145	WERRA-MEISSNER-KREIS	10	8	8	7	7	6	8
	RHEINLAND - PFALZ							
146	KOBLENZ (*)	3	2	2	4	9	1	3
147	AHRWEILER	8	9	6	8	5	5	8
148	ALTENKIRCHEN (Westerwald)	7	7	8	7	7	9	10
149	BAD KREUZNACH	8	6	9	9	5	5	6
150	BIRKENFELD	5	6	6	9	8	6	7
151	COCHEM-ZELL	9	9	9	4	9	8	9
152	MAYEN-KOBLENZ	4	8	8	6	8	7	7
153	NEUWIED	6	6	7	7	3	5	8
154	RHEIN-HUNSRUCK-KREIS	8	8	9	7	6	8	10
155	RHEIN-LAHN-KREIS	7	9	10	5	4	6	7
156	WESTERWALDKREIS	7	7	11	5	4	9	7
157	TRIER	4	3	4	8	11	1	2
158	BERNKASTEL-WITTLICH	9	8	7	9	7	8	10
159	BITBURG-PRUM	10	10	7	9	7	9	10
160	DAUN	10	9	9	9	4	9	10
161	TRIER-SAARBURG	5	11	10	8	6	10	8
162	FRANKENTHAL (Pfalz) (*)	3	2	3	4	9	3	7
163	KAISERSLAUTERN (City) (*)	3	2	5	7	10	3	2
164	LANDAU i.d. PFALZ	5	4	5	4	9	1	9
165	LUDWIGSHAFEN a. Rh. (*)	3	1	4	4	10	3	5
166	MAINZ (*)	1	2	5	3	5	1	2
167	NEUSTADT/WEINSTRASSE (*)	8	6	6	5	6	2	9
168	PIRMASENS (Town)	8	2	6	7	11	2	10
169	SPEYER (*)	3	2	4	4	6	3	7
170	WORMS	7	4	6	4	9	3	3

CENSUS	MUNICIPALITY	A	B	C	D	E	F	G
171	ZWEIBRUCKEN	7	3	5	7	9	3	8
172	ALZEY-WORMS	6	11	10	4	3	10	9
173	BAD DURKHEIM (*)	5	10	9	5	2	6	11
174	DONNERSBERGKREIS	7	9	9	7	3	10	8
175	GERMERSHEIM	3	3	9	4	7	10	4
176	KAISERSLAUTERN	4	11	9	7	6	10	9
177	KUSEL	6	11	10	7	7	10	10
178	SUDLICHE WEINSTRASSE	6	10	7	5	3	9	10
179	LUDWIGSHAFEN (*)	2	11	8	4	1	11	6
180	MAINZ-BINGEN	5	7	8	4	3	6	4
181	PIRMASENS	5	9	9	7	4	11	9

BADEN - WURTTEMBERG

CENSUS	MUNICIPALITY	A	B	C	D	E	F	G
182	STUTTGART (*)	2	1	1	1	9	2	2
183	BOBLINGEN (*)	2	2	5	1	3	6	4
184	ESSLINGEN (*)	2	3	5	1	7	5	4
185	GOPPINGEN (*)	6	3	6	1	5	5	6
186	LUDWIGSBURG (*)	3	4	5	1	5	7	5
187	REMS-MURR-KREIS (*)	4	4	5	1	4	7	6
188	HEILBRONN (City) (*)	4	2	4	3	10	3	4
189	HEILBRONN	6	5	8	3	2	9	6
190	HOHENLOHEKREIS	8	4	8	2	6	9	10
191	SCHWABISCH HALL	9	4	10	2	8	7	11
192	MAIN-TAUBER-KREIS	9	5	9	2	7	4	6
193	HEIDENHEIM	7	3	8	3	6	6	9
194	OSTALBKREIS	8	4	8	3	7	7	7
195	BADEN-BADEN (*)	10	2	3	2	6	1	11
196	KARLSRUHE (City) (*)	2	2	3	3	10	2	2
197	KARLSRUHE (*)	3	6	7	3	3	8	5
198	RASTATT (*)	4	3	7	2	6	7	8
199	HEIDELBERG (*)	1	3	3	3	9	1	1
200	MANNHEIM (*)	2	1	4	3	10	2	3
201	NECKAR-ODENWALD-KREIS	7	6	11	2	7	7	11
202	RHEIN-NECKAR-KREIS (*)	2	7	7	3	3	7	3
203	PFORZHEIM (*)	4	2	4	2	10	2	4
204	CALW	6	6	5	1	2	5	4
205	ENZKREIS	4	6	8	2	2	10	6
206	FREUDENSTADT	9	4	6	1	3	4	8
207	FREIBURG im BREISGAU (*)	1	3	2	3	11	1	1
208	BREISGAU HOCHSCHWARZWALD	4	9	5	3	2	4	3
209	EMMENDINGEN	6	7	5	3	4	7	6
210	ORTENAUKREIS	6	4	7	3	7	5	9

CENSUS	MUNICIPALITY	A	B	C	D	E	F	G
211	ROTTWEIL	9	3	7	2	7	6	11
212	SCHWARZWALD-BAAR-KREIS	5	3	5	3	8	4	9
213	TUTTLINGEN	7	3	8	2	7	8	6
214	KONSTANZ	4	4	5	3	6	3	4
215	LORRACH	4	4	5	1	5	4	8
216	WALDSHUT	7	5	6	1	3	5	8
217	REUTLINGEN	5	4	7	2	7	6	4
218	TUBINGEN	1	6	6	2	9	4	1
219	ZOLLERNALBKREIS	6	3	8	3	7	7	8
220	ULM (*)	4	1	7	3	9	1	3
221	ALB-DONAU-KREIS	7	9	9	3	7	10	9
222	BIBERACH	8	4	10	2	5	7	7
223	BODENSEEKREIS	7	4	5	2	2	4	7
224	RAVENSBURG	8	5	7	2	5	4	6
225	SIGMARINGEN	7	5	8	2	7	7	5
	BAYERN							
226	INGOLSTADT	3	1	9	7	4	4	5
227	MUNCHEN (City) (*)	1	2	1	1	5	1	2
228	ROSENHEIM	4	3	4	2	9	1	2
229	ALTOTTING	10	3	8	5	4	8	9
230	BERCHTESGADENER LAND	10	6	5	2	7	1	7
231	BAD TOLZ-WOLFRATSHAUSEN	6	7	8	2	10	2	7
232	DACHAU	2	10	7	1	3	5	5
233	EBERSBERG (*)	2	11	9	1	1	8	3
234	EICHSTATT	5	9	11	6	8	10	5
235	ERDING	5	10	11	2	3	8	4
236	FREISING (*)	2	6	8	2	3	7	2
237	FURSTENFELDBRUCK (*)	1	11	8	1	1	6	2
238	GARMISCH-PARTENKIRCHEN	5	7	2	2	7	2	5
239	LANDSBERG a. LECH	6	10	11	2	2	8	3
240	MIESBACH	6	8	5	2	3	2	5
241	MUHLDORF a. INN	11	7	10	5	4	7	5
242	MUNCHEN (*)	1	4	6	1	1	4	2
243	NEUBURG-SCHROBENHAUSEN	8	8	8	7	4	9	3
244	PFAFFENHOFEN a.d. ILM	5	6	11	7	2	10	4
245	ROSENHEIM	7	9	6	2	2	5	4
246	STARNBERG (*)	3	8	7	1	2	2	3
247	TRAUNSTEIN	9	5	6	2	5	4	9
248	WEILHEIM-SCHONGAU	7	6	8	2	2	4	5
249	LANDSHUT (Town)	7	2	3	3	2	1	3
250	PASSAU (Town)	4	2	4	10	7	2	2

CENSUS	MUNICIPALITY	A	B	C	D	E	F	G
251	STRAUBING	5	3	5	10	7	2	8
252	DEGGENDORF	7	7	10	10	4	7	8
253	FREYUNG-GRAFENAU	8	9	10	10	8	9	10
254	KELHEIM	7	6	11	7	8	7	9
255	LANDSHUT	8	10	11	3	3	11	5
256	PASSAU	10	8	10	10	4	8	8
257	REGEN	8	7	9	10	6	9	7
258	ROTTAL-INN	11	9	10	5	5	9	9
259	STRAUBING-BOGEN	9	11	11	10	6	10	8
260	DINGOLFING-LANDAU	8	2	11	3	5	9	7
261	AMBERG (Town)	5	3	4	11	7	2	10
262	REGENSBURG (City) (*)	1	2	3	7	11	2	1
263	WEIDEN i.d. OPf.	10	3	6	9	7	1	11
264	AMBERG-SULZBACH	6	10	10	11	6	10	10
265	CHAM	10	9	10	10	8	9	9
266	NEUMARKT i.d. OPf.	8	9	11	7	3	10	8
267	NEUSTADT a.d. WALDNAAB	9	9	11	9	8	11	11
268	REGENSBURG	3	11	11	7	2	11	2
269	SCHWANDORF	6	6	11	10	8	10	10
270	TIRSCHENREUTH	9	6	11	8	8	10	11
271	BAMBERG (Town)	7	2	4	8	10	1	4
272	BAYREUTH (Town)	7	2	5	8	6	3	3
273	COBURG (Town)	7	2	6	6	8	3	4
274	HOF (Town)	9	3	4	7	8	4	8
275	BAMBERG	6	11	11	8	3	11	5
276	BAYREUTH	9	9	10	9	5	11	7
277	COBURG	6	4	9	7	7	11	8
278	FORCHHEIM	7	10	11	8	3	8	6
279	HOF	10	5	8	7	7	10	9
280	KRONACH	7	5	9	7	9	9	10
281	KULMBACH	8	5	7	9	7	7	10
282	LICHTENFELS	7	4	10	7	7	9	7
283	WUNSIEDEL i. FICHTELG.	8	4	7	7	8	8	10
284	ANSBACH (Town)	9	3	3	4	8	2	7
285	ERLANGEN (*)	1	1	5	4	10	2	1
286	FURTH (City) (*)	4	3	5	5	1	3	3
287	NURNBERG (*)	3	1	2	5	11	3	3
288	SCHWABACH (*)	3	5	7	5	5	4	7
289	ANSBACH	10	8	11	4	7	10	10
290	ERLANGEN-HOCHSTADT (*)	3	9	11	5	1	11	3
291	FURTH (*)	1	11	9	5	6	11	7
292	NURNBERGER LAND (*)	4	7	9	5	2	9	8
293	NEUSTADT/BAD WINDSH.	9	8	10	4	6	9	10

CENSUS	MUNICIPALITY	A	B	C	D	E	F	G
294	ROTH	3	11	9	6	2	11	3
295	WEISSENBURG-GUNZENHAUSEN	9	6	10	7	8	8	10
296	ASCHAFFENBURG (Town)	5	2	4	5	6	1	7
297	SCHWEINFURT (Town)	7	1	2	9	11	3	5
298	WURZBURG (City) (*)	2	2	4	4	11	1	1
299	ASCHAFFENBURG	4	8	10	5	4	11	7
300	BAD KISSENGEN	9	8	10	9	9	4	10
301	RHON-GRABFELD	8	6	11	9	4	8	9
302	HASSBERGE	8	8	11	9	8	10	10
303	KITZINGEN	8	8	9	4	5	9	10
304	MILTENBERG	8	8	11	5	6	9	10
305	MAIN-SPESSART	8	7	9	4	6	9	8
306	SCHWEINFURT	5	11	10	9	4	11	8
307	WURZBURG	3	11	8	4	4	11	2
308	AUBSBURG (City) (*)	4	2	3	4	8	3	7
309	KAUFBEUREN	7	5	6	2	7	2	5
310	KEMPTON (Allgau)	9	2	3	2	7	2	5
311	MEMMINGEN	8	2	7	3	6	3	7
312	AICHACH-FRIEDBERG	6	9	10	4	2	10	5
313	AUGSBURG	5	9	8	4	2	11	4
314	DILLINGEN a.d. DONAU	10	7	11	3	5	9	10
315	GUNZBURG	7	5	10	3	5	9	5
316	NEU-ULM	5	5	7	3	4	9	5
317	LINDAU (Bodensee)	11	4	5	3	3	3	8
318	OSTALLGAU	11	7	8	2	5	6	7
319	UNTERALLGAU	11	8	10	3	6	7	8
320	DONAU-RIES	10	5	10	3	6	8	10
321	OBERALLGAU	8	7	5	2	4	5	5
SAARLAND								
322	SAARBRUCKEN (*)	2	3	5	11	10	4	5
323	MERZIG-WADERN	4	8	10	11	8	8	11
324	NEUNKIRCHEN (*)	4	9	7	10	8	7	7
325	SAARLOUIS (*)	2	6	8	11	9	7	6
326	SAAR-PFALZ-KREIS (*)	2	4	7	10	7	4	6
327	SANKT-WENDEL	4	11	10	10	7	9	11
WEST BERLIN								
328	BERLIN (West) (*)	11	4	2	7	9	4	3

APPENDIX "F"

TABLE F-1

GROUPING EXAMPLE USING COMPUTER PROGRAM

	A			B			C
	Original Data			"Z-scores"			Summation of Weighted "Z-Scores"
Area #	v1	v2	v3	v1	v2	v3	
A	1.1	79.5	19	-.21	1.56	-.38	-1.26
B	2.4	16.3	28	1.38	-1.01	1.08	2.08
C	0.3	38.6	14	-1.18	-.10	-1.19	-1.37
D	0.7	42.1	27	-.70	.04	.92	.05
E	1.0	55.5	15	-.33	.59	-1.03	-1.12
F	2.1	14.4	25	1.01	-1.09	.60	1.63

A. Objective is to partition data into three groups such that total variation is minimized. This example uses a group of health-related variables.

	Factor Score
v1: # of hospitals/10,000 population	.800 (w1)
v2: # of people/doctor	-.765 (w2)
v3: # of medical specialists/1,000 people	.750 (w3)

B. Each observation from the original data is standardized using the following formula:

$$Zi = \frac{Xi - \overline{X}}{sd.}$$

Zi= "I"th Z-score
Xi= "I"th observation
$\overline{X}$ = Mean of the Variable
sd.= Standard deviation of the variable

C. Summation of weighted Z-scores are calculated for each census area as follows:

$$\sum Zw(A) = z1\ (w1)^2 + z2\ (w2)^2 + z3\ (w3)^2$$
$$Z(A) = -.21(.64) + 1.56(-.585) + (-.38)(.563)$$
$$Z(A) = -1.26$$

D. Grouping algorithm then sorts the weighted z-scores from highest to lowest, and arbitrarily makes initial groups of equal size:

2.08	1.63	.05	-1.12	-1.26	-1.37
sd=.33		sd=.82		sd=.10	
var.=.11		var.=.68		var.=.01	

Total Variation = .80

E. Each group's variation and standard deviation is calculated. The total variation is calculated and stored.

F. New group divisions are set using the mean of Group I and Group II (0.66), and the mean of Group II and Group III (-.92)

2.08	1.63	.05	-1.12	-1.26	-1.37
sd.=.33		sd.=0	sd.=.17		
var.=.11		var.=0	var.=.03		

Total Variation = .14

G. Standard deviations are compared with those of the last iteration to see how many have changed significantly. Total variation is calculated, and these groupings are stored if the value is less than the previous minimum total variation. New group divisions are again calculated using the mean of Group I and Group II (1.25), and the mean of Group II and Group III (-1.25)

2.08	1.63	.05	-1.12	-1.26	-1.37
sd.=.33		sd.=.82		sd.=.10	
var.=.11		var.=.68		var.=.01	

Total Variation = .80

H. When the predetermined number of group standard deviations do not change significantly (+/- 1/16), the program stops. At this point, the program accepts the iteration that has possessed the lowest total variation. Therefore, the groupings from the second iteration are printed such that Group I consists of observations A, C, and E; Group II of observation D, and Group III has observations B and F.

APPENDIX "F"

TABLE F-2

GROUPING EXAMPLE OF THE URBAN/HOUSING INDICATOR

The following example uses the set of Urban/Housing variables. The selected variables from this socio-economic indicator included x2 "Density", x29 "% Housing With 1 and 2 Apartments" and x30 "% Housing With Greater Than 2 Apartments". The following matrix represents the summation of weighted z-scores for the 328 areas of the Federal Republic of Germany. (For explanation of area numbers, see Appendix "A")

AREA	SUMMATION OF WEIGHTED Z-SCORES
1001	1.76
1002	2.73
1003	1.41
1004	1.56
1005	-1.14
*	*
*	*
*	*
6111	1.90
6112	6.49
6115	2.08
6116	2.72
*	*
*	*
*	*
10044	-1.16
10045	-.83
10046	-1.46
11000	4.90

After sorting the summation of weighted z-scores from highest to lowest, the program makes 11 groups of equal size (9 groups of 30, 2 groups of 29). These groups are then partitioned using the "mean-weighted bi-section" approach outlined in Chapter Three and the previous example. The following matrix shows the eleven group standard deviations, as well as the total variation associated with each iteration. The program will continue re-partitioning the data until the specified number of group standard deviations no longer change.

GROUP STANDARD DEVIATIONS

Run	1	2	3	4	5	6	7	8	9	10	11	Total Variation
1	1.48	.38	.27	.25	.16	.09	.04	.05	.04	.05	.11	73.42
2	1.37	.43	.32	.20	.17	.09	.06	.04	.04	.07	.11	55.36
3	1.37	.40	.28	.26	.15	.10	.05	.04	.04	.07	.11	53.88
				*			*					
				*			*					
				*			*					
19	1.21	.50	.39	.24	.19	.13	.06	.07	.03	.08	.11	35.55
20	1.13	.57	.30	.28	.19	.11	.10	.05	.07	.05	.11	31.81
21	1.18	.53	.37	.25	.19	.14	.08	.09	.03	.07	.11	33.35
				*			*					
				*			*					
				*			*					
40	0.94	.58	.29	.29	.22	.16	.12	.08	.06	.06	.11	19.35
41	0.94	.55	.31	.28	.23	.16	.12	.08	.06	.07	.11	19.15
42	0.94	.55	.30	.30	.23	.16	.12	.06	.08	.06	.11	19.23

After selecting the iteration with the least amount of total variation, the program prints the groups. Column one shows the "new" group number for each area that is designated in column two. The third, fourth and fifth columns present the original observations for the selected variables. The final column prints the weighted z-score associated with each area. Analysis of variance was performed using the following data-matrix.

Group	Area	"x2"	"x29"	"x30"	Summation of Weighted Z-Score
1	5111	2712.52	64.00	36.00	7.81
1	5113	3061.45	66.26	33.73	7.56
1	5916	3525.61	70.58	29.41	6.93
1	8111	2814.39	68.60	31.39	6.86
	*	*	*	*	*
	*	*	*	*	*
6	7317	791.38	92.30	7.69	.17
6	6176	428.30	91.54	8.45	.09
6	8337	127.59	90.66	9.33	.07
6	5166	465.04	91.78	8.21	.06
	*	*	*	*	*
	*	*	*	*	*
11	9376	88.42	99.54	.45	-1.92
11	9176	78.35	99.56	.43	-1.93
11	9673	76.47	99.66	.33	-1.95
11	9278	65.24	99.79	.20	-1.99

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