A Study on Forecasting Models for Cruise Demand:

Comparisons Between South Korea and Hong Kong

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A thesis submitted in partial fulfilment of the requirements for the degree of Master of Shipping Management

The Graduate School of Korea Maritime and Ocean University
Department of Shipping Management

August 2018

Approval Page

This thesis, which is an original work undertaken by Lim Wei Nee in partial fulfillment of the requirements for the degree of Master of Business Administration, is in accordance with the regulations governing the preparation and presentation of dissertations at the Graduate School in the Korea Maritime and Ocean University, Republic of Korea.

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June 2018

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A Study on Forecasting Models for Cruise Demand: Comparisons Between South Korea and Hong Kong

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Abstract

The cruise industry has emerged to be an important part of the tourism sector since there has been a large increase in the number of passengers worldwide. The purpose of this study is to forecast cruise tourism demand, as doing so can ensure better planning, efficient preparation at the destination port and act as a basis for the elaboration of future plans. In this study, forecasting methods such as Exponential Triple Smoothing (ETS), Autoregressive Integrated Moving Average (ARIMA) and Group Method of Data Handling (GMDH) are tested to estimate the cruise demand and the best forecasting model is suggested by comparing the forecast accuracy. The total number of foreign cruise passengers are used as the measure of cruise demand. The results show that GMDH outperforms ETS and ARIMA in terms of forecasting accuracy.

Chapter 1: Introduction

The motivations and objectives of this study will be explained in this chapter. The importance of tourism and the direct contribution of tourism to the country GDP will be covered. It is also briefly introduced that the cruise tourism, a niche form of tourism and the fastest growing segment of tourism led to important forecasting of the cruise's market demand. Lastly, the thesis outline will be presented.

1.1. Motivations and Objectives of Research

Tourism is an important economic activity in most countries around the world as a growing source of foreign exchange earnings. Cambridge Dictionary defined tourism as a business of providing services such as transport, places to stay, or entertainment for people who are on holiday. The industry has a significant indirect and induced impacts on the economy as it provides employment, foreign exchange, income and tax revenue. World Tourism Organization (UNWTO) projected the long-term average growth worldwide for the tourism industry to be 4%. According to the UNWTO World Tourism Barometer (2018), the international tourist arrivals has grown remarkably by 7% in the year 2017 to reach a total of 1,322 million, which led them to project the international tourist arrivals worldwide to grow at a rate of 4% - 5% in the year 2018. The report also indicates that tourism is one of the world's largest growth industry with long-term signs being very positive.

The World Travel and Tourism Council (WTTC) has been measuring the economic impact of travel and tourism since 1991 and they defined that the direct contribution of travel and tourism to GDP as the 'internal' spending on travel and tourism. In other words, the total spending within a country on travel and tourism by residents and non-residents for business and leisure purposes.

According to Travel & Tourism Economic Impact 2018 South Korea report (WTTC, 2018), the direct contribution of travel and tourism to the Korean gross domestic product (GDP) in 2017 was KRW27,571.4bn which account for 1.6% of the total GDP in 2017 and is forecast to rise by 3.7% in 2018. The direct contribution of travel and tourism to Korean GDP is expected to grow by 3.5% pa to KRW40,194.1bn which account for 1.8% of the GDP by 2028. While for the direct contribution of travel and tourism to the Hong Kong GDP in 2017 was HKD118.7bn, accounted for 4.5% of total GDP in 2017 and is forecast to rise by 1.5% in 2018. The direct contribution of travel and tourism to Hong Kong GDP is expected to rise by 3.8% pa to HKD175.0bn which account for 5.2% of total GDP in 2028. The report show that tourism has grown to be a significant activity, which also has grown rapidly to become a major social and economic force for the country; thus, more attention should be paid to develop tourism.

Cruise is becoming more and more popular and is the fastest growing segment of tourism but this segment is still small quantitatively. Cruise Lines International Association (CLIA) states that cruise is currently the fastest growing segment of the travel industry as according to CLIA 2018 Cruise Industry Outlook, 17.8 million of passengers cruised in the year 2009 and CLIA projected that 27.2 million passengers are expected to cruise in the year 2018. The cruise industry has a passenger compound annual growth rate of 6.63% from 1990 to 2020 (Cruise Market Watch, 2018) and the demand in cruising has increased 20.5% in the last five years (2011 – 2016) (CLIA, 2018). The increase in demand for cruise tourism clearly shows that the cruise market is on the upward trend. The demand for cruise tourism is much higher in comparison with the number of international arrivals.

Tourism demand is the basis of all tourism-related business decisions and the success of the business highly depends on the tourism demand. Management failure is quite often due to the failure of meeting the market demand. Demand stands an important role in all planning activities as a determinant of business profitability and estimate of expected future demand.

The increase in demand for Asian cruises and an almost continuous increase in the number and capacity of ships have already created issues in accepting the passengers and ships in many countries. The development of the city infrastructure and all complementary services should follow with the demand of cruise. Therefore, the main objective of this study is to apply the selected forecasting models to foresee the future trends in cruise ship passengers calling South Korea, Busan and Hong Kong in the future period and to suggest a reliable forecasting model for cruise demand. Forecasting the demand in cruising tourism ensures a better planning, more efficient preparation at the destination for future changes and the basis for the elaboration of future development plans for sustainability.

1.2. Scope of Study

In order to achieve the objectives designated by this study, this study started with an introduction explaining its motivations and objectives. The sector of tourism and the direct contribution of tourism to the country's GDP are first to be reviewed. Then, the impact of cruise tourism on the importance of forecasting cruise market demand will be addressed. Lastly, the outline of thesis will be explained.

Chapter 2 illustrates the overview of cruise industry. Besides, the overview of South Korea, Busan and Hong Kong cruise tourism, the basic information on the cruise port, cruise inbound passenger and passenger throughput will be covered too. The literature reviews on tourism forecasting demand techniques and as well as the cruise tourism forecast in South Korea and Hong Kong context will be illustrated too.

Chapter 3 describe the forecasting models that are going to be used in this study such as Autoregressive Integrated Moving Average (ARIMA), Exponential Triple Smoothing (ETS) and Group Method of Data Handling (GMDH).

Chapter 4 utilizes the following data: the number of inbound cruise passenger and cruise passenger throughput. This data was then analysed by using forecasting models.

Lastly, Chapter 5 concludes the findings of this research. The limitations of this study are discussed critically in order to provide insights on the implications as well as directions for future research.

Chapter 2: Overview of Cruise Industry

This chapter illustrate the history of cruise, cruise market and the overview of South Korea, Busan and Hong Kong cruise tourism, including the basic information on the cruise port, cruise inbound passenger and passenger. The literature reviews on tourism forecasting demand techniques, as well as the cruise tourism forecast in South Korea and Hong Kong contexts will be illustrated too.

2.1. History of Cruise

Oxford Dictionary defined that cruise is ‘a voyage on a ship or boat taken for pleasure or as a holiday and usually calling in at several places’. The earliest ocean-going vessels were not primarily concerned with passengers, but rather with the cargo that they carry. The advent of pleasure cruises is on the year of 1844, when the Peninsular and Oriental Steam and Navigation Company, with the familiar name of P&O Cruises, introduces the first passenger cruising services from Southampton to Vigo, Lisbon, Malta, Istanbul and Alexandria aboard the SS Iberia (Chala, 2015; Gibson, 2012). In 1867, Mark Twain was a passenger on a P&O voyage from London to the Black Sea and the record of his trip is preserved in his travel book “The Innocents Abroad” (Gibson, 2012).

During the mid-1880s, there was a dramatic improvement in the quality of voyage for passengers as companies began to make ships more luxurious and to start a pleasure cruise industry (Tomlinson, 2007). By the early of 20th century, White Star Line and Hamburg – America Line were offering luxury cruising. The director of Hamburg – America Line, Albert Ballin designed the first vessel built exclusively for luxury cruising, Prinzessin

Victoria Luise, which was completed at the year 1900. While the White Star Line, owned by American financier J.P. Morgan, introduced the most luxurious passenger ships at that time, the Olympic and the Titanic. These ships were complete with a swimming pool, tennis court, fine dining, luxury services, and staterooms with finer appointments.

The World Wars interrupted the building of new cruise ships, and many cruise liners were converted into troop carriers in World War I and II. In the year 1958, the increase of air travel and transatlantic commercial jet aircraft led to the demise of the liner market and the downturn of business for many companies. Passenger ships were sold and cruise lines went bankrupt. Cruise companies started to offer more affordable cruises. The 1960s witnessed the beginnings of the modern cruise industry where sea cruises took the form of package tours as Norwegian Caribbean Line offered the first annual cruise schedule on board (Wilkinson, 2006).

2.2. Cruise Market

The Cruise Lines International Association, 2018 forecasted that passenger growth 5% to reach a projected 27.2 million passengers worldwide in the year 2018, which is better than 4% passenger growth in the year 2017. The passenger growth between the year 2011 and 2016 has an increase of over 20% from 20.5 million passengers in the year 2011 to 24.7 million passengers in the year 2016. The cruise industry has had a dynamic growth over a period of more than 30 years and it has been driven more by demand from North America than from Europe and the rest of the world. North America represents around 50% of the total demand for cruises worldwide. Europe constitutes around 27% of the total demand and the rest of the world accounts for around 23% of the total demand.

Table 1 shows the international cruise sector growth between the year 2006 and 2016. Over the 10-year period, the demand for cruises worldwide has increased from 15.11 million passengers to 24.73 million passengers with a 63.7% growth rate. North America market has increased by 20.3%, Europe market has increased by 94% and the market from Rest of the World has the most significant growth with an increase of 331.9%.

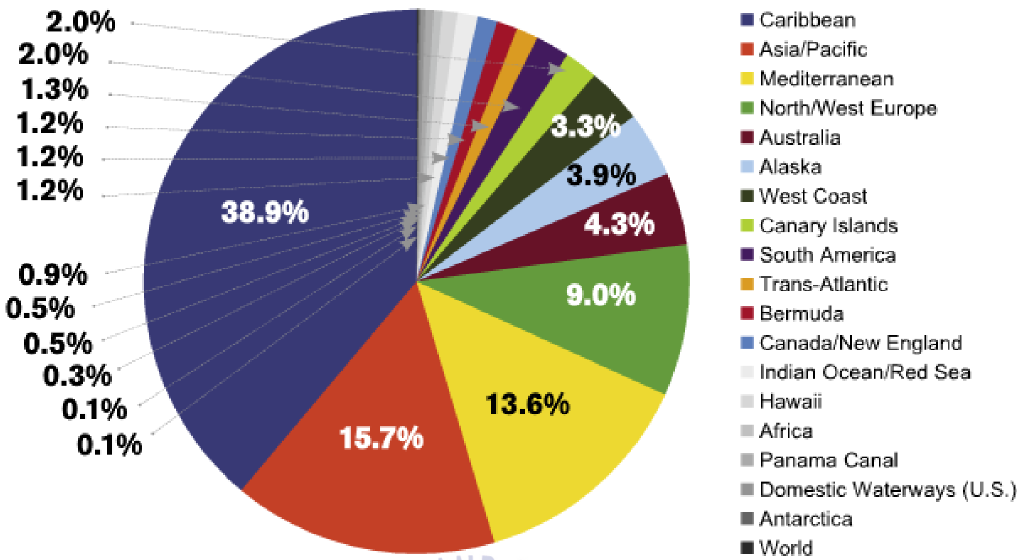

Figure 1 Major Sailing Region (Cruise Industry News, 2018)

According to Figure 1, the top three most popular regions for the cruise destination in the year 2017 were the Caribbean, Asia or Pacific, and Mediterranean regions. The share of Caribbean region in the global demand for the cruise was 38.9%, the share of Asia or Pacific was 15.7% and the share of Mediterranean region was 13.6%.

	2006	2011	2012	2013	2014	2015	2016	10 – Year Growth
North America	10.38	11.44	11.64	11.82	12.21	12.20	12.49	20.3%
Europe	3.44	6.15	6.23	6.40	6.39	6.58	6.67	94.0%
Rest of the World	1.29	2.91	3.03	3.09	3.74	4.4	5.57	331.9%
Total	15.11	20.50	20.90	21.31	22.34	23.18	24.73	63.7%

- Millions of passengers
- Russia and Central and Eastern European countries outside the EU are included in Europe
- Numbers may not add due to rounding

Table 1 International Demand for Cruises (CLIA, 2017)

<Data: Reconstructed based on 'The Contribution of the International Cruise Industry to the Global Economy in 2016'>

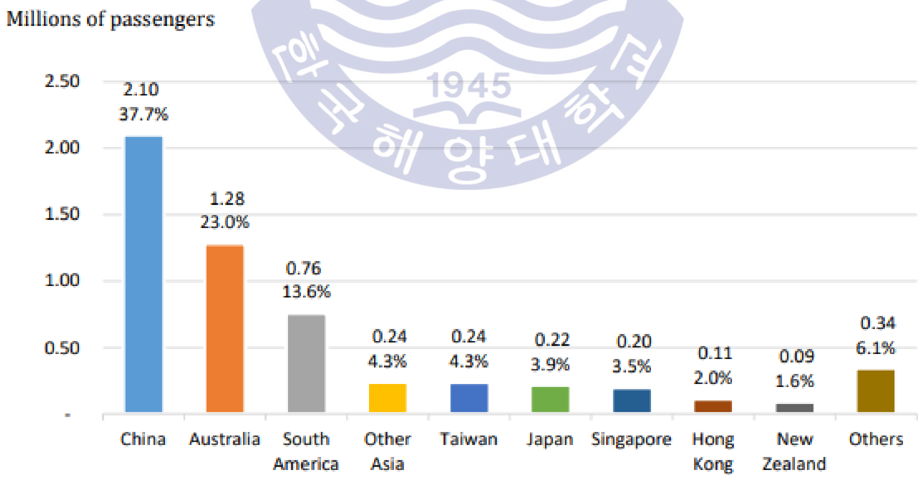

Figure 2 Distribution of Cruise Passengers Sourced from the Rest of the World for the year 2016 (CLIA, 2017)

The distribution of cruise passengers sourced from the Rest of the World in figure 2 shows that the two principal sources of passengers are China with 2.1 million of passengers and Australia with 1.28 million of passengers. The passengers from the two countries accounted for around 61% of all passengers sourced from the Rest of the World.

Focusing on Asia Cruise Industry, the passenger capacity of Asia market has increased from 1.51 million passengers to 4.24 million passengers for the year 2013 to the year 2017; while the number of cruise ships in Asia has increased from 43 ships to 66 ships for the year 2013 to the year 2017, accounted for 53% of growth. The passenger volume grew from 775,000 to nearly 3.1 million passengers between the year 2012 and 2016 with 1% compound annual growth rate. For the passenger volume by source market, China accounted for 67.8% of the market.

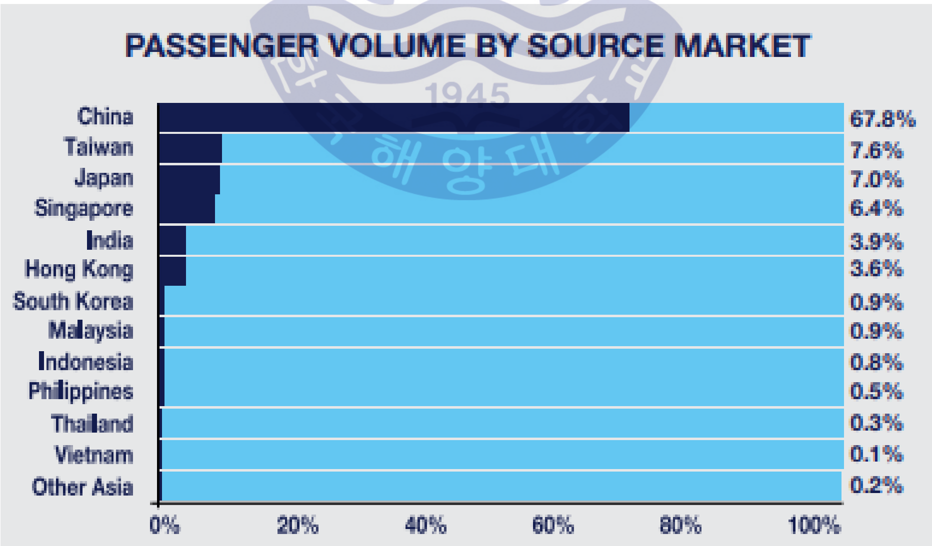

Figure 3 Asia Passenger Volume by Source Market (CLIA, 2017)

There are various indications that Asia is a rapidly growing and dynamic market. Many cruise lines deploy more capacity to this region including brand new and mega cruise ships built exclusively for Asian consumers. Thus, understanding the trends and the overall potential for cruise tourism growth is important to monitor the guest source market.

2.3. Cruise Tourism in South Korea

South Korea is a country that is surrounded by the sea on three sides and boasts eleven port cities. With the rising demand for cruise travel connecting China, South Korea and Japan, Korea is emerging as a new cruise destination in the Northeast Asian region.

The Number of Annual Inbound Cruise Visitors via Cruise Ship Status of South Korea in figure 4 show that the number of foreign cruise tourists grew by approximately 80% annually for the year 2011 to the year 2016. In the year 2016, the number of foreign cruise tourists grew by 115.9% compared to the previous year, the year 2015 from 1,045,876 tourists to 2,258,334 tourists. Besides, the number of port entry of cruise ships also increased from 412 ships to 785 ships.

There are twelve cruise ports in South Korea in total and five of them are major cruise ports. The major cruise ports are in Jeju, Incheon, Busan, Yeosu and Sokcho (Figure 5). Table 2 shows some information about the cruise ports, which include the current situation of the port. Among the five ports, Jeju is the most popular port with 1,177,233 cruise tourists attracted in 2016, Busan came in the second with 533,538 tourists attracted in 2016, Incheon at third with 152,961 tourists and followed by Yeosu and Sokcho.

South Korea’s government has come up with four major strategies and fourteen detailed implementation tasks as shown in table 2.

Strategies	**Detailed Implementation Task**
Expand attraction of foreign cruises	• Expand exclusive/private ports, facilities, etc. for cruises • Expand marketing to attract more foreign cruises • Diversify the port of call's tourism programme • Simplify immigration process and improve quality of service
Construct underlying tourism infrastructure	• Promote cruise home port through selection and concentration strategy • Provide Cruise-Focused Mixed Marine Tourism Services • Build an underlying support system to supply ship articles, etc.
Promote National Cruise Ship Companies	• Ease/Relax the Regulations for crew member and facilities standards. • Apply Tonnage Tax System etc, Improve the condition of the management of ship companies • Expand the base for cruise use for locals
Strengthen Cruise Industrial Capacity	• Train professional manpower such as crew and guides, etc. • Support development of Cruise Liner construction technologies • Secure the safe navigation of cruise liners • Build a control and information system for cruises

Table 2 Four Major Strategies and Fourteen Detailed Implementation Tasks

<Data: Translated from 'Government Policy'>

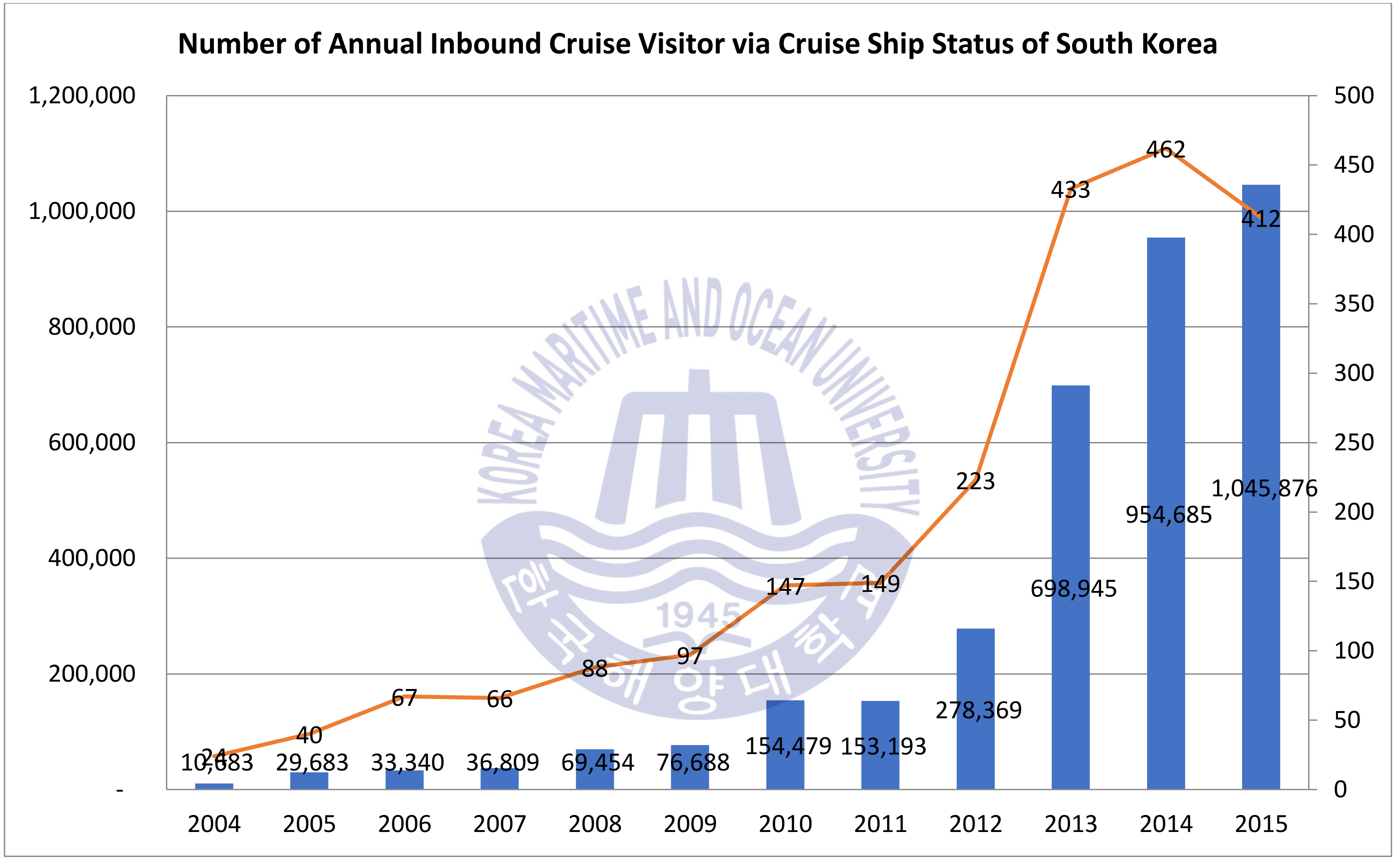

Figure 4 Number of Annual Inbound Cruise Visitor via Cruise Ship Status of South Korea

Figure 5 Cruise Port in South Korea

Location	Type	Note
Incheon	Cruise Pier	Incheon Port – Container pier
		South Port
	Cruise Terminal	South Port's International Passenger Terminal – under construction (to be completed in 2019)
Jeju	Cruise Pier	Jeju port (Outer Port) (one more berth to be completed by the end of 2020)
		Gangjeong Port – Seogwipo (2 berths to be operated in 2017)
	Cruise Terminal	Jeju International Passenger Terminal
		Gangjeong Port Cruise Terminal – under construction (to be completed by 2018)
Yeosu	Cruise Pier	Yeosu Port
	Cruise Terminal	Yeosu International Passenger Terminal
Busan	Cruise Pier	North Port
		Gamman – Container Pier
		Yeongdo – under construction for expansion (to be completed by 2018)
	Cruise Terminal	North Port International Passenger Terminal
		Yeongdo International Cruise Terminal – under construction for expansion (to be completed by 2018)
Sokcho	Cruise Pier	Sokcho Port
	Cruise Terminal	Sokcho International Passenger Terminal

Table 3 Information of Cruise Ports in South Korea

2.3.1. Cruise Tourism in Busan

Busan port is a major international trade centre in South Korea and has been South Korea's major anchorage since its opening in the year 1876. Busan played a significant role in the development of the South Korean maritime industry and various fields of maritime business with its accumulated know – how and infrastructure, as it is located in the centre of the Southeast Maritime Industrial Region covering from Pohang to Yeosu and the world's main trunk route connecting continents across oceans.

Busan is often called a city that is full of vitality. It is the second largest city in South Korea a fascinating city where culture is a unique amalgam of old and new, where modern high – rise buildings and ancient Buddhist temples meet. The city's bustling business district offers a stark contrast to the serene grounds of historical places. To put it briefly, Busan is a microcosm of South Korea, a nation whose startling economic success couples with one of Asia's most sophisticated and venerable cultures.

The cruise route to Busan was first launched in April 2007 with the opening of Busan International Cruise Terminal at Yeoungdo. A large number of cruise ships have called at Busan and the port can accommodate 2 million of cruise tourists. The opening of the International Passenger Terminal in North Port, Busan, allows the city to contribute to the booming Northeast Asian cruise industry.

With the speciality of Busan city and the incentives given by Busan Port Authority, the Busan port plays a more and more important role as a major port that connect the country and the world. The incentives given by Busan Port Authority are support of 20% port charges to local agencies that includes two or more tourist spots in Busan in their travel course, operating free shuttle buses from cruise terminals to subway stations and 30% off of port charges for Busan port, including port dues and dockage.

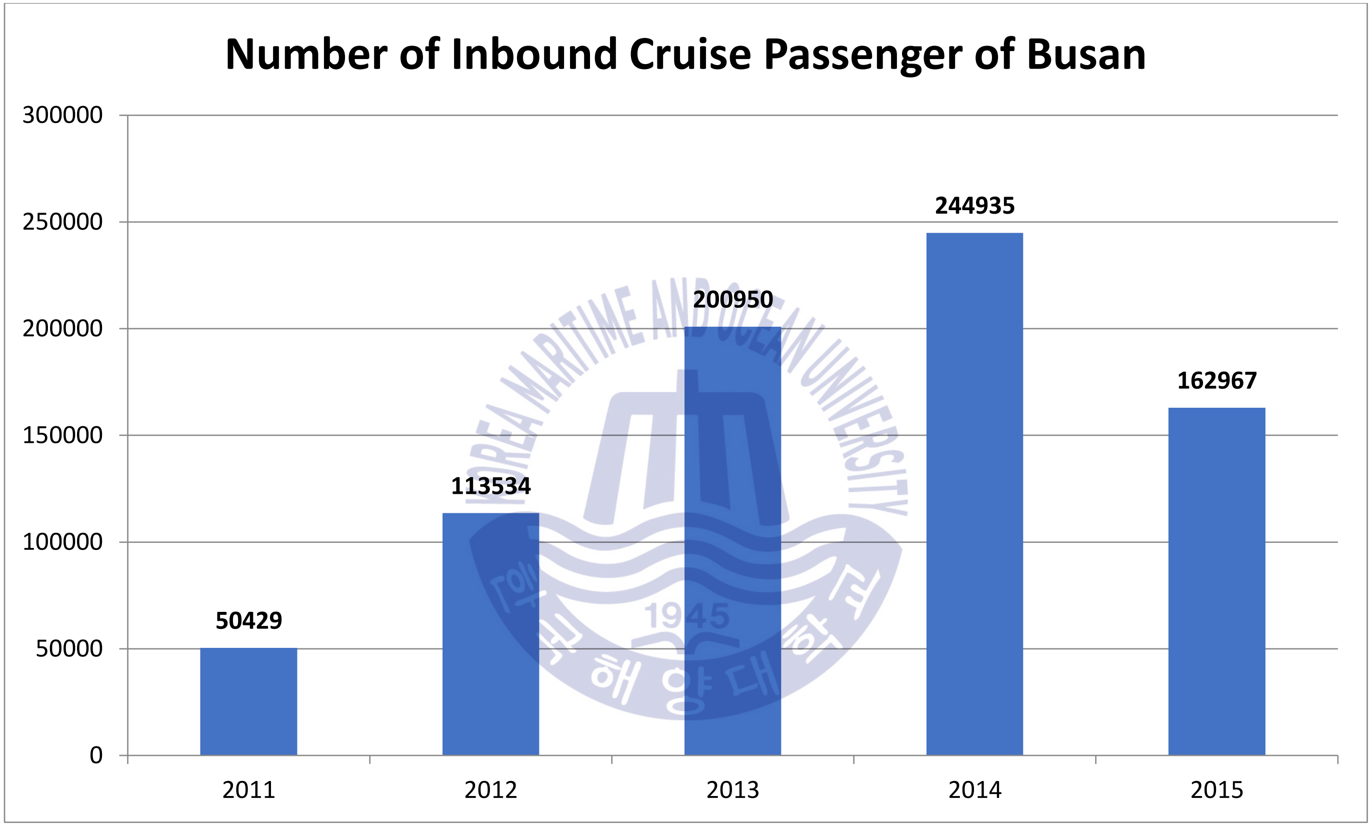

Figure 6 Number of Inbound Cruise Passenger of Busan

2.4. Cruise Tourism in Hong Kong

Hong Kong has become a must-see destination for cruise passengers and other international tourists that are visiting Asia because of its strategic geographical location in the Asia – Pacific region. According to Cruise Industry News (2017), around 75% of the cruise calls in Hong Kong are turnarounds as the ships leaving the North Asian region to other markets are making transit calls in Hong Kong.

With the rising role of Asia in the global economy, the cruise industry started to explore new markets in Asia, especially in the China market. The rapid growth of the Asian cruise industry provides both excellent opportunities and big challenges to Hong Kong. The development of port infrastructures and the growth of the Chinese outbound travel market reinforced Hong Kong's role in the industry but Hong Kong is also facing some fierce competition from the neighbouring ports such as Guangzhou, Shanghai and Shenzhen in mainland China, Singapore, South Korea, Taiwan and Vietnam as they are joining or expanding their cruise tourism business as well.

There are two cruise terminals in Hong Kong which are Kai Tak Cruise Terminal and Ocean Terminal. Table 3 shows some information about the cruise terminals available in Hong Kong.

Kai Tak Cruise Terminal	Facilities	Baggage handling area, customs hall, concourse, immigration hall, passenger waiting hall, roof garden, ancillary commercial area, retail shops, restaurant and car park
	Customs, Immigration and Health Quarantine Operation	Clear 3,000 passengers per hour
	Number of Berths	Two
	Commissioning date	June 2013
	Apron Area	850m length x 35m width • First berth 455m length x 35m width • Second berth 395m length x 35m width
	Cruise Vessel that Can Berth	Displacement tonnage - 110,000 Gross tonnage - 220,000
	Depth of Water	12 metres - 13 metres (for dredging)
	Air Draft Restriction	No
Ocean Terminal	Length	South Berth 381m North Berth 320m
	Width	76.2m
	Height Restriction	No
	Apron Width	9.0m
	Max Draft Allowable	10.0m
	Max Displacement Allowable	50,000 tonnes
	The height of Pier Level	4.2m (Above chart datum)
	Tidal Range	2.7m
	Passenger Gangway	3 telescopic gangways on each side of the terminal, total 6 numbers

Table 4 Hong Kong Cruise Terminal Information

Figure 6 shows the number of cruise passenger throughput of Hong Kong for the year between 2007 to 2017. The cruise passengers throughput increased from 693,093 in the year 2013 to 787,938 in the year 2016 with a growth rate of 13.68%.

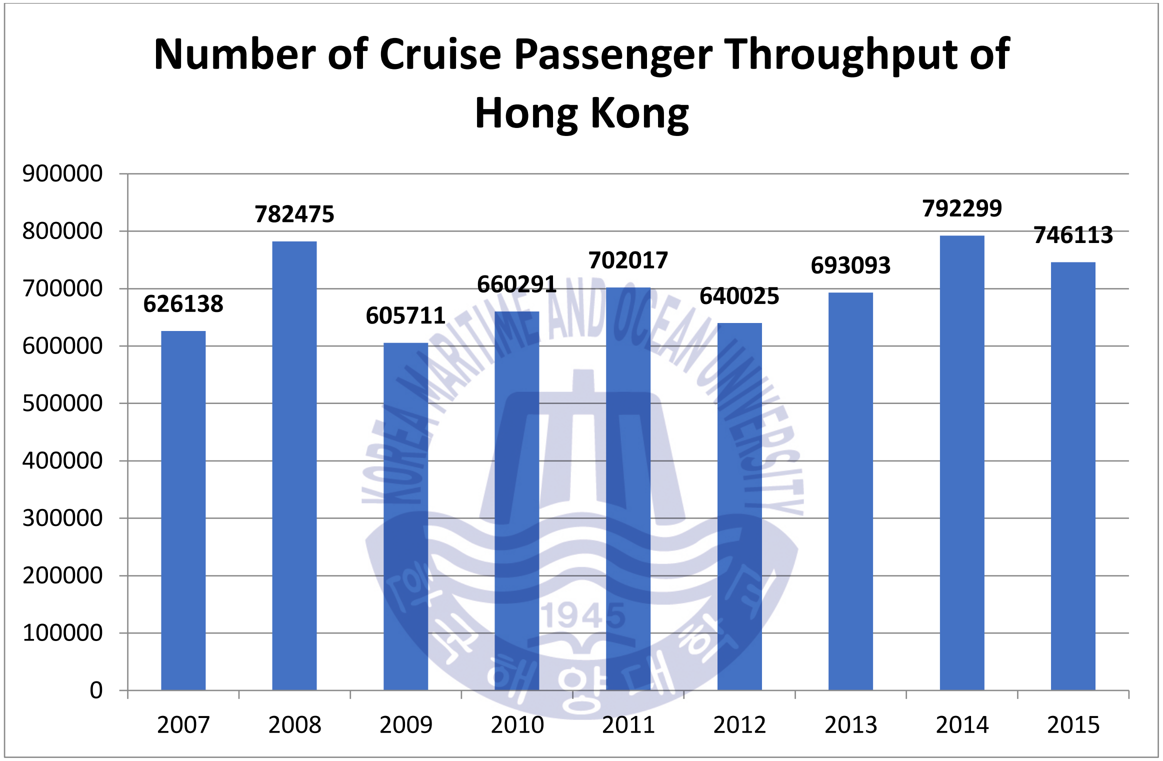

Figure 7 Number of Cruise Passenger Throughput of Hong Kong

2.5. Literature Review

According to Cundiff, Still and Govoni (1976), “Demand forecasting is an estimate of sales during a specified future period based on a proposed marketing plan and a set of particular uncontrollable and competitive forces.” The demand forecasting enables an organisation to take various decisions, such as preparing the budget, stabilizing employment and production, expanding the organisations, and taking management decisions in order to fulfil the objectives or achieve the set goals.

Before designing the value-creating marketing strategies and constructing the marketing programmes to create the demand, the understanding of customer needs and wants is very important. Needs are states of felt deprivation and they are a basic part of the human, while wants are the form of human needs as they are shaped by culture and individual personality. Normally, a consumer’s need to own a product or experience a service is constrained by the willingness and ability of the consumer to pay for the good or service. If the desire to satisfy those needs are backed by buying power, demands are formed. Demand is the underlying force that drives everything in the economy.

Tourism demand modelling and forecasting methods can be broadly divided into two categories: quantitative and qualitative methods. The majority of the published studies used quantitative methods to forecast the tourism demand. Studies of forecasting in the past have also shown that there are two main techniques of quantitative methods, which are the time series model and the multivariate regression model.

This study makes a new attempt in forecasting model by adopting less frequently used methods of Group Method of Data Handling (GMDH). There are some studies that have applied Group Method of Data Handling method to forecast the tourism demand as shown in table 5. However, this method has yet to be used to forecast cruise tourism demand.

Author / Publisher (Year of Publish)	**Title of Paper**	**Analysis Approach**	**Results**
Shabri, A. (2015)	A Novel Hybrid Ensemble Learning Paradigm for Tourism Forecasting	Empirical Mode Decomposition Group Method of Data Handling	Empirical Mode Decomposition – GMDH
Yahya, N.A., Samsudin, R. and Shabri, A. (2017)	Tourism Forecasting using Modified Empirical Mode Decomposition and Group Method of Data Handling	Empirical Mode Decomposition Group Method of Data Handling	Modified Empirical Mode Decomposition – GMDH
Samsudin, R., Saad, P. and Shabri, A. (2010)	Hybridizing GMDH and Least Squares SVM Support Vector Machine for Forecasting Tourism Demand	Group Method of Data Handling Least Squares Support Vector Machine Algorithm	Group Method of Data Handling Least Squares Support Vector Machine Algorithm
Burger, C.J.S.C., Dohnal, M., Kathrada, M. and Law, R. (2001)	A Practitioners Guide to Time - Series Methods for Tourism Demand Forecasting – A Case Study of Durban, South Africa	Group Method of Data Handling – Genetic Regression Algorithm	Neural Network

Table 5 Previous Research on Forecasting Tourism Demand Using GMDH

While for the South Korea Cruise Tourism forecasting, there is only one previous study that forecasted the cruise tourism demand. The information of the paper is listed below.

Author / Publisher (Year of Publish)	**Title of Paper**	**Analysis Approach**
Yoon, Y.H. and Cha, K.C. (2017)	Demand Forecasting for Cruise Inbound Tourists in Korea	Bass Diffusion Model

Table 6 Previous Research on Forecasting Tourism Demand in South Korea

However, for the Hong Kong case, there is no study that forecasted the cruise tourism demand.

Chapter 3: Forecasting Models

A basic introduction to the forecasting models that are going to be used in this study such as Autoregressive Integrated Moving Average (ARIMA), Exponential Triple Smoothing (ETS) and Group Method of Data Handling (GMDH) will be illustrated in this chapter.

3.1. Autoregressive Integrated Moving Average (ARIMA)

Autoregressive Integrated Moving Average (ARIMA) model, which is also known as Box – Jenkins model, is named after the statisticians George Box and Gwilym Jenkins and combined Autoregressive (AR) and Moving Average (MA) models. ARIMA model is a generalization of an Autoregressive Moving Average (ARMA) model. ARIMA has been developed to describe trends, seasonality and residual random behaviour under one model as ARIMA can be applied to cases where data show evidence of non – stationarity in which the differencing step, the "integrated" part of the model, can eliminate the non – stationarity. Given that (Wei, 2006):

Autoregressive model =

$$\emptyset_p(B)z_t = \alpha_t$$

Moving Average model =

$$z_t = \theta(B)\alpha_t$$

Differencing =

$$(1 - B)^d z_t = \alpha_t$$

ARIMA model =

$$\emptyset_p(B)(1 - B)^d z_t = \theta_0 + \theta_q(B)\alpha_t$$

Where $\emptyset$ and θ are parameters, z_t is the actual value at time period t, α_t is the random error at time period t, stationary AR operator $\emptyset_p(B)$ is $(1 - \emptyset_1 B - \cdots\cdots - \emptyset_p B^p)$ and invertible MA operator $\theta_q(B)$ is $(1 - \theta_1 B - \cdots\cdots - \theta_q B^q)$. α_t, random errors, are assumed to be independently and identically distributed with a mean of zero and a constant variance of σ^2. z_t is non – stationary, but dth differenced series, $\{(1 - B)^d z_t\}$ for some integer $d \geqslant 1$, it becomes stationary.

For this study, Real Statistics Using Excel is used. It is a statistics software and works as an Excel add-in that extends Excel's build – in statistical capabilities as it provides some advanced worksheet functions and data analysis tools.

3.2. Exponential Triple Smoothing (ETS)

Exponential Triple Smoothing, also known as Holt-Winters model, is a model or algorithms that can be used to forecast data points in a series, provided that the series is “seasonal”. The Simple Exponential Smoothing (SES) is suitable for data with no trend or seasonal pattern while the Double Exponential Smoothing (DES) is suitable for data with trends, as it uses two level of components to handle trends. To forecast using data with trend and seasonality, ETS is more suitable as it uses three level of components to handle trend and seasonality. ETS can be implemented with the Additive structure or Multiplicative structure. The procedure for updating the estimates of model parameters for the Additive structure is as follow (Kalekar, 2004):

Overall Smoothing:

$$\bar{R}_t = \alpha(y_t - \bar{S}_{t-L}) + (1-\alpha) \times (\bar{R}_{t-1} + \bar{G}_{t-1})$$

Trend Smoothing

$$\bar{G}_t = \beta \times (\bar{S}_t - \bar{S}_{t-1}) + (1-\beta) \times \bar{G}_{t-1}$$

Seasonal Smoothing

$$\bar{S}_t = \gamma \times (y_t - \bar{S}_t) + (1-\gamma) \times \bar{S}_{t-L}$$

Forecast

$$y_t = \bar{R}_{t-1} + \bar{G}_{t-1} + \bar{S}_{t-L}$$

Where y is the observation, $\bar{R}$ is the estimate of the deseasonalized level, $\bar{G}$ is the estimate of trend component, $\bar{S}$ is the estimate of the seasonal index,

t is an idex denoting a time period, L periods is one season and α, β and γ are constants.

For this study, the forecasting tool in Excel 2016 is used. Excel 2016 calculates and predicts the future value based on historical values by using the AAA version of ETS algorithm, which models the time series data using an equation that accounts for additive error, additive trend and additive seasonality.

3.3. Group Method of Data Handling (GMDH)

The group method of data handling (GMDH) is a fast learning machine introduced by Ivakhnenko based on the principle of heuristic self-organizing. It is a typical inductive modelling method for computer-based mathematical modelling of multi-parametric datasets that features fully automatic structural and parametric optimization of models in which a series of operations of seeding, rearing, crossbreeding, selection and rejection of seeds correspond to determination of the input variables, structure and parameters of the model, and the selection of the model by the principle of termination (Ivakhnenko, 1971).

Since its introduction, it has been developing and applied to complex systems in several key areas such as prediction, modelling, clusterization, system identification, as well as data mining and knowledge extraction technologies, to several fields such as social science, science, engineering, medicine, etc. In another way, GMDH algorithm is a model that can be represented as a set of neurons where different pairs in each layer are connected through a quadratic and triquadratic polynomial and new neurons are produced in the next layer, which can be used in modelling the mapping of inputs to outputs.

GMDH builds more complex models gradually that are evaluated by a set of multi-input single output data pairs. Determining the most important input variables, a number of hidden layers, and neurons, which are the complexities involved with other neural networks, are circumvented by GMDH. This is because GMDH is a model that does not require a modeller to make any guesses in terms of parameters, which means having prior knowledge of the data set to be modelled is not required.

The base function of GMDH:

$$Y(x_1, \dots, x_n) = a_0 + \sum_{i=1}^{k} a_i f_i$$

GMDH algorithm has to consider the component subsets of the base function (x = inputs, Y = output, a = coefficients, f = elementary functions dependent on different sets of inputs and k = number of base function components) and choose an optimal model structure that is indicated by the minimum value of an external criterion. After these two processes, the optimal complexity of the identified model will be equal to the level of noise in the input data.

The connection between input and output variables can be expressed by Volterra – Kolmogorov – Gabor (VKG) polynomial function:

$$y_n = a_0 + \sum_{i=1}^{M} a_i x_i + \sum_{i=1}^{M}\sum_{j=1}^{M} a_{ij} x_i x_j + \sum_{i=1}^{M}\sum_{j=1}^{M}\sum_{k=1}^{M} a_{ijk} x_i x_j x_k + \cdots\cdots$$

where: ***X*** is the vector of input variables $(x_1, x_2, \cdots\cdots, x_M)$ and ***A*** is the vector of weighting coefficients $\left(a_0, a_i, a_{ij}, a_{ijk}, \cdots\cdots\right)$.

The architecture of GMDH with three layers and four inputs is shown in figure 4. The number of neurons in each layer depends on the number of input variables. The number of neurons is $h = \binom{p}{2}$ where the number of input variables is p. As the number of inputs is four, the number of nodes in a layer is determined to be six, which is the starting layer to the algorithm.

The coefficients of VKG polynomial function are estimated in each neuron. The desired output is predicted by using the estimated coefficients and input variables in each neuron. p neurons are selected and $h - p$ neurons are eliminated from the network according to the chosen external criteria. Four neurons are selected and two neurons are eliminated from the network as shown in figure 4. The outputs obtained from selected neurons become the inputs for the next layer and this process will continue until the last layer while only one neuron is selected. The obtained output from the last layer will be the predicted value for the time series at hand.

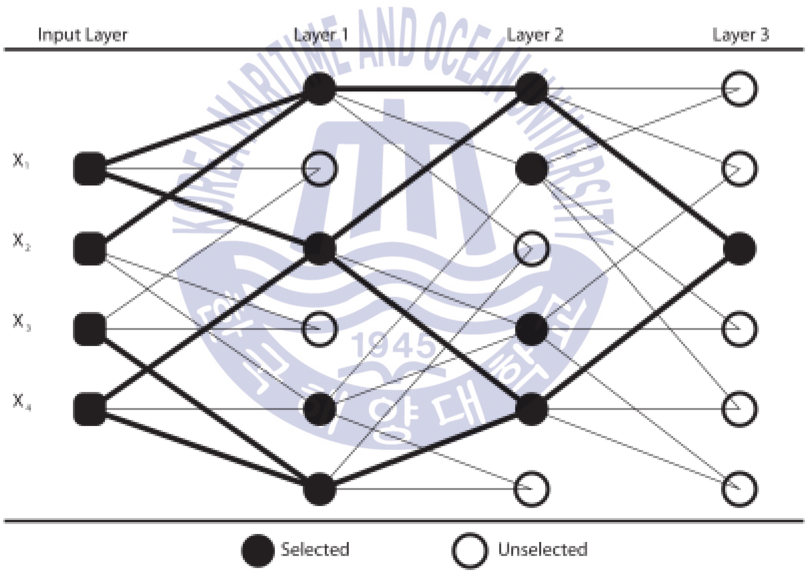

Figure 8 Architecture of GMDH Algorithm (Dag and Yozgatligil, 2016)

The basic GMDH algorithm makes following steps:

Step 1: The data samples are divided into the training sets and testing sets.

Step 2: Generates the structure for the partial models where at this stage, the layers are complexing. The coefficients are estimated using the least-squares method.

$Y = a_0 + a_1x_1$

$Y = a_0 + a_1x_1 + a_2x_2$

$Y = a_0 + a_1x_1 + a_2x_2 + a_3x_3$

$Y = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + \cdots\cdots + a_nx_M$

Step 3: Each of the partial models will be evaluated at all data points and only the best are chosen. This mechanism will be continued until a pre-specified selection criterion is met where the errors in the training network are minimized. The neurons use competitive learning as opposed to back propagation error correction where the neurons compete with each other to respond to the input neurons.

For this study, GMDH Shell, a commercial software, is used for the purpose of forecasting time series accurately. It is a neural network-based software that allows a full spectrum of parametric customization. GMDH Shell software used gradually complicating models to analyse the given historical data, while every model used will be checked if it fits the previously gained data values and the prediction strength of the model will be evaluated to decide whether to build the next model. The application of this software to build a GMDH model will be explained in the following section.

Step 1: Divide the dataset. Seventy percent is devoted to training and thirty percent to testing.

Step 2: Choose a holdout sample. Holdout is used to withholding a sample of observations and to evaluate forecast accuracy using the out-of-sample data.

Step 3: Determine the GMDH output. As GMDH chooses the best model by choosing the parameters all by itself, there is no trial and error required. After the training set has been input, the software builds the best model.

Chapter 4: Data Collection and Analysis

Collection, utilisation and analysation of data by using the forecasting model will be covered in this chapter. The accuracy of the forecast results will be evaluated using the selected accuracy measurement model.

4.1. The Data

The commonly used measurement of tourism demand in empirical research are tourist arrivals and tourist expenditure, in both aggregate and per capita forms (Song et al., 2010) and tourist arrivals are more frequently used compared to tourist expenditure. This paper mainly adopts the total number of passengers arriving by cruise as the dependent variable, so the selection of explanatory variables does not consider the variables of individual countries of origin, but only that of the destination. The data for tourism demand forecast is usually collected yearly, quarterly, and monthly. In order to take seasonal and trend components into consideration for the more detailed analysis of the tourist demand forecasting, the monthly data was more preferred than the annual data, as they only provide limited information for the tourism sector in decision making. This study adopts the forecast of South Korea Cruise tourism demand, Busan Cruise tourism demand and Hong Kong Cruise tourism demand as the research model. For South Korea, monthly data of the country's inbound cruise passengers collected within five years between January 2011 and December 2015 (60 months) was utilized. The data for the first 48 months, from January 2011 to December 2014 are adopted as training samples. While the following 12 months of data, from January 2015 to December 2015, are adopted as test samples. For Busan, monthly data of Busan inbound cruise passengers collected within five years between January 2011 and December 2015 (60 months) was utilized. The data for the first 48 months, from January 2011 to December 2014 are adopted as training samples. While the following 12 months of data, from January 2015 to December 2015, are adopted as test samples. Lastly, for Hong Kong, quarterly data of Hong Kong cruise passenger throughput collected within nine years between January 2007 and December 2015 (36 quarters) was utilized. The data for the first 32 quarters, from January 2007 to December 2014 are adopted as training samples. While the following 4 quarters of data, from January 2015 to December 2015, are adopted as test samples.

The forecast of South Korea and Busan adopted inbound cruise passengers as the data set, while the forecast of Hong Kong adopted cruise passenger throughput, which is the total of cruise passenger arrivals and departures, as the data set. Therefore, the main difference between the data sets is that Hong Kong's data set included the outbound cruise passengers, while the other two data sets do not.

4.2. Analysis of Time Series Features of the Data

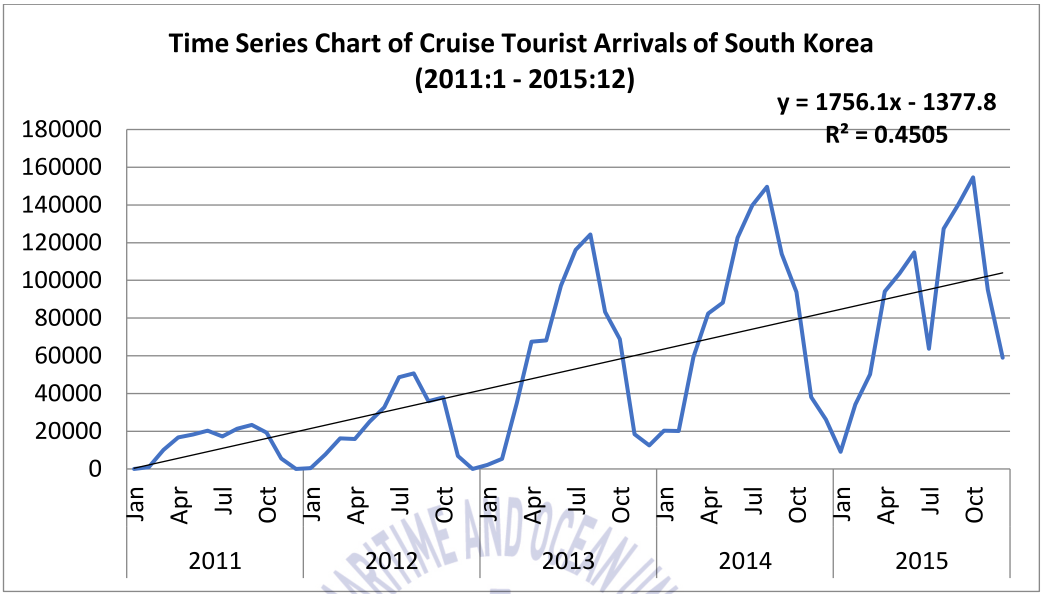

Figure 9 Time Series Chart of Cruise Tourist Arrivals of South Korea

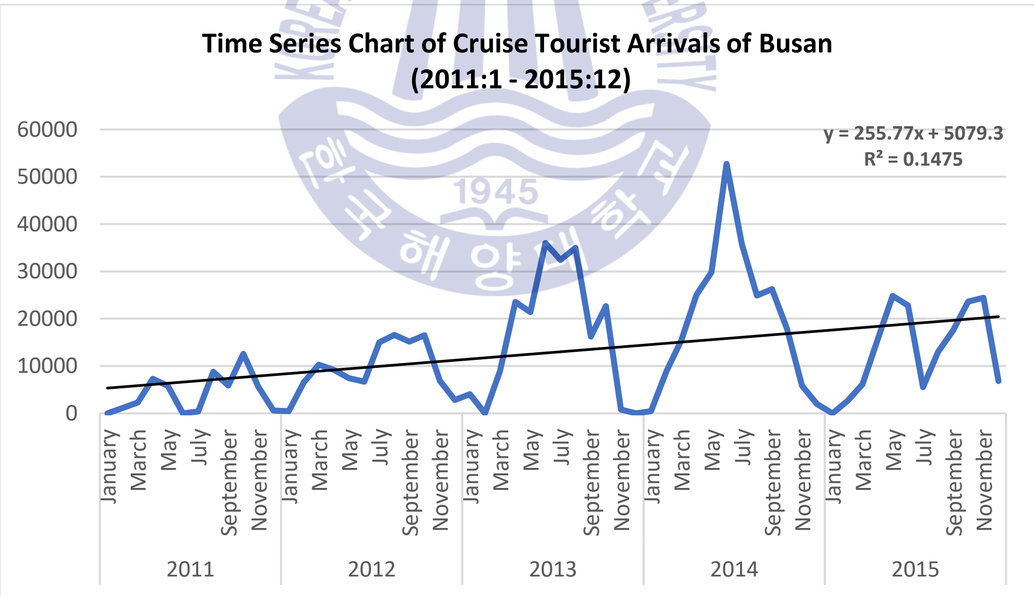

Figure 10 Time Series Chart of Cruise Tourist Arrivals of Busan

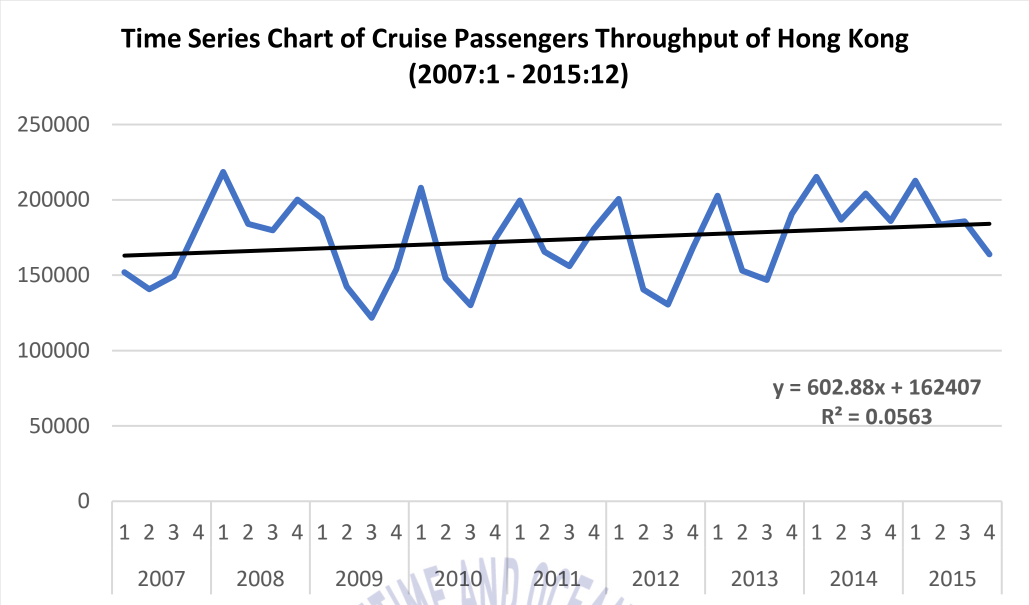

Figure 11 Time Series Chart of Cruise Passengers Throughput of Hong Kong

The series' behaviour indicates that there is seasonality, which is higher values during summer months and lower values during winter months. Butler (2001) defined that seasonality is "a temporal imbalance in the phenomenon of tourism, which may be expressed in terms of dimensions of such elements as numbers of visitors, expenditure of visitors, traffic on highways and other forms of transportation, employment and admissions to attractions''. A seasonal factor, which is also known as a seasonal index or seasonal relative, is a way to measure the seasonal variation or the change that is due to seasonal changes in demand. To identify the seasonality, the ratio-to-moving average method was used in the seasonal decomposition process. The seasonal factor value shows the influence of seasonal fluctuations on the data periodically.

The Seasonal Factor Value of South Korea Cruise Industry	
Months	**Seasonal Factor Value (%)**
January	55.96
February	62.23
March	81.5
April	98.14
May	112.87
June	130.36
July	145.29
August	163.92
September	140.91
October	128.05
November	52.43
December	28.35

Table 7 The Seasonal Factor Value of South Korea Cruise Industry

The Seasonal Factor Value of Busan Cruise Industry	
Months	**Seasonal Factor Value (%)**
January	6.26
February	31.68
March	67.57
April	129.69
May	134.80
June	142.43
July	115.45
August	162.16
September	131.05
October	174.29
November	83.96
December	20.66

Table 8 The Seasonal Factor Value of Busan Cruise Industry

The Seasonal Factor Value of Hong Kong Cruise Industry	
Quarters	**Seasonal Factor Value (%)**
1	112.93
2	93.08
3	91.60
4	102.40

Table 9 The Seasonal Factor Value of Hong Kong Cruise Industry

4.3. Accuracy Measurement of Model

The accuracy measurement is very important to evaluate the correctness of the results of tourism demand forecast. The accuracy of the forecasting model depends on how close the forecast value is to the actual values, which reflect the ability of a forecasting model to predict the future. There are a number of methods that can be used to measure the forecast error, in this study, Root Mean Squared Error (RMSE) and Mean Absolute Percentage Error will be used to evaluate the forecasting performance of the ARIMA, ETS and GMDH. The formulas are shown as follows:

Root Mean Squared Error (RMSE) = $\sqrt{\frac{1}{n}\left(\sum_{i}^{n}\frac{(\hat{y}_i - y_i)^2}{y_i}\right)}$

Mean Absolute Percentage Error (MAPE) = $\frac{1}{n}\sum_{i}^{n}\left|\frac{(\hat{y}_i - y_i)}{\hat{y}_i}\right|$

$\hat{y}_i$ is the actual value in period i; y_i is the forecast value in period i; and n is the number of periods used in the calculation.

4.4. Experiment Results and Generating Future Forecasts

As mentioned above, the accuracy measurement will be compared by two models: RMSE and MAPE.

	RMSE	MAPE
GMDH	23023.33	0.491483
ARIMA	91526.29	0.902087
ETS	27179.23	0.236618

Table 10 Accuracy Comparisons of South Korea Cruise Tourist Arrivals Forecasting for the GMDH, ARIMA and ETS Models

The comparison of the errors of the predicted number of tourists and the actual number of tourists for South Korea in the year 2015 for the three forecast models show that the GMDH model has the lowest error rates in RMSE and the second lowest in MAPE.

	RMSE	MAPE
GMDH	29124601	0.480376
ARIMA	207606933	0.702797
ETS	281057608	1.465231

Table 11 Accuracy Comparisons of Busan Cruise Tourist Arrivals Forecasting for the GMDH, ARIMA and ETS Models

The comparison of the errors of the predicted number of tourists and the actual number of tourists for Busan in the year 2015 for the three forecast models show that GMDH model has the lowest error rates in both forecast accuracy models; thus, it has the best performance.

	RMSE	MAPE
GMDH	4659.56	0.020127
ARIMA	20514.50	0.080189
ETS	20259.87	0.097903

Table 12 Accuracy Comparisons of Hong Kong Cruise Passengers Throughput Forecasting for the GMDH, ARIMA and ETS Models

The comparison of the errors of the predicted number of tourists and the actual number of tourists for Hong Kong in the year 2015 for the three forecast models show that GMDH model has the lowest error rates in both forecast accuracy models; thus, it has the best performance.

Table 13 presented the number of cruise tourist arrivals to South Korea predicted by different forecasting models chosen for the January 2015 to December 2015 period.

Months (2015)	Actual	GMDH	ARIMA	ETS
January	9,040	39,313	17,342	9,040
February	34,152	44,568	12,210	46,240
March	50,123	73,557	9,265	64,042
April	94,106	85,368	7,576	79,546
May	103,591	95,512	6,607	85,075
June	114,778	118,858	6,052	101,668
July	63,706	107,498	5,733	98,894
August	127,369	139,387	5,551	103,200
September	140,336	123,111	5,447	97,014
October	154,618	114,115	5,387	95,127
November	95,031	71,766	5,354	71,861
December	59,026	49,651	5,335	63,789

Table 13 Number of Cruise Tourist Arrivals to South Korea Predicted by GMDH, ARIMA and ETS Models for the Year 2015

Table 14 presented the number of cruise tourist arrivals to Busan as predicted by different forecasting models chosen for the January 2015 to December 2015 period.

Months (2015)	Actual	GMDH	ARIMA	ETS
January	0	0	1,184	0
February	2,651	5,532	2,138	13,019
March	6,181	11,351	1,322	19,765
April	15,573	19,924	2,308	29,718
May	24,852	26,658	1,460	34,174
June	22,830	29,866	2,480	55,616
July	5,506	16,509	1,597	38,552
August	12,954	17,621	2,651	28,923
September	17,546	18,427	1,733	29,379
October	23,624	21,528	2,824	21,692
November	24,456	14,929	1,869	9,391
December	6,794	4,797	2,997	5,791

Table 14 Number of Cruise Tourist Arrivals to Busan Predicted by GMDH, ARIMA and ETS Models for the Year 2015

Table 15 presented the number of cruise passengers throughput to Hong Kong as predicted by different forecasting models chosen for the January 2015 to December 2015 period.

Quarters (2015)	Actual	GMDH	ARIMA	ETS
1	212,709	206,848	176,722	212,709
2	183,693	176,930	181,578	166,630
3	185,782	183,210	181,404	160,318
4	163,929	164,305	183,026	190,429

Table 15 Number of Cruise Passengers Throughput of Hong Kong Predicted by GMDH, ARIMA and ETS Models for the Year 2015

Earlier in this section, the results for the test data for the year 2015 was analysed by comparing the actual value and the values forecasted by forecasting models selected. GMDH presented the best performance for both the South Korea and Hong Kong data sets as it has the lowest error rate and the values forecasted are the closest to the actual values.

The reason that GMDH worked better than the other two models is because of the advantage of using pairs of inputs; only six weights (coefficients) have to be computed for each neuron. The number of neurons in each layer increases approximately as the square of the number of inputs. During each training cycle, the synaptic weights of each neuron that minimize the error norm between predicted and measured values are computed, and the branches that contribute least to the output of the neuron are discarded. The remaining branches are retained and their synaptic weights kept unchanged thereafter. A new layer is subsequently added and the procedure is repeated until the specified termination conditions are met.

Since GMDH has the best performance, it is used to forecast the cruise tourism demand to South Korea, Busan and Hong Kong for the year 2016 and the forecast will be presented in table 16, 17 and 18.

Months (2016)	Forecast
January	52,999
February	58,184
March	81,566
April	95,926
May	109,315
June	133,287
July	128,905
August	161,768
September	136,058
October	139,569
November	67,243
December	17,350

Table 16 Monthly Cruise Tourist Arrivals to South Korea Forecasted for the Year 2016

Months (2016)	Forecast
January	4,957
February	5,911
March	14,319
April	24,524
May	33,419
June	36,158
July	24,548
August	22,936
September	17,040
October	20,095
November	8,283
December	13,471

Table 17 Monthly Cruise Tourist Arrivals to Busan Forecasted for the Year 2016

Quarters (2016)	Forecast
1	183,135
2	157,242
3	151,042
4	116,581

Table 18 Quarterly Cruise Passengers Throughput of Hong Kong Forecasted for the Year 2016

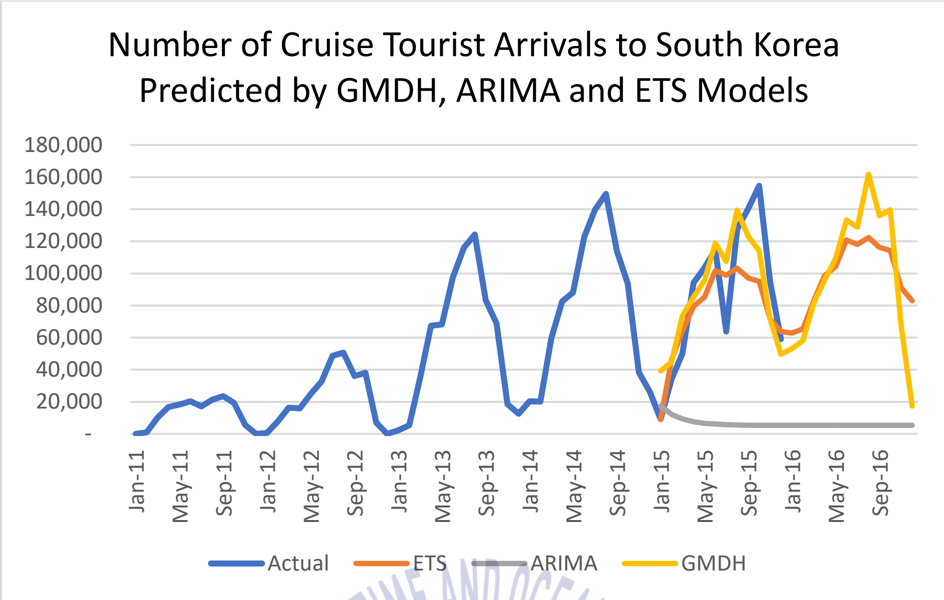

Figure 12 Number of Cruise Tourist Arrivals to South Korea Predicted by GMDH, ARIMA and ETS Models

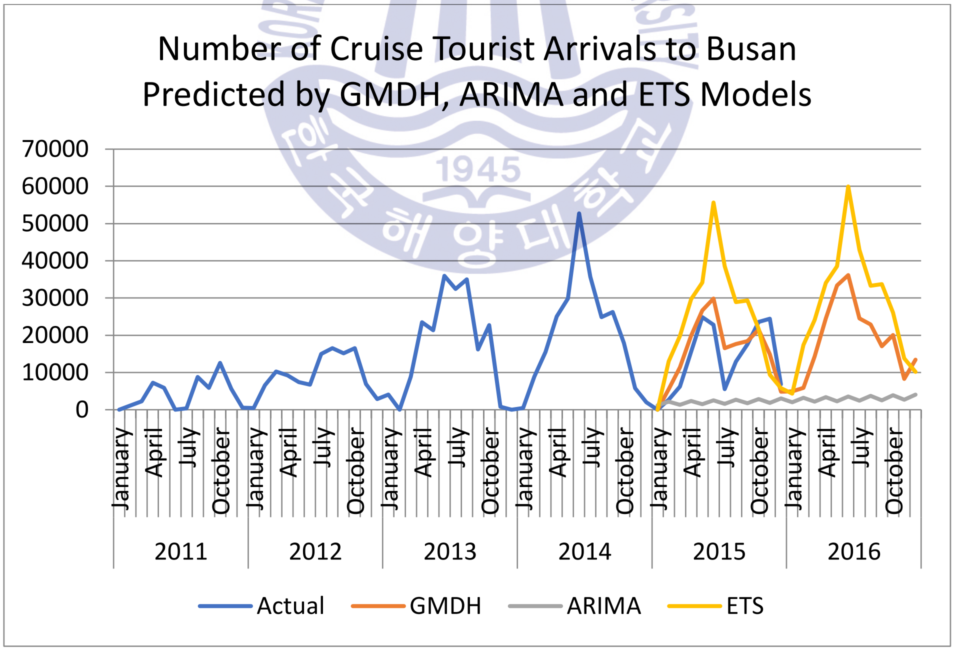

Figure 13 Number of Cruise Tourist Arrivals to Busan Predicted by GMDH, ARIMA and ETS Models

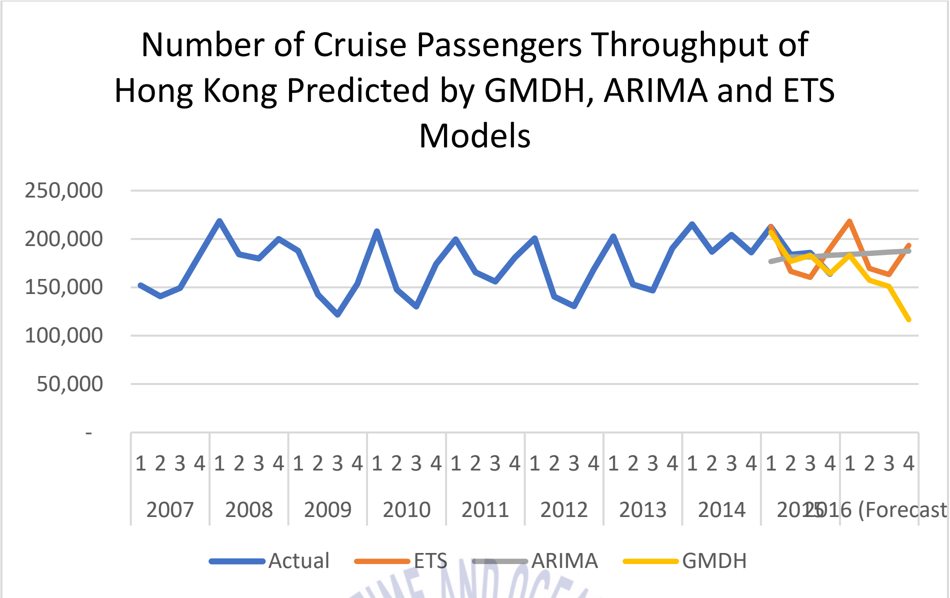

Figure 14 Number of Cruise Passengers Throughput of Hong Kong Predicted by GMDH, ARIMA and ETS Models

Chapter 5: Conclusions and Future Study

The development of cruise tourism has been receiving increasing attention from many countries. In order to increase the number of tourists, various measures could be taken. Successful investments require the correct forecasts of tourism demand. Correct demand forecasts can help both the public and private sectors to enhance the allocation of resources and balance demand and supply in the tourism industry.

This study adopted the ARIMA, ETS and GMDH model as the cruise tourism demand forecast model. The result indicated that GMDH model is the optimal model with the lowest error rate. ETS turned out to be the sub – optimal forecast model while ARIMA turned out to be the worst forecast model. GMDH not only show the lowest error rate in forecasting the inbound cruise passenger, but also show the lowest error rate in forecasting the cruise passenger throughput. As mentioned earlier, the reason that GMDH worked better than the other two models is because in using pairs of inputs, only six weights (coefficients) have to be computed for each neuron.

Considering the limited attempts in forecasting cruise tourism demand in literature by using Group Method of Data Handling, suggested models will contribute to decision making managers and practitioners in the cruise tourism sector and the cruise tourism demand literature. More cruise tourism demand forecasting should be conducted and more attempts to develop various kinds of forecasting methods that are related to specific aspects of tourism demand should be made. Besides, considering the limited number of cruise destinations or cruise terminals to test with the suggested forecasting model, more cruise destinations or cruise terminals should be included and further testing of the forecast accuracy of the suggested forecasting model should be conducted.

References

Burger, C.J.S.C., Dohnal, M., Kathrada, M. and Law, R. (2001), *A Practitioners Guide to Time - Series Methods for Tourism Demand Forecasting – A Case Study of Durban, South Africa.*

Chala, K., (2015), *History of cruise tourism*. [PDF] Available at: http://dspace.nuft.edu.ua/jspui/bitstream/123456789/20650/1/77Karuk_M.pdf [Accessed 4 Apr. 2018].

CLIA, (2017), *2017 Asia Cruise Trends*. [PDF] Available at: https://www.cruising.org/docs/default-source/research/clia-2017-asia-cruise-trends-report.pdf?sfvrsn=0 [Accessed 3 Apr. 2018].

CLIA, (2017), *The Contribution of the International Cruise Industry to the Global Economy in 2016*. [PDF] Available at: https://cruising.org/docs/default-source/research/global_economic_contribution_2016.pdf?sfvrsn=2 [Accessed 3 Apr. 2018].

CLIA, (2018), *2018 Cruise Industry Outlook*. [PDF] Available at: https://cruising.org/docs/default-source/research/clia-2018-state-of-the-industry.pdf?sfvrsn=2 [Accessed 3 Apr. 2018]

Cruise Industry News, (2018), *Annual Report 2018 – 2019.* [PDF] Available at: https://www.cruiseindustrynews.com/annual-cruise-industry-report.html [Accessed 3 Apr. 2018]

Cruise Korea, (2017), *Government Policy.* Available at: http://cruise.visitkorea.or.kr/content/content_view.do?cate_idx=60&topmenu=1 [Accessed 19 May. 2018]

Cruise Market Watch, (2018), *Growth of Ocean Cruise Line Industry*. Available at: https://www.cruisemarketwatch.com/growth/ [Accessed 17 Apr. 2018]

Cundiff, Edward W & Govoni, Norman A. P & Still, Richard Ralph, (1976), *Fundamentals of modern marketing*, 2nd ed, Prentice-Hall, Englewood Cliffs, N.J

Dag O, Yozgatligil C (2016), *GMDH: An R package for short term forecasting via GMDH Type neural network algorithms*. The R Journal, 8(1), pp. 379–386.

Gibson, P., (2012), *Cruise Operations Management: Hospitality Perspectives*, 2nd ed, Routledge.

Ivahnenko, A.G., (1971), *Polynomial Theory of Complex Systems*, IEEE Trans. Syst. Man Cybern.

Ivakhnenko, A.G., (1978), *The Group Method of Data Handling in Long-Range Forecasting*, Technol. Forecast. Soc. Change, 12(2–3), pp. 213–217.

Kalekar PS., (2004), *Time series forecasting using Holt-Winters exponential smoothing*. Mumbai: Kanwal Rekhi School of Information Technology.

Oxford Dictionaries, (2017), *Cruise*. Available at: https://en.oxforddictionaries.com/definition/cruise [Accessed 19 May. 2018]

R.W. Butler, (2001), *Chapter 2 - Seasonality in Tourism: Issues and Implications*, In Advances in Tourism Research, edited by Tom Baum and Svend Lundtorp, Pergamon, Oxford, Pages 5-21, Seasonality in Tourism.

Samsudin, R., Saad, P. and Shabri, A. (2010), *Hybridizing GMDH and Least Squares SVM Support Vector Machine for Forecasting Tourism Demand.*

Shabri, A. (2015), *A Novel Hybrid Ensemble Learning Paradigm for Tourism Forecasting*.

Song, H., Li, G., Witt, S.F. & Fei, B. (2010), *Tourism demand modelling and forecasting: how should demand be measured?*, Tourism Economics, 16(1), pp. 63-81.

Tomlinson, S. (2007). *Smooth Sailing – Navigating the Sea of Law Applicable to the Cruise Line Industry*, Jeffrey S. Moorad Sports Law Journal, 14(1), 127 – 158).

UNWTO, (2018), *2017 International Tourism Results: The Highest in Seven Years*. Available at: http://media.unwto.org/press-release/2018-01-15/2017-international-tourism-results-highest-seven-years [Accessed 19 May. 2018]

Wei, W. (2006). *Time series analysis*. Boston: Pearson Addison Wesley.

Wilkinson, P.F. ed., (2006). *The Changing Geography of Cruise Tourism in the Caribbean*. In: Cruise Ship Tourism. Oxford: CABI, pp. 170 – 183.

WTTC, (2018), *Hong Kong*. [PDF] Available at: https://www.wttc.org/-/media/files/reports/economic-impact-research/countries-2018/hongkong2018.pdf [Accessed 19 Apr. 2018]

WTTC, (2018), *South Korea*. [PDF] Available at: https://www.wttc.org/-/media/files/reports/economic-impact-research/countries-2018/southkorea2018.pdf [Accessed 19 Apr. 2018]

Yahya, N.A., Samsudin, R. and Shabri, A. (2017), *Tourism Forecasting using Modified Empirical Mode Decomposition and Group Method of Data Handling.*

Acknowledgments

I would first like to devote the greatest gratitude to my supervisor, Professor Seong – Cheol Cho. The door to Professor Cho's office was always open whenever I ran into trouble or had a question about my research or writing. He consistently allowed this thesis to be my own work but steered me in the right the direction whenever he thought I needed it.

Certainly, I would also like to thank the thesis committees, Chairman Professor Han – Won Shin and Member Professor Dong – Keun Ryoo who gave me their very valuable comments on this thesis. Without their passionate participation and input, the thesis could not have been successfully conducted.

Not forgetting to mention, I would also like to send my deepest appreciation to all the professors in Korea Maritime and Ocean University who have dedicated time and effort in advising and coaching me during my study period. I would also like to thank the assistant of Shipping Management, Miss Da – Young Kang who helped me a lot through the process of thesis writing with her warm assistance and I am very grateful to have her.

Finally, I must express my very profound gratitude to my parents and to all my friends for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this thesis. This accomplishment would not have been possible without them.