# PREDICT REVENUE PASSENGER MILES BY USING MULTIPLE REGRESSION

LIM POH LUAN

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF SCIENCE WITH HONOURS

MATHEMATICS WITH ECONOMICS PROGRAM SCHOOL OF SCIENCE AND TECHNOLOGY UNIVERSITI MALAYSIA SABAH

APRIL 2008



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30<sup>th</sup> of April, 2008

LIM POH LUAN

HS2005-2208



#### **CERTIFIED BY**

#### Signatures

1. SUPERVISOR

(PROF. DR. ZAINODIN BIN HAJI JUBOK)

2. EXAMINER 1

(PN. DARMESAH GABDA)

3. EXAMINER 2

(PN. NORAINI ABDULLAH)

4. DEAN

(SUPT/KS, ASSOC. PROF. DR. SHARIFF A. K. OMANG, ADK)

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#### ACKNOWLEDGEMENT

First and foremost, I would like to express my gratitude to my supervisor, Prof. Dr. Zainodin Bin Haji Jubok for his supervision along this final year project. Without his constant guidance, I would not have finished this dissertation.

Besides my supervisor, I would like to thank my course-mate, Looi Yeok Hoon, for her help in solving the problems that I faced along this final year project. Thanks are extended to my housemates in Sabah who had kept encouraging me. Heartiest appreciation to my housemates, for their never ending support throughout my study.

Last, but not least. I thank my family, especially my parents for giving me unconditional support and encouragement. I would like to thank my sister too, for listening to my complaints and frustrations. Thank you very much!



#### ABSTRAK

Disertasi ini adalah berkenaan dengan pembentukan satu model linear regresi yang terbaik dengan tujuan untuk menganggar revenue passenger miles dalam negeri bagi industri penerbangan Amerika Syarikat pada masa akan datang di mana revenue passenger miles merupakan pengukuran trafik penumpang. Penganggaran revenue passenger miles adalah penting bagi pengurusan syarikat penerbangan supaya pelbagai keputusan boleh dibuat dengan berasaskannya. Di samping itu, disertasi ini juga berminat dalam menganalisis kesan interaksi dalam regresi berganda. Analisis di sini juga fokus pada beberapa faktor penting yang mempengaruhi revenue passenger miles, seperti populasi, bilangan operator, keuntungan operasi dari penumpang, pendapatan Negara bagi Amerika Syarikat, bilangan kapal terbang Amerika Syarikat yang terlibat dalam kemalangan dan bilangan kematian daripada kemalangan kapal terbang. Dalam kajian ini, cara untuk menyenaraikan senarai model yang mungkin telah diperkenalkan dan proses penghapusan dijalankan dengan tujuan untuk mendapatkan model terpilih. Kriteria Lapan pilihan digunakan untuk memperoleh model yang terbaik. Dengan mengunakan Wald test, pembolehubah yang telah dibuang sebelum terjadinya model terbaik diuji, sama ada keputusan untuk menghapus pembolehubah tersebut adalah wajar. Diikuti oleh ujian kerawakan, tujuan ujian ini adalah untuk menguji kerawakan reja. Dalam bahagaian akhir projek ini, revenue passenger miles akan dianggarkan dengan mengunakan model terbaik yang diperolehi. Selain itu, perbandingan antara nilai anggaran dan nilai sebenar dibuat, dan didapati sisihan diantaranya adalah tidak ketara. Maka model terbaik yang diperolehi boleh dikatakan suatu model yang baik dalam penganggaran revenue passenger miles.



#### ABSTRACT

This dissertation is about to form a best linear regression model in order to predict the domestic revenue passenger miles of United States air transportation industry, which is a measure of airline's passenger traffic in the future. Prediction of Revenue passenger miles is important for airline management in order to make various decision based on it. Besides, we are interested to analyze the interaction effects in multiple regression. Analysis also focus on some important factors that influencing revenue passenger miles such as population, number of airlines, operating revenue from passengers, gross national product of United States, number of American planes in an accident and number of fatalities from aircraft accidents. In this study, the way to list out all possible models is introduced and elimination procedures are carried out in order to get the selected models. Eight selection criteria is employed to get the best model. By carrying out the Wald test, the variables which are eliminated before the best model is formed, is tested whether the decision to remove the variables is acceptable or not. This is followed by randomness test; the purpose of this test is to test the randomness of the observation residuals. In the last section of the project, revenue passenger miles will be predicted base on the best model. Besides, comparison between estimated value and actual value is made, and it is found that the variation of them is not critical. Hence, the best model obtained can be said as a good model in predicting revenue passenger miles.



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#### **CHAPTER 1**

#### INTRODUCTION

#### 1.1 Importance of Transportation

Owen (1992), a transportation consultant highlighted the importance of transportation. He emphasized that although transportation is just one of many factors influencing the nature of society, but we can see its special role from the fact that without it, the effective operation of other sectors of the economy is almost always precluded. Mobility brings many people in contact with other people who are from different places, hence has become an integral part of agriculture, manufacturing, programs of education and the conduct of international trade, travel and investment. There are various types of transportation, such as rail, automobiles, ships, aircraft and special purpose vehicles. The growth and changes in modes of transportation have also greatly encouraged travel. According to Hudman and Jakson (2003), replacement of transatlantic ships by airplanes was followed by the jet age from the 1960s till today.



#### 1.2 Introduction to the Air Transportation Industry

The Wright brothers, Orville and Wilbur, were two Americans who launched the world's first successful airplane at Kitty Hawk, North Carolina, on 17 December 1903. Their great invention make humanity's age-old dream of flight became a reality and changed the world forever. As mentioned by Sweet (2004), the invention of the airplane enabled humans for the first time in history to travel rapidly and easily over land-dominated obstacles like mountains, deserts, and ice bergs. Besides, its greatest tribute is to air transport service, which the movement of travellers, cargo and mail by aircraft, and the service provides the integral link between communities, businesses and nations.

Air transport services have also enable commercial innovations such as just-intime freight shipments from manufacturing plants to customer over longer distances. Furthermore, it is also important to the sustained development of the world's largest industry, tourism. According to Sweet (2004), the interconnectivity of the airline industry has framed the perception that the planet seems smaller. Therefore, travellers can literally visit to the Seven Wonders of the World as introduced by Romer and Romer (1995): Great Pyramid of Giza, Hanging Gardens of Babylon, the Statue of Zeus at Olympia, Temple of Artemis at Ephesus, Mausoleum of Maussollos at Halicarnassus, Colossus of Rhodes and Lighthouse of Alexandria, all in shorter periods of time.



Wells (1994) found that, like any other industry, air transportation also makes its direct contribution to the economy through its employment and revenue generation and an indirect contribution through its purchases of goods and services from supplier industries. Radnoti (2002) mentioned that there are several trades connected with the airline industry, such as aircraft and engine manufacturers, vendors and suppliers.

The contribution of air travel also has significantly improved the efficiency of business and government activity. This is done by expanding the potential geographic area of personal contact, communication and supervision of activities. According to Wells (1994), air travel has contributed to enhance life-styles by boarding opportunities for vacations, educational travel, and visiting friends and relatives. Hence supporting travel related industries, such as hotels, rental cars and travel agencies. Besides, the rapid delivery of the mail has improved communications too.

Radnoti (2002) had introduced some of the major air carriers in the United States. They are Air Alaska, American Airlines, American Eagle, American Trans Air, Continental Airlines, Delta Airlines, DHL and so forth. These major air carriers generally serve larger cities with a significant volume of traffic. Their revenue range is up to \$100 million per year.



The ability of an airline to generate revenue depends on many factors. Radnoti (2002) showed some examples of normal revenue accounts and the related activities that generate the revenue. These are outlined in Table 1.1:

Revenue Account	Generating Medium
Passenger	Passenger traffic
Freight	Freight traffic
Mail	Government contracts
Excess baggage	Passenger traffic
Charter	Available aircraft time
Duty free sales	On-board sales
Services performed	Maintenance handling for other airlines
Leasing income	Lease of equipment to other airlines

Table 1.1 Normal Airline Revenue Accounts

(Source: Radnoti, 2002)

Therefore, the sources of revenue generated by an airline can be classified as passengers, cargo, excess baggage, mail, and miscellaneous revenues from nonoperative sources.

Air traffic in a given period, in other words, the demand for output produced by airlines which has been met during that period. According to Holloway (1997), air traffic is measured by the following:



- a. For passengers: Revenue Passenger Miles (RPMs),
- b. For freight: Freight Ton-Miles (FTMs)
- c. For passenger and cargo combined: Revenue Ton-Miles (RTMs)

Revenue passenger miles (RPMs) are distance-weighted measures in which they are generated by flying one revenue passenger one mile. In short, they are a measure of an airline's passenger traffic. According to Doganis (2001), revenue passenger miles can be obtained by multiplying the number of fares paying passengers on each flight stage by flight stage distance. If an airplane enplaned passenger much further, it would generate more revenue passenger miles (RPMs).

On the other hand, revenue ton-miles are generated by flying one ton one mile. Holloway (1997) had further introduced that there is a standard assumed weight per passenger and accompanied baggage which allows passenger traffic to be combined in a single measurement with cargo (freight, mail, and unaccompanied baggage).

#### 1.3 Statement of Problem

Nowadays, the term revenue passenger miles might sound strange to the public and how it is evaluated. Therefore, this study is carried out to identify the factors that influencing the revenue passenger miles.



Factors that might influence the revenue passenger miles which might be considered in this study are airline deregulation, number of American planes in an accident, number of fatalities from aircraft accidents, and the number of airlines.

According to Sweet (2004), there were few statutes for economics regulation of the air transportation industry existed between 1926 and 1928. But, the Airline Deregulation Act of 1978 was implemented into law on 24<sup>th</sup> of October, 1978. As explained by Sweet (2004), the purpose of this deregulation legislation was to encourage air transport system that placed primary reliance upon competitive market forces as the basic determinant of commercial airline operations.

After the Airline Deregulation Act of 1978 was signed into law, air passenger traffic performed an exponential growth. Wells (1994) stated that, in 1938, the number of passengers (domestic and international) carried by U.S airlines increased from little over 1 million to almost 268 million in 1978. With the increase in average length of journey, the U.S. airline revenue passenger miles grow from 533 million in 1938 to 219 billion in 1978.

According to Guzhra and Pagiavlas (2004), the tragic events of 11<sup>th</sup> September, 2001, affected commercial aviation. This is obviously number of air planes in an accidents, and the number of fatalities from aircraft accidents would greatly influence the demand for air travel.



Wells (1994) said that the board investigates hundreds of accidents, annually including all carrier accidents, all in flight collisions, fatal general aviation accidents and all air taxi commuter accidents.

In this study, not only the main factors that influencing the revenue passenger miles are examined, but the interactions between the factors also are interested. This is to look at the interactions between factors' effects on the revenue passenger miles.

#### 1.4 Importance of Study

All levels of management within all segments of the air transportation industry have to made decision daily. The decisions are made about what is likely to happen in the future. Therefore, as stated by Wells (1994), they need to predict, which is an attempt to quantify demand in the future time period. Quantification in this study is in terms of physical volume, which is revenue passenger miles.

In this study, the purpose is to predict the revenue passenger miles. Hence, by using the predicted revenue passenger miles, an airline can provide a basis for scheduling and developing fleet requirement. Besides, Radnoti (2002) found that a basic for evaluating station staffing and facilities requirement can be provided.



Furthermore, Wells (1994) proposed that the advertising director for a major air carrier needs prediction of revenue passenger miles as a basis for assigning funds to promote a new, low fare to selected cities. Based on the prediction on revenue passenger miles, marketing strategies and promotional programs can be developed.

According to Holloway (1997), traffic predictions are the basis for revenue and profit forecast. Therefore, an airline needs prediction to plan and be ready for the preceding requirement such as maintenance planning, manpower planning and allocation of other resources. Multiple regression analysis will be applied to find the best model which explains the revenue passenger miles and hence to predict it.

#### 1.5 Objectives

The objectives for this study are:

- To identify the factors that influencing the revenue passenger miles of the air transportation industry.
- To identify the effects of higher order interaction variable in predicting the revenue passenger miles
- To obtain the best model in order to explain the revenue passenger miles of the air transportation industry.
- d. To predict the revenue passenger miles of the air transportation industry by using multiple regression.



#### 1.6 Scopes of the Study

This study focuses on the revenue passenger miles, which is a distance-weighted measure for a revenue passenger flying one mile. Besides, this study is focused on the factors that influence the revenue passenger miles of the air transportation industry. The purpose of this study is to identify the factors that influencing the revenue passenger miles of an air transportation industry and predict the revenue passenger miles, hence multiple regression analysis with interaction is employed to achieve the objectives. The annual data for domestic revenue passenger miles of United States air transportation industry will be collected and analysed.



#### **CHAPTER 2**

#### LITERATURE REVIEW

### 2.1 Introduction

According to Jong *et al.* (2007), transport models are regularly used in many countries all over the world to predict the international, national, regional or local transport volumes and traffic flows on specific network links for a single scenario or a limited number of scenarios. Wells (1994) suggested that the prominent independent variables used in forecasting various segment of the air transportation include gross national product (GNP), disposable personal income (DI), and consumer spending on services. Besides, he also suggested the dependent variables which might include such things as revenue passengers enplaned, revenue passenger miles, passenger revenue, and so forth.



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#### 2.2 Importance to Analyze Air Travel Market

According to Abed *et al.* (2001), analyzing air travel market is an integral part of an airline's corporate plan that reflects the capacity utilization, manpower requirements and financial projections for the operating capital projects. By evaluating the demand side of the air transportation industry, it helps to reduce the airline company's risk. Besides, it also helps in decision making regarding the development of infrastructure facilities to ensure the improvement of services are provided to air passenger.

#### 2.3 Reviews on Factors Influencing Air Demand

In the study of Abed *et a.l* (2001), they mentioned that several explanatory variables including total expenditures and population size had been used to develop a model that represent domestic air travel demand. Besides, there are several factors affecting air travel demand, and each of the factors is composed of elements which can stimulate or constrain air travel growth. According to Abed *et al.* (2001), the factors in air travel demand analysis, is more conveniently categorized into two broad groups, they are those external to the airline industry and those within the industry itself. Those external to the airline industry are the factors which are outside the control of the individual airline and even the whole airline industry. For example, these are basically long range economic, social, demographic, and political trends. In the study of Profillidis (2000), they stated that it's generally accepted that air transport demand is closely related to GDP and this is confirmed by the income elasticities that have been found from the studies carried out around the world. This statement is figured out in Figure 2.1.



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