Modelling Crude Oil Demand in Malaysia

By

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Petroleum Engineering

10760

Dissertation submitted in partial fulfilment

of the requirements for the

Bachelor of Engineering (Hons.)

(Petroleum Engineering)

August 2011

Universiti Teknologi PETRONAS

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
Geosciences and Petroleum Engineering Department
Universiti Teknologi PETRONAS
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Bachelor of Engineering (Hons.)
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Approved by,

(Mr. Elias Abllah)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

August 2011

ACKNOWLEDGEMENTS

First of all, I would like to say Alhamdulillah, praise to the Almighty God for giving an utmost opportunity for the author, and for giving the strength and health to do this project work until it was done.

Secondly the author is grateful for all the supports shown by parents. They have continuously provided moral and financial supports until the end of this project. The special thank goes to the helpful supervisor, Mr Elias Abllah. The supervision and support that he gave truly help the progression and smoothness of this final year project. The co-operation is much indeed appreciated.

Not forgetting, A'fza Binti Shafie, for her precious helps in providing the required data and information which are sufficient for the accomplishment of this final year project.

Last but not least, the author would like to express his gratitude to fellow colleagues who have always provided moral supports and a never-ending assistance in ensuring this final year project is finished within the given time frame.

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1.2 PROBLEM STATEMENT

Oil has been the cheap energy source that has fired the industrial society for the last century. However, threatening signs of oil depletion has become a horror nightmare for humankind. The implications are catastrophic for industrial societies, and also the yearned for economic development of the less developed countries.

When we are talking about demand, the first thing that will come to people mind is the price. In 2008, Malaysia petrol price rose from RM1.92 to RM2.70 a litre, cutting down the annual subsidy for petrol to only 30 sen per litre. The subsidy For diesel was also cut, raising the diesel price from RM1.58 to RM2.58 per litre.

As we can see, once the production does not satisfy the demand, the oil price will jump. This will be followed by the increase of other daily product price. Some people even taking advantages from the increment by increasing their product price without control. This will cause burden the citizen of Malaysia, especially people with low income.

Because of that, there is a real need for estimating of future demand of petroleum. This will enable the policy-makers to plan for cost effective investment and operation of existing and new refineries so that the supply of crude oil can be adequate enough to meet the future demand.

1.3 OBJECTIVES

1) **Create a mathematical model of crude oil demand in Malaysia.** Study the method that has been chosen and develop a mathematical equation for crude oil demand in Malaysia.
2) **Forecasting the demand for next 5 years.** By completing the mathematical equation for the demand, the chart can be extended for a couple of year to estimate the demand based on a certain criteria.

1.4 SCOPE OF STUDY

The scope of study for this research project revolves around finding the mathematical equation or model that can represent the crude oil demand in Malaysia. Because of that, first the author needs to collect the historical data of petroleum consumption in Malaysia. The data must be at least from 20 years ago.

The trend of demand for each of this product need to be deliberate and observe based from the time series data covering the certain period. From this we will study when the demand has gone up or down and try to analyse the factor that affecting the product demand.

Next, the data that has been gain will be implemented into equation using econometric modelling method to create an equation form for the demand. Thus the author needs to study on mathematical method that most suitable to generate the equation based from the data that has been gain. There are a couple of method that was commonly used by the economist, like curve fitting model, time series model, and regression model.

Then the equation that has been developed will be plotted within the same time frame as the actual data. The two data then will be compared to see the similarity and the accuracy of the trend and value between the one generated from the equation and the actual demand data. If the pattern is same, it will be extended for another 5 year to forecast the demand in the future.

1.4 RELEVANCY OF PROJECT

In terms of the relevancy of this project, it poses a great deal of significance to the oil and gas industry. The world nowadays is in demand of oil as the most important source of energy. With the days of easy oil that have long gone, every oil and gas companies are striving towards the hard way to produce oil and gas.

To make it simple, forecast is required for two basic reasons. The first one is the future are uncertainty and the second one is the full impact of any decision taken today can only be felt in the future. Because of that forecasting of the future improved the efficiency of the decision making process. For example, if the weather was always the same from day to day forecast would not be produce. It is only the weather changes that forecast become relevant.

The ability to forecast demand accurately is the primary condition for optimizing business decisions. The optimization of merchandizing initiatives is only possible through the implementation of industry specific causal demand models, where the impacts of price changes, promotions, displays and ads on to future demand can be measured with sufficient confidence.

Although retail organizations recognise the importance of good forecasts, few implement an effective formal process to support it involving suitable resources, skills, methods and tools to ensure the production of accurate and relevant forecasts. Also, little effort is often spent on the systematic monitoring of the quality the different information sources used to build demand models.

Demand Forecasting also help manages the balancing act between minimizing inventory investment and optimizing revenue opportunities. It provides a sophisticated, yet easy to use solution to the forecasting challenges that overwhelm many companies. Consider the complications the forecaster faces in anticipating demand, accurately and efficiently.

1.5 FEASIBILITY OF PROJECT

All the objectives stated earlier are achievable and feasible in terms of this project duration and time frame. However it can only touch a portion of forecasting method and maybe just using a simple modelling technique. Forecasting covers a really big area. Even if we give two people with identical data can end up with completely different conclusion. Each of the stockbrokers is processing the available information in the light of their year of experience and their intuitive feel for the market. For that reason, although the author was able to develop the equation and model for the demand, he would not be able to determine how accurate his forecasting was. In forecasting, everything depends on everything, where it was full of uncertainty. Sometimes the trend can change because of factors that we can't even explain, and sometimes the behaviour can change beyond our expectation or prediction. In conclusion this project can be completed in this duration of times, but it will take years of experience to develop the "feel" that will affect the forecasting itself.

CHAPTER 2

LITERATURE REVIEW AND THEORY

2.1 LITERATURE REVIEW

This paper will be discussing about model for crude oil demand in Malaysia. Unfortunately, the data that was needed is really hard to get. The reason is Malaysia statistical record was still developing hence the data that are available is not complete just for a short period of time.

As we already know, the specific nature of demand function depending on varies of factor, but it was constrain by the information availability. In much simpler word the more data that available, the better the model will be. But when there were too many uncertainties which mean lack of data, the easiest way to forecast the demand is by using Time Series method.

Time series techniques are forecasting that rely on very little information. It was quite different from the other methods that predict future movement in a variable by relating it with other variable. In fact time series method does not use information other than the past value of the data series to be forecasted is required. It depends solely on the past behaviour of the targeted variable. But most of the time this method are consider naive since we are not using the data that already available.

However this does not mean that time series method is unreliable. The predictions of even the most sophisticated forecasting procedures are always adjusted to conform with the good sense of forecaster. In that sense, if the time series method outperformed more complex and time consuming method, than it will be a total embarrassment. If the complicated method cannot be more accurate than the simple time series method, then what's the point? Because of that time series method has become a benchmark to other forecasting method as references for the better result.

Below show the summary of journal that was use as the references by the author. All of it explaining about method that they used to forecast the demand, factors that effecting demand in others country. But there were some factors that are not relevant for our country such as weather, season, and nuclear energy replacement.

Modelling energy demand of developing country
By Subhes C. Bhattacharyya, Govinda R. Timilsina

In this journal the authors explain regarding method that usually used to create model for energy demand. This journal is more general since it includes energy such as electricity and etc. The author also touches briefly about econometric studies for transportation which is the largest consumption for petroleum demand. The author also give example of method that previous people has used in order to forecast demand. The most commonly used method are single equation, share model and co-integrated model. However recent econometric studies on forecasting demand have relied on combination of co-integration and error correction model.

Often these model are at aggregate level and do not consider the efficiency of the vehicle or vehicle stock and most of it focus on particular fuel type rather than considering the entire set of transport fuel thereby ignoring the substitution possibility. This journal also mention that most of the studies show that price does not play a significant role on influencing demand in developing countries where income drives the demand.

The author also emphasize that the simplicity of the model, straight forward interpretation and limited data requirement were most favoured. These kind of model often outperformed complex specification.

Forecasting the transport energy demand based on PLSR method in China
By Ming Zhang, Hailin Mu, Gang Li, Yadong Ning.

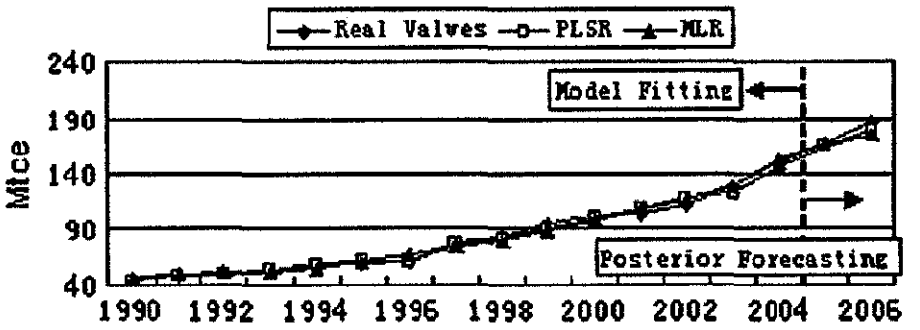
This journal basically explains regarding transportation energy demand for 2010, 2015, and 2020, based on Partial Square Regression (PLSR) method. The authors divide the forecasting into two different scenarios.

Fuel consumption is likely to grow up further with economic and population growth, rapid industrialization, urbanization and agricultural development increase freight, GDP, and passenger transport and higher real income stimulate leisure related travel.

PLSR is a statistical tool that has been specifically designed to deal with multiple regression problem where the number of observation is limited, missing data are numerous and the correlation between the predictor variable are high. Authors explain that PLSR method is mainly used for modelling linear regression between multi dependent variable, and multi independence variable.

By using PLSR it can avoid harmful affection in modelling due to multi co linearity and regressing when number of observation is less than number of variable. However PLSR method is still new in economical section and it was not popular to be used for modelling and forecasting demand.

This is the result that the author gets by using PLSR method in. The charts generated from the equation have the same pattern with the actual data. This proves the accuracy of PLSR method in forecasting the energy demand.



Modelling demand for crude oil product in spain.

By D.J Pedregal, O, Dejuan, N. Gomez, M.A Tobarra

Based from journal crude oil product demand in Spain, the author classified the main consumption into 2 major category, transportation model and industrial and residential model. Then from this 2 category the author divide it into 5 main petroleum products gasoline, diesel, kerosene, LPG, and gas.

The author also collects the data for substitute product to crude oil product, such as electricity from wind power, natural gas, and others to see its effect to the pattern of crude oil demand in Spain. Since those energy sources has the potential to substitute demand of crude oil.

Method that was used by this author are called unobserved component model (UCM) which decomposes a time series in unobserved component but meaningful from an economic view, such as mainly trend, seasonal, and irregularity. The benefit of using Unobserved Component model is that it enables the component of the same type to interact among the different time series. For example trends are related among them but independent of all seasonal components.

In conclusion the author said about the importance of considering the consequences in term of energy demand not only in direct term but also in indirect term. He also said that price has little impact on energy demand and tax policies are not useful to restrict consumption. Tax policies may be useful to increase government tax collection.

Forecast and analysis of demand for Petroleum Product in India

By Raghavendra D Rao, Jyoti K Parikh

On the other hand, from a journal Forecast and analysis of demand for petroleum product in India, the author generates econometric models based on time series data for individual product in order to capture product specific factor affecting demand. The model was then validated against historical data by testing port he ex post forecast accuracy.

In this journal the author used trend analysis method as it is the simple's approaches for time series method. This is recommended by Subhes C. Bhattacharyya (2009) in his journal that simpler model is better and more preferable. This method involve extrapolation of past growth trend, with the restrictive assumption that factor which brought about change in past will continue unchanged in the future. However this assumption has flows where it will not always valid for future projection.

This is the example of result that the author compares with the actual chart to see the accuracy of the model compared to actual data. The data shows that time series method are one of the reliable methods to forecast demand.

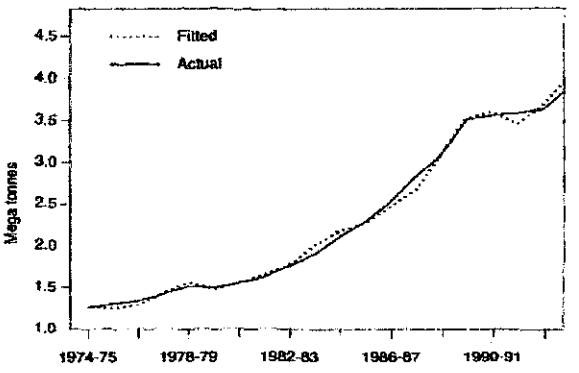


Figure 1 Petrol: actual and estimated consumption

$$PETROL = 4.9E + 37\ GDP^{-14.23 + 0.64 \ln(GDP)}\ P_{com}^{-0.27 - 0.04 \ln(\tau)}\ \tau^{0.15 \ln(\tau)} \quad (1)$$

Future Projection of Energy Prices: predictive Model.

By Hadi A. Belhaj, SPE, Texas Tech University, and T. Lay, Dalhousie University

Modelling approach criteria

- There is no accurate global energy pricing exist, since in order to accomplish that, complete accurate and transparent data with additional comprehensive modelling are needed
- Unexpected event like wars, earthquakes, severe weather, storm, tsunami, and etc is hard to capture using a single model. This is because the occurrence and frequency are uncertainty.
- China India future energy demand is one of the factors that must be taken seriously.
- Every single world economy is directly or indirectly affecting the demand.
- Although weather was commonly consider as major factor, but normal weather factor like normal rain is not a factor.

2.2 THEORY

What is Economic Model

Economic modelling is a way of systematic thinking on how to value of one variable to determine value of another variable. Models contain endogenous variable, exogenous variable, parameter and assumption. Exogenous variable is the independent variables, which are predetermined and given outside the model. While endogenous variable is a variable in a model that was least partly function of other parameters and variables in a model.

Microeconomic and Macroeconomic

In the journal some author says about microeconomic and macroeconomics. Macroeconomic is the study of the behaviour an economy at the aggregate level, as opposed to the level of a specific subgroups or individuals. Factors studies include inflation, unemployment, and industrial production, often with the aim of studying the effect of government policy on these factors.

On the other hand microeconomics is the study of the behaviour of small economic units, such as that of individual consumers or households. It was opposite of macroeconomics.

Economic Forecasting

Economic forecasting seeks to create models that can accurately predict how the economy will change based on data that we can observe. Such models usually attempt to take historical trends and data to create formulas to make projections about the future. In some cases economists might use their own expert judgment or create guesses as to how the economy might respond to situations that have little or no historical president.

Forecasting Horizon

Forecasting can be divided into 3 category, short term, medium term, and long term. Each of these categories has their own purposes and method.

- **Short term** forecasting period is from 1 day until 1 year. It good for estimating staffing level, purchasing stock, and inventory level. Usually people use quantitative method for short term forecasting.
- **Medium term** forecasting period is about 2 years. I good for aggregate planning, capacity planning, and forecast sales of a product. It takes mixture of quantitative method and judgment in order to make this type of forecasting.
- **Long term** is for period of 5 years and above. Its importance for research and development program, determining the plant location, and for product planning. It required expert in principle judgment since long term forecasting tend to become not accurate, and this is a very huge risk to be taken.

Type of Forecasting

There are 2 type of forecasting method; the first one is qualitative method. This method was highly based on experience, judgment, and knowledge of the forecaster.

The second one is quantitative method, where we used data and statistic to estimate and forecast the future.

However both are equally importance since economy sometimes moves beyond the expectation of data, because of that the "feel" of an experience forecaster should be taken into account.

History and Data

At its core, economic forecasting is based upon observable data from the past and present. Data allows economists to form a historical picture of economic indicators, which they can use to predict how indicators might change. For instance, if a national census shows that population has increased 10 percent in a certain city over the past five years, that information might be able to help form a forecast about future population growth. An important part of forecasting is analyzing trends in data or behaviour in current data that resemble trends of the past

New Products

New products can be the most challenging to forecast. The products that are very new and are not similar to other items or services on the market can be particularly difficult. These items have no historical data on which to base past performance and trends in demand. So we will not know how this new product will affect petroleum demand. For example if Malaysia started project for nuclear reactor for electrical energy, how thus it will affect diesel and gas consumption. We also don't know how people in Malaysia will accept the change, will they approve it, or maybe disagree with it. All of this things will affect the scenario that forecaster will face.

Impact of India China oil demand

A leading international energy agency today says that demand for oil imports by China and India will almost quadruple by 2030 and could create a supply depletion as soon as 2015. This was cause by high population growth rate in China and India

Bolstered by speedy economic development and industrialization, energy demand from Asia has been one of the main contributors to higher oil prices. Over the last two years, China and India accounted for about 70 percent of the increase in energy demand and the world's energy needs would increase 55 percent by 2030.

Car sales in China, which overtook Japan last year and are expected to overtake the United States by 2015. This is one of the factors that will contribute to rising oil demand.

China's and India's oil imports are expected to jump until 19.1 million barrels a day in 2030.it stated that their total consumption on 2006 reach 5.4 million barrels, higher that amount that was imported by United State and Japan. By 2030, global oil demand is expected to reach 116 million barrels a day.

Time Series Approaches

Time series analysis can be classified as descriptive, predictive and control. It can be used to calculate the probability of value between two specified limit. Time series analysis account for the facts that data points that was taken, have an internal structure like variation trend and autocorrelation. Time series approach covers two element which is understand underlying forces and structure that produce the observe data, and fitting the model for casting. There are many methods that are used to model and forecast time series. But the one commonly used is moving average.

Moving Average Model (MA)

The moving average (MA) model describes a time series that is a linear function of the current and previous random shock. Random shock was also known as error, residual or a white noise process. The random shocks at each point are assumed to come from the same distribution, typically a normal distribution, with location at zero and constant scale. The distinction in this model is that these random shocks are propagated to future values of the time series. As a simple example, assume that we are forecasting a monthly time series. We might use this model.

$$F(t) = 1/12 \ (Y_{t-1} + Y_{t-2} + ...+ Y_{t-12})$$

Thus in order to forecast a period ahead would be given by

$$\hat{Y}_{t+1} = 1/12 \ (Y_t + Y_{t-1} + Y_{t-2} + Y_{t-3}+..... + Y_{t-11})$$

Autoregressive Model (AR)

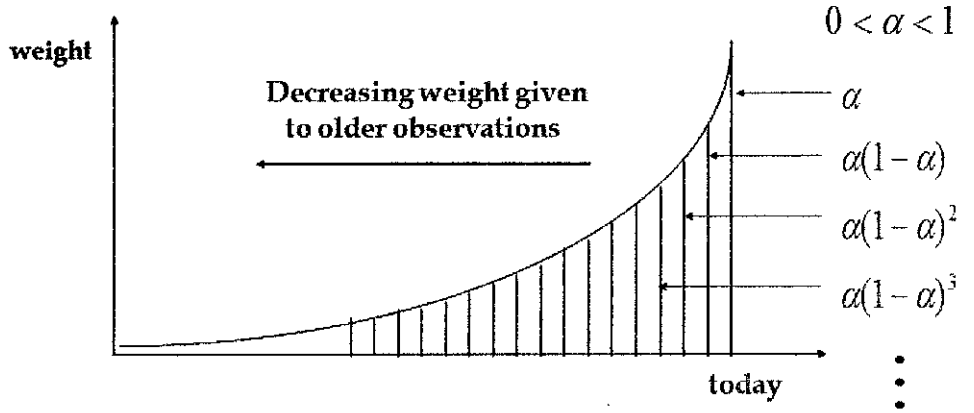
The autoregressive model (AR) is one of a group of linear prediction formulas that attempt to predict an output of a system based on the previous outputs and inputs. The best way to test code for computing AR coefficients is to generate artificial series with known coefficients and then check that the AR calculation gives the same results. For example one can generate the series.

$$x_t = a_1 x_{t-1} + a_2 x_{t-2} + a_3 x_{t-3} + a_4 x_{t-4} + a_5 x_{t-5}$$

"a" will work as a weightage that was given to each data. Usually a bigger weight will be given to latest data and smaller weight will be given to alder one. It imply on how the much that specific data will effect the forecasted data.

Autoregressive Moving Average Model (ARMA)

Forecasting model or process in which both autoregressive analysis and moving average methods are applied to a well-behaved time series data. ARMA assumes that the time series is stationary-fluctuates more or less uniformly around a time-invariant mean. Non-stationary series need to be differenced one or more times to achieve stationary. ARMA models are considered inappropriate for impact analysis or for data that incorporates random shocks.



$$F_t = \alpha D_t + \alpha(1-\alpha)D_{t-1} + \alpha(1-\alpha)^2 D_{t-2} + \cdots$$
$$F_t = \alpha D_t + (1-\alpha)[\alpha D_{t-1} + \alpha(1-a)D_{t-2} + \cdots]$$
$$F_t = \alpha D_t + \alpha(1-\alpha)D_{t-1} + \alpha(1-\alpha)^2 D_{t-2} + \cdots$$
$$F_t = \alpha D_t + (1-\alpha)[\alpha D_{t-1} + \alpha(1-a)D_{t-2} + \cdots]$$

$$F_t = aD_t + (1-a)F_{t-1}$$

Autoregressive Integrated Moving Average Series (ARIMA)

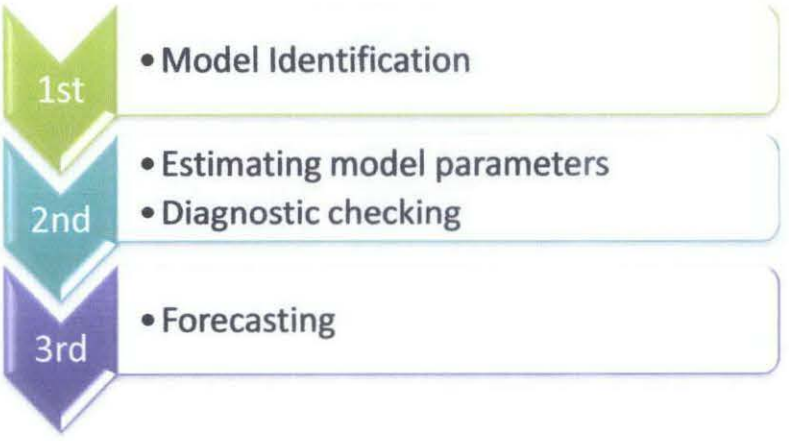
The models developed by this approach are usually called ARIMA models because they use a combination of autoregressive (AR), integration (I) - referring to the reverse process of differencing to produce the forecast, and moving average (MA) operations. It was developed by BOX and Jenkins

For ARMA process, the series must have stationary (moving sideways). This means all that both the expected value of the series and its autocovarience function are independence of time. Most of the time series are non stationary but some of it can be transforming to a stationary series by integrating. So the inclusions of integration into ARMA model change it into ARIMA. This will allow the model to predict a value in a response time series as a linear combination of its own past value, past error, and current and past value of other time series.

- ARIMA(1,1,0) = differenced first-order autoregressive model
- ARIMA(0,1,1) without constant = simple exponential smoothing
- ARIMA(0,1,1) with constant = simple exponential smoothing with growth
- ARIMA(0,2,1) or (0,2,2) without constant = linear exponential smoothing
- A "mixed" model--ARIMA(1,1,1)

Development of Model

There are 3 modelling stages procedure in order to develop ARIMA model



CHAPTER 3
METHODOLOGY

3.1 RESEARCH METHODOLOGY

Basically, there are eight strategic approaches involved in this project research methodology. Those elements will be further discussed below.

3.1.1 Problem Statement

3.2.1 Crude oil productions in Malaysia are decreasing by years. By creating a demand model we can estimate whether our production can meet the demand or not. Hence opening a new path for investment strategies to ensure the security of Malaysia energy supply.

3.1.2 Project Objectives

- Create a model of crude oil demand in Malaysia.
- Forecasting the demand for next 5 years.

3.1.3 Background Study

- Study on factor that effecting the demand.
- To study trend of petroleum demand in Malaysia.

3.1.4 Literature Review & Theory

- Study on method that was used to forecast demand in India
- Study on method that was used to forecast demand in Spain
- Study on other method used for modelling

3.1.5 Data Acquisition

- Analyse production and demand from the past
- Collect data regarding crude oil product that was highly consume by citizen of Malaysia
- Collect total oil consumption in Malaysia for the past 20 years

3.1.6 Data Analysis & Calculation

- Choosing the best method to use based on the data that was required.
  - Curve fitting model
  - Regression model
  - Time series model

3.2 PROJECT ACTIVITIES

3.2.1 Study on past journal to understand about economic modelling. From here we can have a brief idea about the method that the author used, factors that effecting the demand, and assumption about the scenario that they made.

3.2.2 Collect data regarding crude oil product that was highly consumed by people in Malaysia.

3.2.3 Discuss with lecturer or expert regarding model method that are most suitable to be used based on the data that has been collected

3.2.4 Study about the method that has been selected, time series modelling, moving average.

3.2.5 Identify all factors and variable affecting the trend of the demand in order to generate a mathematical equation for the demand.

3.2.6 Apply the method to collected data, using Microsoft excel. Generate graph from the new data that was gained

3.2.7 Try to compare the generated model with an actual data collected

3.3 KEY MILESTONE

The key milestones for Final Year Project I have been planned and organized in detail, as summarized below:

Week 1 - 2: Selection of Final Year Project title

Week 2 - 5: Preliminary literature review on Modelling Crude Oil Demand in Malaysia

Week 6: Submission of Extended Proposal

Week 6 – 8: Collecting past data on crude oil demand in Malaysia

Week 7: Identify Affecting factors for the demand

Week 7 – 8: Collect data on the factor effecting demand

Week 9: Project defence and progress evaluation

Week 9 – 11: Meet with expert to select the best method to generate the demand model

Week 12: Analysis of results and discussions

Week 13: Submission of draft Interim Report

Week 14: Submission of Interim Report

The key milestones for Final Year Project II have been planned and organized in detail, as summarized below:

Week 1- 5: Study method to be used for modelling

Week 6-7: selecting the most suitable method for data availability and demand trend in Malaysia

Week 7: applying the method with the data available

Week 8: Submission of Progress Report

Week 9: create the equation and prepared the graph of the model

Week 10: comparing the result with actual data

Week 11: Pre-EDX, submission of draft Final Report & Technical Paper

Week 12: EDX & Submission of Final Report

Week 13: Oral presentation

3.4 Final Year Project Gant Chart

no	Task	Week 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Selection of Project Topic							Mid Sem Break							
2	Preliminary research work														
3	Preliminary report submission														
4	Literature Review														
5	Collecting Data														
6	Generate Equation														
7	Draft Interim Report Submission														
8	Interim Report Submission														

FYP I Gantt Chart

No	Task	Week 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Study method to be used for modelling														
2	selecting the most suitable method for data availability and demand trend in Malaysia														
3	applying the method with the data available														
4	Submission of Progress Report														
5	create the equation and prepared the graph of the model														
6	comparing the result with actual data														
7	Pre-EDX, submission of draft Final Report & Technical Paper														
8	EDX & Submission of Final Report														
9	Oral presentation														

FYP II Gantt Chart

CHAPTER 4
RESULTS / FINDINGS

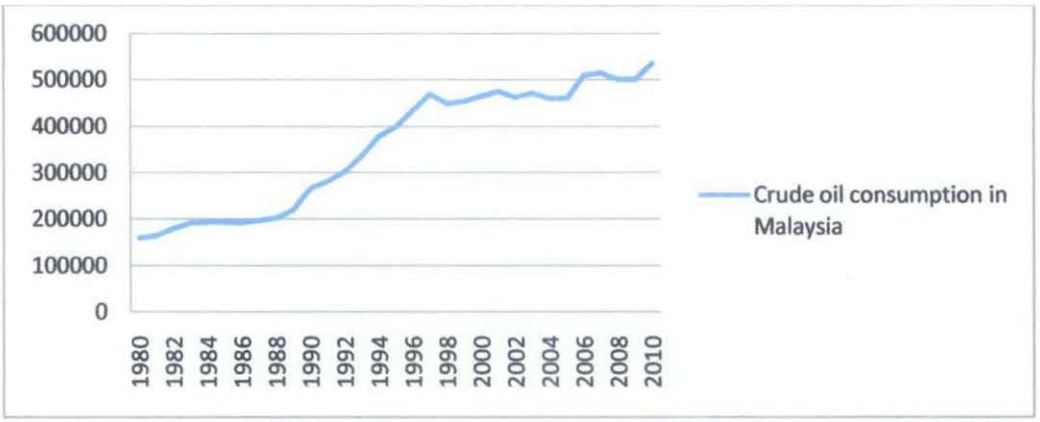
In this chapter, the author will present the finding and data result from the project. The author will also present the data calculation that will lead to the parameters that we need to analyze the result. Lastly the author will present the Data Analysis.

This is the data that has been collected; it shows the petroleum usage in Malaysia. However the data available was only from 1980 until 2010 and this quite limited data that can be used to create the model

Year	Oil - consumption
1980	160000
1981	165000
1982	180000
1983	192000
1984	194000
1985	194000
1986	192270
1987	197300
1988	202500
1989	220070
1990	265980
1991	281530
1992	301520
1993	335950
1994	377510
1995	399160
1996	435260
1997	469340
1998	449230
1999	454320
2000	465020
2001	475100
2002	462750
2003	472,000
2004	460,000
2005	460,000
2006	510,000
2007	515,000
2008	501,100
2009	501,100
2010	536,000

Malaysia crude oil Consumption 1980 - 2010

Malaysia crude oil Consumption 1980 - 2010



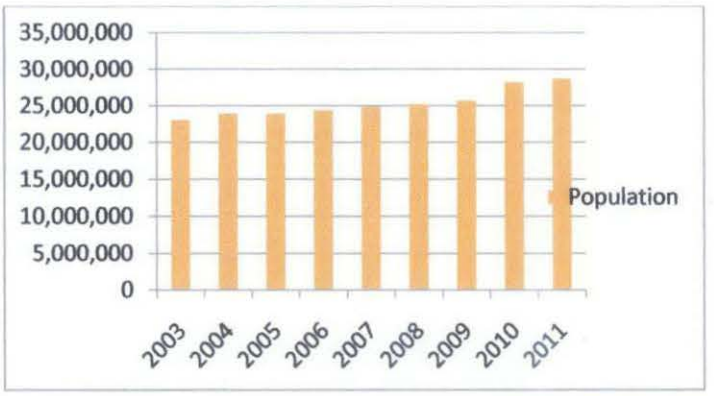
The increment trend in crude oil demand is already been expected since; the consumption is likely to grow up further with population growth, and rapid industrialization. But as we can see from the trend, crude oil demand in Malaysia is quite stable and not volatile. Just from 1980 until 1998 there was a huge increment in the demand.

When we look back to the history that is where Tun Dr. Mahathir bin Mohamad was announced as Malaysia 4th prime minister. Tun Dr. Mahathir bin Mohamad who was titled with father of modernization who has bring Malaysia into era of globalization fits the theory of rapid industrialization will increase demand in crude oil energy.

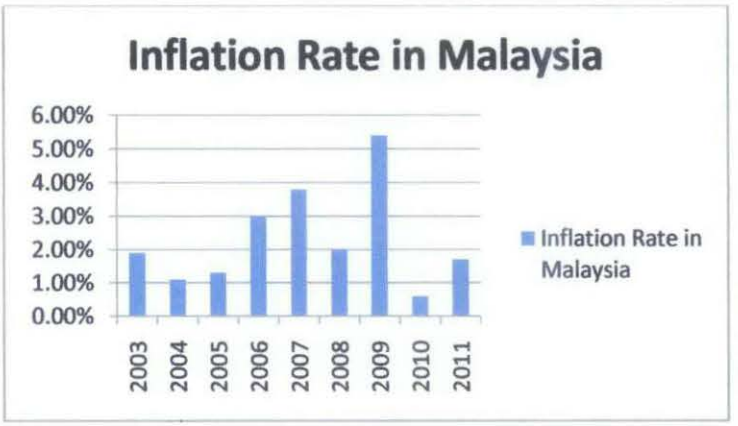
Why used Times Series method

Other method such as single equation – regression method and multi equation model, can be used and constructed to explain and forecast of the future with one or more variable. However since the data that was collected was too short and did not meet the period of crude oil demand in Malaysia (1980 – 2010) then this method was not suitable for this project due to lack of data.

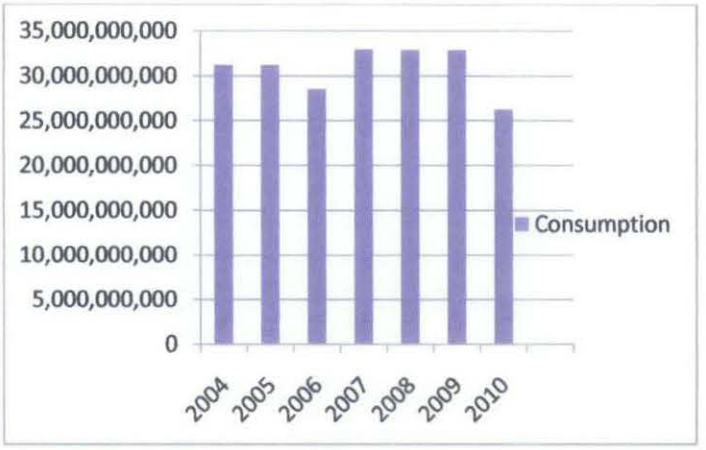
On the other hand, time series method did not predict the future movement by relating it with to a set of other variable. Instead, the prediction was made solely on the past behaviour of the variable. A time series model account for pattern in the past movement of a variable and use that information to predict it future movement



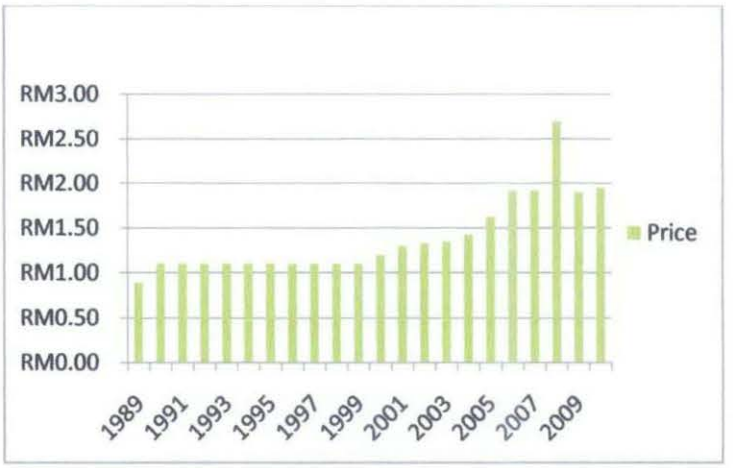
Statistic population growth in Malaysia



Statistic of Inflation rate in Malaysia



Malaysia Natural gas consumption statistic



Petrol Price Statistic in Malaysia

Data that the author collects was not sufficient to do a regression technique; all of this data was only from 2003 until 2010. It did not meet the time frame of crude oil demand in Malaysia data so it's impossible to study the impact of this variable to the demand. Due to this reason and time restriction to complete this project, time series model is the best choice the author have.

However there was an interesting fact that was show from above data. When we have a look on petrol price statistic in Malaysia, in 2008 there was sudden increase in petrol price. But when we compare it with crude oil demand, there were no changes for the demand at that particular year. This shows that petrol price does not effecting the demand for petroleum.

On the other hand, when we look at inflation rate in Malaysia, there was an increase in 2009. Inflation occurs when there was increase in price of the goods in other word decrease of purchasing power for the currency. The increment in petrol price causes increase in production cost forcing supplier to increase the price of the goods resulting in higher living cost.

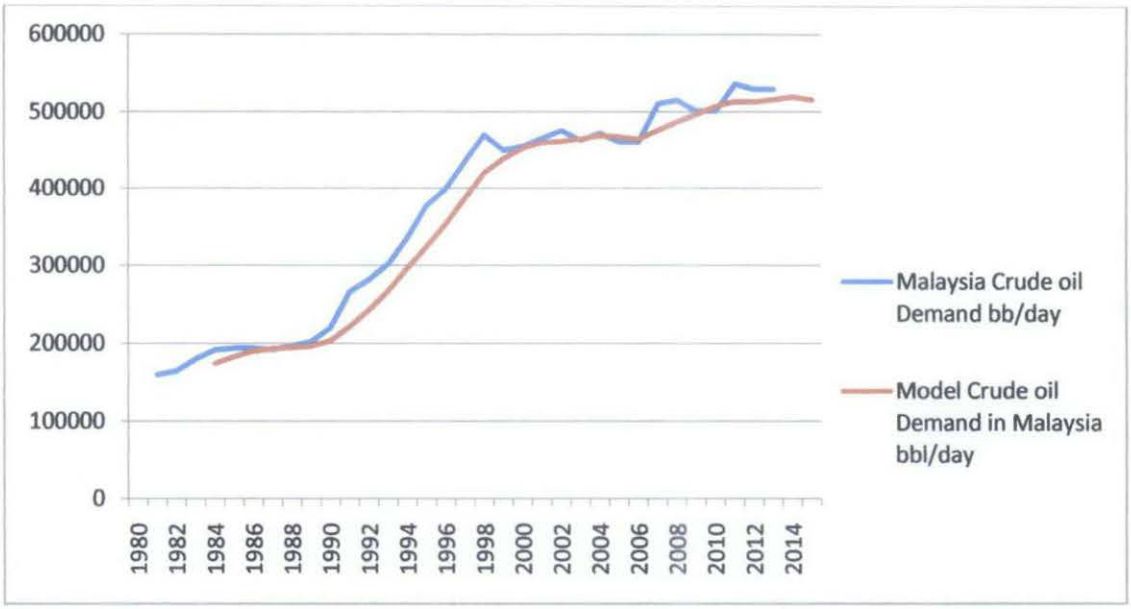
That the reason why subsidizing play an importance roll to control goods price in order to reduce inflation. A country usually will try to maintain their inflation and depletion rate below 3%.

Result

For the 1st try, the author used a **simple moving average model**. Where this method use solely on the history of the demand to create the modal and forecast the future. He used 2 periods of last historical data as a guide to predict the future data. The equation used was:

$$D_{t+1} = (D_{t-1} + D_{t-2} + D_{t-3} + D_{t-4})/4$$

If the period used as a guide to create the model was too long, then the new data that gain will be very short and its value was far from the actual value. Below was the result gain from the equation



Actual Vs simple average Model

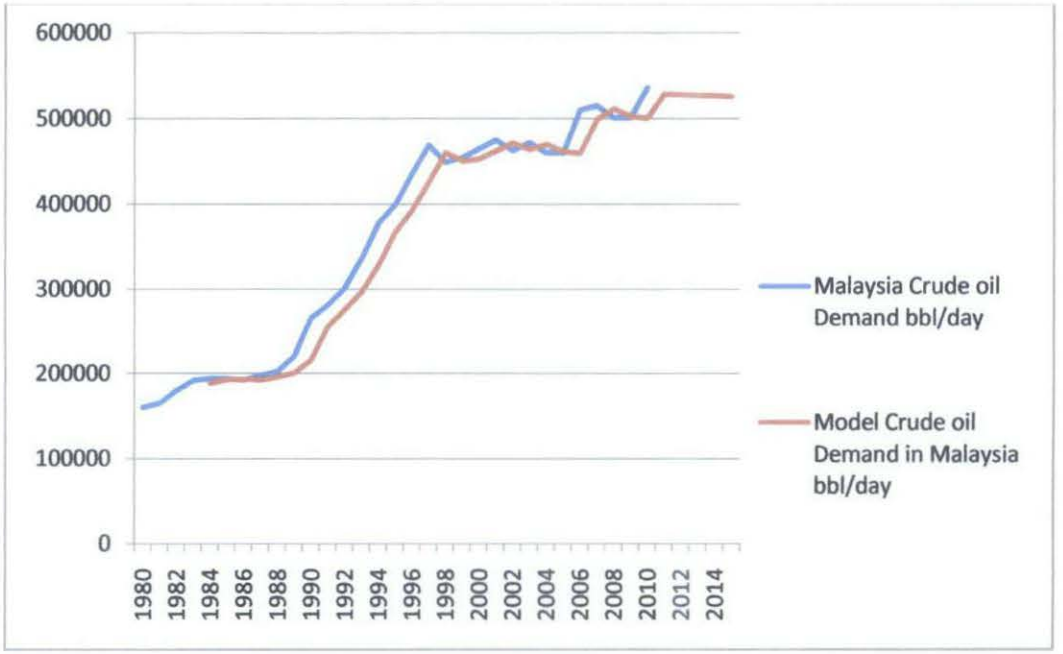
Based from the graph generated its shows that demand in Malaysia has stable increment, however since the forecasted graph is moving below the actual demand there a possibility that the demand will go down.

The simple moving average model is useful if we believe that a likely value for the series is a simple average of its value for the last 4 years. It may be unrealistic however to assume that a good forecast of demand can be given by a simple average of its past value. It is more reasonable to have more recent value of demand play more role than earlier value. Because of that for the 2nd try, the author used an **exponentially weighted moving average model**.

$$D_{t+1} = \alpha D_t + \alpha(\alpha-1) D_{t-1} + \alpha(\alpha-1)^2 D_{t-1} + \alpha(\alpha-1)^3 D_{t-3}$$

Here α is a number from 0-1 that indicates how heavy we weight the recent value relative to the older one. In general, the more erratic a data series, the close to zero α should be set. This is because, if the data was volatile, we must not have too much trust that the future be affected by the previous data. Hence less weightage is more suitable to be implied.

In this case, since the data of crude oil demand in Malaysia is quite stable, then the author put a larger weightage to the α which is 0.8. So the result was:

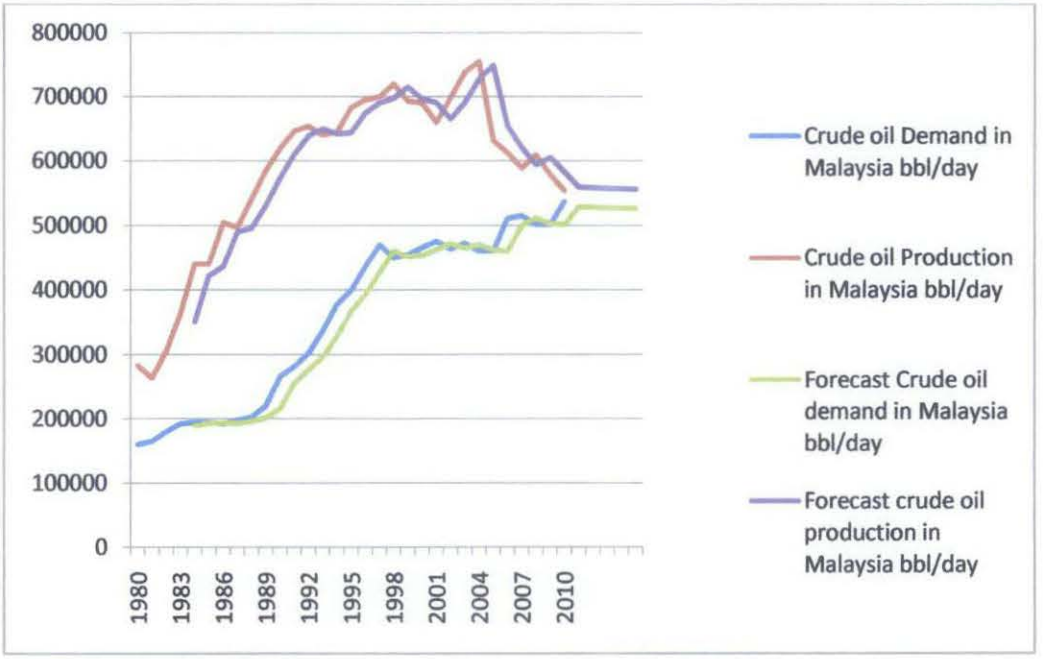


Actual Vs exponentially weighted moving average model

We can see that the forecasted model is almost similar to the actual one meaning lest error compared to simple moving average. The forecast also shows that the demand have the possibility to move down in next 5 years. Based from both result we can see that Exponential Weighted Moving Average Model is much more suitable to represent crude oil demand in Malaysia.

Production Vs Demand in Malaysia

Author also have made a comparison and forecast on crude oil production in Malaysia. Since demand and supply is something that can't be separated, it wise to see whether production in Malaysia can cope with the demand.



As we can see Malaysia production has declining from the last ten years. There a possibility in the next couple of years, production in Malaysia can't satisfy the demand. So it is really importance for us to prepare for the worst. Maybe someday our country needs to import oil from outside like country such as India.

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

The purpose of forecasting is to reduce the risk and cost in decision making, by predicting the uncontrollable aspect of event. It's one of the options so that we will be prepared for the worse condition that may come hence we will be able to come up with a backup plan.

As for time series forecasting technique, it was a procedure that only relies on a very little information. Because of this reason Time series method are inexpensive in term of time and effort. It also suitable when there is not much data available to do the forecasting, or in the need of quick estimation. However this technique was consider naive since it ignore all readily available data. But it does not mean that time series method is unreliable, it still used as a bench mark for other forecasting technique

As in the author opinion, Time series technique specializes for moving average model, it is more accurate for a short period of forecasting. Since it only rely solely from past historical data, there a high chance that it will miss some unexpected value such as riot, earthquake, war, or even new founding of technology that will change the outcome. For example for oil and gas there a new technology such as LPS that can enhance the production rate of a depleted well with lower cost. This will make the production economical hence increasing the supply in the market.

Because of that it is better to used a method that consider all effecting factor in order to gain more accurate result for long term forecasting such as multi equation regression model. Although it was more complicated and time consuming, but having a sight of the future can change everything.

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Appendices

Year	Oil - consumptio
1980	160000
1981	165000
1982	180000
1983	192000
1984	194000
1985	194000
1986	192270
1987	197300
1988	202500
1989	220070
1990	265980
1991	281530
1992	301520
1993	335950
1994	377510
1995	399160
1996	435260
1997	469340
1998	449230
1999	454320
2000	465020
2001	475100
2002	462750
2003	472000
2004	460000
2005	460000
2006	510000
2007	515000
2008	501100
2009	501100
2010	536000

	Year	Simple Moving Average	Exponentially Weighted Moving
	1980		
	1981		
	1982		
	1983		
	1984	174250	188704
	1985	182750	192736
	1986	190000	193536
	1987	193068	192293
	1988	194393	196053
	1989	196518	200962
	1990	203035	216000
	1991	221463	255738
	1992	242520	276119
	1993	267275	296181
	1994	296245	327714
	1995	324128	367210
	1996	353535	392410
	1997	386970	426304
	1998	420318	460303
	1999	438248	450961
	2000	452038	453137
	2001	459478	462086
	2002	460918	471897
	2003	464298	464004
	2004	468718	469819
	2005	467463	461369
	2006	463688	459666
	2007	475500	499341
	2008	486250	511264
	2009	496525	502544
	2010	506800	500800
Moving Average Forecast (4 period)	2011	513300	528307
	2012	512875	527648
	2013	515819	527007
	2014	519498	526365
	2015	515373	525679

Data For crude oil demand in Malaysia and generated data from model

Year	Oil - Production
1980	283000
1981	264000
1982	306000
1983	365000
1984	440000
1985	440000
1986	504000
1987	497000
1988	540000
1989	585000
1990	619000
1991	646000
1992	653390
1993	640000
1994	644990
1995	682490
1996	695030
1997	700000
1998	720000
1999	693000
2000	690030
2001	659210
2002	698460
2003	737860
2004	755350
2005	631070
2006	612600
2007	588220
2008	608800
2009	577870
2010	553960

	T	Simple Moving	Exponentially Weighted Moving
	1980		
	1981		
	1982		
	1983		
	1984	304500	351219
	1985	343750	421882
	1986	387750	436038
	1987	437250	490016
	1988	470250	495136
	1989	495250	530464
	1990	531500	573530
	1991	560250	609261
	1992	597500	638016
	1993	625848	649624
	1994	639598	641176
	1995	646095	643435
	1996	655218	673852
	1997	665628	689958
	1998	680628	697172
	1999	699380	714609
	2000	702008	696448
	2001	700758	690424
	2002	690560	664557
	2003	685175	690758
	2004	696390	727553
	2005	712720	748907
	2006	705685	653794
	2007	684220	619945
	2008	646810	593620
	2009	610173	604797
	2010	596873	582448
Moving Average Forecast (10 period)	2011	582213	558873
	2012	580711	558120
	2013	573688	557341
	2014	572643	556602
	2015	577314	555892

Data oil production in Malaysia and generated data from model