Forecasting Asia Pacific Mobile Market Trends Using Regression Analysis

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Abstract

This paper forecasts Asia Pacific mobile market trends by observing growth trends of GSM and UMTS user numbers. Regression analysis is selected as the forecasting tool. It is predicted that both of the GSM and UMTS markets in Asia Pacific will keep experiencing an exponential growth. However, the growth rate for GSM will be relatively stable while the one for UMTS will gradually decrease. The share of Asia Pacific GSM market will be relatively steady while the share of Asia Pacific UMTS market will slowly go down in the next couple of years. In the near future, GSM will still occupy the largest market share in the mobile world. In Asia Pacific, the coming of the 3G era will be later than the rest of the world. It is expected that the GSM subscriber number will reach to about 1.5 billion in Asia Pacific by the end of 2008.

1. Introduction

Forecasting is the act of making predictions of future events based on current and previous information. [1][2] It is an important strategic management and planning tool and is an integral part of the decision-making activities for every business, including telecommunication businesses. [3] Accurate forecasts can help organizations to set appropriate goals and objectives.

This paper aims to forecast Asia Pacific mobile market trends using regression analysis, one of the most useful forecasting techniques. The market trend can be directly reflected by the variation of subscriber numbers. In order to simplify the problem, this paper only focuses on the study of customer growth trends of GSM (Global System for Mobile Communications) and UMTS (Universal Mobile Telecommunication System),because they are the most popular technologies in Second Generation (2G) and Third Generation (3G) wireless technologies respectively. They can represent the development trends of the whole 2G and 3G mobile technologies.

For a complete research work, the Asia Pacific market trends are compared with the world mobile market trends rather than studied separately.

2. Forecasting Techniques: Regression Analysis

Regression analysis is a statistical tool that is used to investigate the relationship between variables by determining the values of parameters for a function that best fits the input data. With the knowledge of existing data, regression analysis can provide excellent forecasts.

There are different types of regression models. The most popular three, linear, logarithmic and exponential models will be introduced in the following sections.

2.1 Linear Regression

A linear trendline is a best-fit straight line used with simple linear data sets, which indicates that the data is increasing or decreasing at a steady rate. The equation in which the trendline based on is:

$$y = mx + b \quad \ldots (1)$$

Where m is the slope and b is the intercept.

2.2 Logarithmic Regression

A logarithmic trendline is a best-fit curve used when the rate of change in the data increases or decreases quickly and then levels out. The equation in which the trendline based on is:

$$y = c\ln x + b \quad \ldots (2)$$

Where c and b are constants.

2.3 Exponential Regression

An exponential trendline is a curve used when data values rise or fall at increasingly higher rates. The equation in which the trendline based on is:

$$y = ce^{bx} \quad \ldots (3)$$

Where c is the starting point of the trendline (if x=0, y=c) and b represents the increasing rate.

2.4 Trendline Reliability

Trendline reliability is measured by the R-squared value (R^2). R^2 reveals how closely the estimated trendline values match to the actual values. A trendline is more reliable when its R-squared value is more close to 1. In order to get a closely fitting trendline, R^2 should be no less than 0.985. R^2 is calculated as follows [4][5]:

It is assumed:

$\hat{Y}_i$ is the predicted value

Yi is the actual value

Ymean is the mean value of all the sample values

R^2=explained variation/total variation

= 1 - unexplained variation/total variation

Where:

Total variation = $\sum (Y_i - Ymean)^2 = \sum Y_i^2 - n*Ymean^2$

Explained variation = $\sum(\hat{Y}_i - Ymean)^2 = \sum\hat{Y}_i^2 - n*Ymean^2$

Unexplained variation = $\sum (Y_i - \hat{Y}_i)^2 = \sum Y_i^2 - \sum \hat{Y}_i^2$

Total variation = Explained variation + unexplained variation

So

$R^2 = 1-(\sum Y_i^2 - \sum \hat{Y}_i^2)/ (\sum \hat{Y}_i^2 - n*Ymean^2 + \sum Y_i^2 - \sum \hat{Y}_i^2)$

$= 1 - (\sum Y_i^2 - \sum \hat{Y}_i^2)/ (\sum Y_i^2 - n*Ymean^2)$ (4)

2.5 Limitations of Regression Analysis

Although regression analysis is a powerful forecasting tool, it does not consider the impact of external factors. [3] Telecommunication industry is expanding and dynamic and is closely associated with other industries, such as IT and electronics. A new innovation in those industries can put great effects on the telecommunication industry. It also should be noted that some factors could not be easily expressed in numerical terms, such as social and political factors. However, these issues exceed the scope of this paper.

3. Forecasting Using GSM World Data

Reliable data source is the most important factor for forecasting. Without sufficient and reliable data, whatever forecasting techniques you use, it is impossible to get accurate results. This paper uses the data from GSM World, which is a website of the GSM Association, an authority in mobile business that publishing statistics of GSM and other types of mobile technologies regularly. [6]

The software tool selected to analyze trendlines is Excel because of its powerful built in functions to plot trendlines based on given data, to calculate R^2 values and to produce trendline equations.

There are two important things that should be noticed for trendline analysis. One is that if two trendlines are compared, the time unit of them must be uniform. Otherwise, wrong conclusions will be drawn. In this paper, quarter is used as the time unit. Another important thing is that predictions should be made based on long-term trends. Short-term trends may have many uncertainties while regularities probably can be found by observing long-term trends.

3.1 Asia Pacific Mobile Market Overview

According to the latest statistics from GSM world, up to June 2006, the number of world mobile subscribers was 2405.8 millions, where about 4/5 of them are GSM (including GPRS/EDGE) subscribers. UMTS subscribers occupied 3.1% of the market. By June 2006, Asia Pacific had the largest GSM market and the second largest UMTS market in the world, which occupied 37.6% and 47.8% of the world market share respectively.

3.2 Forecasting on GSM Market

GSM is the most popular 2G mobile technology, which was first implemented in Europe, 1992. [7] By comparing R^2 values from different types of trendlines (linear, logarithmic and exponential), it is found that the overall growth trend best fits into an exponential line. Figure 1 shows the Asia Pacific GSM subscriber growth trend from 1995 quarter 4 (Q4) up to the middle of 2006.

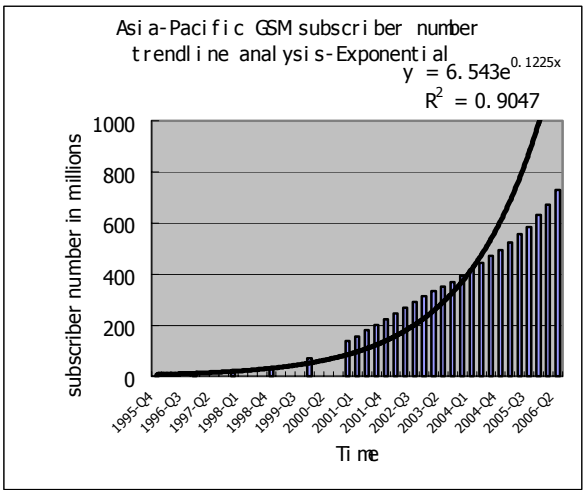

Figure 1. Asia-Pacific GSM Subscriber Trendline Analysis (1995-Q4 to 2006-Q2)

From figure 1, it can be seen that the trendline does not match the actual data very well. The R^2 value of the trendline is low (0.9047) because the variation of the increasing rate is great, which continuously goes down. In order to observe the trend more clearly, the whole period is divided into two. Figure 2 and 3 show the growth trends before and after year 2001 respectively. It does not mean that year 2001 has any special meaning. It is just used as a breakpoint to compare the increasing rates. Now it can be seen that the R^2 values are more close to 1(0.9857 and 0.9853), which means that the trendlines are more reliable. Although both of the two trendlines are exponential, the b value of the former is 0.2074 while the later is only 0.0669. This means after a quickly expanding at the beginning stage, the Asia Pacific GSM market climbed in a lower and steadily pattern in the last few years.

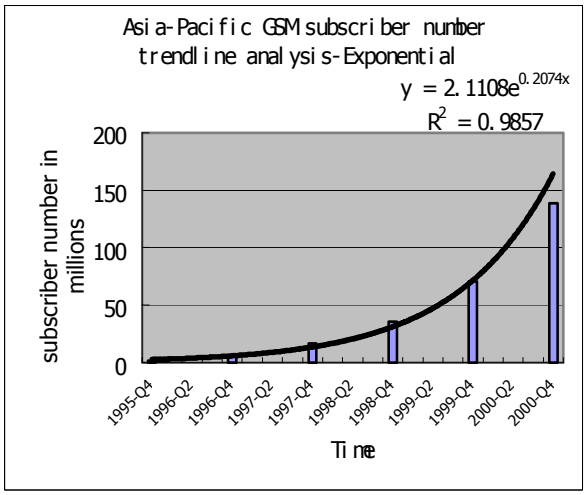

Figure 2. Asia-Pacific GSM Subscriber Trendline Analysis (1995-Q4 to 2000-Q4)

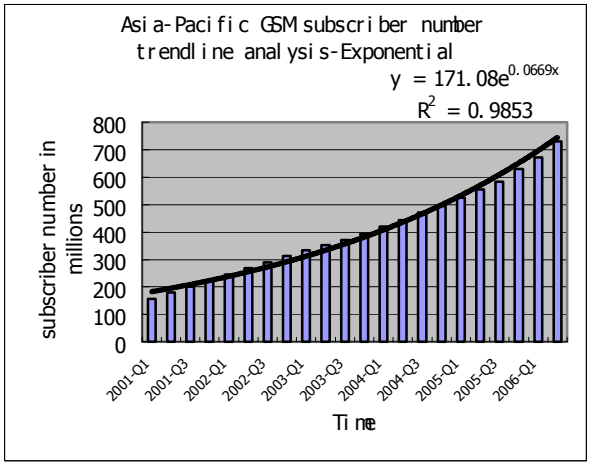

Figure 3. Asia-Pacific GSM Subscriber Trendline Analysis (2001-Q1 to 2006-Q2)

Figure 4 shows the world GSM subscriber growth trendline after 2001. By comparing it with figure 3, it is found that they are quite similar. Both of them are exponential trendlines and with similar b values (0.062 for the world trendline and 0.0669 for the Asia Pacific one). This is because the increasing rates of the Asia Pacific and world GSM customers are quite close. Therefore, the GSM market share of Asia Pacific was relatively stable in the last couple of years. Figure 5 shows that it fluctuated slightly between 36.9% and 39.4% in the last four years.

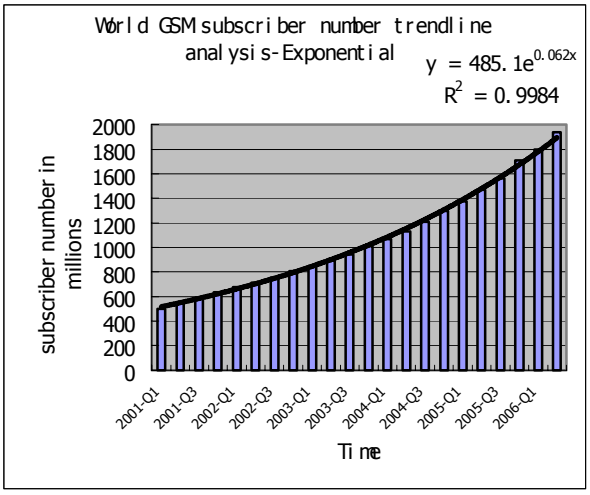

Figure 4. World GSM Subscriber Trendline Analysis (2001-Q1 to 2006-Q2)

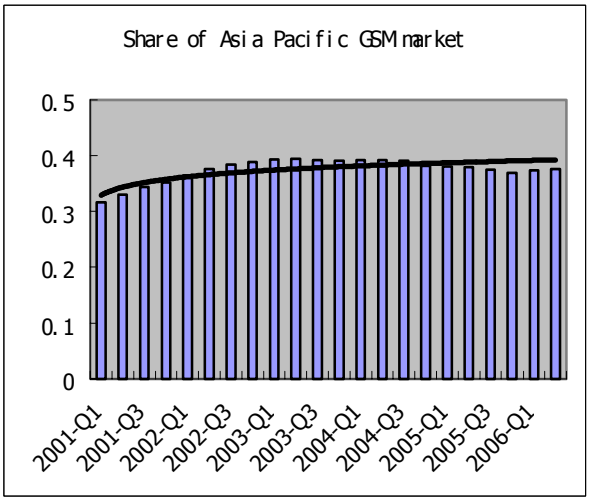

Figure 5. Share of Asia Pacific GSM market

From the above observations and analyses, it is predicted that the Asia Pacific GSM market will still experience a stable exponential growth in the near future. According to the exponential trendline model, it is expected that the Asia Pacific GSM subscriber number will climb to nearly 1.5 million by the end of 2008 (shown in figure 6). The GSM market share of Asia Pacific will also be stable in the next few years.

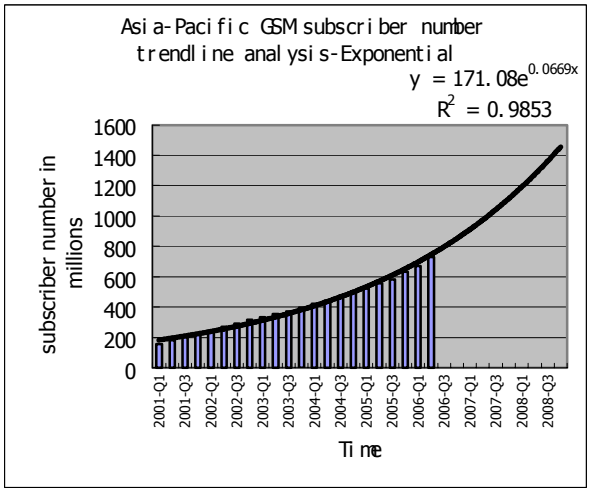

Figure 6. Forecast on Asia Pacific GSM Subscriber Number by 2008-Q4

3.3 Forecasting on UMTS market

UMTS (3GSM) is a 3G mobile system based on WCDMA technology, which was started in the beginning of 21st century. Its subscriber number in Asia Pacific also had experienced an exponential growth from 2004 to the middle of 2006 but with a much higher increase rate compared to the GSM trendline (show in figure 7). However, this trendline is not as reliable as the one in figure 3 (lower R^2 value of 0.982). This is because its increasing rate is continually decreased (shown in table 1).

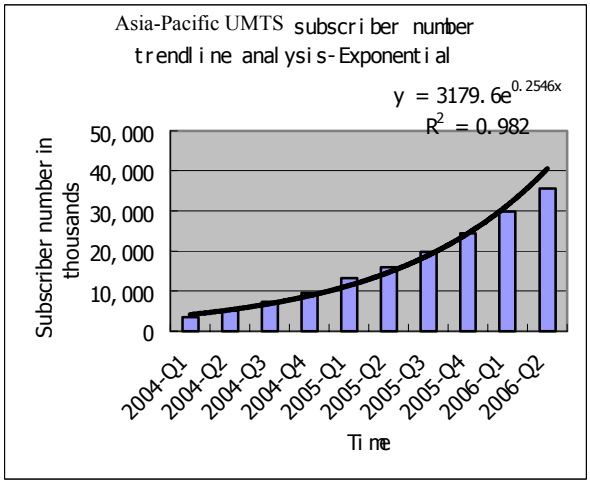

Figure 7. Asia Pacific UMTS Subscribers Trendline Analysis (2001-Q4 to 2006-Q2)

Table 1. Variation of the b value for Asia Pacific UMTS Subscriber Growth Trendlines with the Elapse of Time

Period	b value for the exponential trendline
2004-Q1 to 2006-Q2	0.2541
2004-Q2 to 2006-Q2	0.2386
2004-Q3 to 2006-Q2	0.2258
2004-Q4 to 2006-Q2	0.2154
2005-Q1 to 2006-Q2	0.2016
2005-Q2 to 2006-Q2	0.2008
2005-Q3 to 2006-Q2	0.1951
2005-Q3 to 2006-Q2	0.1883

By comparing the Asia Pacific and world UMTS user growth trendlines (figure 7 and figure 8), it can be seen that although both of them had experienced an exponential growth, the growth-increasing rate for the Asia Pacific trendline is lower than the average world level (b value of 0.2546 compared to 0.3036). Figure 9 further proves this by showing the variation of the Asia Pacific UMTS market share. In the beginning of 2004, Asia Pacific area occupies nearly 80% of the total UMTS market. However, its market share decreased sharply to below 50% by the middle of 2006.

From the above observations and analyses, it is forecasted that the UMTS market will also experience an exponential growth but with a gradually decreased increasing rate.

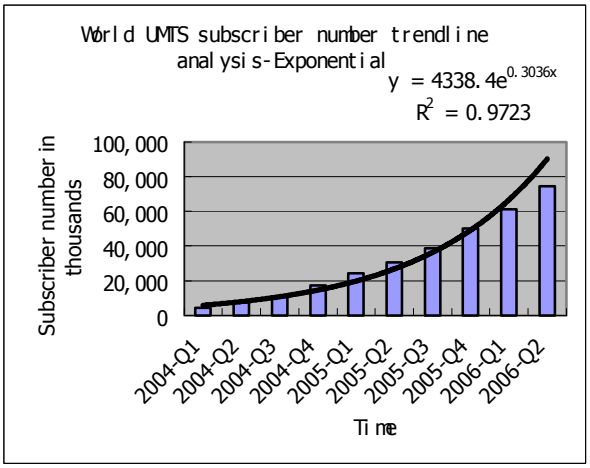

Figure 8. World UMTS Subscriber Trendline Analysis (2004-Q1 to 2006-Q2)

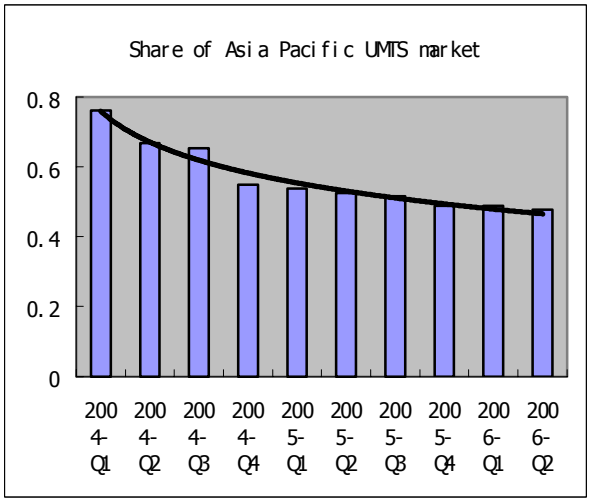

Figure 9. Share of Asia Pacific UMTS market

3.4 Comparison between GSM and UMTS Markets' Growth Trends

In the above sections, the GSM and UMTS markets are analyzed separately. In this section, the two will be compared with each other. Figure 10 and 11 show the share of GSM and UMTS markets from 2001-Q4 up to 2006-Q2. The market share of GSM climbs slowly from nearly 70% to above 80%, while the UMTS market share increases sharply to more than 3%.

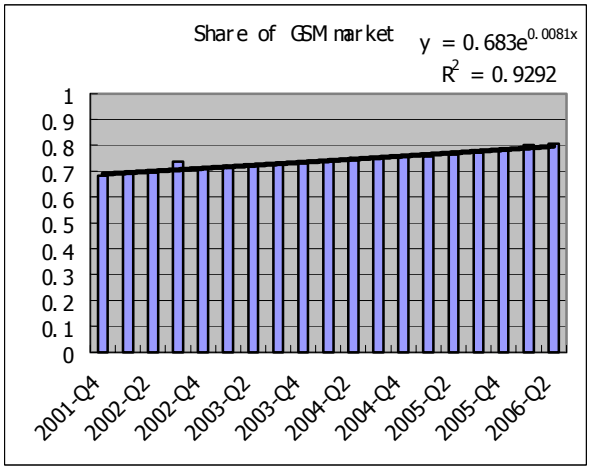

Figure 10: Share of GSM Market in the Mobile World

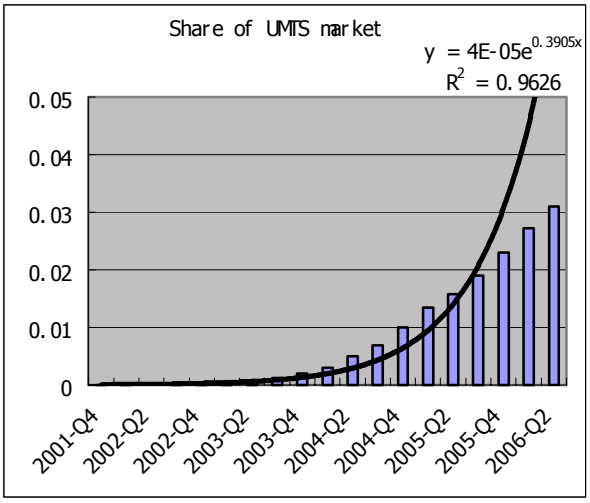

Figure 11: Share of UMTS Market in the Mobile World

It is predicted that the GSM market still has certain potential to be further developed. GSM will continue to dominate the mobile market in the near future, although it is undoubtable that 3G technologies will finally take place of it. The time taken to move into the 3G era in Asia Pacific will be longer than the rest of the world. This is because the Asia Pacific GSM market growth rate is similar to the world but the development of its UMTS market cannot keep up with the speed of the rest of the world.

4. Conclusions, managerial implications and future works

From the above trendline analyses, the following conclusions can be drawn:

- Both of the GSM and UMTS markets in Asia Pacific will keep experiencing an exponential growth. The growth rate of the later will be much sharply. However, the growth rate for GSM will be relatively stable while the one for UMTS will gradually decrease.
- The share of Asia Pacific GSM market will fluctuate slightly around 35%-40% while the share of Asia Pacific UMTS market will slowly go down in the next couple of years.
- In the near future, GSM will still occupy the largest market share in the mobile world. In Asia Pacific, the coming of the 3G era will be later than the rest of the world.
- It is expected that the GSM subscriber number will reach to nearly 1.5 billion in Asia Pacific by the end of 2008.

According to the above conclusions, it is recommended for telecommunication businesses that in their short-term plans for Asia Pacific mobile market, the emphasis could still be put onto GSM because GSM technology will keep dominating the Asia Pacific market in the near feature. Although the growth rate of UMTS market is much higher, the absolute number of increased GSM customers overwhelms the one of UMTS due to its large cardinal number. For example, from 2006-Q1 to Q2, the number of Asia Pacific GSM users increased by nearly 60 million, which is about ten times as large as the number of increased UMTS users in Asia Pacific during the same period. However, it is undoubtable that 3G/UMTS will take place of GSM eventually. The long-term development plan should focus on the UMTS market.

The availability of data is critical for precise forecasts. However, UMTS is a new technology that has just been in operation for a few years. Therefore it is difficult to get enough data. In the future, when more data are available, it is able to make more precise and detailed forecasts on the UMTS market. Furthermore, regression analysis is only one of the data analysis techniques. In our future works, different data analysis methods will be compared with regression analysis. More reliable and accurate results could be got by using different techniques together rather than only relying on regression analysis.

5. References

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