Type of Day Forecasting

Luminita Baloi[1], Michael Bulmer and Carmen Tintos
[1]University of Queensland, Australia, s008436@student.uq.edu.au

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EXTENDED ABSTRACT

In recent years the dynamic of the telecommunications industry has changed significantly. This industry becomes deregulated and more competitive in many countries, such as France, United States, United Kingdom, and Australia. In Australia, there are currently more than 10 active mobile phone providers. As a result, consumers are changing their patterns of behaviour. They move in and out of different segments of the market, and from arrangements with one provider to another, with prices becoming highly competitive. At the same time, the change in technology is producing an explosion of new products, increasing the difficulty of forecasting.

The deregulation and increased competition in the telecommunications industry has increased the pressure for forecasters to understand the new market and to be able to incorporate and respond quickly to new changes. One of the challenges is to accurately forecast the monthly revenue of mobile usage – the topic of this research.

In comparison with other deregulated industries such as for energy, the forecasting literature in telecommunications is very poor. An extensive search with different web engines, such as Econlit, Web of Science, and Google, did not show any work in forecasting the monthly revenue of mobile usage.

The purpose of this paper is to develop a model in order to forecast, with high accuracy, the monthly revenue of mobile usage in a deregulated market. Usually, the monthly revenue of mobiles usage is forecast by the direct calculation of usage and forecast yield and contains high errors as a consequence of bundles, discounts and reward options. For any operator, a wrong prediction of the monthly revenue of mobile usage provides misleading results and negatively influences the planning process.

The forecasting model presented in this paper is developed using the indexes obtained from the number of each day type in the month, the weekly call profile and underlying patterns. Minutes of use (MOU) and monthly revenue figures for the period January 2004 to February 2005 were used. The minutes represent the total time spent on the mobile-to-mobile calls. The historical data includes the monthly revenue ($ millions) and the daily profile for the minutes (millions) (Figure 1).

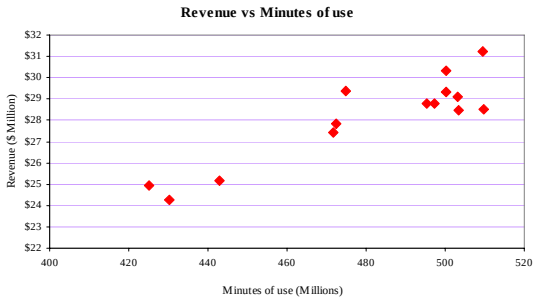

Figure 1. Revenue vs Minutes of use

The methodology presented in this paper forecasts the mobile revenue with very high accuracy, with errors less than 1%. The software used for the modelling was Minitab and Excel, with macros developed in Visual Basic for Applications. Due to the confidentiality and price sensitivity of data, a direct comparison between these two methodologies cannot be provided.

The next phase of the research is to forecast the monthly revenue of mobile usage using larger data and to include a direct comparison of the results provided by the old and new methodology.

1 INTRODUCTION

Telecommunication industries are increasingly deregulated worldwide. As in many other countries, the Australian telecommunication industry made important steps towards deregulation and thus the competition is intensifying. As a result, the number of operators is increased, the users are changing their patterns and move in and out of different segments of the market or operators. The prices are declining and the consumer behaviour is changing. At the same time, the rapid change in technology produces an explosion of new products emerging on the market, increasing the complexity of forecasting.

In comparison with other deregulated industries such as for energy, the forecasting literature in telecommunications is very poor – in particular, forecasting the monthly revenue of mobile usage in a deregulated market. While some books (Loomis and Taylor, 1999; Loomis and Taylor, 2001) include issues specific to the actual deregulated market, there are books currently selling (Taylor, 1994) which do not cover current topics. An extensive search on different web engines (Econlit, Web of Science and Google) did not show any work in forecasting the monthly revenue of mobile usage in a deregulated market – the topic of this research.

Traditionally, the monthly revenue of mobile usage is forecast by the direct calculation of usage and forecast yield. Although the daily time series reflect a clear pattern, the impact of bundles, discounts and reward options considerably distort the net revenue result.

2 MODELLING

2.1 DATA

In the current environment, the market data is not publicly available and is extremely difficult to obtain from companies (McBurney *et al.*, 2002); the data is highly sensitive and confidential. For this research, data was obtained from a mobile operator and was scaled, preserving the initial pattern and all the necessary information. Daily minutes of use (MOU) and monthly revenue figures for the period January 2004 to February 2005 were used. The minutes represent the total time spent on the mobile-to-mobile calls. The historical data includes the monthly revenue ($ millions) and the daily profile for the minutes (millions).

2.2 MODEL DEVELOPMENT

By analysing the calendar variations, a vector for the public holidays and semi-holidays was constructed. The vector is 1 when there is a public holiday or semi-holiday and 0 otherwise. All the important holidays were included in the modelling, such as: Christmas Day (Xmas), Boxing Day, Mother's and Father's Day, Queen Birthday, Labour Days in Vic, NSW, Qld, and WA, Anzac Day, Australia Day, Easter and Melbourne Cup. Semi-holidays in this model were defined as follows: 1st week of holidays after New Year's Eve (NYE), 2 days before Xmas, and the period between Xmas and NYE. This vector is used in the computation of the number of adjusted days in a month.

The monthly minutes were computed from the daily MOU. For the period Jan 04 - Dec 04 the correlation between the monthly revenue and MOU is 90%, and 90.5% for the period Jan 04 - Feb 05, suggesting a very strong relationship, see Figure 2. Looking in detail at the daily MOU, it is evident that there are calendar variations which are a function of the day in the week and type of day.

The data for the year 2004 was used for the model development and the first two months of 2005 were kept for model testing. An analysis of the monthly revenues and MOU shows that the series are very high correlated. When the monthly figures of revenue are regressed against the MOU, the result obtained is less than expected.

Thus:

$$\text{Revenue (\$M)} = -1.89 + 0.0624\ \text{MOU (M)}$$

with R-square (adjusted) of 79.1% and p-value for the constant more than 0.05. Full results of the regression are shown in **Table 1**. Furthermore, by introducing the time trend, the equation is not improving, giving R-square (adjusted) of 77.9%.

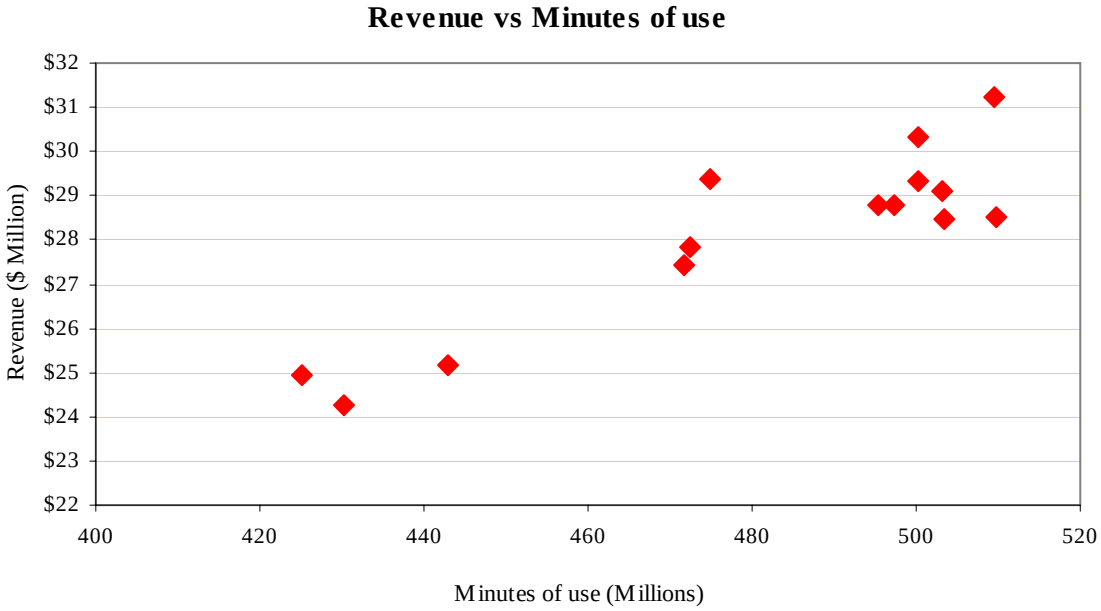

Figure 2. Revenue vs Minutes of use

Table 1. Regression analysis: Revenue ($M) versus MOU (M)

Regression Analysis: Revenue ($M) versus MOU (M)

The regression equation is

Revenue ($M) = - 1.89 + 0.0624 MOU (M)

Predictor	Coef	SE Coef	T	P
Constant	-1.89	4.59	-0.41	0.69
MOU (M)	0.06	0.01	6.52	0

S = 0.982697 R-Sq = 81.0% R-Sq(adj) = 79.1%

By plotting the average monthly minutes of use by weekdays (excluding public holidays and semi-holidays), it can be seen that it is possible to fit a regression equation for each day of the week, see Figure 3.

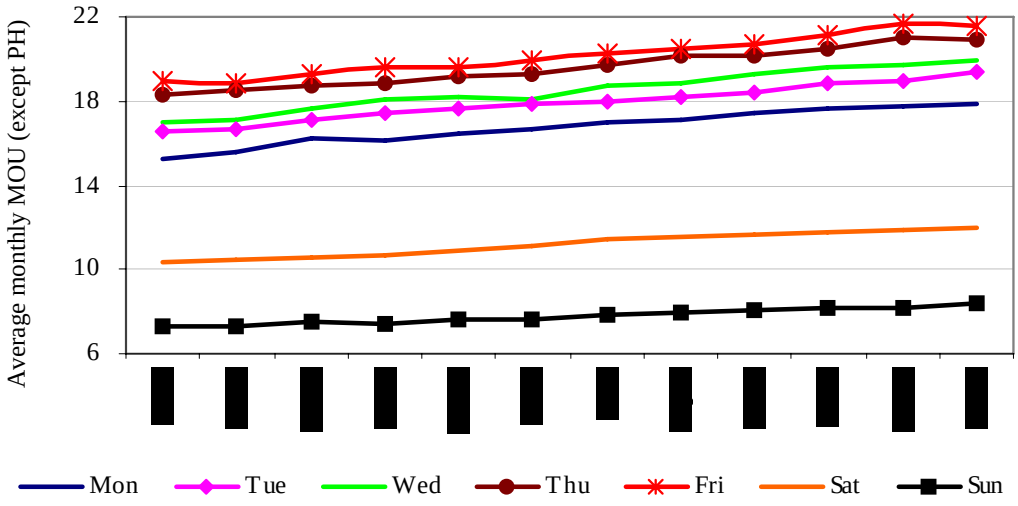

Figure 3. Average monthly MOU by day

In order to obtain the forecasts for Jan-05 and Feb-05, a forecast for each of the weekdays and weekends is developed using the 12 months of 2004. The results are shown in the Table 2.

Table 2. Regression analysis and equations

Day	Predictor	Coef	SE Coef	T	P
Mon	**Constant**	15.20	0.10	156.35	0
	Month	0.24	0.01	18.23	0
Tue	**Constant**	16.33	0.06	284.42	0
	Month	0.24	0.01	31.36	0
Wed	**Constant**	16.73	0.09	183.40	0
	Month	0.27	0.01	21.88	0
Thu	**Constant**	17.89	0.10	171.61	0
	Month	0.26	0.01	18.56	0
Fri	**Constant**	18.47	0.10	176.74	0
	Month	0.26	0.01	18.40	0
Sat	**Constant**	10.11	0.04	227.16	0
	Month	0.17	0.01	27.38	0
Sun	**Constant**	7.12	0.04	175.17	0
	Month	0.10	0.01	18.99	0

Day	S	R-Sq(adj)
Mon	0.158	96.8%
Tue	0.093	98.9%
Wed	0.148	97.7%
Thu	0.169	96.9%
Fri	0.170	96.8%
Sat	0.072	98.6%
Sun	0.066	97.0%

Using the equations obtained, the forecasts for Jan-05 and Feb-05 are produced and are used as an input in the revenue forecast.

For each of the holidays and semi-holidays of the months, from Jan-04 to Dec-04, the weight was calculated as a percentage of the standard average profile. Using these weights, a monthly number is calculated and used in the model. For example, due to the holidays, the month of Jan-04 has 3.6 Mondays, 3.9 Tuesdays, 3.8 Wednesdays, 4.5 Thursdays, 4.6 Fridays, 4.7 Saturdays and 3.7 Sundays. The total number of days in the month forms the 'Total adj days'. Using this index and the 12 months of data (2004) the regression equation that gives the best results is:

Revenue ($M) = 0.0503 MOU (M) + 1.30 Mon - 0.442 Thu - 0.947 Sat - 0.527 Sun + 0.224 'Total adj days' (**Model 1**).

The statistics for the Model 1 are shown in **Table 3**.

Table 3. Regression analysis for the model

Predictor	Coef	SE Coef	T	P
Noconstant				
MOU (M)	0.050331	0.001162	43.32	0
Mon	1.29536	0.069910	18.53	0
Thu	-0.44153	0.082000	-5.38	0.002
Sat	-0.9466	0.067460	-14.03	0
Sun	-0.52666	0.069030	-7.63	0
Total adj days	0.2244	0.034080	6.58	0.001

S = 0.0876727

Durbin-Watson statistic = 2.45213

2.3 RESULTS

Model 1 is than used to predict the monthly revenue of mobile usage. The forecast for the testing period is shown below. It has very low errors, less than 1%.

Table 4. Testing Period - forecast and error

Month	Revenue ($Millions)	Predicted revenue	Error	% Error
Jan-2005	$29.3	$29.5	-$0.2	-0.52%
Feb-2005	$28.8	$28.7	$0.1	0.37%

3 CONCLUSIONS

The forecasting techniques in the telecommunications industry have to reflect the changes produced by an increasingly deregulated and competitive environment. In this paper, a new methodology was developed to forecast the monthly revenue of mobile usage.

The forecasting model was developed using the indexes obtained from the number of each day type in the month, the weekly call profile and underlying patterns. The model forecasts the mobile revenue with high accuracy, with errors less than 1%.

Unfortunately, due to the confidentiality and price sensitivity of data, a direct comparison between the model presented in this paper and the traditional method cannot be provided. However, based on my experience the monthly revenue forecast based on yield has higher errors due to the continuous change in yield (erosion of revenue due to competition).

The next phase of the research is to forecast the monthly revenue of mobile usage using larger data and to include a comparison of the results between the old and new methodology. However, it has to be noted again that due to the commercial sensitivity, the research in this highly competitive market place is limited in real life.

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