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# Statistical Modelling Approach to Estimation of Average Revenue per User in Telecom Service- a Case Study

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**Abstract:** ***Indian telecom market is the second largest telecom market in world just after china. According to the recent reports by TRAI, Indian telecom sector has the lowest tariff in the world. Indian telecom market has 10-12 service providers striving for the market share at any point of time. Intense competition has put pressure on service providers to reduce the tariff prices. India being a developing country, people are more concerned about affordability of mobile services, because of this reason service providers have come up with per second billing from per minute billing that is nothing but implementation of pay per use tariff concept. Recent trends in the Indian telecom sector have shown growth in the number of subscribers but at the same time ARPU has been falling continuously. ARPU is one of the indicators of market performance of the service provider. In this paper a model has been developed to predict the future trends in the ARPU so that TSP's can formulate new strategies to increase their ARPU. This study considers different factors that affect the ARPU of the TSP, Multiple linear regression equation has been formulated to explain the factors that determine the ARPU. Results of the model developed show that ARPU depends on subscriber base, number of operators and percentage of new users added periodically. This study considers Karnataka Region Telecom services for constructing model for ARPU prediction.***

**Keywords: ARPU- Average Revenue per user, TRAI- Telecom Regulatory Authority of India, TSP's – Telecom service providers, Indian Telecom Market, Multiple linear regression**.

## 1. Introduction

Initially when mobile entered the market one call was costing Rupees 16/minute. ARPU was around 500 rupees but very few people were having mobile connection it was mostly the business persons used mobile who could afford high cost of mobile device and as well as call charges. Later when technology started advancing hardware cost went on reducing year by year and simultaneously efficient network infrastructure was also available for operators at a cheaper cost, with combination of these two mobile services penetrated the developing countries market very rapidly. In the span of 8 years that is from 2005 to 2013 subscriber base has increased nearly 18 times at the same time overall ARPU has reduced by 71%. One important point that should be noted is although ARPU has been decreasing operators are still making profits, three reasons can be stated to explain this fact, One subscriber base is increasing, so operators achieve the breakeven with huge customer usage, second operational costs have gradually reduced over the years with innovation in the area of tower technology and incorporation green towers in the network operating costs have reduced, and last but the most important is revenue for operators has increased with increase in the subscription to VAS services like GPRS, MMS, Caller tunes etc.

India is the second largest telecom market in the world, with 895.51 million customers (Oct 2013 TRAI). It is evident that Indian telecom market is the fastest growing and highly competitive market in world because of the fact that there are on an average 10-12 operators fighting for market share. Indian market has shown phenomenal growth of 35% in last few years. India has one of the lowest tariffs in the world. Indian market is highly price sensitive market which is putting pressure on operators to reduce the tariff charges. After the implementation of MNP in India average monthly churn rate has increased (Oct'13 TRAI Report). Effect of reduction in the initial investment and monthly expense in mobile services, more number of lower income groups is signing up for the service, that is the reason to observe high growth in the number of subscribers over last decade. Vast geographic expanse of India acted as a catalyst to boost mobility, Narrowing gap of call costs between fixed and wireless convinced customers to subscribe to wireless connections, Reduced cost of handsets affordability factor, In remote areas where providing fixed line connections was difficult, wireless did the magic are the major drivers of telecom industry in India (Richa Mishra[7]).

## 2. Literature Review

In this is era of Whatsapp, Line, Skype smartphones have become very common, Innovations in hardware technology has helped to reduce the prices of the smartphones and at the same time demand for GRPS data services are growing in fast paced manner. As the demand for services increases it is must for operator to setup new infrastructure to cater the needs of users. Investment in latest technology for network operations require, lot of capital investment and this is in turn expected from consumers who are already utilising the existing network. Income of telecom service provider depends on usage by the consumers and payment for utilised service as per the plan. This is termed technically as average revenue per user per month that is ARPU. APRU defines the income and profit margin of the operator.

Mobile subscriber base has been increasing constantly in India. Tele-density of the country is around 73% as per the recent reports by TRAI(Oct.2013). Debabrata Das[3] developed a model for prediction of number of subscribers in the coming years with help of logistic and Gompertz distributions. It has been predicted that number of subscribers

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is going to be 1.24 million by 2015-2016 with 98% tele-density. As per the recent reports by TRAI(Oct.2103) urban tele density is around 140% and rural is about 40%.Sanjay(et.al)[7] suggests that mobile telephony should be spread in all the areas especially in rural areas of the country as it leads to increase in the efficiency of all the sections of the society and he also concludes that mobile telephony growth has led to good increase in GDP growth. FDI also affects the mobile telephony growth as well as GDP growth in a positive way.

ARPU is the main indicator for measurement of performance of telecom operator. Intensive competitive pressure and fierce price competition have both contributed to the declines of ARPU in the past few years. (A.K.N Prasad)[4]**.** The same conclusion was drawn by the author Mahinda B Herath[1]. But he adds one major point that is with declining ARPUs, most operators tend to believe that serving low-ARPU customers is inherently unprofitable which he feels is a misconception. Martin[5] says ARPU becomes reasonably stable once penetration reaches typically 50–70%. This stability continues as penetration rises, until it gets above 100%. Indian ARPU pattern has never shown any stability right from the start of the mobile service in the country. He attributes this to lower GDP per capita in the region– there will be more people who cannot afford mobile services, so saturation effects would be expected at lower levels of penetration

Arunkumar L[2] in his research work benchmarked telecom operators by considering three factors namely ARPU, ACPU and AOPPU. He devised strategies to increase ARPU of one of the operator. The strategies he suggested are operator should try to target high value customers they should focus on improving brand value. Two other major points that are made in this paper are to share infrastructure of other players than setting up their own and spectrum sharing. Mahinda B Herath[1] also devised almost similar strategy for the low ARPU market that is, Positive AMPU* Volume=Business model for low ARPU world. AMPU is in turn the profit of the operator.

It is observed that many people have carried out research about ARPU of telecom service providers, but there has not been an attempt to construct model using multiple linear regression to determine and predict the future values of ARPU. In this paper this issue is considered and at most effort has been made to make the model to be more realistic and flexible to minor changes in the values of the affecting factors. Factors used for constructing model are taken from Martin Garner(et. al) [5].

## 3. Methodology

Multiple linear regression was considered here to explain the factors affecting the ARPU and which after validation will help to predict the future values of ARPU. ARPU of TSP depends on many factors; they are subscriber base of the TSP, Number of operators in that circle, Percentage of users adding periodically, still many other factors may be responsible for the ARPU determination but these are identified to be major ones even in the literature.

Table.1

| **Variable name given in the model** | **Variable considered** | **Variable Type** |
|---|---|---|
| Y | ARPU | Dependent variable |
| X1 | Subscriber base | Independent variable |
| X2 | Number of Operators | Independent variable |
| X3 | Percentage of new users added | Independent variable |

Data collection was carried out in consultation with industry personnel and other executives. Periodic data reports by TRAI and COAI were collected and supporting data was collected through annual reports by service providers and DoT.

As APRU depends on the multiple factors, multiple regression was built by first considering correlation matrix of variables under consideration. After observing the correlation matrix final variables were selected. Multiple linear regression was built using step wise regression method to understand the model viability and prediction capability. Here in this paper also step wise regression method was followed by introducing one variable at a time. Below graphs show the trends of variables under consideration with respect to time.

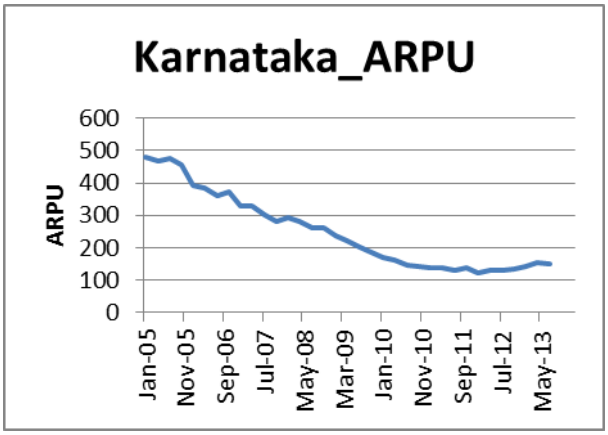


Fig.1

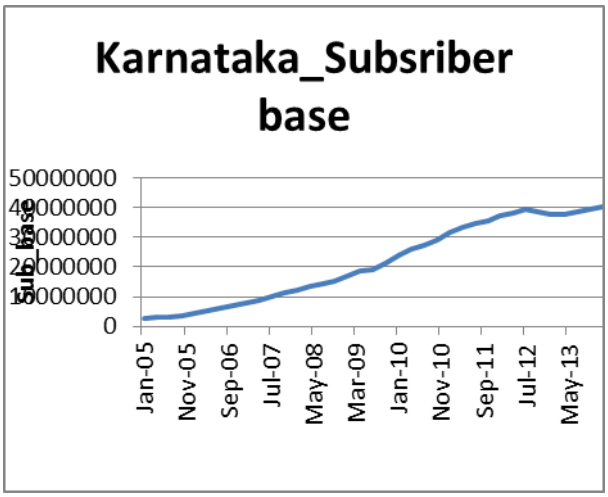


Fig.2

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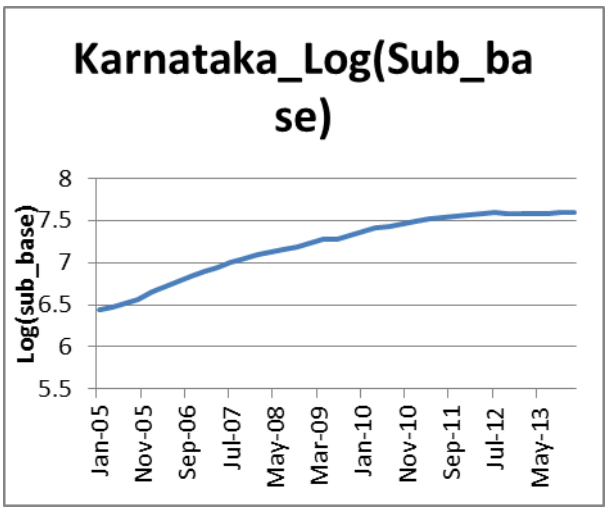


Fig.3

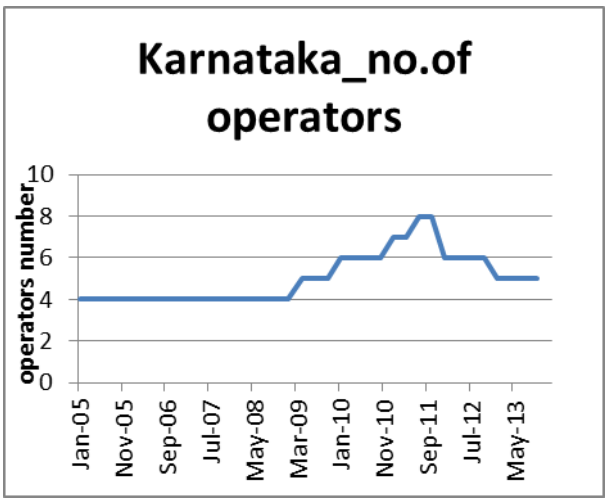


Fig.4

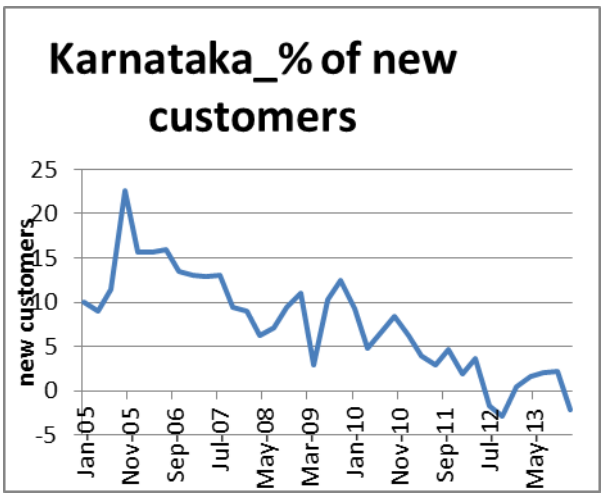


Fig.5

It is observed that in Karnataka region that ARPU has been in the declining trend. From January 2013 very little upward trend of ARPU is seen. This is because of increase in subscription to Data services by large number of customers and many 2G licences were cancelled hence number of operators were reduced which resulted in the increase in the ARPU. In the subscriber base graph it can be observed that towards the end of 2012 there is dip in the subscriber base number. This can attributed to the cancellation of 2G licences because of scams that took place during auctioning of spectrum. This can be clearly observed in the percentage of new users added graph below, in that graph during end of 2012 users added was negative that means many customers discontinued from mobile service. Otherwise the trend has been increasing always. Subscriber base variable is discrete variable and magnitude of the values is also large compared to other variables and there is one more major issue with subscriber base variable used directly which will be discussed in the further sections, so that variable is transformed using logarithms of the original variable and forming a new transformed variable to make the future calculations easier.

## 4. Results and Tables

This final model equation was arrived through step wise regression model. In the earlier version of the model Subscriber base was considered as it was, but the main problem observed in that case was VIF for that variable was above 5 which is not acceptable according to statisticians. In this model subscriber base was transformed by taking logarithm to the base 10 and model is built.

***ARPU=2540.49-312.299*Log(Sub_base)-7.01561*No.of.operators-1.70283*per_new_users***

Model was developed using the statistical package Minitab. Below table shows the coefficients of regression equation. P-value of all the coefficients convey (P-value<0.05) that all the factors are significant in determination of the dependent factor.

Coefficients:
Table.2

| Term | Coef | SE Coef | T | P |
|---|---|---|---|---|
| Constant | 2540.49 | 76.0070 | 33.4245 | 0.000 |
| Log(Sub_base) | -312.30 | 10.9405 | -28.5451 | 0.000 |
| No.of.operators | -7.02 | 2.5903 | -2.7084 | 0.011 |
| Perc_new_users | -1.70 | 0.6196 | -2.7484 | 0.010 |

Summary of model

Table.3

| | | | |
|---|---|---|---|
| R-sq= 98.97% | R-Sq(adj)=98.87% | R-Sq(pred)=98.55% | S=12.4250 |

R-squared for this model is above 98% that means 98% of variance is explained by the factors under consideration.

Analysis of VarianceTable.4

| Source | DF | Seq SS | Adj SS | Adj MS | F | P |
|---|---|---|---|---|---|---|
| Regression | 3 | 457807 | 457807 | 152602 | 988.489 | 0.000000 |
| Log(Sub_base) | 1 | 455624 | 125792 | 125792 | 814.823 | 0.000000 |
| No.of.operators | 1 | 1017 | 1132 | 1132 | 7.335 | 0.010906 |
| Perc_new_u | 1 | 1166 | 1166 | 1166 | 7.554 | 0.00989 |

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| | | | | | | |
|---|---|---|---|---|---|---|
| sers | | | | | | 43 |
| Error | 31 | 4786 | 4786 | 154 | | |
| Total | 34 | 46293 | | | | |

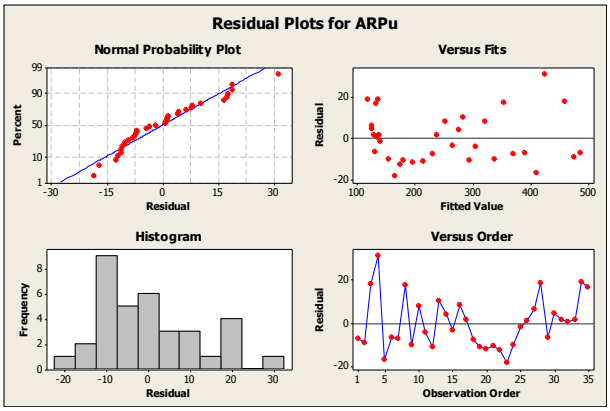


Fig.6

Above graph (Fig 6) is important one to be considered for checking the viability of the model. Residual plot almost normal behaviour of residuals is observed. P-value of A-D test for residuals is 0.057, just above the border line. There is no pattern followed by residuals v/s fitted value which is also positive result to add to the good model. Figure 7 plots the actual and predicted variation v/s time. There is good match observed in the predicted and the actual values.

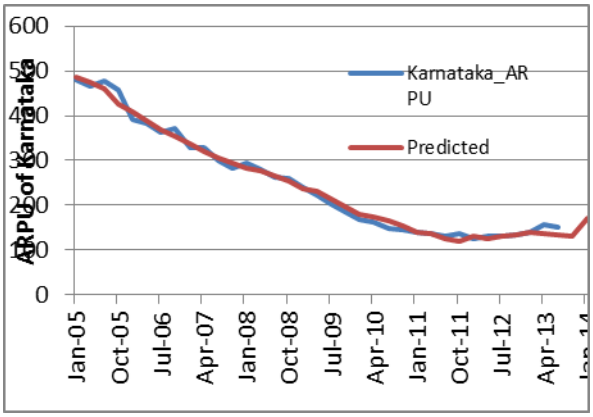


Fig.7

## 5. Validation of the model

Important consideration for any multiple linear regression model is the multi co-linearity effect in the model which reduces the model quality by affecting the predictability of the model.

In this model multi co-linearity was addressed by calculating VIF factors for each independent variable in the model. As per general terms VIF value of 0-5 is acceptable and 5-10 is a problem, where reconsideration required. Above 10 is not acceptable. In the model that is discussed above the VIF's of all the variables are calculated as shown in the table 5.

Coefficients:Table.5

| Term | VIF |
|---|---|
| Constant | |
| Log(Sub_base) | 3.69234 |
| No.of.opeartors | 2.21535 |
| Percentage_new_users | 2.63100 |

With all the VIF's in the acceptable region, conclusion can be drawn that multi co-linearity is not observed in this model.

## 6. Conclusion

The model developed was proved to be adequate and proper for the prediction of ARPU. ARPU will in turn define AMPU and hence the profit of the operator. Once ARPU is predicted relevant strategies can be formulated by service providers, like reduction of operations cost or adding more subscribers etc. Both researchers and professionals have started talking in terms of AMPU, but ARPU is the basis on which AMPU will be derived. In this context this study is significant. Results obtained through statistical model are near to reality. Future works in this area can be to add more variables to the model and develop better modelling framework for determination of future ARPU values of service providers.

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