1. **Introduction**

The age of the telephone simplified communication between two parties. What used to be a cumbersome task of either sending a messenger or even in some cases lighting smoke signals became a simple spin of a dial. In an instance, people were able to communicate with each other and the physical constraint of distance was eliminated. The constant need for teenagers to communicate with each other has increased with the improvement in technology which begs the question, “what is the economic impact of a household with teens on the usage of telephone”

This paper will address the question above as the main topic. However, other supplemental questions that will provide a basis for the final conclusions will be addressed by the paper. These supplemental questions will be “what is the relation of income and the status of married couples to single (divorced) couples?” “Do married couples with children call more during peak hours?” “What is the effect of having teens in the household in terms of calling during peak hours?” “Based on peak and off peak calling, which tariff plan is the least expensive to a household with teenagers?”

Once the final supplemental question has been answered, the main question will neatly summarize the conclusions of each subtopic and a main conclusion will be drawn from the results of the supplemental questions.

1. **Data Description I**

From the data provided (TelephoneS15) I pooled a couple of the variables needed to conduct hypothesis testing together. After conducting a summary analysis to measure the sample size of the data together with the mean and standard deviations, I created a new variable called mar\_1 which is equivalent to married couples only. By doing this I was able to distinguish between married couples and the singles (including the divorced couples) in the area

Another variable that I worked was household size (hhsize). According to census posted on census.gov, about 6.061 million people were single parents in the 1980s with an increase of 1 million in the 1990s (census, Single parent households). This would imply that for each year in the 1980s there was an increase of 100,000 single parents. When our data was collected in 1986 the total amount of single parents was relatively 6.661 million and according to the census page the total population was roughly 241 million (census, Monthly estimates). This gives us a relatively small estimate of 2% of single parents over the population. Using the above assumption, I segmented the household size to those who had more than two people.

The data described by table 1 is the summary statistics of income of the people involved in the statistics. The mean income of the people in the data is about 4.88 which would roughly translate to about $15000 with a standard deviation of 2.29. This data comes in handy when handling the regressions necessary in knowing the solution to the first supplemental question.

Table 1: Descriptive Statistics.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Obs. | Mean | Std. Dev. | Min | Max |
| income | 2,763 | 4.88346 | 2.299488 | 1 | 9 |

In addition to this data, I added the summary statistics of the individual tariffs as well as the different calling times (off peak, peak and shoulder) and different plans. These average statistics can be found on the Data Documentation page under the title “Appendix 1”.

1. **Empirical results.**

Y = β0 + β1mar\_1 + β2income + β3 educ. + β4 hhsize + µ; where y= MAP…… (i)

For the equation stated above, I used the new generated variable mar\_1 and regressed it against MAP. I accounted for education, income and house size and they were part of the independent variables that were in the initial model. The results are displayed on table 2 below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| MAP | Coef. | Robust Std. Err. | t | P>t | [95% Conf. | Interval] |
| mar\_1 | -6.06675 | 10.59352 | -0.57 | 0.567 | -26.83878 | 14.70528 |
| income | -16.3595 | 2.287912 | -7.15 | 0 | -20.84571 | -11.87332 |
| educ | -17.5817 | 2.976211 | -5.91 | 0 | -23.41751 | -11.74585 |
| hhsize | 48.1554 | 4.781639 | 10.07 | 0 | 38.77944 | 57.53135 |
| \_cons | 198.3703 | 18.18664 | 10.91 | 0 | 162.7095 | 234.0311 |

Table 2.

The results above show the various coefficients of the regressions that determine the model. The coefficient of a married person using minutes on plan A during peak hours is 6.066 points lower than the single and divorced couples after controlling for all the other variables.

One assumption that could be derived from this was the fact that the married people who were using plan A during peak hours had probably worked during the time of peak hours and hence were never home to make phone calls at the time. However, what stands out is “house hold size in relation to phone calls”. After controlling for all the other variables we see that β4 implies that for every unit increase in household size there was a 48.1554 increase in peak hour calling for households using minutes in plan A.

Married couples were positively correlated to income and this implied that married couples brought in more money from their work collectively than their counterparts. This observation will be important after the bill calculation of each individual tariff and finding out why a couple would opt for one tariff over the other.

Since household size was positively correlated to MAP, this meant that teens might have a positive correlation to MAPS since school ended at 3pm and they would be home during part of the peak hours. Hence the next model I used was one that would confirm my suspicion.

Y = β0 + β1mar\_1 + β2 income + β3 educ. + β4 hhsize+ β5 teens + µ; where y= MAP…… (ii)

Table 3.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| MAP | Coef. | Robust Std. Err. | t | P>t | [95% Conf. | Interval] |
| mar\_1 | -0.8181 | 10.46911 | -0.08 | 0.938 | -21.3462 | 19.70997 |
| income | -16.4617 | 2.281357 | -7.22 | 0 | -20.9351 | -11.9884 |
| educ | -16.8562 | 2.941597 | -5.73 | 0 | -22.6242 | -11.0883 |
| hhsize | 38.6614 | 4.859705 | 7.96 | 0 | 29.13234 | 48.1904 |
| teens | 48.1159 | 11.58246 | 4.15 | 0 | 25.40473 | 70.8271 |
| \_cons | 207.3725 | 18.03304 | 11.5 | 0 | 172.0129 | 242.7321 |

When teens was added to the model, we find that when we hold everything else constant there was a positive correlation between MAPS meaning that holding all constant, when you increase the amount of teens by 1 there was an increase of 48.11 units in MAPS. Teens and household size are also positively correlated and in fact which would be the right assumption and also teens and married couples are positively correlated. This analysis gave me an idea to the second supplemental question in terms of the impact of teens and peak hour calling in a household.

In order to prepare myself for the last supplemental question, I generated a new variable called mar1\_teens which was equivalent to a married couple with teens in the household. This would take care of all the teens who might have been emancipated adults or even the single/divorced individuals with kids. After regressing with the new variable I came up with the model

Y = β0 + β1mar\_1 + β2income + β3 educ. + β4 hhsize+ β5 teens +β6 mar1\_teens+ µ;

Where y= MAP…… (iv)

The table represented below is the condensed version of the above model. The expanded table can be found in the appendix labelled as labelled as Appendix 2.

Table 4.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| MAP | Coef. | Robust Std. Err. | t | P>t | [95% Conf. | Interval] |
| educ | -18.903 | 3.019564 | -6.26 | 0 | -24.8238 | -12.9822 |
| mar\_1 | 33.32537 | 9.046015 | 3.68 | 0 | 15.58772 | 51.06302 |
| income | -15.4544 | 2.297741 | -6.73 | 0 | -19.9599 | -10.9489 |
| teens | 82.54945 | 19.8003 | 4.17 | 0 | 43.72453 | 121.3744 |
| mar1\_teens | 9.017716 | 23.36302 | 0.39 | 0.7 | -36.7931 | 54.82851 |
| \_cons | 279.5916 | 16.89433 | 16.55 | 0 | 246.4648 | 312.7184 |

In this case we find that the married couples who have teens generally have a positive correlation to the amount of MAP variable in the data. The variable mar1\_teens is statistically significant to a 10% significance level. The interpretation of β6 is every person who is married and has a teenager in the house, holding everything else constant, are relatively 9 times higher in the use of MAP than the single individual with no teenager.

Finally, I needed to calculate the difference in the bill statement between the households who had teenagers and those who did not. The Appendix 4 in the appendix shows that those people who were married and had teens paid at least 8.5% higher than the single adults with who had no teenagers.

1. ***Hypothesis testing***

When testing to see whether married couples paid more than single couples, I found that on average they paid at least .50 dollar extra with the average bill of single couples being 18.57 and the bill for unmarried couples being 19.01. This statement is supported by the Anova values of Appendix 5 and the tabular values of Appendix 5(ii).

The next hypothesis I tested was whether the married couples with teens paid more in general. The data is represented by Appendix 6. The values represented show that they did in fact pay on average more in general than their counterparts.

1. ***Conclusions:***

This paper shows that people in Kentucky who were married and had teens definitely made a higher amount of phone calls compared to their single counterparts. We begin by noting the significant difference of income between married couple and single (divorced) couples. This could be due to the fact that in most married households, both of the partners contribute in terms of bringing in some form of income. Also it is important to note that at this time the level of women in the labor force had grew in America (Miltra, 2).

Another conclusion is that married couples had a negative correlation to the variable MAP. This could be explained in different ways but one way I thought about it was due to the fact that couples would be working, they generally would not be home to actually use the land line phone. This is supported due to the fact that even though they had a negative correlation to MAP, hhsize had a positive correlation to MAP. Hence this would mean that someone else in the household might be home during peak hours to make the call (results in Table2 above).

After conducting more test, we find that teens are positively correlated to MAP. Since they are also positively correlated to household size, we could conclude that they actually correlated highly with the amount of Minute, Peak calls in plan A. This lead to a bigger household bill of the married couples with teens to the single couples without teens. In General, teens created a significant correlation as to determine whether a couple would pay higher or lower in their bill.

Finally, we can see that the economic status of a household may or may not change depending on a couple of things. For one since the income of the parents are positively correlated to income, they may bring in more money than the bill would affect them. However the presence of teens prove one fact, addition to teens in a household correlates to an increase in the bill and since at the time, the land line bill was usually paid by the parents, then this would imply that there might have been some economic significance when correlating the bill to parents with teens.

1. **Appendix**

Appendix 1.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| tariff = 0 |  |  |  |  |  |
| Variable | Obs | Mean | Std. Dev. | Min | Max |
| MAP | 2,094 | 218.9847 | 256.9026 | 0 | 3390 |
| MAS | 2,094 | 236.2101 | 272.0043 | 0 | 2222 |
| MAO | 2,094 | 159.4408 | 204.3196 | 0 | 1899 |
| MBP | 2,094 | 47.37345 | 98.3261 | 0 | 1490 |
| MBS | 2,094 | 62.75167 | 124.1287 | 0 | 1255 |
| MBO | 2,094 | 36.21633 | 78.21545 | 0 | 920 |
| CAP | 2,094 | 54.57211 | 55.03161 | 0 | 480 |
| CAS | 2,094 | 44.30755 | 48.45655 | 0 | 609 |
| CAO | 2,094 | 36.28128 | 39.4075 | 0 | 533 |
| CBP | 2,094 | 9.643266 | 17.64028 | 0 | 272 |
| CBS | 2,094 | 9.646132 | 16.83577 | 0 | 245 |
| CBO | 2,094 | 6.706781 | 11.51853 | 0 | 127 |
| tariff = 1 |  |  |  |  |  |
| Variable Obs | Variable Obs | Mean | Std. Dev. | Min | Max |
| MAP | 669 | 104.4111 | 142.5044 | 0 | 1220 |
| MAS | 669 | 110.4664 | 165.7605 | 0 | 1774 |
| MAO | 669 | 76.49477 | 116.4691 | 0 | 1091 |
| MBP | 669 | 38.3722 | 69.05652 | 0 | 714 |
| MBS | 669 | 57.41555 | 97.57956 | 0 | 698 |
| MBO | 669 | 31.15097 | 53.14864 | 0 | 505 |
| CAP | 669 | 28.69357 | 34.43027 | 0 | 310 |
| CAS | 669 | 23.13602 | 29.67268 | 0 | 251 |
| CAO | 669 | 19.41555 | 24.68261 | 0 | 186 |
| CBP | 669 | 8.333333 | 12.56258 | 0 | 160 |
| CBS | 669 | 8.633782 | 11.69134 | 0 | 94 |
| CBO | 669 | 6.061286 | 7.624858 | 0 | 50 |

Appendix 2.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| MAP |  | Coef. | Robust Std. Err. | t | P>t | [95% Conf. | Interval] |
| educ |  |  |  |  |  |  |  |
|  | 2 | -51.58226 | 14.33031 | -3.6 | 0 | -79.6816 | -23.483 |
|  | 3 | -72.34165 | 15.31649 | -4.72 | 0 | -102.375 | -42.3086 |
|  | 4 | -91.09291 | 15.62221 | -5.83 | 0 | -121.725 | -60.4604 |
|  | 5 | -128.5539 | 17.79237 | -7.23 | 0 | -163.442 | -93.6661 |
|  | 6 | -89.53661 | 17.53329 | -5.11 | 0 | -123.916 | -55.1568 |
| mar\_1 |  | 29.48764 | 8.828055 | 3.34 | 0.001 | 12.17733 | 46.79794 |
| income |  |  |  |  |  |  |  |
|  | 2 | -116.275 | 26.73706 | -4.35 | 0 | -168.702 | -63.8482 |
|  | 3 | -111.2692 | 26.05221 | -4.27 | 0 | -162.353 | -60.1853 |
|  | 4 | -119.8608 | 24.44262 | -4.9 | 0 | -167.789 | -71.933 |
|  | 5 | -157.6681 | 23.19293 | -6.8 | 0 | -203.146 | -112.191 |
|  | 6 | -132.5476 | 23.13384 | -5.73 | 0 | -177.909 | -87.1861 |
|  | 7 | -146.7393 | 23.33988 | -6.29 | 0 | -192.505 | -100.974 |
|  | 8 | -155.9655 | 24.65731 | -6.33 | 0 | -204.314 | -107.617 |
|  | 9 | -137.7555 | 27.54584 | -5 | 0 | -191.768 | -83.7428 |
| teens |  | 80.73455 | 18.9175 | 4.27 | 0 | 43.64056 | 117.8285 |
|  |  |  |  |  |  |  |  |
| mar1\_teens |  |  |  |  |  |  |  |
|  | 1 | 61.70565 | 27.79027 | 2.22 | 0.026 | 7.213674 | 116.1976 |
|  | 2 | -43.90322 | 47.68021 | -0.92 | 0.357 | -137.396 | 49.58953 |
|  | 3 | -41.45872 | 124.5947 | -0.33 | 0.739 | -285.768 | 202.8502 |
|  | 4 | 422.524 | 77.26951 | 5.47 | 0 | 271.0117 | 574.0363 |
| \_cons |  | 330.1086 | 28.35251 | 11.64 | 0 | 274.5141 | 385.703 |

Appendix 3: Bill regressions between households

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | Robust |  |  |  |  |
| bill | Coef. | Std. Err. | t | P>t | [95% Conf. | Interval] |
|  |  |  |  |  |  |  |
| mar\_1 | 0.290027 | 0.190633 | 1.52 | 0.128 | -0.08377 | 0.663824 |
| mar1\_teens | 0.852563 | 0.33927 | 2.51 | 0.012 | 0.187316 | 1.517811 |
| income | -0.04819 | 0.037975 | -1.27 | 0.205 | -0.12265 | 0.026273 |
| \_cons | 18.75916 | 0.19549 | 95.96 | 0 | 18.37584 | 19.14248 |

Appendix4: including the significance levels

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  | MAP | MAP | MAP | MAO | bill | bill |
| mar\_1 | 1.257 | 29.488\*\*\* |  |  | 0.541\*\* | 0.290 |
|  | (10.286) | (8.828) |  |  | (0.185) | (0.191) |
| educ=1 | 0.000 | 0.000 | 0.000 | 0.000 |  |  |
|  | (.) | (.) | (.) | (.) |  |  |
| educ=2 | -57.702\*\*\* | -51.582\*\*\* | -51.754\*\*\* | -32.659\*\* |  |  |
|  | (14.158) | (14.330) | (14.316) | (10.594) |  |  |
| educ=3 | -67.781\*\*\* | -72.342\*\*\* | -72.196\*\*\* | -35.004\*\* |  |  |
|  | (15.040) | (15.316) | (15.306) | (12.073) |  |  |
| educ=4 | -83.665\*\*\* | -91.093\*\*\* | -89.005\*\*\* | -44.194\*\*\* |  |  |
|  | (15.273) | (15.622) | (15.593) | (12.931) |  |  |
| educ=5 | -117.853\*\*\* | -128.554\*\*\* | -126.910\*\*\* | -69.682\*\*\* |  |  |
|  | (18.244) | (17.792) | (18.061) | (17.073) |  |  |
| educ=6 | -85.569\*\*\* | -89.537\*\*\* | -88.384\*\*\* | -68.118\*\*\* |  |  |
|  | (16.969) | (17.533) | (17.375) | (11.889) |  |  |
| hhsize | 38.151\*\*\* |  |  |  |  |  |
|  | (4.771) |  |  |  |  |  |
| teens | 47.048\*\*\* | 80.735\*\*\* | 80.510\*\*\* | 109.354\*\*\* |  |  |
|  | (11.284) | (18.918) | (18.774) | (18.946) |  |  |
| mar1\_teens=1 |  | 61.706\* |  |  |  |  |
|  |  | (27.790) |  |  |  |  |
| mar1\_teens=2 |  | -43.903 |  |  |  |  |
|  |  | (47.680) |  |  |  |  |
| mar1\_teens=3 |  | -41.459 |  |  |  |  |
|  |  | (124.595) |  |  |  |  |
| mar1\_teens=4 |  | 422.524\*\*\* |  |  |  |  |
|  |  | (77.270) |  |  |  |  |
| mar1\_teens |  |  | 9.913 | -24.714 |  | 0.853\* |
|  |  |  | (22.394) | (21.666) |  | (0.339) |

----

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| mar\_1 |  |  | 34.386\*\*\* | -8.438 |  |  |
|  |  |  | (8.910) | (6.920) |  |  |
|  |  |  | -13.648 | 23.585\*\* |  |  |
|  |  |  | (10.249) | (8.269) |  |  |
| month=12 |  |  | 19.611 | 5.662 |  |  |
|  |  |  | (10.871) | (8.154) |  |  |
| Constant | 258.440\*\*\* | 330.109\*\*\* | 327.752\*\*\* | 203.372\*\*\* | 18.939\*\*\* | 18.759\*\*\* |
|  | (28.674) | (28.353) | (28.767) | (17.770) | (0.255) | (0.195) |
| Observations | 2763 | 2763 | 2763 | 2763 | 2763 | 2763 |
| R-squared | 0.141 | 0.116 | 0.113 | 0.122 | 0.007 | 0.009 |
| Standard errors in parentheses |  |  |  |  |  |  |
| ="\* p<0.05 | \*\* p<0.01 | \*\*\* p<0.001" |  |  |  |  |

Appendix 5(i): testing for the average increase in bill between married and single couples

Number of obs. = 2,763 R-squared = 0.0023

Root MSE = 4.54217 Adj. R-squared = 0.0019

Source | Partial SS df MS F Prob.>F

-----------+-----------------------------------------------------------------

Model | 131.18795 1 131.18795 6.36 0.0117

mar\_1 | 131.18795 1 131.18795 6.36 0.0117

Residual| 56963.067 2,761 20.631317

-----------+-------------------------------------------------------------------

Total | 57094.255 2,762 20.671345

Appendix 5(ii): expressing the average increase in bill between married and single couples

Summary of bill

mar\_1 | Mean Std. Dev. Freq.

------------+-----------------------------------------

0 | 18.574338 4.6883193 1,331

1 | 19.010429 4.4019894 1,432

------------+------------------------------------------

Total | 18.800354 4.5465751 2,763

Appendix 6: Testing for the mean change between married couples with teens and their counterparts

Number of obs. = 2,763 R-squared = 0.0093

Root MSE = 4.52866 Adj. R-squared = 0.0079

Source | Partial SS df MS F Prob.>F

-----------+----------------------------------------------------------

Model | 531.15207 4 132.78802 6.47 0.0000

mar1\_teens | 531.15207 4 132.78802 6.47 0.0000

Residual | 56563.103 2,758 20.508739

-----------+------------------------------------------------------------

Total | 57094.255 2,762 20.671345

# Bibliography

1. Monthly Estimates of the United States Population: April 1, 1980 to July 1, 1999, with Short-Term Projections to November 1, 2000 – Cont. Population Estimates Program. Population Division, U.S. Census Bureau, <http://www.census.gov/popest/data/national/totals/1990s
2. /tables/nat-total.txt>.
3. Single-Parent Households: 1980 to 2009, U.S. Census Bureau, Statistical Abstract of the United States: 2011, <<http://www.census.gov/compendia/statab/>2011/tables/11s1335.pdf>.
4. Toossi, Miltra. A century of change: the U.S. labor force, 1950–2050. Monthly Labor Review May 2002. Page 15. < http://www.bls.gov/opub/mlr/2002/05/art2full.pdf>.