Is It Worth Your Money?
Finding The Most Cost-Effective University

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Introduction

"What College should I go to?" is a subjective question asked by almost anyone seeking a higher education. With tuition costs rising, it is in the best interest of prospective students to know what the most cost-effective institution is to attend.

UC Merced, for example, draws in students by advertising its smaller class sizes and access to academic resources. The university prides itself on having a small student body and actively encourages communication between staff and students. The purpose of this study is to determine the most ideal student faculty ratio given acceptance rate, graduation rate, and tuition cost.

Hypothesis

I believe that schools with higher student faculty ratios will have a greater graduation rate and will not be significantly more expensive or have a lower acceptance rate. When there are less students per instructor, it provides an environment for students to receive more personalized help and thus positively influences their academic success.

Procedure

Initially, I will plot graduation rate as a function of student faculty ratio (SFR). There will be a correlation analysis if the linear model yields a relevant R^2.

Next, I will compute the distribution of SFR over 777 universities in the United States. With this data I will be able to identify the mean, and pick two thresholds to represent high SFR, moderate SFR, and bottom SFR. A "good" or "high" SFR is a value that is closer to 1. This data represents both public and private universities. To produce a more conclusive analysis I will also compute the distribution of SFR over all public and private schools independently.

Using the resulting thresholds, I will create a series of plots that represent the three categories of SFR and their respective graduation rates. From this data, it should be clear whether or not there is a relationship between SFR and graduation rate. This plot will be repeated for the data on public schools and private school independently.

The existing data set does not have a column for acceptance rate but does have a column for applicants and accepted applicants. Utilizing for loops, a new column will be created for the acceptance rate referred to as AR. A mean AR will be calculated for all schools, public schools, and private schools independently. This will be compared against the mean AR for the three categories of SFR in all schools, private schools, and public schools independently. Tuition will be plotted by density and a mean tuition cost for all schools, public schools, and private schools will be calculated.

Consequently, the accumulated data will be sufficient to compute the percentage difference between elements like acceptance rate, graduation rate, and tuition between schools for the different thresholds of SFR.

Analysis

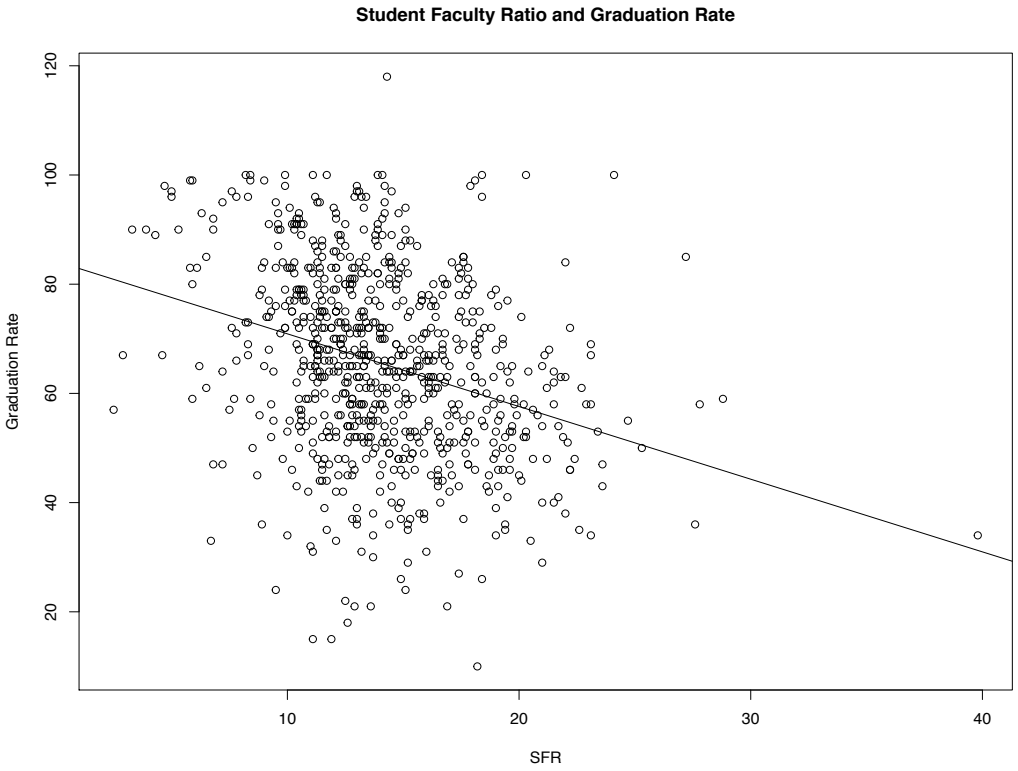

Figure 1: Plot of Graduation Rate and Student Faculty Ratio

```
Call:
lm(formula = Grad.Rate ~ S.F.Ratio, data = schoolData)

Residuals:
    Min      1Q  Median      3Q     Max
-54.443 -11.094   0.284  11.612  52.817

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  84.2168     2.1713  38.786   <2e-16 ***
S.F.Ratio    -1.3310     0.1484  -8.971   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 16.36 on 775 degrees of freedom
Multiple R-squared:  0.09407,   Adjusted R-squared:  0.0929
F-statistic: 80.48 on 1 and 775 DF,  p-value: < 2.2e-16
```

Figure 2: Results of Linear Analysis on Figure 1

Initial modelling of Graduation Rate as a function of SFR was shown to have an R^2 of 0.0929 so an analysis of correlation was omitted, and assessment of the density began.

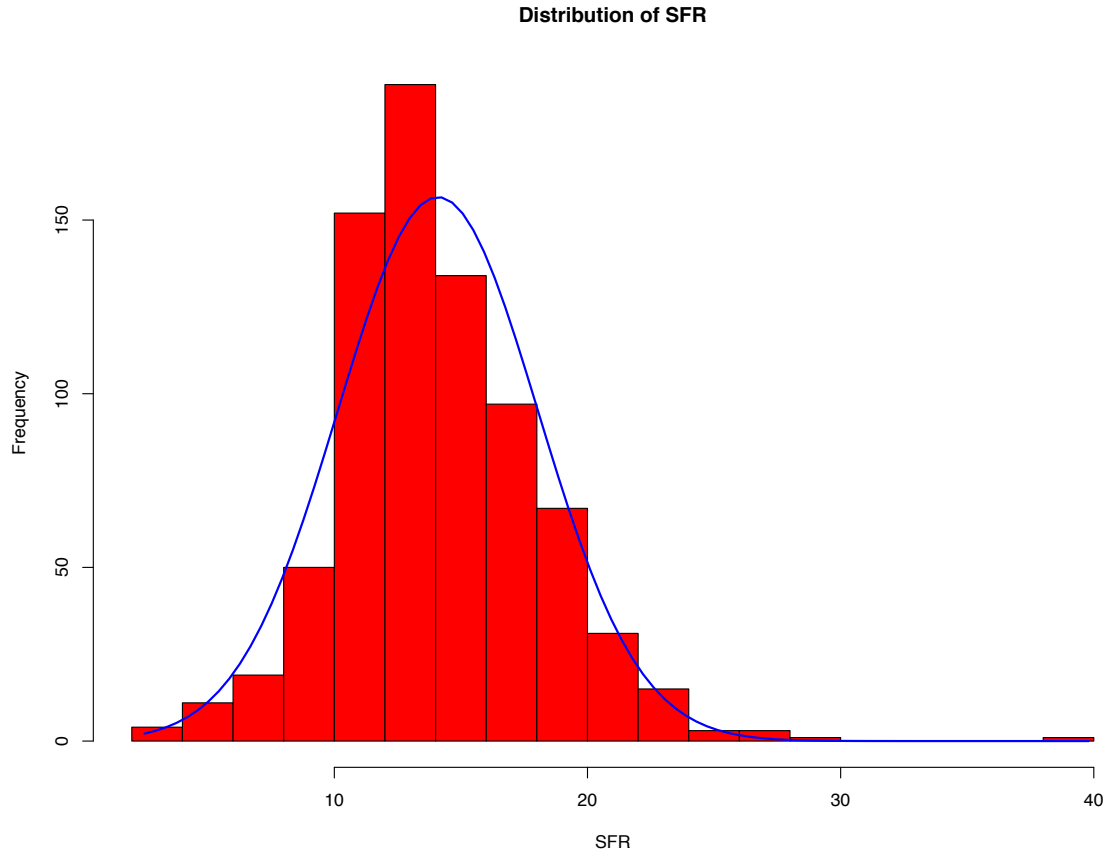

Figure 3: Distribution of SFR with Mean = 14.08

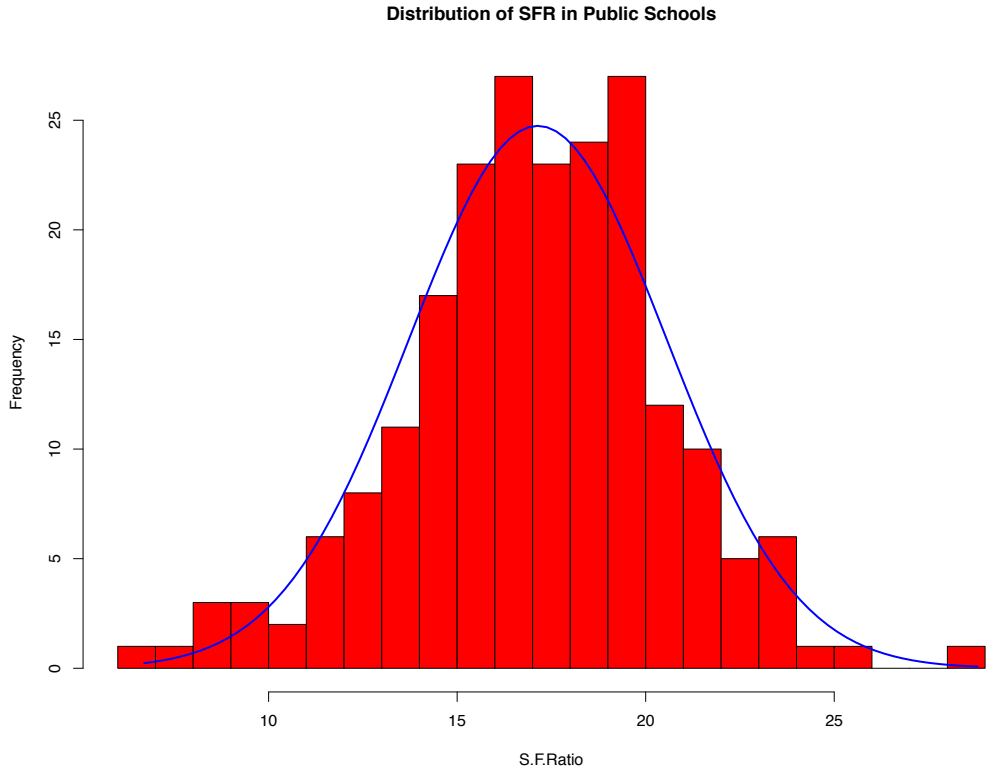

Figure 4: Distribution of Student Faculty Ratio in Public Universities with Mean = 17.14

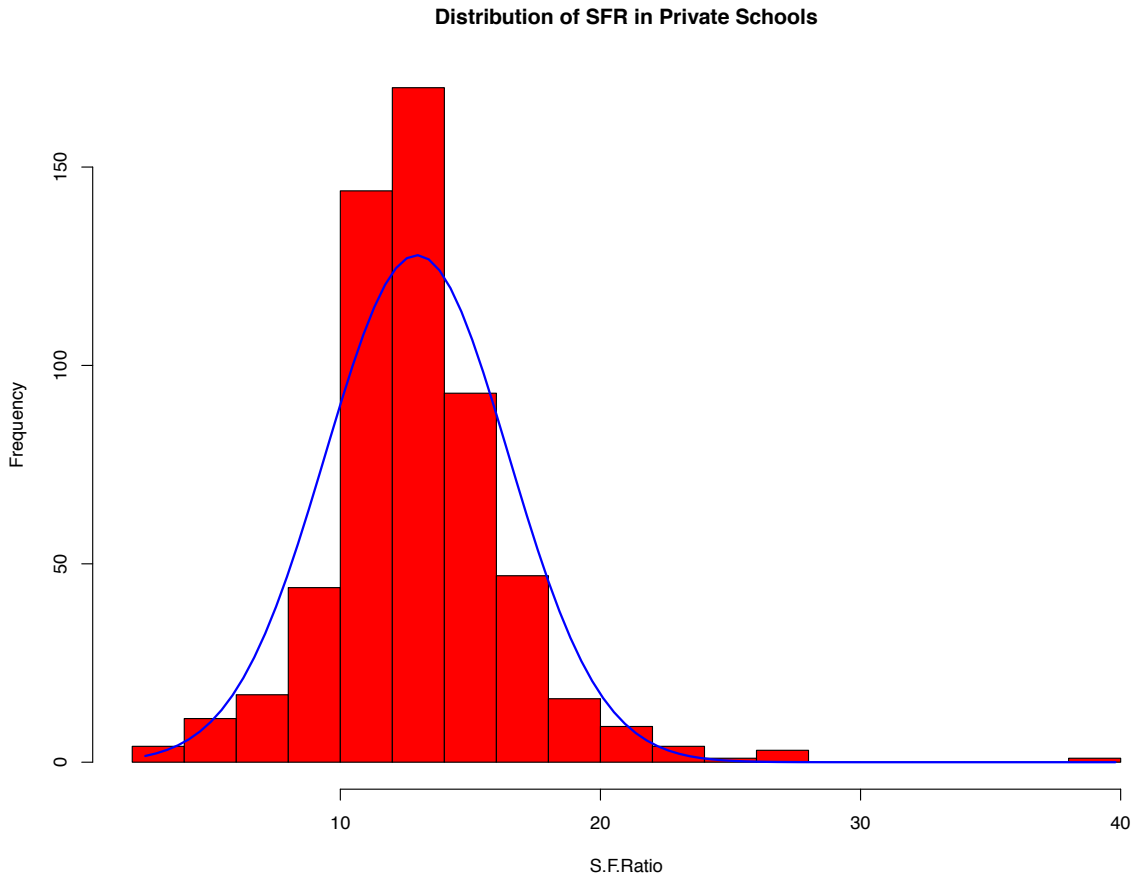

Figure 5: Distribution of Student Faculty Ratio in Private Universities with Mean = 12.94

Using figures 3, 4, and 5, a series of thresholds were constructed to represent the high SFR, middle SFR, and bottom SFR universities. A majority of universities had an SFR that fell between 10 and 20, so the thresholds were assigned as follows:

- A high SFR school has a SFR <10
- A middle SFR school has a SFR > 10 and < 20
- A bottom SFR school has a SFR > 20

Using these thresholds, a series of violin plots were constructed to visualize the density of particular graduation rates for each threshold of SFR.

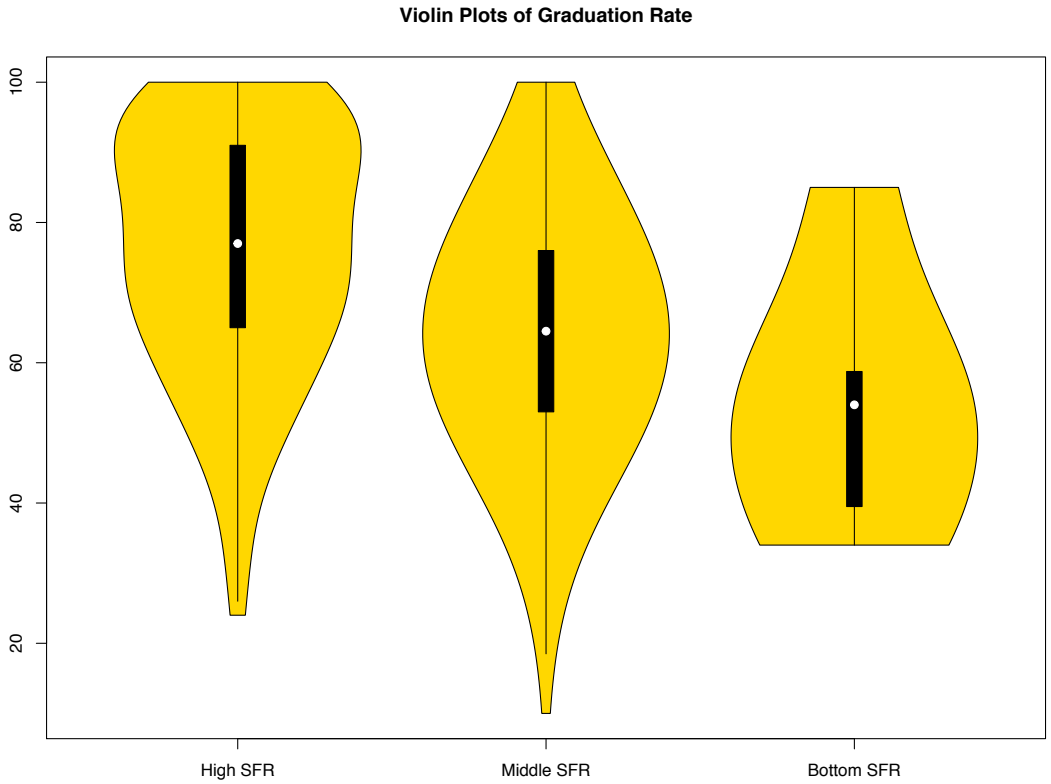

Figure 6: Density of Graduation Rate for all Universities in Thresholds

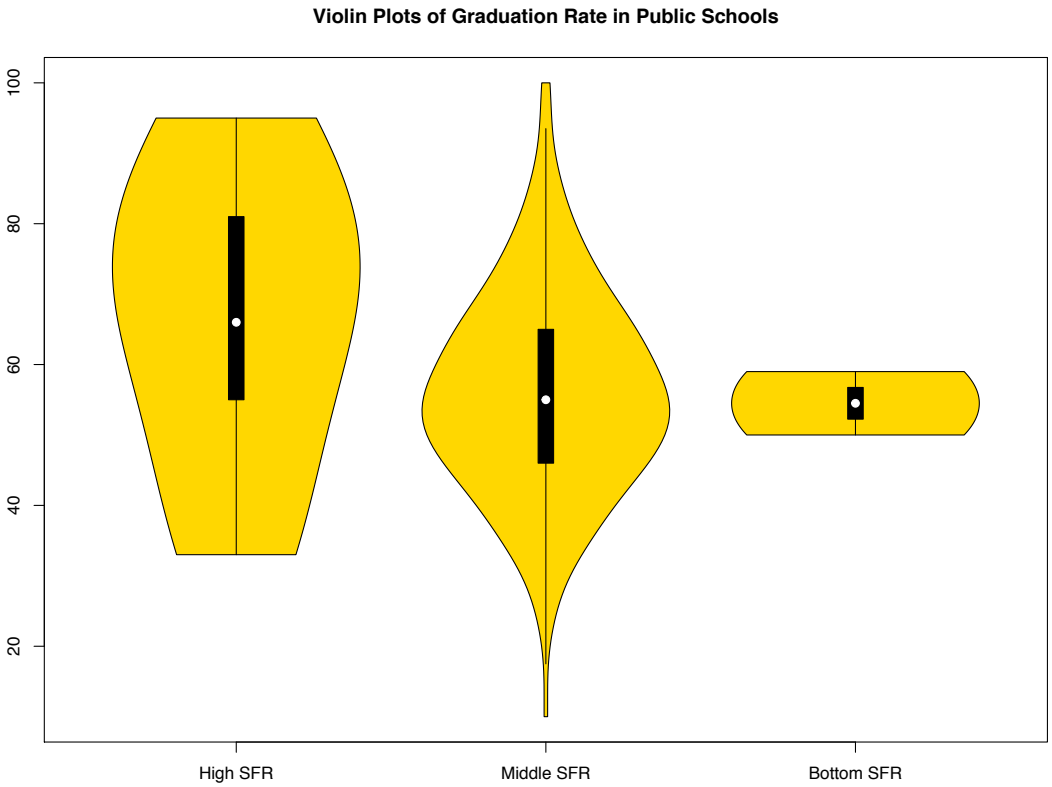

Figure 7: Density of Graduation Rate for all Public Schools in Thresholds

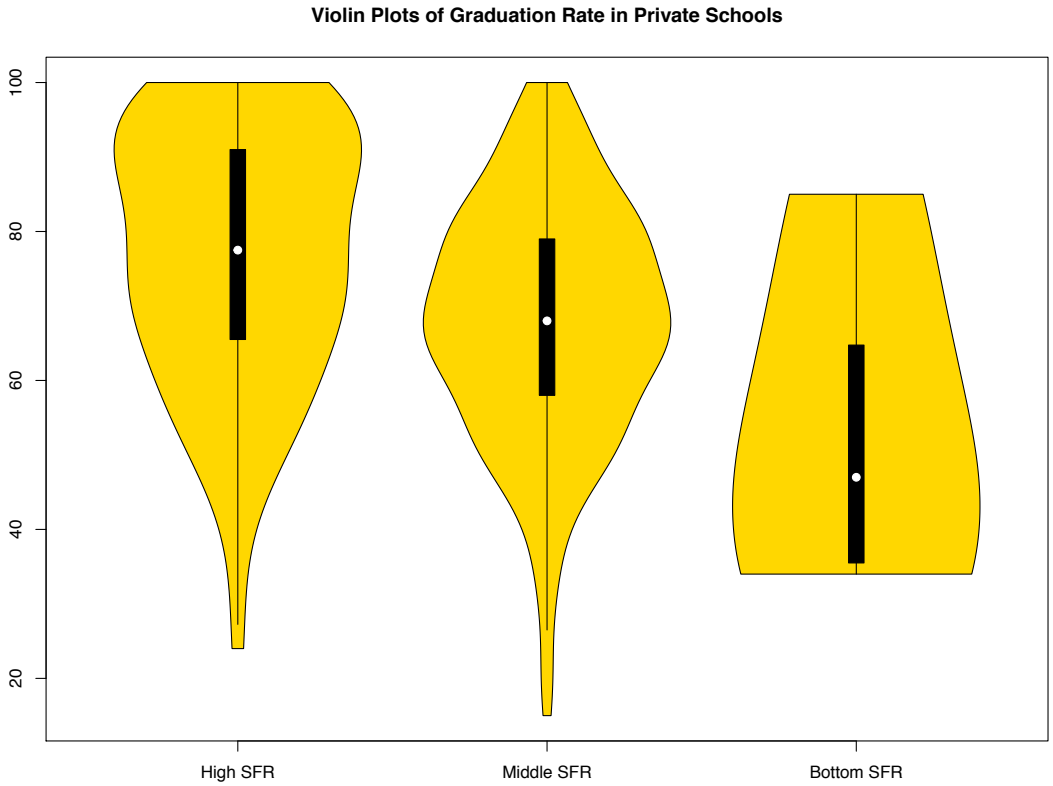

Figure 8: Density of Graduation Rates for Private Schools in Thresholds

The Violin Plots in figures 6-8 illustrate the connection between graduation rate and student faculty ratio. Similarly, to box plots, the dot represents the average graduation rate. In all cases, the High SFR category (SFR < 10) has higher graduation rate. The following figures are the analysis of both tuition and acceptance rate.

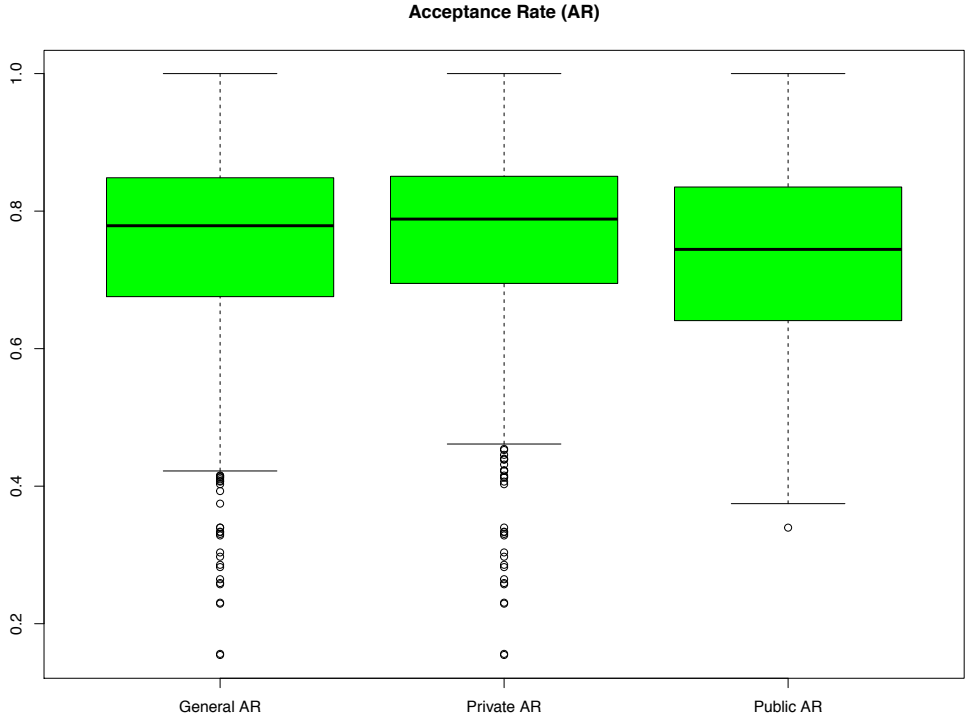

Figure 9: Acceptance Rate for Universities of all SFR

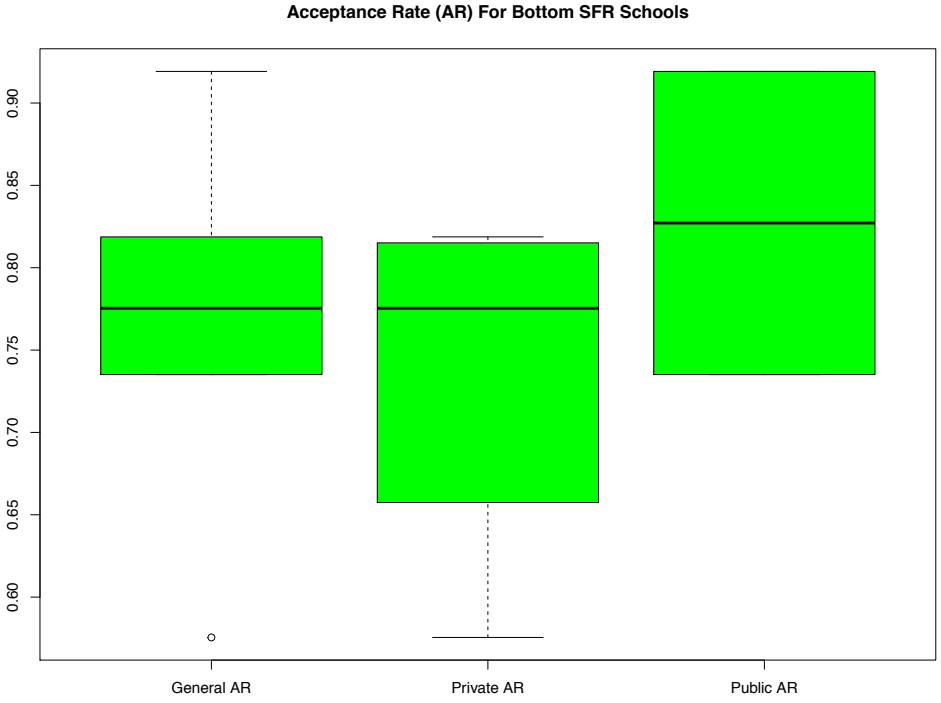

Figure 10: Acceptance Rate for Universities in Bottom SFR

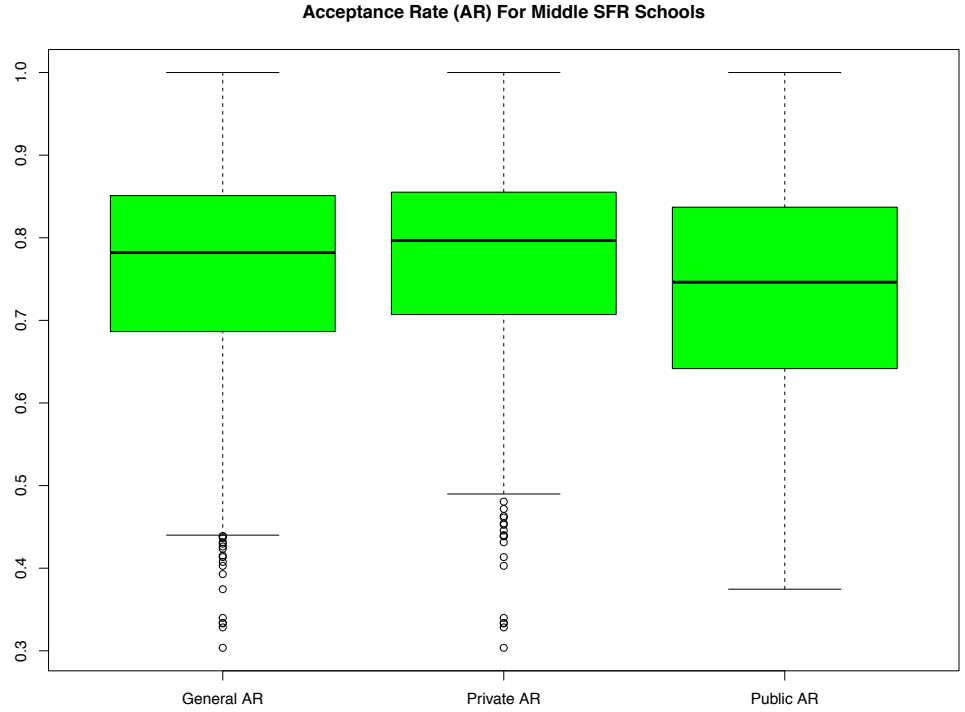

Figure 11: Acceptance Rate for Universities in Middle SFR

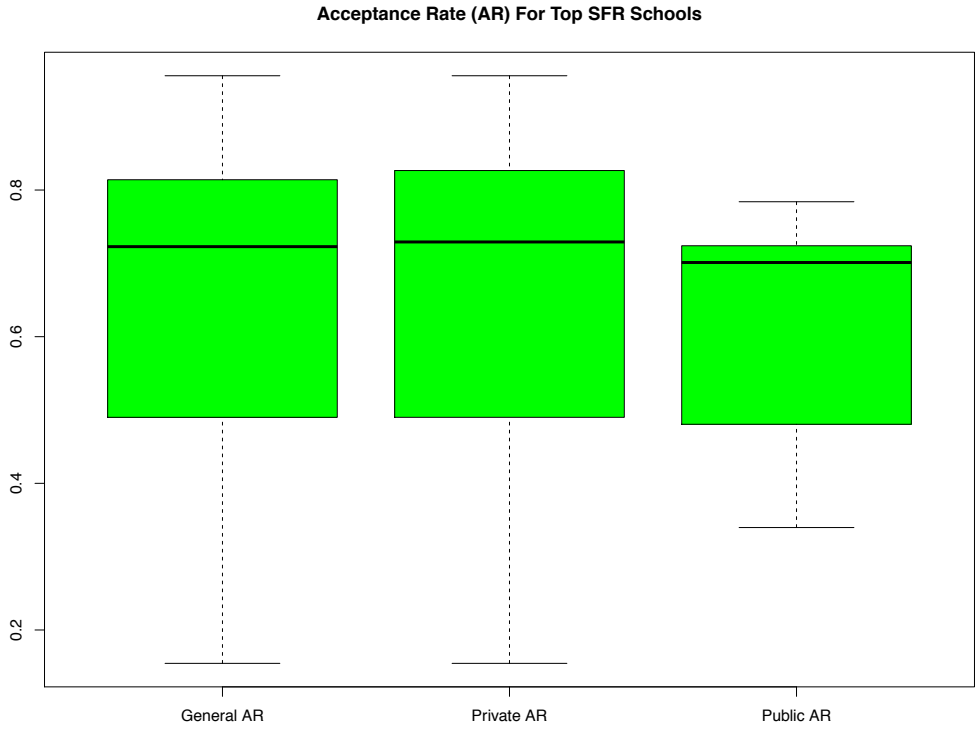

Figure 12: Acceptance Rate for Universities in Top SFR

Figure 13: Distribution of Tuition

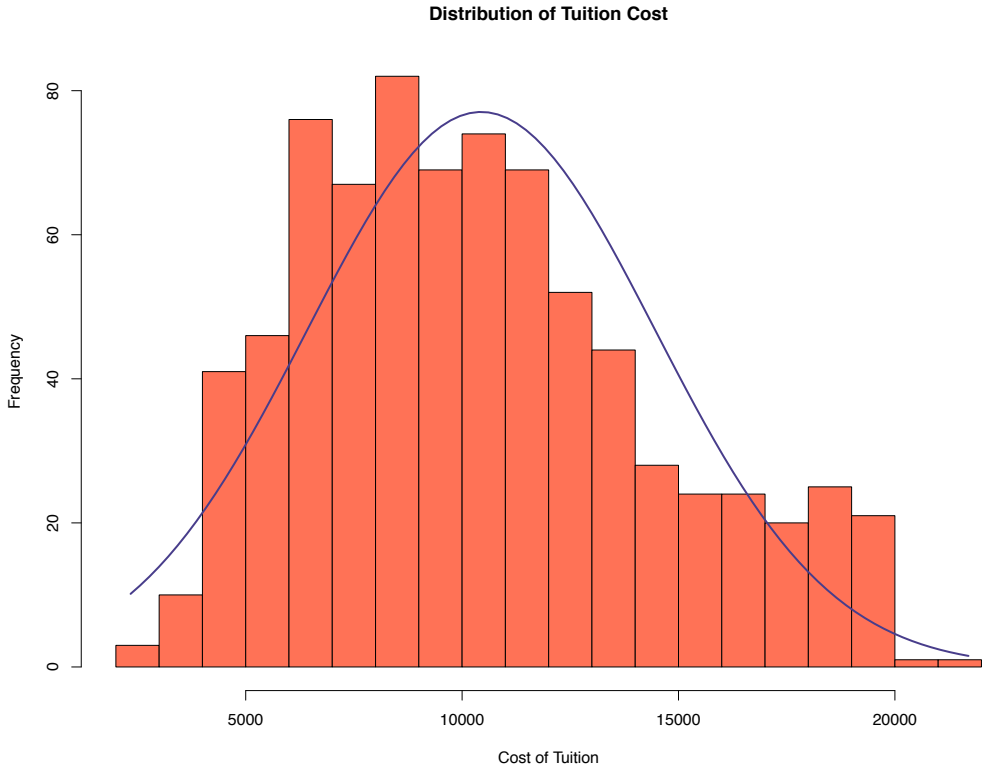

Figure 13: Distribution of Tuition Cost in all Universities

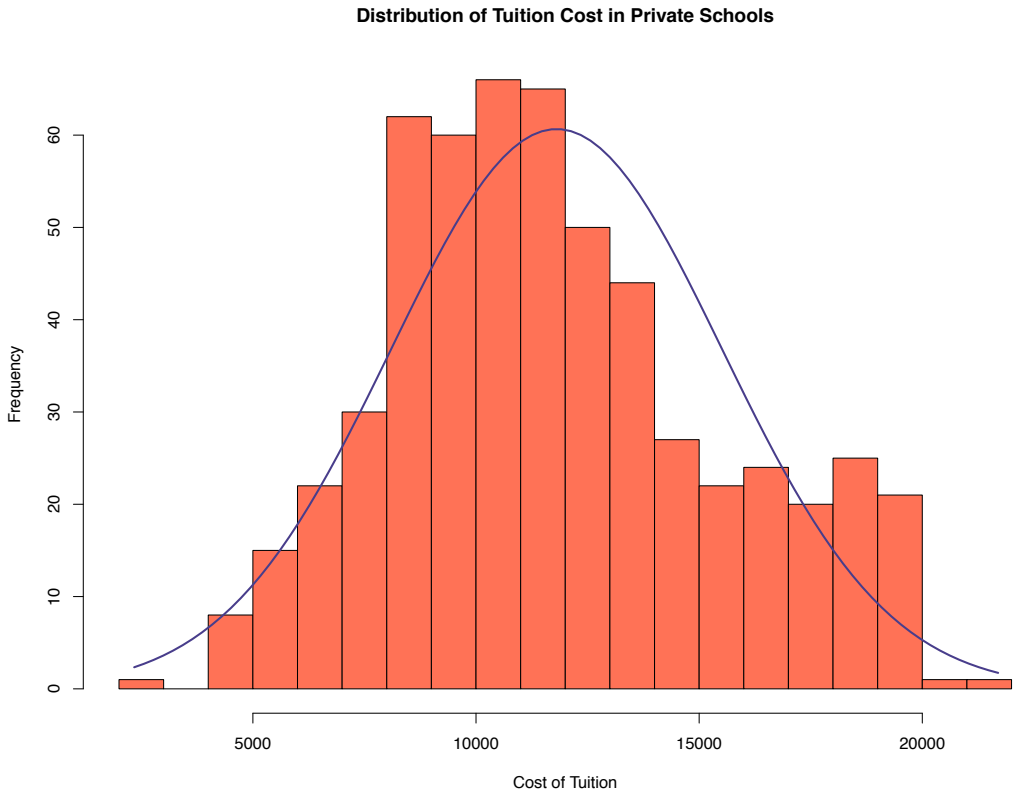

Figure 14: Distribution of Tuition Cost in Private Universities

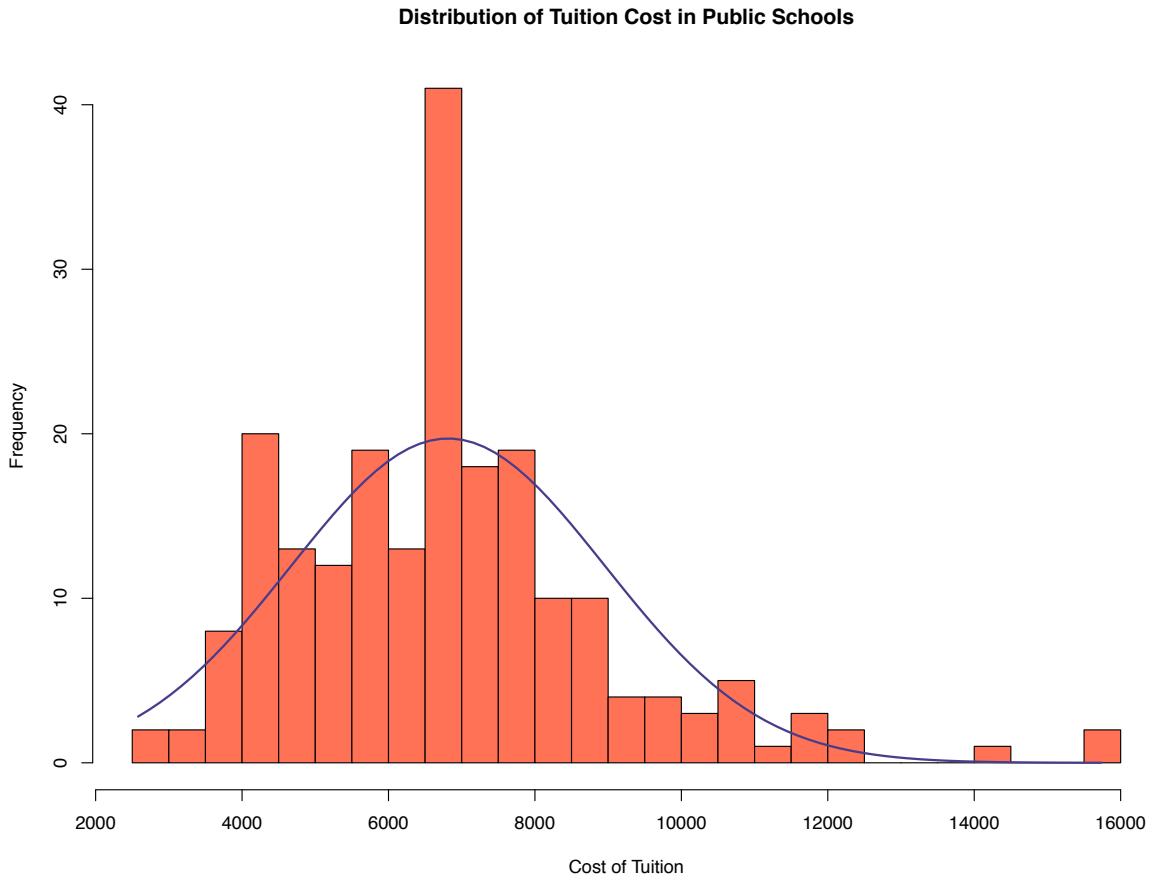

Figure 15: Distribution of Tuition Costs in Public Universities

Using Figures 9-15 the following data was collected:

- Mean Acceptance Rate = 0.74
- Private Mean Acceptance Rate = 0.75
- Public Mean Acceptance Rate = 0.73
- Public Mean Graduation Rate = 66.57
- Private Mean Graduation Rate = 76.97
- Public Average Tuition = $6813.41
- Private Average Tuition = $11805.98

Figures 6-8 show that universities with a higher SFR also have higher graduation rates than universities with a low SFR. With this knowledge in hand, it is possible to determine whether public or private schools with high SFR are more cost-effective. The average acceptance rate for both public and private schools are nearly identical, so it will not be taken into consideration when assessing cost-effectiveness. Since the data for average tuition and graduation rate is present, the percent difference will be calculated and assessed. The following lines of code detail the computation:

```
Dif_in_T = (abs(Pri_meanT - Pub_meanT)/((Pri_meanT + Pub_meanT)/2)) * 100
Dif_in_GR = (abs(Pri_meanGR - Pub_meanGR)/((Pri_meanGR + Pub_meanGR)/2)) * 100
```

Output:

Dif_in_GR	14.4924417666362
Dif_in_T	53.6276417733655

From this result we can see that the difference in tuition far exceeds the difference in graduation rate.

Conclusion

After analysis my hypothesis was proved to be correct. As observed in figures 6-8, average graduation rate increased as student faculty ratio increased. Also, these universities did not become exceedingly expensive. The most cost-effective university for a prospective student to apply to would be a public institution with a SFR < 10. This takes into account metrics such as graduation rate, acceptance rate, and tuition. Although the graduation rate is higher in private institutions, the 53% raise on average tuition is too great for only a 14% raise in graduation rate. This is general, and there will certainly be outliers where acceptance rate is vastly different from the average and this was not considered in the analysis. However, there are factors such as school prestige and alumni networks that impact a degrees cost-effectiveness. For example, a university with a poor alumni network could negatively affect the cost-effectiveness of a degree.

When a prospective student asks themselves the question “what school should I apply to?” the cost-effective solution is a public institution with a high student faculty ratio. Generally, students will be paying the least tuition and have the greatest odds of graduating.