

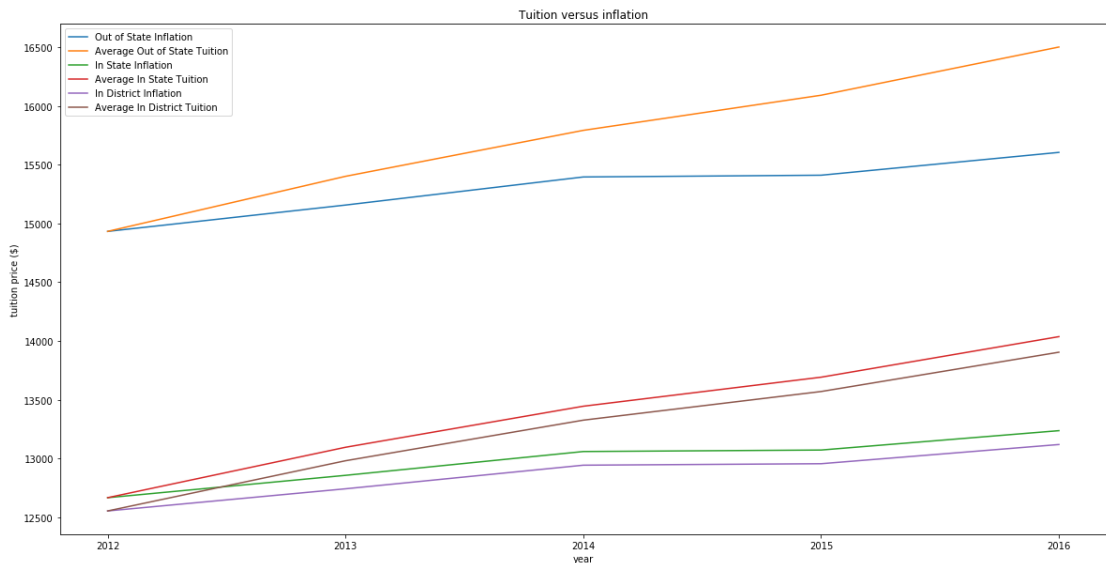
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## University Tuition Correlations

### I. Introduction

Today, higher education is considered by many to be a necessity in the United States. Conventional wisdom states that, without a college degree, the best paths in life are blocked to many people. However, as higher education has become more important in the world, it's price has increased dramatically. Today, tuition price outpaces the rate of tuition noticeably, for both in state and out of state tuition, which can be seen in Figure 1. This paper attempts a brief analysis of whether this increase in tuition prices is to the benefit of students, or correlated with any outside factors, such as national housing prices or the S&P 500.

Figure 1. Tuition prices versus inflation from 2012 to 2016.



### II. Methods

III. Analysis for this paper was performed using the National Center for Education Statistics' (NCES) Integrated Postsecondary Education Data System (IPEDS) [1]. This public database contains a large range of data and includes within it every institution that receives federal

financial aid. However, it has a handful of drawbacks that should be noted at the beginning of this paper. Although the IPEDS contains a large range of data for a large range of schools, it does not have a long range of historical data. Therefore, this analysis only looks at tuition prices, and other school data, between 2012 and 2016. This paper also focuses on only out of state tuition. This is to truly focus in on market effects encouraging students to attend more expensive universities, and because in state university pricing appears to broadly follow the same pattern as out of state pricing. Finally, it should be noted that IPEDS data is extremely basic, and only the data the schools report on their current classes. Therefore, although useful for a preliminary study, it does not reveal the long-term outcomes or correlations related to attending higher education.

To analyze the relationship between various factors that could be tied to tuition and tuition, a simple cross-correlation function was used. This function compares the overlap between two functions, in paper one function to be compared is always tuition price, while the other is inflation [2], graduation rate, application rate, acceptance rate, net price of college attendance, average US house price [3], and the S&P 500 [4]. The last two comparisons, housing prices and the S&P 500, were included to check if, instead of school specific factors, increasing tuition prices are more correlated to general macroeconomic factors.

#### IV. Results

The results of this paper are presented below, in Figure 1- Figure 8. In these plots, the exact height of the y-axis is a function of the two functions being cross-correlated. Therefore, it is not the exact scale of the y-axis that is of interest, but the mean y value compared to the highest peaks. The x-axis shows the full set of schools for which cross-correlations could be calculated. Therefore, each point shows how strongly correlated a specific factor is to tuition price at only one school. If one factor is extremely correlated to tuition prices, we expect to see a plot with very few points at 0, which is to say we would expect to see very few schools where the factor is uncorrelated to tuition price.

Figure 2. Correlation between tuition price and inflation.

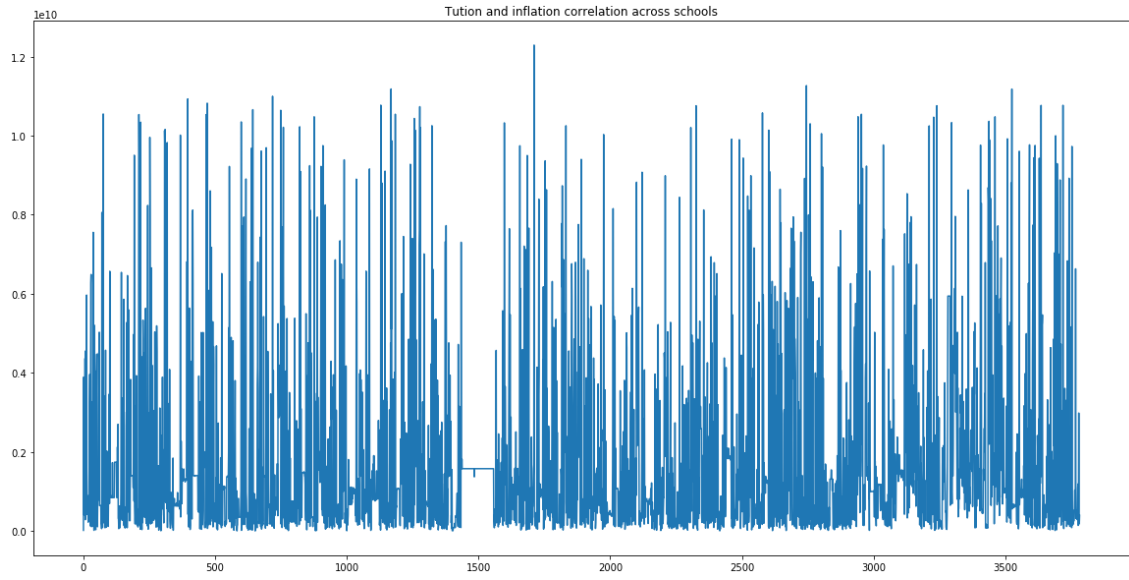


Figure 3. Correlation between tuition price and graduation rate.

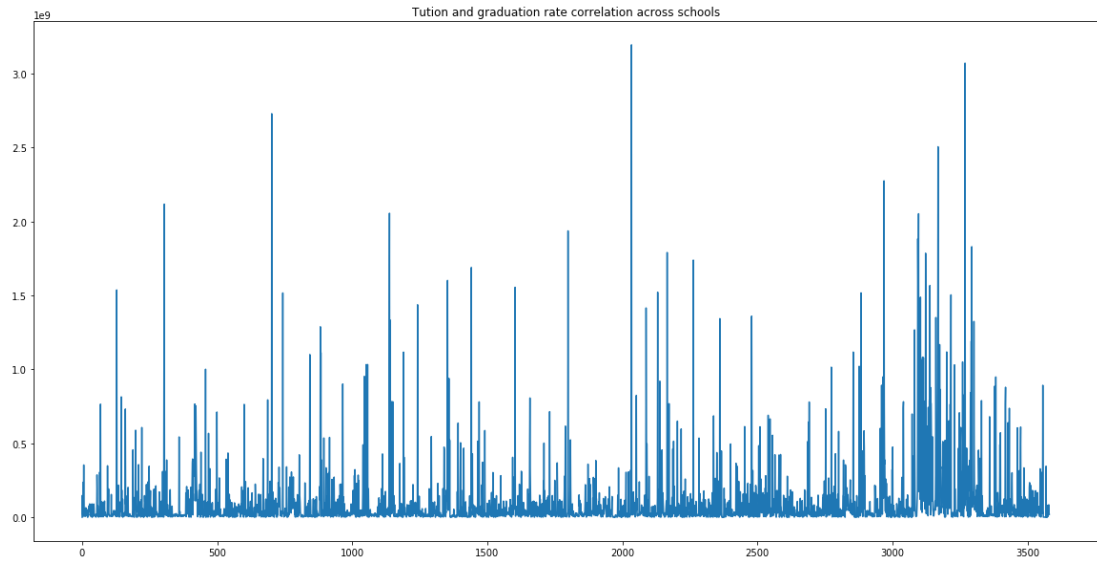


Figure 4. Correlation between tuition price and application rate.

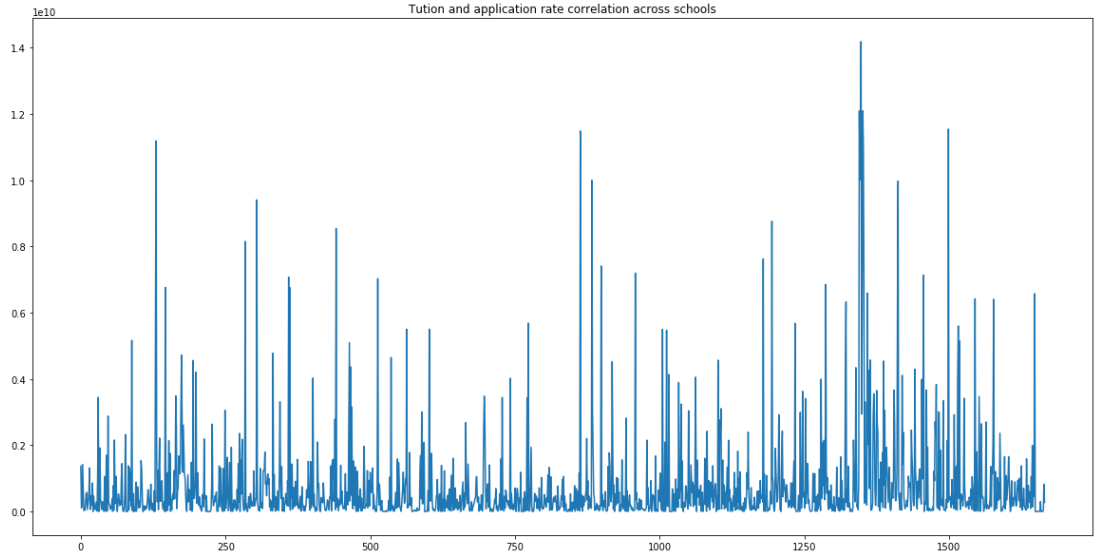


Figure 5. Correlation between tuition price and application rate.

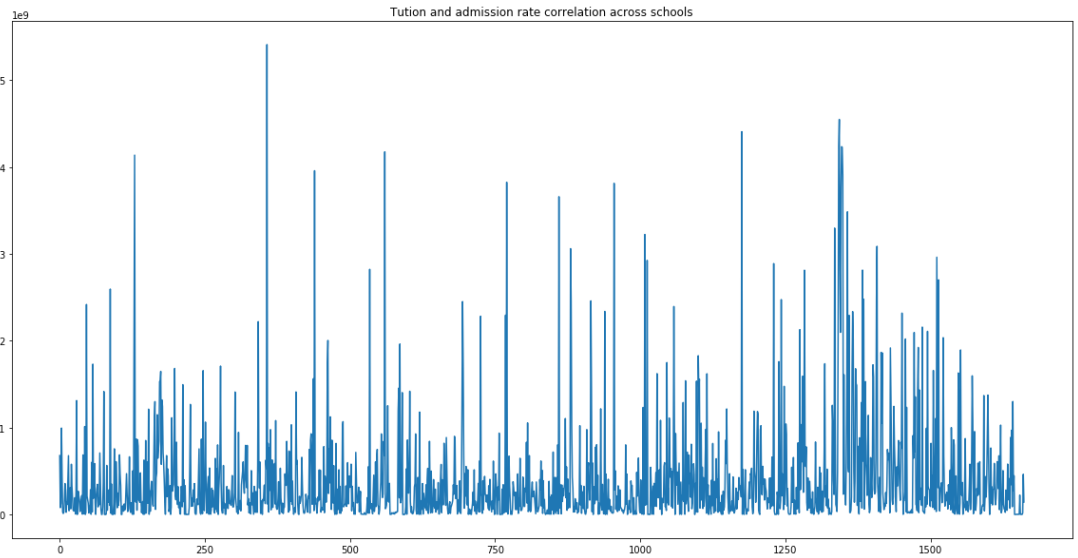


Figure 6. Correlation between tuition price and application rate.

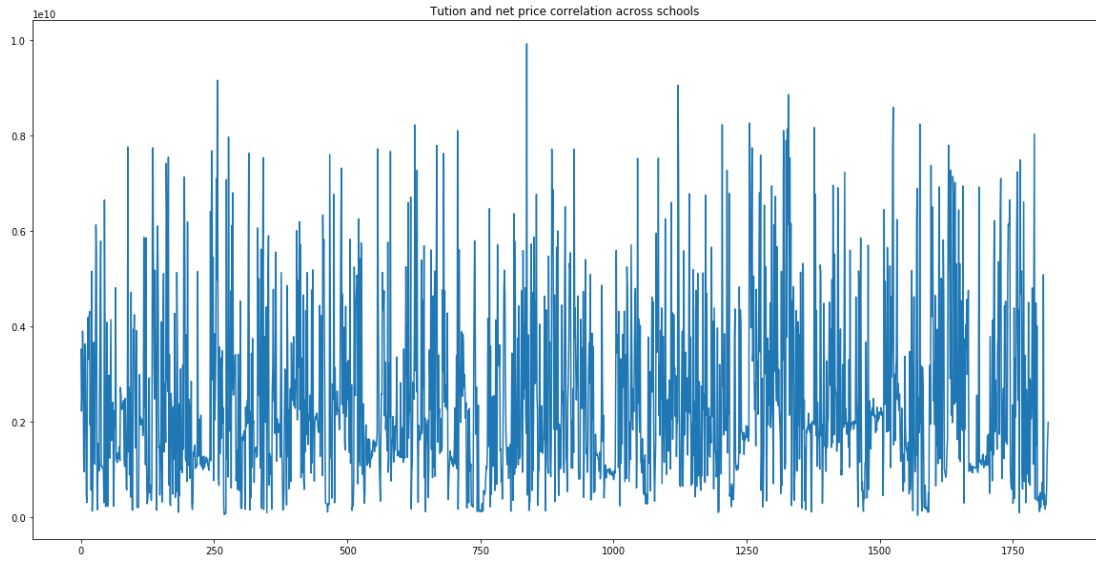


Figure 7. Correlation between tuition price and national housing prices.

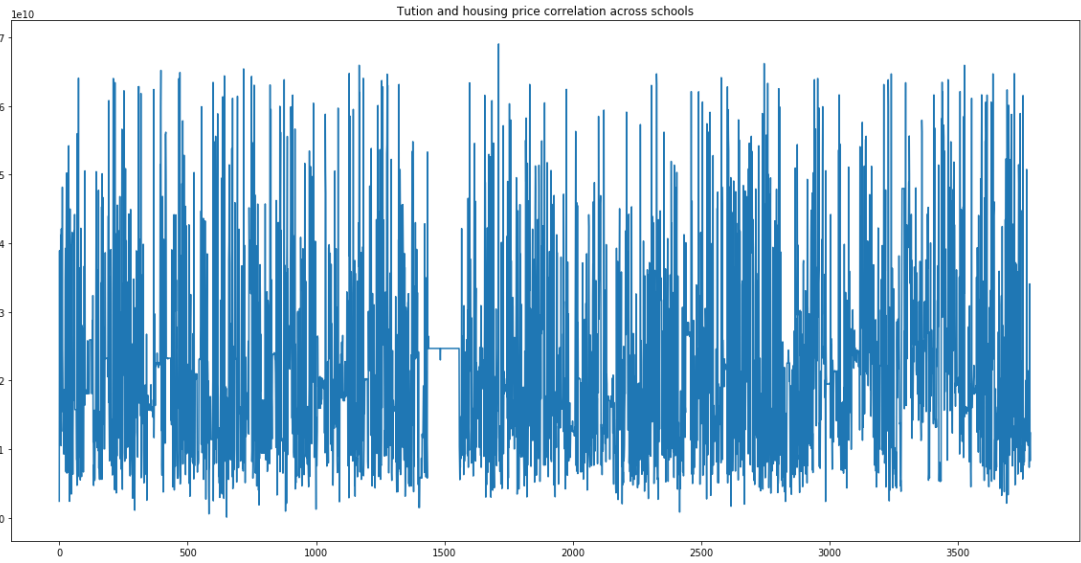
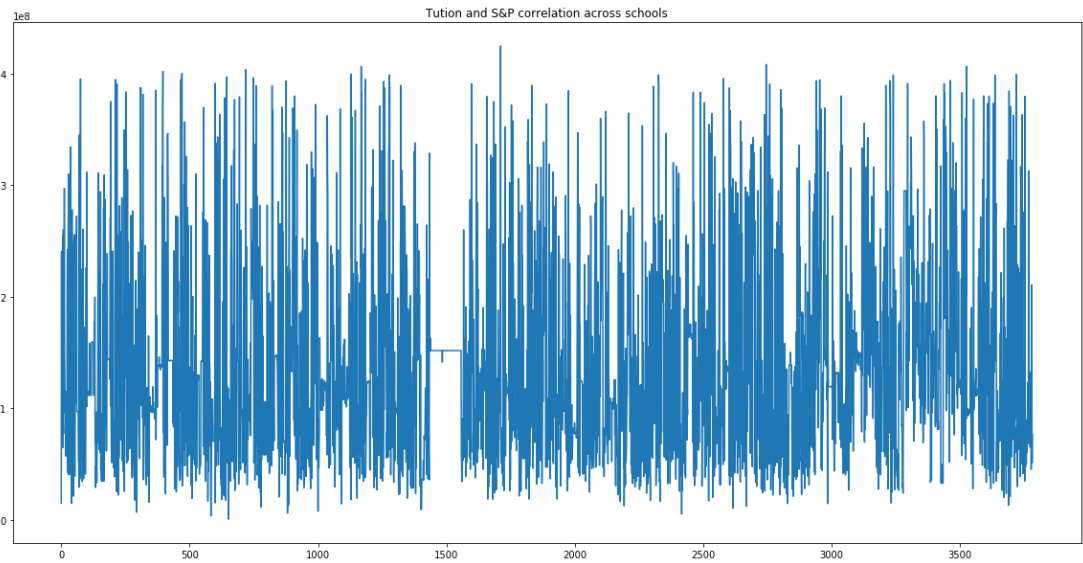


Figure 8. Correlation between tuition price and the S&P 500.



The most obviously correlated plot is for net price, which makes sense, as tuition is contained in net price. However, it is interesting to note that there is not noticeable correlation between tuition price and application rate, acceptance rate, or graduation rate. This indicated that schools do not adapt their pricing to changes in these rates. This may indicate that schools do a far more complex calculation when determining their prices than simply evaluating demand for their product. It is also worth noting that tuition price is correlated more closely to housing price and the S&P 500 than inflation.

#### V. Conclusions

When viewing the data presented in this paper, it initially appears that tuition price in the United States is not correlated to any particular outcome. However, the lack of correlation of a few considered points is interesting to note. First, for most universities, application rate, admission rate, and graduation rate are completely untethered from tuition price increases. This indicates that, over the short term, students do not vastly change their behavior when applying to and choosing higher education, and that short-term increases in admission or graduation rate do not swiftly alter the price of tuition at college. This makes some intuitive sense, as colleges swiftly and seemingly erratically changing their tuition price year to year would be seen as unstable. However, there is a noticeable correlation between housing prices or the S&P 500 and tuition prices. It is an interesting result that these correlations are

better than those between tuition price and inflation, which reflects the perspective that higher education is an investment, as stocks and houses may be.

This research could be easily improved by further work. The most obvious next step is to find even more historical data, to supplement the IPEDS database and look to see if the correlations seen here are true-long term relationships, or short-term features. Also, drilling down to find correlations between smaller subsets of schools (regions, private vs public, schools with similar acceptance rates, etc.) could prove interesting. Looking at regional housing data or other regional market data could also be revealing. Finally, this paper was entirely focused on higher education in the United States. The US higher education system is not subsidized in the way that higher education is in many other developed nations, so performing a similar analysis for other countries could be interesting.

#### VI. Sources

[1] IPEDS (School data)

[2] US CPI (Inflation)

[3] Zillow (House Prices)

[4] Standards & Poors (S&P500)