College Tuition, Diversity, & Pay



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Background

Tuition costs keep rising along with student debt and graduates often can't find opportunities related to their degree. Some even take post-college bootcamps and other professional development programs to learn more technical and in demand skills. Given the reality of today's job market versus the cost of higher education, there are questions prospective students should consider before investing a significant amount of time and money.

Questions

For this project, I wanted to delve into the question of whether the payoff of college is worth the investment. The question I sought to answer are: Is college still worth it? Which schools, types, sizes, and states are the most lucrative?

To assess this, Net Present Value will be calculated for college costs & career earnings.

Present Value shows present day equivalent of future earnings and costs. For example, having $50 today is better than having $50 in a year because you can invest the $50 and earn interest, dividends, appreciated value, etc.

Below is the formula we'll be using for Present Value

- Present value (PV) $=FV/(1+r)^n$ where
    - FV equals future income (or expense)
    - r = opportunity cost of delayed income/expenses
        - Referred to as the discount rate in this context)
        - 6% 10yr S&P 500 avg after-tax real return will be used for this analysis
    - n = # of time periods (years, months, weeks) till payment

Goals

The main objective of this study is to give parents & prospective students knowledge & perspective to make better college & career decisions so they don't wind up drowning in debt after college. I'd also like this research to push colleges to make their programs more profitable for students.

Dataset

This study will assess data from Kaggle's 'College tuition, diversity, and pay' dataset.

https://www.kaggle.com/datasets/jessemostipak/college-tuition-diversity-and-pay?resource=download&select=tuition_cost.csv

- Usability Score of 10
    - several code notebooks
    - thousands of views & downloads
- Mostly data from 2018-2019, with some data from earlier
- 5 Files, 33 columns with wide range of String and Integer values
    - Tuition Cost
    - Salary Potential
    - Diversity School
    - Tuition Income
    - Historical Tuition

Data Inspection & Cleaning

At first glance, the Tuition Income & Historical Tuition files were deemed unusable for this analysis. Tuition Income (which was supposed to represent colleges' income) had many price & net cost values that didn't remotely match Tuition Cost file numbers – or reality, for that matter. The Historical Tuition file's numbers seemed accurate, but they weren't broken down by college

like the other files and were even missing years. That leaves us with 3 files: Tuition Cost, Salary Potential, & Diversity School.

Data cleaning started with capitalization & standardization of column & college names, and conversion of integers to floats to improve output displays. Duplicates & null values also had to be identified. This was not a simple task because many college names that appeared to be duplicates were actually for different colleges in different states (exception one row in Salary Potential, which truly was a duplicate).
Null Room & Board values were considered to be 0 since they mostly were for 2-year local colleges where Room & Board didn't apply.

Data Transformation

Name-State Code combinations had to be populated and used to distinguish each row in each of the 3 tables for proper merging and plotting.

A % Enrollment column and rows for Male enrollment had to be added to Diversity School. Diversity School came with about 10 rows for each category (e.g. Women, Asian, etc.) so it needed to be parsed into single row copies for merging & plotting. Single row copies were created for Women, Men, and Total Minority rows.

Then it was time to calculate & value Career Pay and College Costs.

Career Pay (after tax) was projected and totaled assuming

- Early Career Pay starts at age 22 (4 year degree)
- Mid Career Pay starts at age 32
- Retirement at age 65
- Constant annual raises based on 10-year growth rate between Early and Mid Career Pay
- Current Federal & NY State Income Tax brackets. Standard deduction was applied to Federal taxes

Career Pay PV (Present Value) was calculated by applying the 6% before-mentioned discount rate to biweekly paychecks of the course of the career pay forecast (assuming student is 18 years old and it's May of the current year).

The below is an example of the result. Note how much of an impact applying Present Value has on Total Career Pay.

Early_career_pay	Mid_career_pay	Total_Career_Pay	Total_Career_Pay_PV
54,400	104,500	8,631,893	1,545,348
57,500	103,900	7,771,540	1,455,598

College Cost was projected & totaled assuming

- It's May of current year
  - Initial Fall Term payment due 4 months from now
  - Spring Term payment due 4 months after that, and so on
- 4% annual growth rate for Tuition and Room & Board

Separate In-State and Out of State totals calculated for public schools and Degree Length was accounted for.

College Cost PV (Present Value) was calculated by applying the 6% before-mentioned discount rate to all Fall & Spring Term payments

In_state_total	Out_of_state_total	Total_College_Cost_In_State	Total_College_Cost_Out_of_State	Total_College_Cost_In_State_PV	Total_College_Cost_Out_of_State_PV
2,380	2,380	4,760	4,760	4,580	4,580
12,602	21,024	25,204	42,048	24,250	40,457
18,222	29,238	72,888	116,952	68,820	110,424

Various combinations of tables were merged for different plotting, as not all colleges were in all 3 files.

Career Pay formulas were adjusted in Tuition-Salary merged tables to account for Degree Length. Degree Profit and Degree Profit NPV columns were created by subtracting College Cost from Career Pay

Degree_Profit_In_State	Degree_Profit_Out_of_State	Degree_Profit_NPV_In_State	Degree_Profit_NPV_Out_of_State
6,352,414	6,308,350	2,529,518	2,487,914
6,372,109	6,372,109	2,584,076	2,584,076

Analysis

Finally, the data was ready for plotting and analysis.

The Top 10 most profitable schools for students are listed below. Unsurprisingly, Harvard leads the list that also includes MIT, Caltech, Yale, and Stanford. But a Public school with much lower tuition came in second. SUNY Maritime is an engineering- focused college that correlates with very positive career outcomes. In fact, it ranks above Harvard when considering In-State as opposed to Out of State tuition. Out of State Degree Profit was used as the index by default because Out of State tuition is more comparable to Private school tuition.

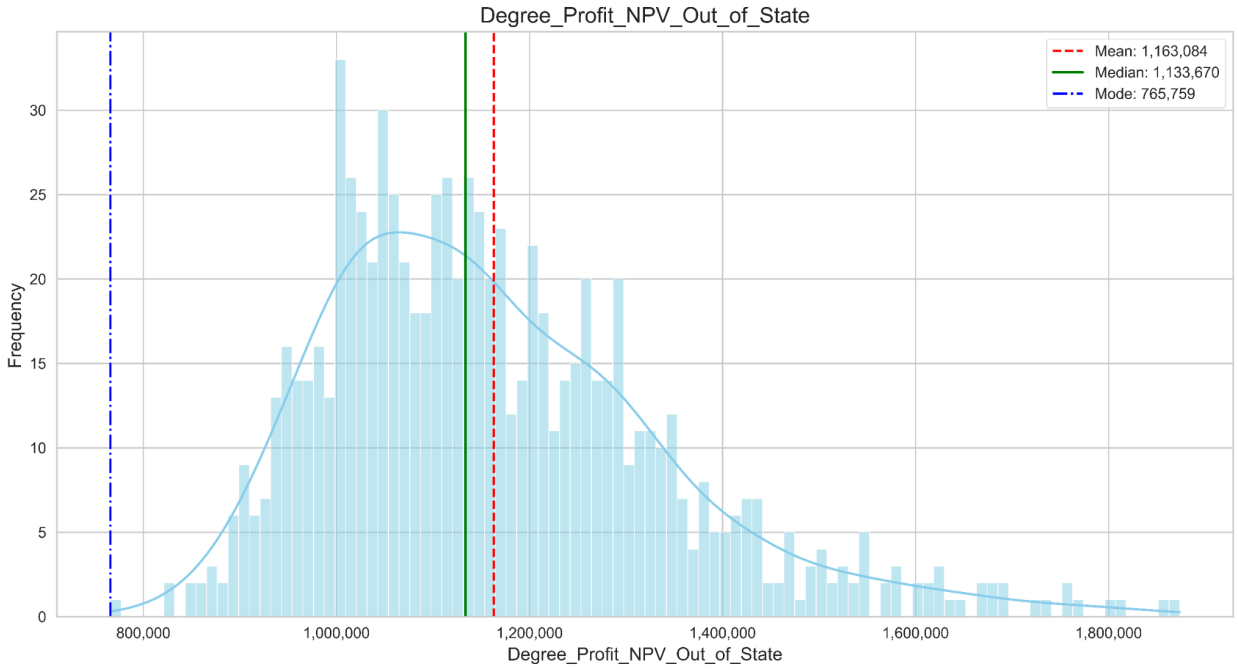
Only disappointment here was some of the STEM percentages, SUNY Maritime's 32% and Albany College of Pharmacy and Health Sciences' 2%. These two schools have much higher STEM percentages in reality. For most colleges though, the STEM percentages made sense so they were still used for later analysis.

	School- State	Type	In_state_tuition	Out_of_state_tuition	Better%	STEM%	Total_Career_Pay_PV	Degree_Profit_NPV_In_State	Degree_Profit_NPV_Out_of_State
1	Harvard University- MA	Private	50,420	50,420	54	19	2,128,880	1,873,648	1,873,648
2	SUNY Maritime College- NY	Public	8,283	18,063	53	32	1,967,607	1,889,032	1,852,096
3	Massachusetts Institute of Technology- MA	Private	51,832	51,832	52	69	2,064,389	1,810,055	1,810,055
4	Harvey Mudd College- CA	Private	56,876	56,876	55	85	2,082,878	1,799,611	1,799,611
5	California Institute of Technology- CA	Private	52,362	52,362	53	97	2,026,097	1,769,705	1,769,705
6	Yale University- CT	Private	53,430	53,430	53	22	2,024,297	1,762,078	1,762,078
7	Albany College of Pharmacy and Health Sciences...	Private	35,105	35,105	82	2	1,931,804	1,757,979	1,757,979
8	Stanford University- CA	Private	51,354	51,354	56	51	1,983,727	1,730,243	1,730,243
9	Colorado School of Mines- CO	Public	18,964	38,584	60	93	1,923,952	1,802,594	1,728,494
10	Stevens Institute of Technology- NJ	Private	52,202	52,202	47	79	1,942,853	1,688,127	1,688,127

A histogram for Out of State Degree Profit is shown below.

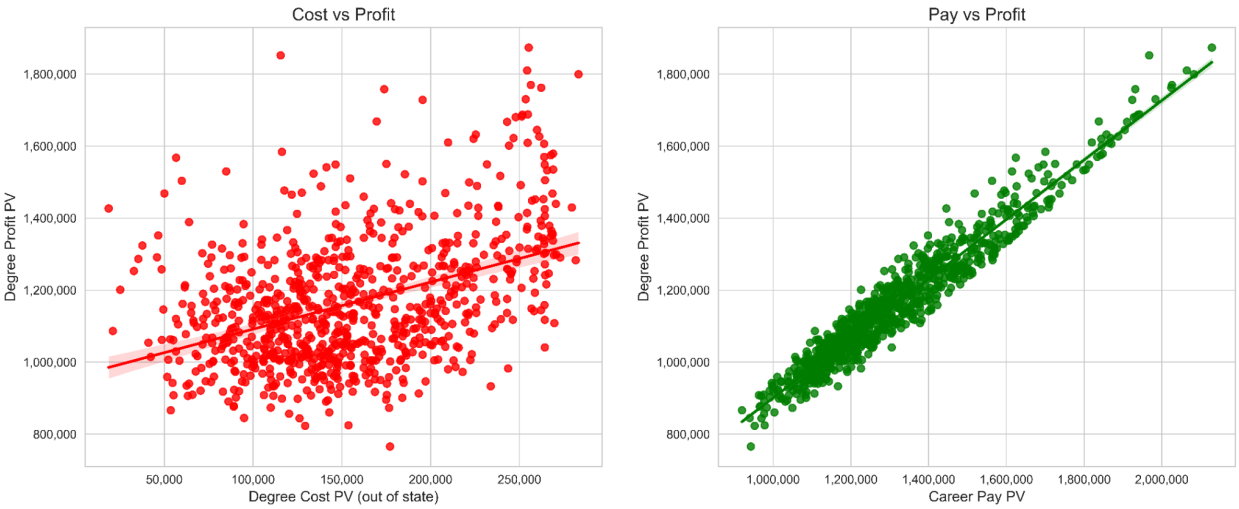
Note:

1. There are no negative values, which means all Degree Pay makes up for degree cost
2. The Top 10 noted before truly are outliers, with Degree Profits well above the $1.2 million average

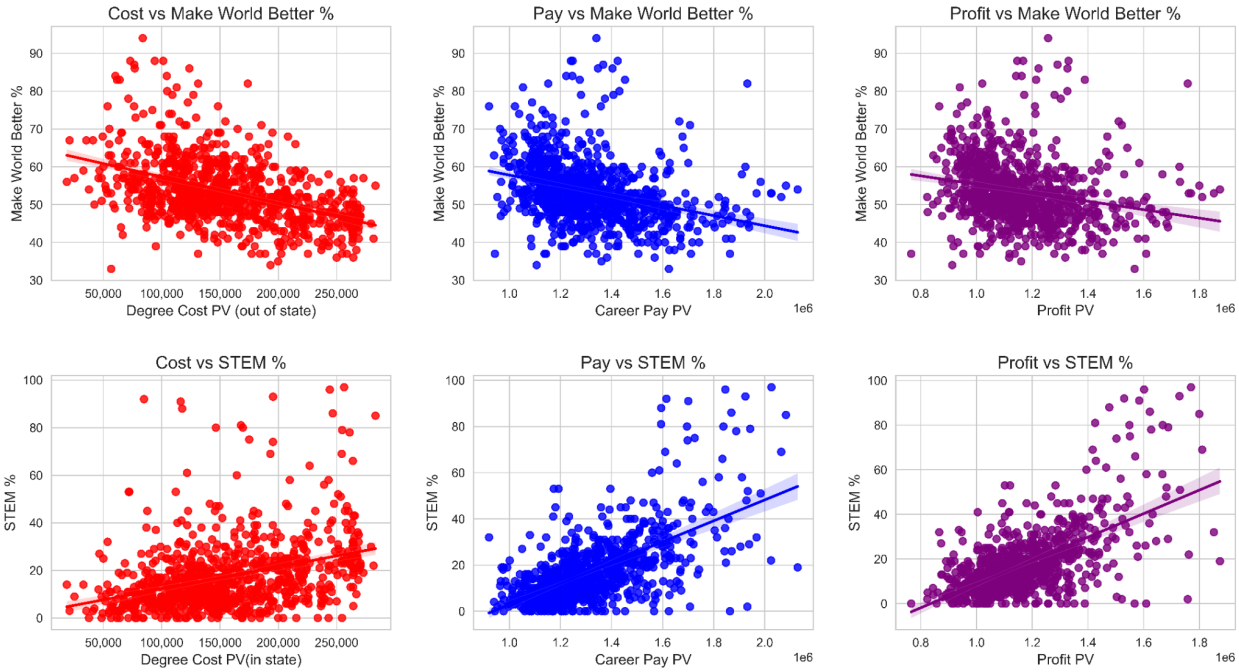


Correlations for Cost, Pay, and Profit

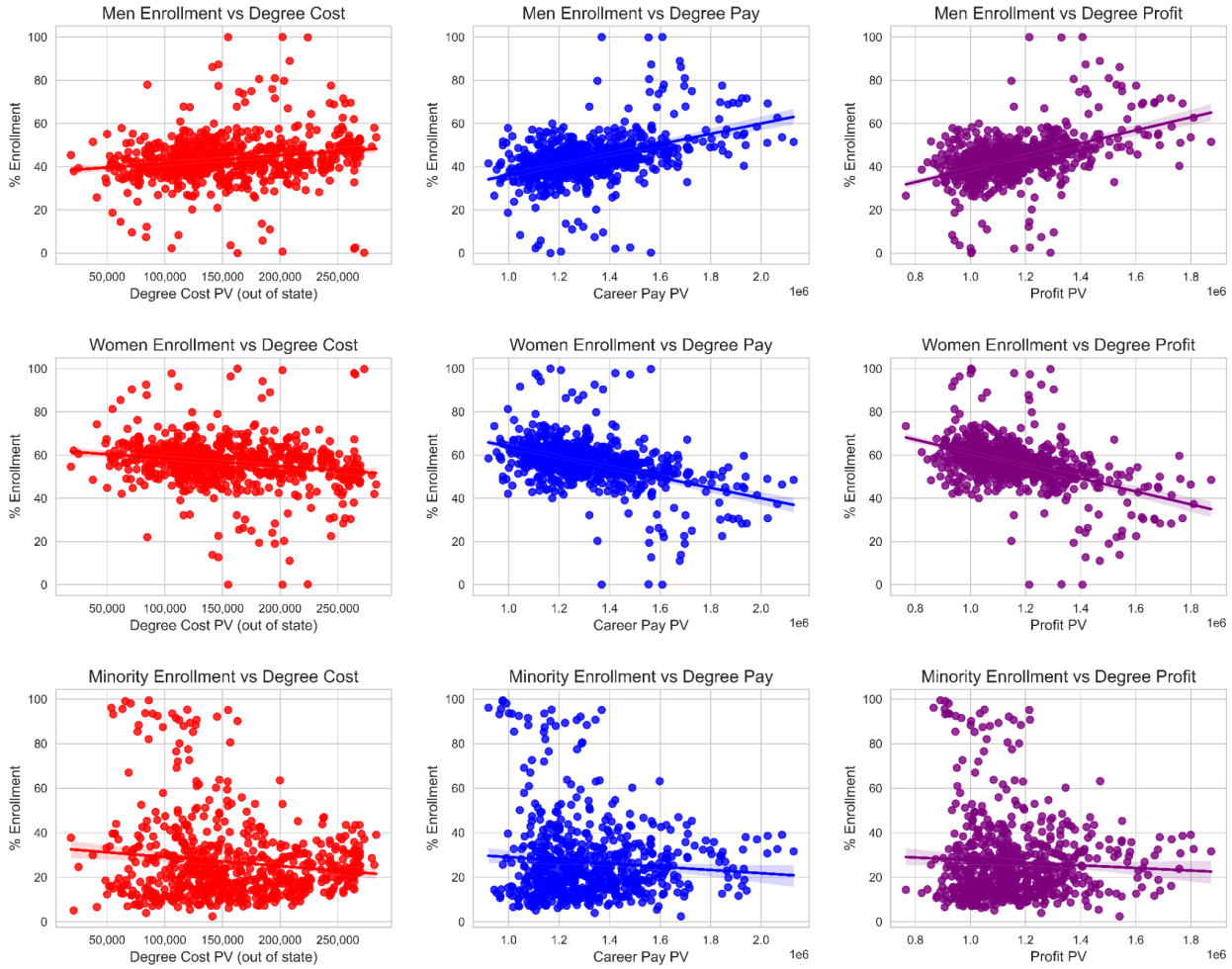
Both Degree Cost & Degree Pay have a positive correlation with Degree Profit. Despite college costs coming sooner and pay later, the 40+ years earning a salary have much more of an impact on Degree Profitability.



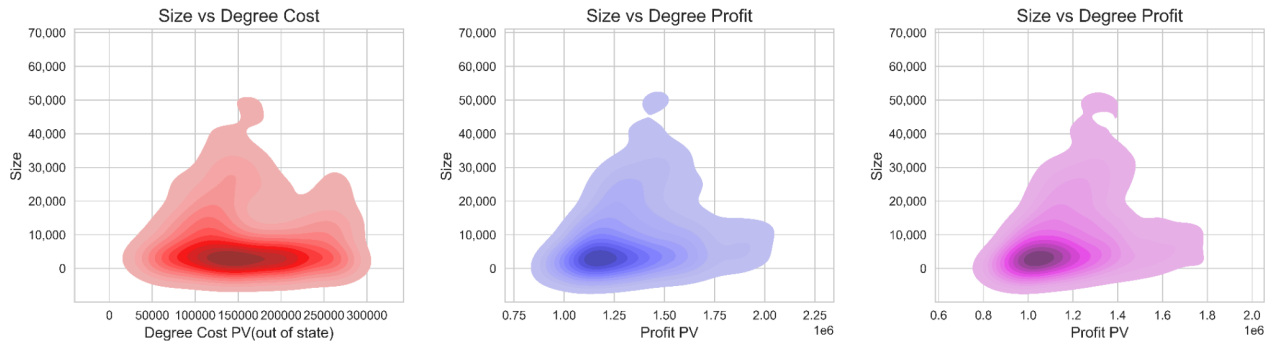
Make World Better% represents the percentage of graduates who feel they make the world a better place. It has a negative correlation with Degree Cost & Pay. In contrast, STEM% has a positive correlation with both.



Minority Enrollment has a neutral correlation with Degree Cost & Pay. Men & Women Enrollment shows both positive and negative correlations respectively. We can't interpret this to mean college is better for men than women though. More analysis by degree and career path would have to be done before drawing conclusions here.



College Size (in terms of total student enrollment) has a neutral correlation with Degree Cost but a positive correlation with Degree Pay. Possibly because larger schools are more well known and have larger networks.

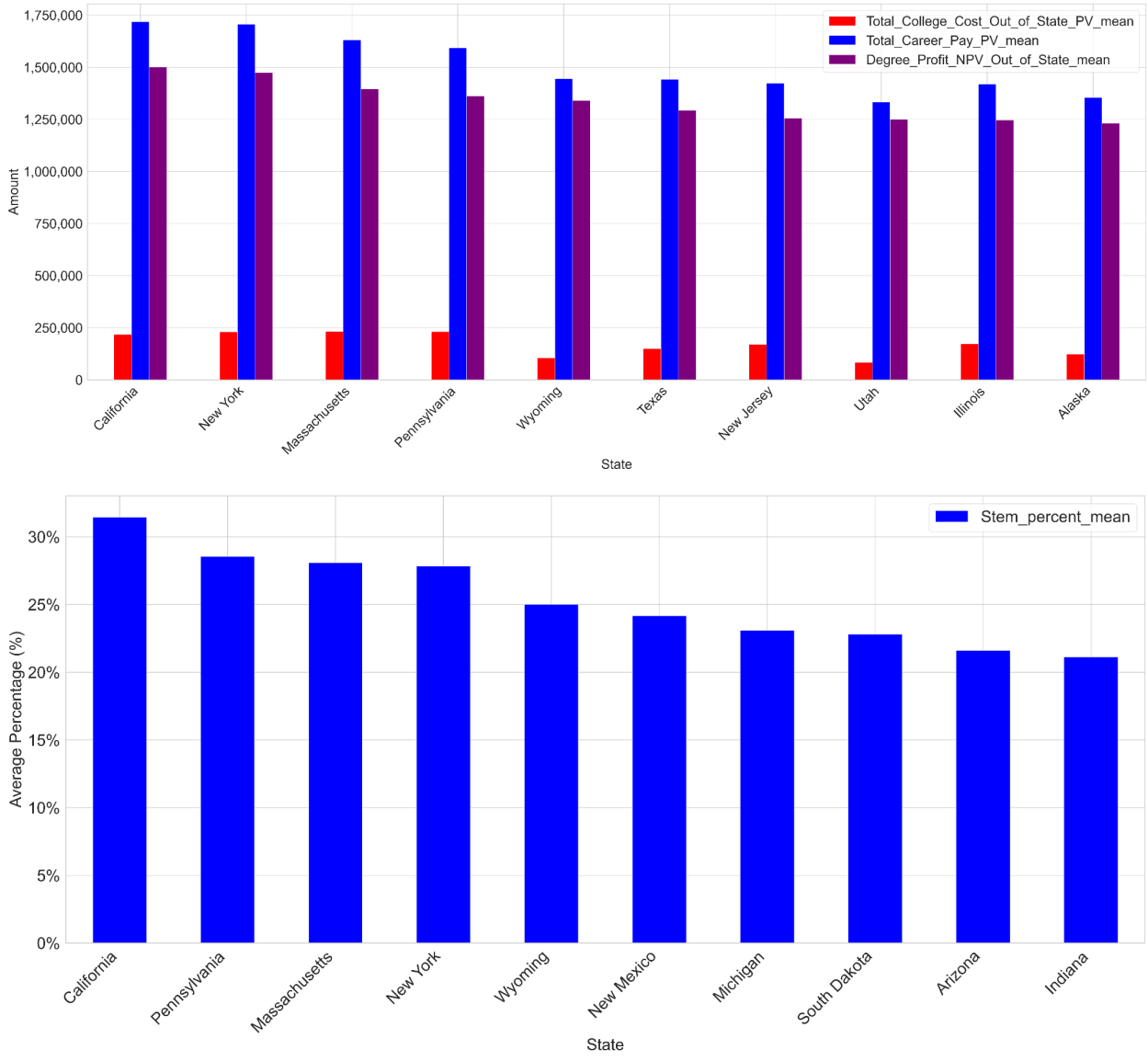


Analysis by State

Location is not only a factor in the value of real estate but in the value of a degree. As shown in the chart below.

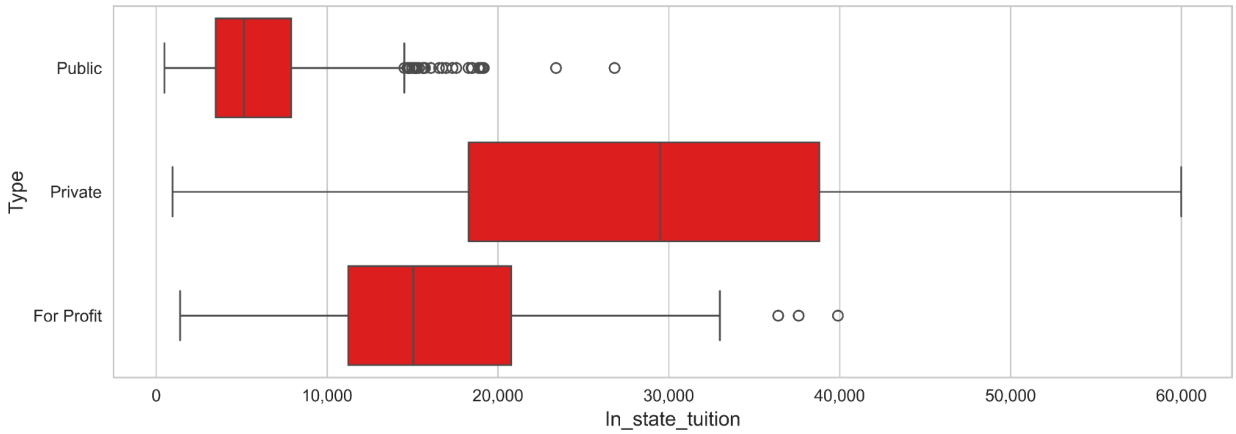
The highest paying and most profitable degrees for students are concentrated in CA, NY, MA, and PA.

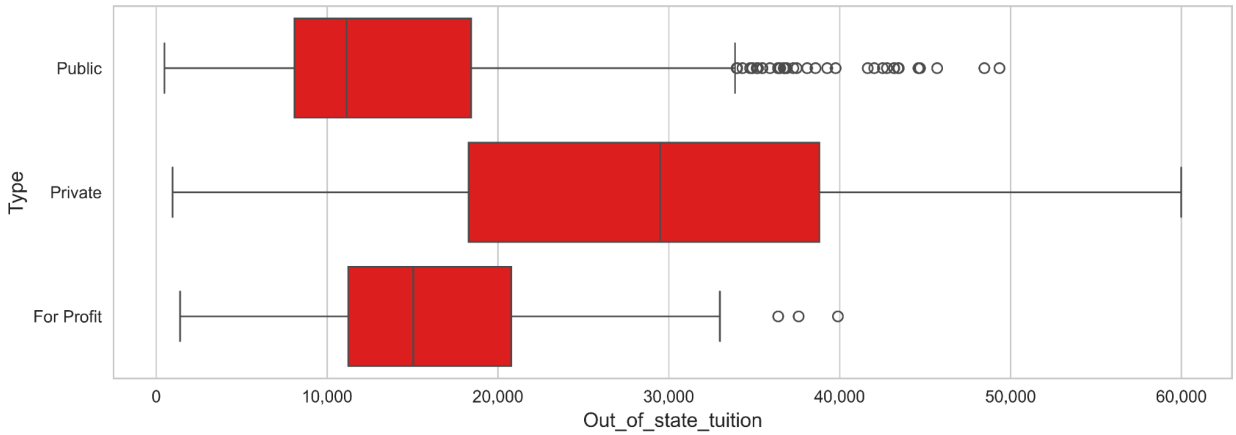
Degrees from these schools were more or less the most expensive, and had the highest percentage of STEM graduates.



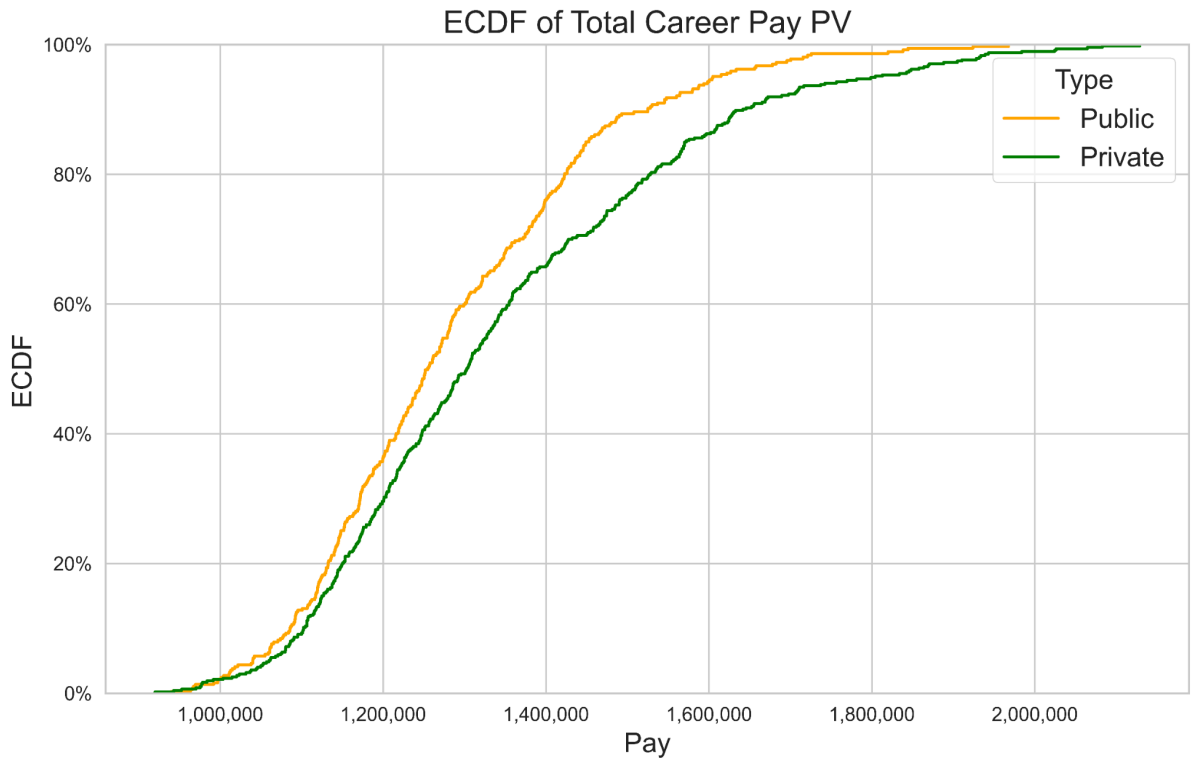
Analysis by Type (Public, Private, For-Profit)

Public tuition was well below both Private & For-Profit tuition, even when using Out of State rates. Surprisingly, For-Profit tuition was lower than Private tuition, though.





Unfortunately, there was no pay info for For-Profit schools, but we can see below that Private school degrees pay more than ones from Public schools. Nevertheless, the significantly lower Public tuition puts the average Public Degree Profitability higher than that of Private, even when using out of state rates.



Unfortunately, there were only four 2-year degrees with pay information, so an analysis by degree length could not be completed.

Conclusions

- All schools are at least somewhat lucrative for students, as average Career Pay exceeds College Cost for even the poorest performing schools.
- The Most Profitable schools for students:
    - Are Concentrated in CA, NY, MA, PA
    - Have the Highest Salary Potential, mostly regardless of cost
        - Though high Earnings to Cost ratio put SUNY Maritime at the top
    - Are the Most Expensive
        - Higher Tuition, Room & Board, High Cost of Living States
    - Have the Highest STEM%s and Lowest Make World Better %s
    - Are generally larger schools
- Public colleges are cheaper than For-Profit & Private schools, even when using out of state rates

Future Work

To truly assess whether college is worth it, we'd need to compare these results to those of non-college career paths. While also doing the same analysis by Degree, Career Path, and national School Rank. This same type of analysis can also be applied to international schools and Bootcamps, like NYC Data Science Academy's program for Data Science with Machine Learning (which I'm currently enrolled in)

Thanks for reading and I hope you got as much out of this as I did. My GitHub link is below if you'd like to review my work.

https://github.com/edwardweldon100/Python-Data-Analysis-Project