# Which Undergraduate Majors Make the Most Money?*

## Analysis of Returns to College Major

Diana Liu

February 13, 2024

This paper answers the question of which majors yield the highest returns in terms of income, analyzing data from students in the arts, sciences, business, and applied science disciplines. Through an examination of mean and median incomes and distributions across these categories, we identify applied science majors as yielding the highest returns, followed by business, arts, and science majors. Differences in mean incomes among majors can be partially explained by their preferred industries of employment. While business majors tend to gravitate towards higher-paying sectors such as finance, insurance, and real estate (FIRE), arts and science majors often find themselves in lower-paying industries like public administration and construction. Notably, applied science majors, despite preferring the construction industry, exhibit superior earnings, suggesting a capacity to secure high-paying positions within a traditionally lower-paying industry due to above average knowledge from relevant coursework.

## Table of contents

---

# 1 Introduction

The majority of college and university students cite higher income potential as one of the main reasons for choosing their degree. By knowing what degrees earn the most income, prospective students will be able to make better informed decisions about their choice of major, and plan their education around their financial goals. The return to a major is the increase in income that is the result of choosing the specific major, so the estimand is the return to majoring in either arts, business, sciences, or applied science.

This paper uses the same data set as "Will Studying Economics Make You Rich? A Regression Discontinuity Analysis of the Returns to College Major" (Bleemer and Mehta 2022) who found that economics majors had one of the highest returns. We want to use a similar line of reasoning to rank the categories of majors: arts, business, science, or applied science by highest to lowest returns.

In the results section we analyse the mean, median, and distribution of income and rank the majors from highest to lowest returns. Then examine whether or not the differences in mean income among majors can be explained by their preferred industry of employment. This is done through analyzing each major's preferred industry and the mean income of said industry, examining whether or not the mean income of the preferred industries coincide with the mean income of the major.

In the discussion section, we found that applied science majors had the highest returns with mean wage income of 59636 USD, followed by business 55104, arts 45699, and science 45427 (Table 4). Some of the returns can be explained by preferred industry. Business majors preferred the finance insurance and real-estate industry (FIRE) which is the highest paying

industry with a mean income of 57802 USD (Table 5). Arts and Science majors preferred the public administration, FIRE, and construction industries. Public administration and construction are the two lowest paying industries with mean income of 43075 45514 respectively, coinciding with the mean income of arts and science majors(Table 5)(Table 4). An explanation to why their preference for the FIRE industry did not increase mean income for arts and science majors is that they hold lower paying positions in the industry than business majors due to a lack of relevant coursework and knowledge. Applied science majors earn the highest mean income but prefer the construction industry which has low mean income. This is likely due to applied science majors holding high paying positions within a low paying industry as they have more knowledge and training from coursework than the average worker in the industry.

# 2 Data

The authors of the original paper took public student data from the University of California, Santa Cruz (UCSC) registrar for their analysis. This data set contains all newly admitted students between 1999 and 2014, for each student, the original publication observes many variables like race, SAT score, and GPA that this paper will not cover. These additional variables are removed during the data cleaning process leaving remaining variables of YEAR, DEGFIELD, INCWAGE, and INDNAICS. The original paper has already constructed and cleaned the data, additional cleaning of the data set. This paper was written using R (R Core Team 2022) and further analysis was performed with tidyverse (Wickham et al. 2019), gt (Richard Iannone 2024), shiny (Chang et al. 2024), ggplot2 (Wickham 2016), scales (Wickham, Pedersen, and Seidel 2023), psych (William Revelle 2024), dplyr (Wickham et al. 2023), vtable(Huntington-Klein 2023) and ggpubr (Kassambara 2023).

Similar data sets from other schools can be used to verify the results produced by UCSC data. Taking student data from schools in different regions of the US or from different countries can make the results more generalizable, this is discussed further in the weaknesses and next steps section.

## 2.1 Time Span

The cleaned data set contains student data from 2009 to 2017 with approximately 4000 observations each year except in 2011, 2012, and 2015 where the data is missing. There is a total of 24857 observations of student data that will be included in the analysis.

## 2.2 Major of Study

DEGFIELD is a 2 digit code that specifies the primary major of study each student is enrolled in. Using a spreadsheet of DEGFIELD codes and its corresponding major provided by IPUMS

USA[1], each code can be matched to the student's major. For example, the code 62 corresponds to the label "Business" seen in the first row of Table 3. This matching creates a new column called Label, referring to the name of the major the student studies.

The specific majors are placed into 4 categories: Arts, Sciences, Business, and Applied Science. Arts contains fine art and humanities majors like Philosophy and Religious Studies, Social Sciences, and History. Sciences contains majors like Agriculture, Mathematics, and Life Sciences. Applied science contains majors like Engineering. Finally, Business is its own category. There are a total of 10972 observations in Arts, 7693 in Business, 3362 in Applied Science and 2617 in Science (Table 1).

Table 1: Number of UCSC students in each category of majors from 2009 to 2017.

| Arts | Business | Applied Science | Sciences |
|-------|----------|-----------------|----------|
| 10972 | 7694 | 3362 | 2617 |

Note: Arts has the most students with over 10,000 enrolled followed by business with 7694 students, applied science with 3362 students, and sciences with 3362 students.

## 2.3 Wage Income

INCWAGE refers to the wage income that was reported by the students after graduation in USD. This variable was constructed by Bleemer and Mehta (2022) from the survey results of biannual UC Undergraduate Experience Survey (UCUES), conducted online in the spring of even-numbered years.

The estimand in Bleemer and Mehta (2022) as well as this paper is the wage income of former students. Wage income is defined as the income from the individual's primary employment, excluding investments, the sale of property, and additional jobs. Since the wage income is self reported, measurement error is difficult to determine and non response bias could affect the results. The possibility of non response bias from former students who did not respond to the survey being systematically different than those who did is explored further in the weaknesses and next steps section. In later analysis, wage income is truncated to between 0 and 200000 USD to prevent the mean and other calculations from being skewed by outliers.

From summary statistics, the lowest reported wage income was 106 USD and the highest was 690189, with a mean of 50472 and median of 43645 (Table 2). Median income according to US Census Data from around the same time period is approximately 37000 (Kayla Fontenot and Kollar 2018), supporting the claim that individuals who complete an undergraduate degree earn more on average than those who do not. In this paper, the wage income of students in each category is compared to determine which majors earn the most income on average.

---

[1]IPUMS USA collects public census data https://usa.ipums.org/usa-action/variables/DEGFIELD#description_section

Table 2: Summary statistics of wage income of all UCSC students from 2009 to 2017 rounded to the nearest dollar

| summary_stats | all_students |
|---|---:|
| Min | 106 |
| 1st Quartile | 28714 |
| Median | 43645 |
| Mean | 50472 |
| 3rd Quartile | 62625 |
| Max | 690190 |

Note: UCSC students who attained an undergraduate degree in any major had an average income of 50472 USD

## 2.4 Industry of Employment

The North American Industry Classification System (NAICS) is a system of numerical codes that correspond to specific industries, INDNAICS takes the first 2 digits of the NAICS code which refers to broader categories of industries(Table 3). For example, 111110 is the NAICS code for soybean farming, its first two digits 11 is the general industry of agriculture. Each observation in the data set of the code is mapped to its industry name, creating a new Industry column.

Industry was also self reported by former students in the same UCUES survey as wage income. There are 20 general industries, but students only reported Wholesale Trade, Utilities, Rental/Leasing, Public Administration, Manufacturing, Management Firms, Finance Insurance Real Estate (FIRE), and Construction. The analysis will focus on the most popular industries which are Public Administration, FIRE, and Construction as well as two less popular industries of Utilities and Wholesale Trade.

There are two components of industry that are analyzed in this paper. First, the most popular industries for each category of majors are determined, this establishes a relationship between the major an individual studies and the industry they choose to work in. For example, a business student would be more likely to work in FIRE than manufacturing. Then we calculate the median income of each industry to explain that the difference in the wage income of different majors stem from employment in more or less profitable industries.

Table 3: Sample of cleaned UCSC students' data

| YEAR | DEGFIELD | INCWAGE | INDNAICS | Industry | Label |
|---|---|---|---|---|---|

| 2009 | 62 | 37371 | 92 | Public Administration | Business |
| 2009 | 62 | 40874 | 52 | FIRE | Business |
| 2009 | 62 | 29196 | 52 | FIRE | Business |
| 2009 | 62 | 116783 | 23 | Construction | Business |
| 2009 | 53 | 40874 | 92 | Public Administration | Criminal Justice and Fire Protection |
| 2009 | 55 | 234 | 23 | Construction | Social Sciences |

# 3 Results

## 3.1 Analysis of Returns to Major

From Table 4, science majors have the lowest median income of 38619 USD, followed by arts majors 40125, business majors 46713, and applied science majors earned the most with 57428. The difference between the highest and lowest paying majors is 18809 USD, and the average difference between majors is 6270 USD, this is nearly the difference in income among those who have an undergraduate degree and those who do not of 6645(Kayla Fontenot and Kollar 2018).

This ranking is the same for mean income, with a smaller gap between wage income of different majors. For all four majors, the mean income is higher than the median. This indicates that the distributions are skewed to the right, which is confirmed by (Figure 1).

Table 4: Summary statistics of business, arts, sciences, and applied sciences majors' wage income

| summary_stats | Business_Majors | Arts_Majors | Science_Majors | Applied_Science_Majors |
|---|---|---|---|---|
| Min | 152 | 106 | 212 | 370 |
| 1st Quartile | 32160 | 25551 | 24524 | 36998 |
| Median | 46713 | 40215 | 38619 | 57428 |
| Mean | 55104 | 45699 | 45427 | 59636 |
| 3rd Quartile | 66432 | 56212 | 55032 | 74081 |
| Max | 690190 | 690190 | 690190 | 690190 |

Applied science majors have the highest mean income of 59636 USD, followed by business majors with 55104, then arts majors 45699, and science majors 45427.

By plotting wage income for all majors on separate histograms, we can see that wage income is normally distributed and skews right (Figure 1). For the histograms, max wage income is truncated to 200000 so that the main distribution curve can be zoomed in on. The bin width is 5000 USD as 40 bins per histogram is a size that is optimal for visualizing the distribution without the graph looking too busy. The Like the summary statistics the median for arts, sciences, and business majors are just under 50000 while for applied science majors it is over 50000 (Figure 1).
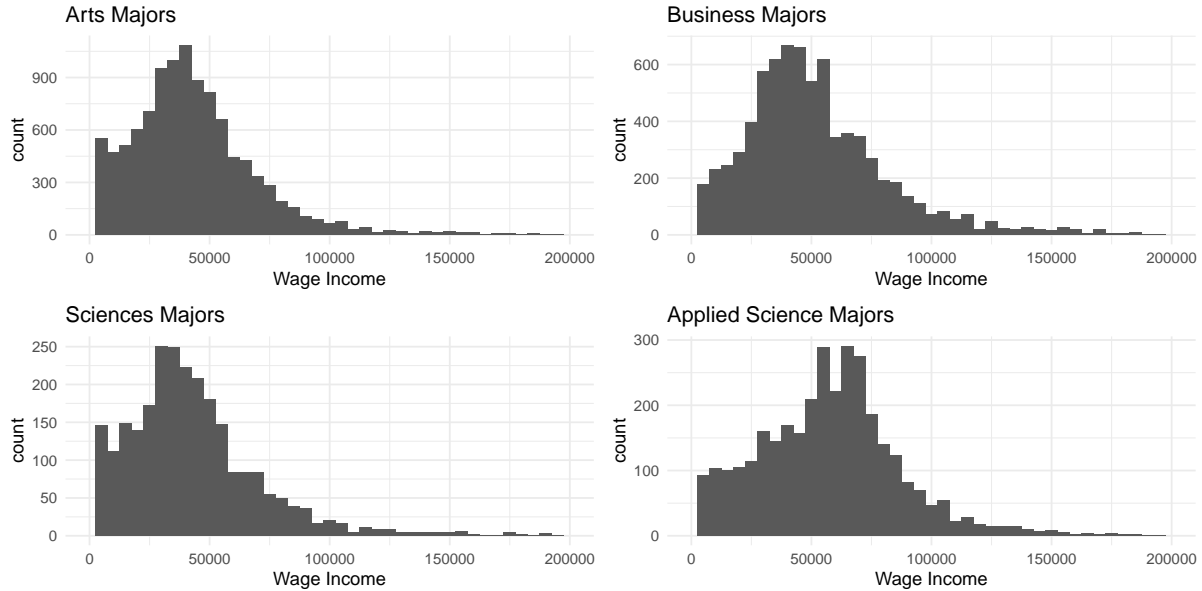


Figure 1: Distribution of wage income of former UCSC students grouped by business, arts, sciences, and applied sciences majors. We find that all four incomes are distributed normally with right skew. Applied science's peak of distribution is further to the right on the x-axis than the other three majors, which means they have the higher median income. Business majors' peak is further right than arts and sciences, so they have the next highest median. Arts and sciences majors both have peak distributions just under 50000 USD, making them the lowest earning majors. The majors can be ranked by median income as applied science, business, arts, sciences.

## 3.2 Analysis of Preferred Industry

For each major, student data about the individual's self-reported industry is plotted on a bar graph. Arts majors prefer to go into the public administration industry the most with nearly 5000 students going into the industry, followed by the finance insurance real-estate (FIRE) 4000, and construction 2000. Business majors unsurprisingly prefer FIRE with over 5000 students choosing it. Construction, public administration and management firms are far less popular, with under 1000 in each. Science majors prefer public administration, FIRE,

and construction almost equally with approximately 1000 students in each industry. Lastly, applied science majors prefer construction with 2000 students in the industry, followed by FIRE and public administration with less than 1000 students in each (Figure 2).

Popularity is measured by the number of students who choose each industry. FIRE, public administration, and construction are the most popular industries for all four majors with around 11000, 7500, and 6000 students respectively. Other industries that are unpopular like wholesale trade, utilities, and manufacturing have less than 300 students (Figure 2).
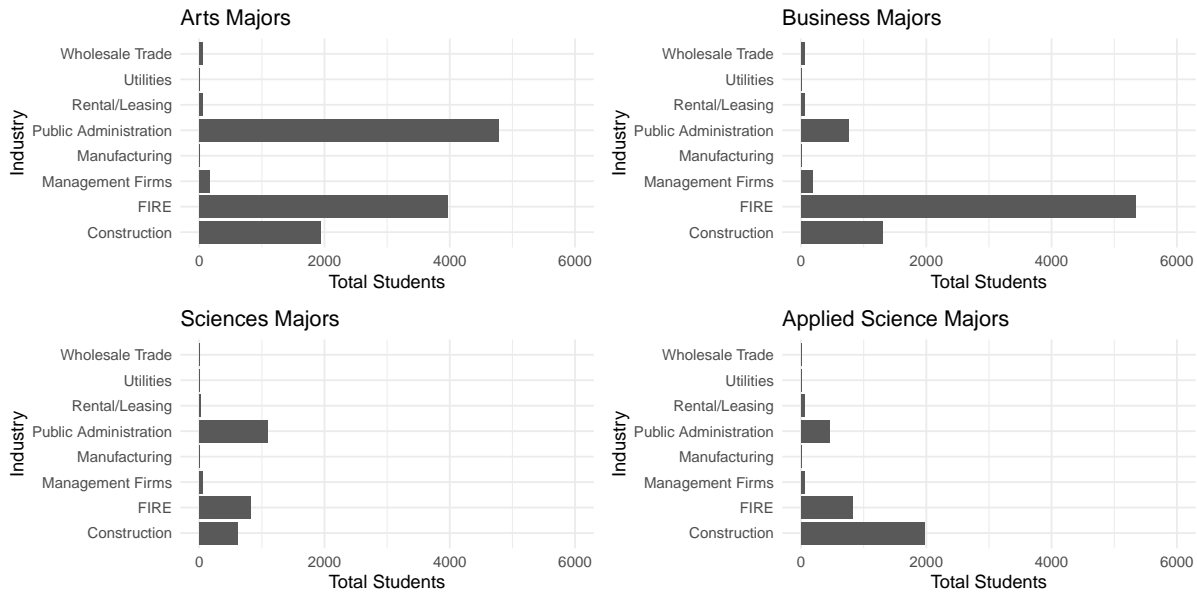


Figure 2: Count of how many students are in each industry of employment grouped by business, arts, sciences, and applied sciences majors. Figure shows that arts majors prefer public administration and FIRE almost equally with around 4000 students in each industry. Construction is their third preference with around 2000 students. Business majors disproportionately prefer FIRE with nearly 5000 students, their second and thrid preferred industries are public administration and construction with about 1000 students in each. Sciences majors prefer public administration, FIRE, and construction almost equally with about 1000 students in each industry. Finally, applied science majors prefer construction with about 2000 students, then FIRE with about 1000, and public administration with about 500.

## 3.3 Analysis of Industry Income

Now the popular industries of public administration, FIRE, and construction can be compared with less popular ones to determine if industry choice has an effect on income for each of the four majors. For this, the less popular industries of wholesale trade, rental/leasing, and

management firms are selected. Wage income in all industries are normally distributed and skews right (Figure 1).

Public administration and Construction both have a median income of around 41000 USD, with FIRE's median being slightly higher at 46565 (Figure 1) (Table 5). This lines up with median income information for arts and business students. Business students have a relatively higher wage income because their preferred industry, FIRE, has a higher median income. Applied science students on the other hand have the highest median wage income, but the construction industry' is slight's median is much lower, with a difference of $57427 - 42925 = 14502$USD. Science students also choose to go into the same industries of public administration, FIRE, and construction but have a lower median income than the median of any industry (Table 5)(Table 4).
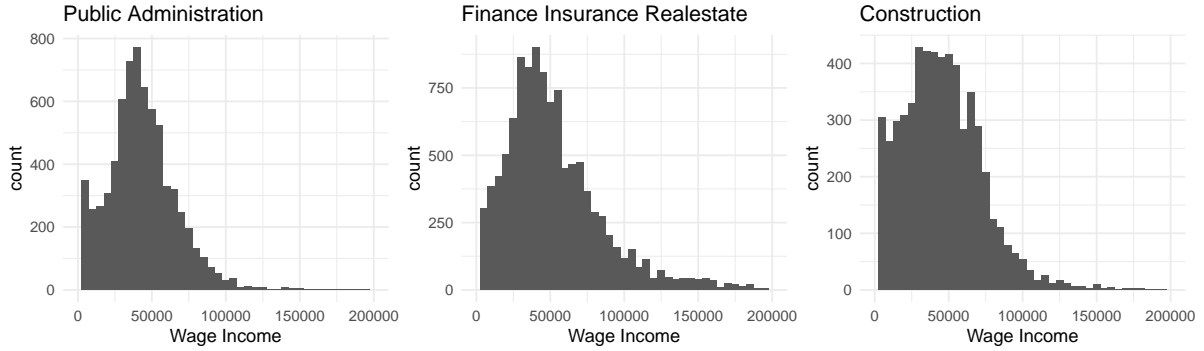


Figure 3: Distribution of wage income in the popular industries grouped by public administration, FIRE, and construction. FIRE's peak of distribution is the furthest along the x-axis, indicating higher median income. Construction's peak is just below 50000 USD followed by public administration with is further to the left. The three popular industries can be ranked in median income as FIRE, construction, and public administration.

Table 5: Summary statistics of public administration, FIRE, construction industries wage Income

| summary_stats | Public_Admin | FIRE | Construction |
|---|---|---|---|
| Min | 115 | 106 | 172 |
| 1st Quartile | 28574 | 30373 | 25268 |
| Median | 41274 | 46565 | 42925 |
| Mean | 43075 | 57802 | 45514 |
| 3rd Quartile | 56056 | 68913 | 62022 |
| Max | 627290 | 690190 | 473200 |

The FIRE industry has the highest mean income with 57802. Construction had the next highest income with 45514. Public administration has the lowest mean income of 43075. We can rank the popular industries from high-paying to low-paying: FIRE, construction, public administration

Observing the three unpopular industries, wholesale trade has a median around 30000 USD and management firms and rental/leasing have a median around 50000 (Figure 4). This allows the higher and lower paying industries to be distinguished, FIRE has a higher median and mean income followed by public administration and construction (Table 5).

## 4 Discussion

### 4.1 Which Undergraduate Majors Make the Most Money?

Summary statistics and histograms of wage income for the four different majors indicate that applied science majors earn the most money followed by business, arts, and sciences students. This ranking is largely consistent with the findings of Bleemer and Mehta (2022) with the exception of science students. Bleemer and Mehta (2022) found that both technology/information management students, an applied science major, and business management & economics, had the highest mean wage income of just over 60000 USD. Bleemer and Mehta (2022) also found that arts majors like psychology and sociology had average wage around 40000 USD which is also consistent with our analysis. However, a discrepancy are science majors. In Bleemer and Mehta (2022), mathematics majors had an average income of 50000 USD which differs by approximately 5000 USD from the mean income of 45427 USD from **?@tbl-major-summary-income**. This significant difference is likely due to the only math majors being analysed in Bleemer and Mehta (2022). Math majors only represent 7% of the data set and could have been an outlier earning significantly more income than the average sciences major.

With this we can rank the four majors by average income from highest to lowest: applied science, business, arts, science with income of 59636 USD, 55104, 45699, and 45427 respectively. Observing the percentage differences between each major's wage income, arts and sciences majors only have a 0.6% difference in their mean income. The two high income majors of applied science and business earn approximately 30% and 20% more than arts and science majors respectively. Generalizing these results, an applied science major can expect to earn 8.2% more than a business major, 30.5% more than an arts major, and 31.3% more than a sciences major. And a business major can expect to earn 20.6% more than an arts major and 21.3% more than a sciences major.

Average individual income is approximately 37000 USD in 2017 (Kayla Fontenot and Kollar 2018) and average income for an individual with a bachelor's degree in any major is 50472 (Table 2), there is a $(50472 - 37000)/37000 \approx 36.4\%$ income increase for completing an undergraduate degree. The difference between the highest and lowest income majors is 31.3% which

suggests that the choice of major has a similar amount of impact on income as the choice of pursuing an undergraduate degree or not.

$$Percent\ Difference$$
$$Applied\ Science\ and\ Business : (59636 - 55104)/55104 \approx 8.2\%$$
$$Applied\ Science\ and\ Arts : (59636 - 45699)/45699 \approx 30.5\%$$
$$Applied\ Science\ and\ Sciences : (59636 - 45427)/45427 \approx 31.3\%$$
$$Business\ and\ Arts : (55104 - 45699)/45699 \approx 20.6\%$$
$$Business\ and\ Science : (55104 - 45427)/45427 \approx 21.3\%$$
$$Arts\ and\ Science : (45699 - 45427)/45427 \approx 0.6\%$$

## 4.2 Is High Preferred Industry Income A Cause of High Income Majors?

In the analysis of preferred industries, public administration, FIRE, and construction were the most popular for all four majors. Business majors disproportionately preferred FIRE, about half of applied science majors preferred construction and the other half was split between public administration and FIRE. Arts majors preferred public administration and FIRE, and sciences students preferred all three popular industries almost equally. Then from plotting histograms of wage income in each of the three popular industries, it can be established that FIRE has the highest average wage income of 57802 USD followed by construction with 45514 and public administration with 43075.

These findings suggest that business majors are able to earn a higher income because they tend to pursue a career in the highest paying industry, FIRE. The mean income of business majors 55104 USD is quite close to the mean income of the FIRE industry of 57802. The slight difference could be due to that construction and public administration which have a lower mean income than FIRE are business majors' second and third preferred industries, thus lowering the overall average for the major.

Science majors prefer public administration, FIRE, and construction almost equally, and construction and public administration are the lowest paying industries, this is likely to be the reason why they have the lowest average income. Science majors' mean wage income is 45427 USD, which coincides with the mean income of the construction 45514 and public administration industries 43074. FIRE which has a substantially higher mean income than the other two industries would be expected to increase the mean for science majors, but this is not the case. One explanation could be due to science majors holding lower than average income roles in the FIRE industry. Science majors who pursue careers in the FIRE industry are likely to have less relevant training than business majors due to the different courses each major has to take to achieve their degree. Since science majors have less relevant course work and therefore knowledge in the FIRE industry, they are more likely to get below average income positions.

Arts majors earn less than some majors and more than others because they tend to pursue careers in public administration and construction which have relatively low average wages as well as FIRE. Their mean wage income of 45699 is slightly higher the mean wage income of the public administration 43074 and construction 45514 industries and well below that of the fire industry 57802. This could be due to the same reason as science majors earning less in the industry, a lack of relevant coursework and knowledge. Another explanation is that there are far more arts students prefer public administration and construction which lowers the mean income for the arts major compared to preferring public administration, construction, and FIRE industries equally.

For applied science majors who have the highest average income, the findings are inconsistent because construction, the second lowest paying, is their preferred industry. Since income in each industry is normally distributed and skews right, this could be due to applied science majors obtaining higher paying roles in the construction industry as engineers. This would allow them to make significantly more than the average worker in the construction industry. Since the mean income for applied science majors 59636 USD is well within the 3rd quartile of the construction industry income of 62022, this could be the reason why applied science majors earn more than their industry average.

## 4.3 Weaknesses and next steps

The biggest weakness of this analysis is that the data comes from one university UCSC. UCSC is a moderately selective public university where nearly all students attain a bachelors degree (Bleemer and Mehta 2022). So the possibility that their students' results are systematically different from all other students in the US and therefore cannot be generalized cannot be ruled out.

Another weakness is that wage income and industry of employment are self reported by students who participated in the UC Undergraduate Experience Survey, this means that non response error could affect the results of the analysis. Former students who answered the survey can be systematically different from those who did not in a variety of ways. For instance, students who make significantly less than average may feel embarrassed to report their income honestly. Data is also missing from 2011, 2012, and 2015 when the survey was not conducted, the missing data could have significant impacts on results like the mean wage income for different majors.

The findings of the analysis could be corroborated by similar analysis conducted for different universities in the US to see if the results can be applicable for selective and prestigious universities as well as community colleges.

## 5 Conclusion
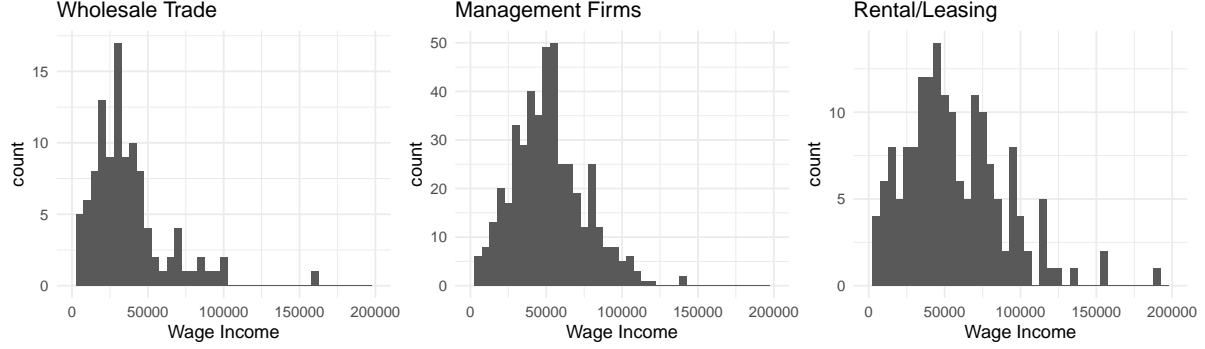
# Appendix

## A Additional Figures and Tables



Figure 4: Distribution of wage income in the unpopular industries grouped by wholesale trade, management rirms, and rental/leasing. Rental/leasing's peak of distribution is the furthest along the x-axis, indicating higher median income. Management firms's peak is just above 50000 USD followed by wholesale trade with is further to the left. The three popular industries can be ranked in median income as rental/leasing, management, and wholesale trade.

Table 6: Combined summary statistics of wage income grouped by industries of public administration, FIRE, construction, wholesale trade, rental/leasing, management firms.

| summary_stats | Public Admin | FIRE | Construction | Wholesale Trade | Rental/ Leasing | Management Firms |
|---|---|---|---|---|---|---|
| Min | 115 | 106 | 172 | 860 | 1044 | 491 |
| 1st Quartile | 28574 | 30373 | 25268 | 18371 | 33206 | 35771 |
| Median | 41274 | 46565 | 42925 | 30986 | 50100 | 51102 |
| Mean | 43075 | 57802 | 45514 | 46570 | 55952 | 52723 |
| 3rd Quartile | 56056 | 68913 | 62022 | 45991 | 76652 | 64506 |
| Max | 627290 | 690190 | 473200 | 571980 | 190490 | 434340 |

Note: With analysis of other less popular industries, all industries can be ranked relative to each other into high-paying, mid-range, and low-paying. FIRE and renting/leasing are the high-paying industries. Management firms and wholesale trade are mid-range, and construction and public administration are low-paying.

# References

Bleemer, Zachary, and Aashish Mehta. 2022. "Will Studying Economics Make You Rich? A Regression Discontinuity Analysis of the Returns to College Major." *American Economic Journal: Applied Economics* 4 (12): 1–22. https://doi.org/10.1257/app.20200447.

Chang, Winston, Joe Cheng, JJ Allaire, Carson Sievert, Barret Schloerke, Yihui Xie, Jeff Allen, Jonathan McPherson, Alan Dipert, and Barbara Borges. 2024. *Shiny: Web Application Framework for r*. https://shiny.posit.co/.

Huntington-Klein, Nick. 2023. *Vtable: Variable Table for Variable Documentation*. https://nickch-k.github.io/vtable/.

Kassambara, Alboukadel. 2023. *Ggpubr: 'Ggplot2' Based Publication Ready Plots*. https://rpkgs.datanovia.com/ggpubr/.

Kayla Fontenot, Jessica Semega, and Melissa Kollar. 2018. "Income and Poverty in the United States: 2017 Current Population Reports." *United States Census Bureau*. https://www.census.gov/content/dam/Census/library/publications/2018/demo/p60-263.pdf.

R Core Team. 2022. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

Richard Iannone, Barret Schloerke, Joe Cheng. 2024. *Gt: Easily Create Presentation-Ready Display Tables*. https://github.com/rstudio/gt.

Wickham, Hadley. 2016. *Ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. https://ggplot2.tidyverse.org.

Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D'Agostino McGowan, Romain François, Garrett Grolemund, et al. 2019. "Welcome to the tidyverse." *Journal of Open Source Software* 4 (43): 1686. https://doi.org/10.21105/joss.01686.

Wickham, Hadley, Romain François, Lionel Henry, Kirill Müller, and Davis Vaughan. 2023. *Dplyr: A Grammar of Data Manipulation*. https://dplyr.tidyverse.org.

Wickham, Hadley, Thomas Lin Pedersen, and Dana Seidel. 2023. *Scales: Scale Functions for Visualization*. https://scales.r-lib.org.

William Revelle. 2024. *Psych: Procedures for Psychological, Psychometric, and Personality Research*. Evanston, Illinois: Northwestern University. https://CRAN.R-project.org/package=psych.