California State University East Bay

STAT 650 Advanced R

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Unemployment in STEM

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Introduction

Does obtaining a STEM (Science, Technology, Engineering and Mathematics) degree truly ensure that you will obtain a lucrative career? While we know that all STEM degrees do not secure the same level of earnings, surely they are at least equal in employment opportunities. Unfortunately, this is not the case as we've observed.

Although government agencies and politicians have long espoused the importance of our youth pursuing careers in STEM, the availability of these careers does not always match the market demand of our ever growing workforce. Although entry into some STEM careers is possible with a HS diploma or associates degree, often a minimum of a 4-years bachelor degree is mandatory and for others, a graduate degree such as a masters or doctoral degree is necessary for entry into specific careers.

As projected, many STEM careers which require degrees do have faster than average employment growth, but this is not true across the board for all STEM careers requiring degrees. In those instances where the growth of the workforce outpaces that of the growth of employment opportunities, we end up with highly educated individuals who are either unemployed or underemployed.

Data Description

The data was obtained from the American Community Survey 2010-2012 Public Use Microdata Series and used in the fivethirtyeight story The Economic Guide To Picking A College Major. Our data dimensions are **173 rows** by **21 columns**. Below are our variables and their descriptions.

- `Rank`: Rank by median earnings
- `Major_code`: Major code, FO1DP in ACS PUMS
- `Major`: Major description
- `Major_category`: Category of major from Carnevale et al
- `Total`: Total number of people with major
- `Sample_size`: Sample size (unweighted) of full-time, year-round ONLY (used for earnings)
- `Men`: Male graduates
- `Women`: Female graduates
- `ShareWomen`: Women as share of Total
- `Employed`: Number employed (ESR == 1 or 2)
- `Full_time`: Employed 35 hours or more
- `Part_time`: Employed less than 35 hours
- `Full_time_year_round` | Employed at least 50 weeks (WKW == 1) and at least 35 hours (WKHP >= 35)
- `Unemployed`: Number unemployed (ESR == 3)
- `Unemployment_rate`: Unemployed / (Unemployed + Employed)

- `Median`: Median earnings of full-time, year-round workers
- `P25th`: 25th percentile of earnings
- `P75th`: 75th percentile of earnings
- `College_jobs`: Number with job requiring a college degree
- `Non_college_jobs`: Number with job not requiring a college degree
- `Low_wage_jobs`: Number in low-wage service jobs

Results

In *Table 1*, we list all 16 major categories and their average median salaries and workforce sizes arranged in descending order by unemployment rate. We highlight the STEM major categories: `Biology & Life Sciences` , `Computers and Mathematics`, `Engineering`, `Health`, and `Physical Sciences`. Below, we find that STEM major categories are in the top eight for Average Median Salary as well as in the bottom ten for Unemployment Rate for all major categories (see *Figure 1*).

Major Category	Workforce Sample Size	Unemployment Rate	Average Median Salary ($)
Engineering	**450189**	**0.0662322**	**57382.76**
Business	1168619	0.0683516	43538.46
Computers & Mathematics	**256267**	**0.0716948**	**42745.45**
Law & Public Policy	158285	0.0852576	42200.00
Physical Sciences	**147111**	**0.0535650**	**41890.00**
Social Science	444468	0.0966886	37344.44
Agriculture & Natural Resources	70767	0.0540365	36900.00
Health	**394360**	**0.0563267**	**36825.00**
Biology & Life Science	**325651**	**0.0701794**	**36421.43**
Industrial Arts & Consumer Services	200569	0.0574665	36342.86
Interdisciplinary	10570	0.0708609	35000.00
Communications & Journalism	357512	0.0751080	34500.00
Arts	316342	0.0892325	33062.50
Education	504808	0.0494624	32350.00
Humanities & Liberal Arts	595219	0.0858524	31913.33
Psychology & Social Work	413636	0.0804862	30100.00

Table 1: Average median salary ($), unemployment rate, and total workforce sample size data by major category.

In *Figure 1*, you see that the STEM major categories `Physical Sciences`, `Health`, and `Engineering` are below the average unemployment rate of 6.82% for all major categories with rates of 5.36%, 5.6.3%, and 6.62% respectively. The other STEM major categories are not too far off with unemployment rates of 7.02% and 7.17% for `Biology & Life Sciences` and `Computers & Mathematics`. For all major categories, the minimum unemployment rate was 4.95% for `Education` and the maximum was 9.67% for `Social Science`.

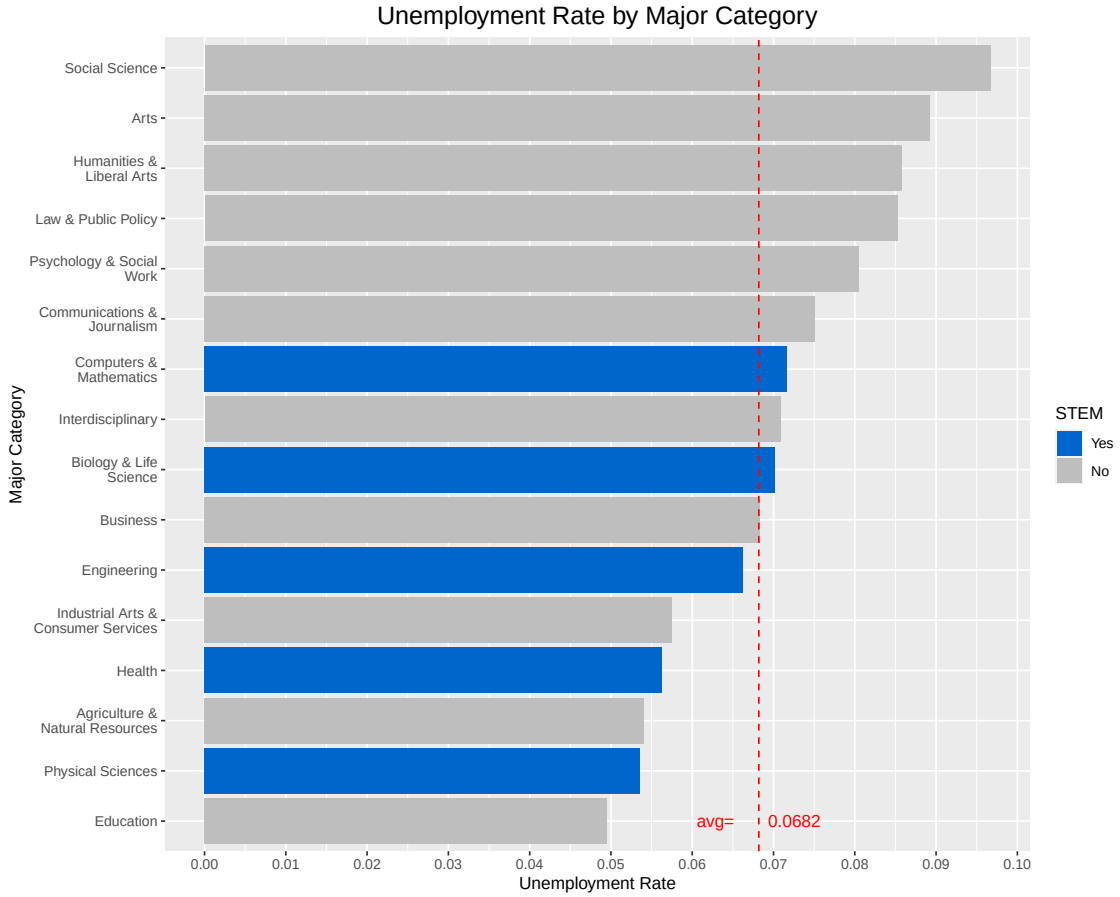

Figure 1: Unemployment rates by major category with STEM major categories highlighted in blue and the overall average unemployment rate represented by a red dotted vertical line.

In *Figure 2*, we visualize the summary statistics of individual majors within STEM major categories by their median salary with the bubble size reflective of the unemployment rate of each major. We again see that the physical sciences and health majors tend to have lower rates of unemployment but visually a fairly average median salary in comparison to other STEM major categories, with the exception of engineering majors which by in large have visually higher median salaries than all of the other STEM majors.

As expected, we see that computer and mathematics majors on the whole have higher unemployment rates than the majors in the other STEM major categories.

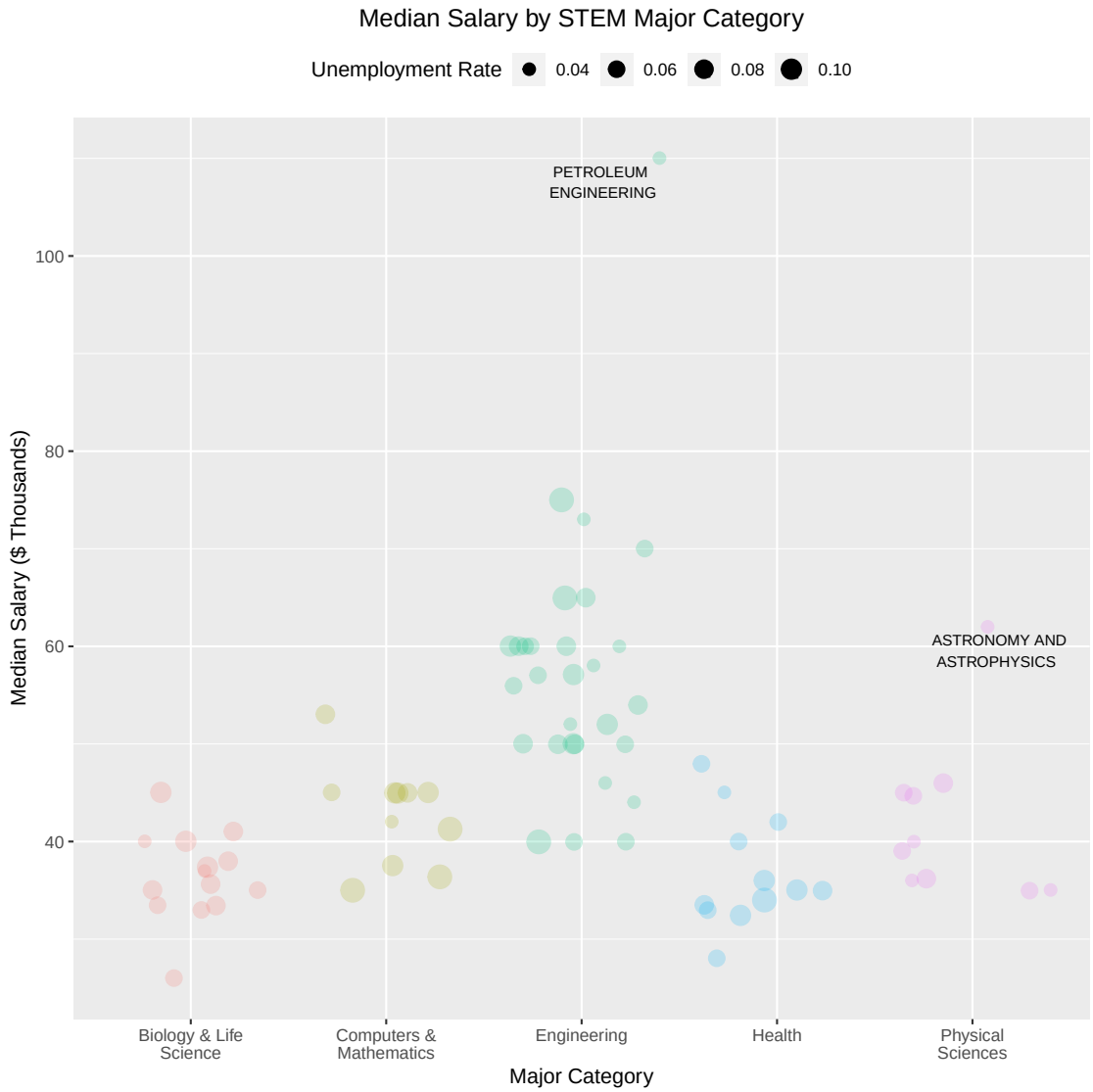

Figure 2: Jitterplot of median salary of STEM majors, divided by major categories and size reflective of unemployment rate.

Conclusion

In conclusion, we saw that the association between earnings and unemployment is indeed weak as evidenced by the relatively low earnings with the major category of health care yet lower than average unemployment rate in contrast to the higher earnings in the engineering major category yet higher than average unemployment. Also, we found that those earning degrees in STEM major categories of Computers & Mathematics, Biology & Life Sciences, and Engineering had a higher than average unemployment level across all STEM and non-STEM major categories.

Therefore, we cannot conclude that obtaining a degree in a STEM field is the magic bullet to ensuring lucrative employment; however, we suspect it may be due to the fact that the varying occupations requiring such degrees have differing levels of growth and employment levels. Ideally, potential workers will want to aim for fields with many job openings relative to their employment size, such as those pertaining to healthcare or computer-related careers. Other occupations (particularly, certain engineering or mathematics positions) may have small employment levels with lower than average expected growth.

Overall, many STEM careers do enjoy median incomes above the national average so they are still worth striving for compared to other non-STEM careers with high unemployment and lower median salary.

Bibliography

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Code Appendix

For supplementary R script, visit https://github.com/lgibson7/Unemployment-in-STEM