

Statistical Analysis of STEM Occupational Employment in US

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Abstract

In this study, the different STEM occupational employment number and salary data in United States is discussed and analyzed by using statistical techniques. We analyzed Bureau of Labor Statistics data from the years 2005 to 2015. Employment number trends and salary trends for each STEM occupation is discussed. Future STEM occupational employment numbers and salary is forecasted as well.

Introduction

There were nearly 8.6 million STEM jobs in May 2015, representing 6.2 percent of U.S. employment. Computer occupations made up nearly 45 percent of STEM employment, and engineers made up an additional 19 percent. Mathematical science occupations and architects, surveyors, and cartographers combined made up less than 4 percent of STEM employment. Salary for STEM occupations varied vastly. The national average salary for all STEM occupations was \$87,570, nearly double the national average salary for non-STEM occupations \$45,700. Ninety-three out of 100 STEM occupations had salary significantly above the national average salary for all occupations of \$48,320. Petroleum engineers was the highest paid STEM occupation, with an annual mean salary of \$149,590, over \$100,000 higher than the national average across all occupations. Physicists (\$118,500) was also among the highest paid STEM occupations. Employment in STEM occupations grew by 12.5 percent, or 957,260 jobs, between May 2005 and May 2015, compared with 5.6 percent net growth in non-STEM occupations. Computer occupations and engineers were among the types of STEM occupations with the highest job gains. Employment in computer occupations was nearly 2.9 million in May 2005 and nearly 3.9 million in May 2015. Employment of engineers was nearly 1.3 million in May 2005, compared with over 1.6 million in May 2015. The STEM group that is projected to grow fastest from 2015 to 2025 is the mathematical science occupations group at 28.2 percent, compared with the average projected growth for all occupations of 6.5 percent. This group includes occupations such as statisticians and mathematicians. Other STEM occupations will grow by 12.5 percent from 2015 to 2025. By 2025, the STEM occupations with the largest projected growth include architectural, engineering, and related services industry, each is projected to grow by at least 8 percent. The industry with the largest percent change in employment from 2015 to 2025 will be in computer systems design and related services, a nearly 41 percent positive change in employment. All data on STEM occupations was collected from the Bureau of Labor Statistics, Occupational Employment Statistics (OES), from the years 2005 and 2015. The number of employees of each STEM occupation and the salary data for each STEM occupation was collected. Linear regression model was used in this research to forecast the trend for five popular STEM occupation for the years 2025 and 2030.

Methodology

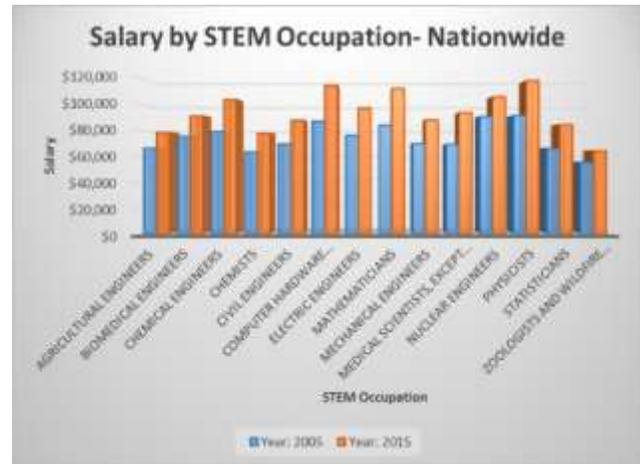
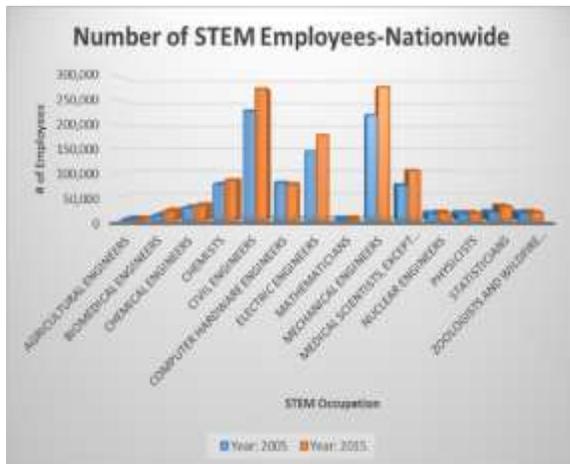
The objective of this study is to analyze the trend and forecast the number of employees and the salary of each occupation in Science, Technology, Engineering, and Mathematics (STEM) during the years of 2005 and 2015. A regression analysis is used to forecast future STEM occupational employment number and salary for the years 2025 and 2030. The linear regression equation is used to analyze and forecast for the years 2025 and 2030. The linear regression equation can be stated as:

$$y = \beta_0 + \beta_1x + \varepsilon, \text{ where}$$

y = dependent variable (# of Employment, Salary by Occupation),
 x = independent variable (Years), β_0, β_1 = Regression Coefficient, ε = Error

Results and Discussion

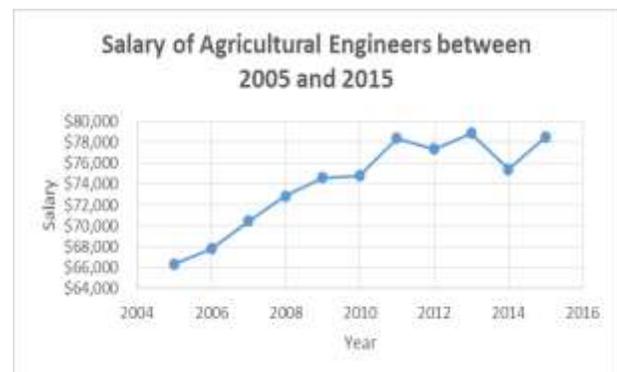
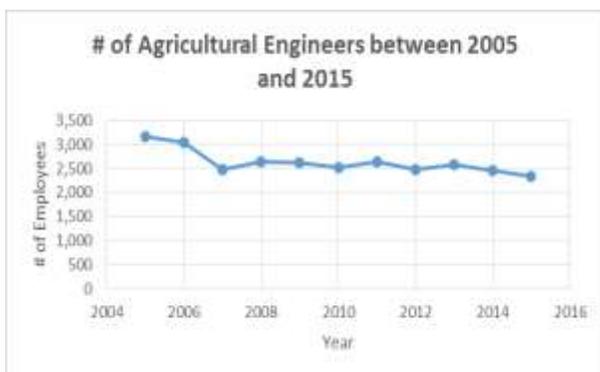
The data in this study was collected from the Bureau of Labor Statistics Data System on all STEM occupations for the number of employees and salary by occupation.



From the above graph we can see that the number of STEM Employees of Civil and Mechanical Engineers had the highest employment numbers during the years 2005 with 229,700 nationwide employment for Civil Engineers and 220,750 nationwide employment for Mechanical Engineers. In 2015, Civil and Mechanical Engineers continued to have the highest number of employment with Civil Engineers having 275,210 employment in its field and Mechanical Engineers being the highest having 278,640. Mathematicians had the lowest employment number in both 2005 and 2015 with the average summary of 2,930 in 2005 and 3,170 in 2015. From the graph on the salary by STEM Occupation we can see that, in 2005 Physicists had an average salary of \$91,480 and Nuclear Engineers had an average \$90,690 which places the two occupations with the highest average salary nationwide for that year. Zoologist and Wildlife Biologists had the lowest salary for 2005 with \$55,280 as the average salary. In 2015, Physicists remained the highest nationwide salary having \$118,500 with Computer Hardware Engineers following behind with \$114,970. The lowest nationwide salary in 2015 was again Zoologists and Wildlife Biologists having \$64,230 as its average salary.

The statistical analysis on employment number and salary trends of five specific occupations: Agricultural Engineers, Civil Engineers, Electrical Engineers, Mathematicians and Mechanical Engineers are given below:

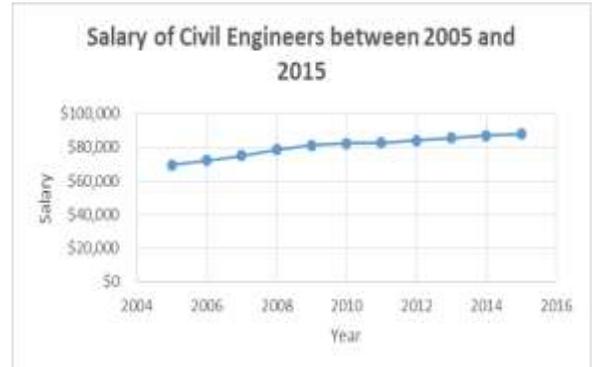
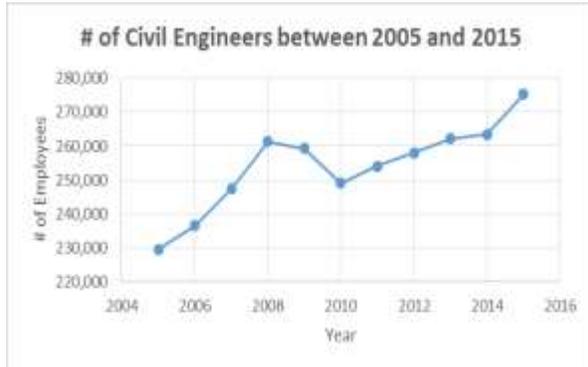
Agricultural Engineers:



From the above graph we can see that Agricultural Engineers has the maximum number of employment was in the year of 2005 with 3,170 employees then it slightly decreased and the minimum employment number was in 2015 with 2,330 employees.

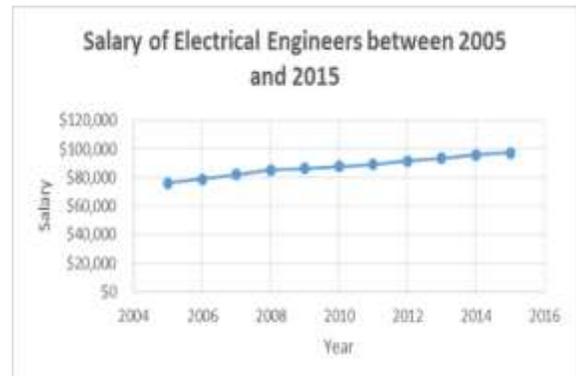
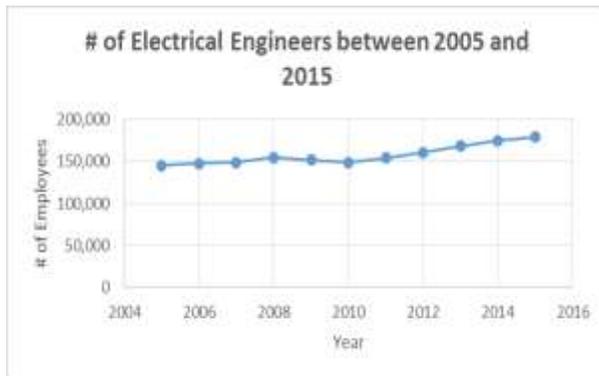
From the graph we can see that the salary of Agricultural Engineers had its lowest salary in 2005 with the average of \$66,370 and it increased significantly and the highest salary is in 2013 with \$78,880 on average.

Civil Engineers:



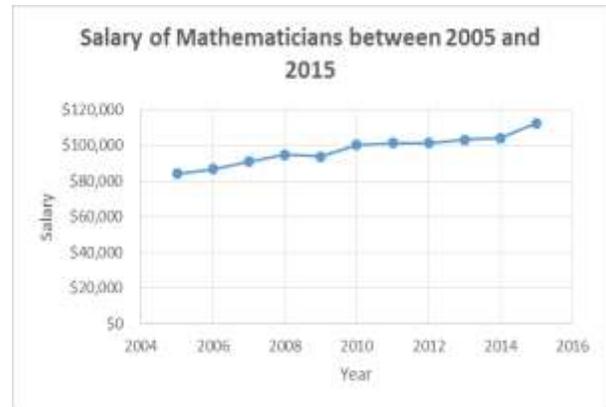
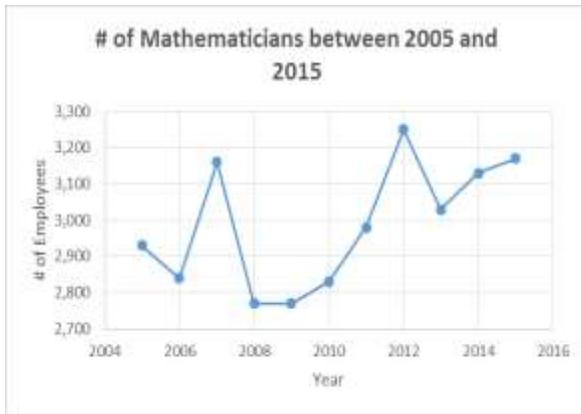
From the above graph we can see that Civil Engineers has the minimum number of employment was in the year of 2005 with 229,700 employees then it significantly increased and the maximum employment number was in 2015 with 275,210 employees. From the graph we can see that the salary of Civil Engineers had its lowest salary in 2005 with the average of \$69,480 and it increased significantly and the highest salary is in 2015 with \$87,940 on average.

Electrical Engineers:



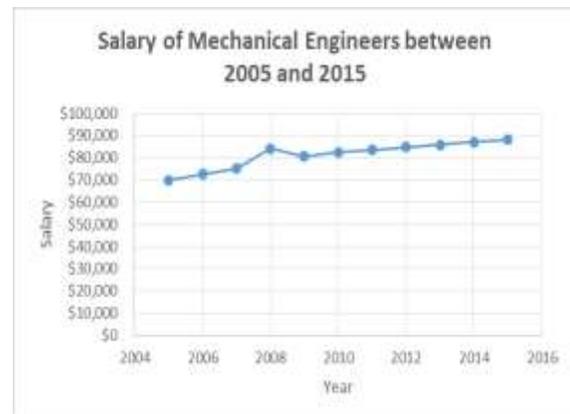
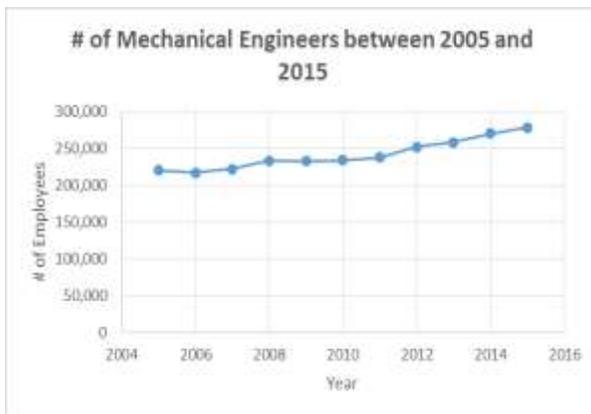
From the above graph we can see that Electrical Engineers has the minimum number of employment was in the year of 2005 with 114,920 employees then it significantly increased and the maximum employment number was in 2015 with 178,580 employees. From the graph we can see that the salary of Electrical Engineers had its lowest salary in 2005 with the average of \$76,060 and it increased significantly and the highest salary is in 2015 with \$97,340 on average.

Mathematicians:



From the above graph we can see that Mathematicians had a drastic employment decrease in 2006 and 2008, this occupation was able to reach its highest employment number with 3,250 in 2012. From the graph we can see that the salary of Mathematicians had its lowest salary in 2005 with the average of \$84,180 and it increased significantly and the highest salary is in 2015 with \$112,560 on average.

Mechanical Engineers:



From the above graph we can see that Mechanical Engineers has the minimum number of employment was in the year of 2005 with 220,750 employees then it significantly increased and the maximum employment number was in 2015 with 278,640 employees. From the graph we can see that the salary of Mechanical Engineers had its lowest salary in 2005 with the average of \$70,000 and it increased significantly and the highest salary is in 2015 with \$88,190 on average.

Regression Models and Forecast

After analyzing the number of employees and the salary of each of the five occupations from 2005 to 2015, the prediction of each occupation are forecasted for the years 2025 and 2030 using the linear regression equation, $y = \beta_0 + \beta_1x + \epsilon$. A regression model is depicted for each occupation for the number of employees and its linear trend as well as the salary by occupation along with its results for the predicted years.

Number of Employees in different STEM occupations

- Agricultural Engineers: $\hat{y} = 122868.2 - 59.8182\hat{x}$
- Civil Engineers: $\hat{y} = -6457699 + 3339.273\hat{x}$
- Electrical Engineers: $\hat{y} = -6203051 + 3164.455\hat{x}$
- Mathematicians: $\hat{y} = -54389.1 + 54545\hat{x}$
- Mechanical Engineers: $\hat{y} = 1972 + 0.000155\hat{x}$

Number of Employees		
STEM Occupation	2025	2030
Agricultural Engineers	1,736	1,437
Civil Engineers	304,329	321,025
Electrical Engineers	204,970	220,792
Mathematicians	3,415	3,558
Mechanical Engineers	1,973	1,973

Salary in different STEM occupations:

- Agricultural Engineers: $\hat{y} = -2286335 + 1174.364\hat{x}$
- Civil Engineers: $\hat{y} = -3505623 + 1784.182\hat{x}$
- Electrical Engineers: $\hat{y} = -3999248 + 2033.273\hat{x}$
- Mathematician: $\hat{y} = -4824319 + 2448.727\hat{x}$
- Mechanical Engineers: $\hat{y} = -3311923 + 1688.182\hat{x}$

Salary by Occupation		
STEM Occupation	2025	2030
Agricultural Engineers	\$91,752.10	\$97,623.92
Civil Engineers	\$107,345.55	\$116,266.46
Electrical Engineers	\$118,129.83	\$128,296.19
Mathematicians	\$134,353.18	\$146,596.81
Mechanical Engineers	\$106,645.55	\$115,086.46

Conclusion

From the analysis we found that employment numbers of most of the STEM occupation is increasing but the employment numbers of few of the STEM occupation is decreasing from 2005 to 2015. The salary of all STEM occupation increased significantly from 2005 to 2015. The number of Agricultural Engineers have decreased but the salary of Agricultural Engineers increased significantly from 2005 to 2015. The forecasted the number of Agricultural Engineers in 2025 and 2030 is 1,736 and 1,437. The forecasted salary for Agricultural Engineers in 2025 and 2030 is \$91,752.10 and \$97,623.92. The number of Civil Engineers have increased and the salary of Civil Engineers increased significantly from 2005 to 2015. The forecasted the number of Civil Engineers in 2025 and 2030 is 304,329 and 321,025. The forecasted salary for Civil Engineers in 2025 and 2030 is \$107,345.55 and \$116,266.46. The number of Electrical Engineers have increased and the salary of Electrical Engineers increased significantly from 2005 to 2015. The forecasted the number of Electrical Engineers in 2025 and 2030 is 204,970 and 220,792. The forecasted salary for Electrical Engineers in 2025 and 2030 is \$118,129.83 and \$128,296.19. The number of Mechanical Engineers have increased and the salary of Mechanical Engineers increased significantly from 2005 to 2015. The forecasted the number of Mechanical Engineers in 2025 and 2030 is 1,973 and 1,973. The forecasted salary for Mechanical Engineers in 2025 and 2030 is \$106,645.55 and \$115,086.46. The number of Mathematicians have increased and the salary of Mathematicians increased significantly from 2005 to 2015. The forecasted the number of Mathematicians in 2025 and 2030 is 3,415 and 3,558. The forecasted salary for Mathematicians in 2025 and 2030 is \$134,353.18 and \$146,596.81.

References

- Bureau of Labor Statistics. Retrieved from <https://www.bls.gov/oes/tables.htm>
- Sweeney, S. H. (2004), Regional Occupational Employment Projections: Modeling Supply Constraints in the Direct-Requirements Approach*. *Journal of Regional Science*, 44: 263–288.
- Triola, Mario (2007) *Elementary Statistics*, Pearson, 10th edition.
- William M. Mendenhall, Terry L. Sincich (2015) *Statistics for Engineering and the Sciences*, Sixth Edition, Taylor& Francis.