A Data-Driven Look at Tech Compensation in the US During COVID-19:

Amazon, Microsoft, and Google

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Introduction

In this paper, we present a comprehensive analysis of tech compensation trends in the United States during the COVID-19 pandemic, focusing on industry giants Amazon, Microsoft, and Google. This project represents the culmination of our DTSC 2302 course, enabling us to apply our knowledge in Python, data science methodologies, and data ethics to conduct a meaningful investigation.

Our research dives into the impact of the pandemic on compensation for tech positions at these companies in comparison to pre-pandemic salaries. We analyzed a dataset with information on yearly compensation, job titles, and years of experience, and cleaned the data to make sure it was accurate. We also considered how the pandemic affected tech compensation overall.

We hypothesize that the total yearly compensation for tech jobs increased during and after the pandemic, with a higher growth rate compared to previous years. This was driven by demand for tech talent due to remote work and digital innovation. Our paper discusses our research methods and findings, using statistics, regression models, and visualizations, and concludes with key findings and suggestions for future research.

Our research aligns with findings from Sendall et al. (2022) regarding the impact of the pandemic on IT professionals' salaries. "According to the Tech Salary report by Dice.com (2021), overall technologist salaries in the US increased by 3.6% between 2019 and 2020, averaging $97,859. The report indicated that the fastest growing salaries in tech were in the areas of cybersecurity, data scientist, DevOps Engineer, Tech Support Engineer, and Cloud Engineer" (Sendall, Peslak, Ceccucci, & Hunsinger, 2022). This suggests a positive trend in tech compensation even during the pandemic.

Our central research question asks: How did the yearly compensation for tech jobs at Amazon, Microsoft, and Google in the US change during the COVID-19 pandemic compared to the years before?

Context and Implications

After the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic in March 2020, various industries faced significant disruptions. Sectors reliant on in-person interactions saw declines due to social distancing measures and the contagious nature of the disease (Zeng, Chen, & Lew, 2020, p. 725). Tech industry employees also felt the impact, with layoffs occurring, particularly in companies reliant on pre-COVID spending habits (Di, 2021). Job postings across industries plummeted from March to November 2020, reflecting the pandemic's widespread effects (Sendall et al., 2022).

Despite the economic downturn, technological innovation thrived during the pandemic, proving essential across various sectors like healthcare and delivery services. Remote work options in IT and technology allowed professionals to retain their jobs and created new opportunities amid the crisis (Gsuri & Thakkar, 2022, p. 56). Salaries in technology, particularly in cybersecurity, engineering, and data science, exhibited positive growth trends (Sendall et al., 2022). Understanding this context is crucial as we examine salary trends among major technology companies, each impacted differently by the pandemic based on their products and services.

Our research paper impacts a variety of stakeholders close to the technology industry that were affected by the COVID-19 pandemic. One of the primary stakeholders in this research is tech employees, who were undoubtedly impacted by the pandemic. They would likely benefit in understanding how their income, salary and benefits may have been impacted by the pandemic. This could help them evaluate and compare to how stable their jobs are at their current company versus others. Those who experience lower income as a result of the pandemic would experience harm as their financial stability would be at risk.

Among the primary stakeholders are tech giants like Amazon, Microsoft, and Google, the focus of our research. These companies stand to benefit from analyzing competitor salaries to attract top talent. However, if their pay is perceived as unethically low, it could harm their reputation among employees and investors. Lastly, investors in tech companies hold interest in understanding if compensation to employees in their companies of interest are maximizing or hurting profits. Conflicting interests may arise between tech companies and investors, who prioritize profit over stable compensation for tech employees.

Our project has the potential to contribute positively to various stakeholders and promote ethical practices. Our research takes into account the ethical standards of fairness, transparency, and privacy. In an effort to encourage transparency, all data used in this project is available for review and all sources are from peer reviewed journals, creating trust among those who are impacted by this research. This will hopefully push companies to be transparent about how they decide and community compensation for their employees. Lastly, we ensure that employee data used in this analysis does not contain sensitive information that can reveal the identity of the employee.

Overall, our research will allow stakeholders to make informed decisions, take accountability and encourage them to prioritize employee well being. By bringing to light compensation trends across several top tech companies, employees will be able to compare their salaries for similar roles and decide whether their pay is equitable and fair. Tech companies may use our research to understand the importance of supporting employees through financial challenges and implement resources accordingly.

Measurement

The dataset we are using holds information collected from a survey administered to a sample of workers employed with tech-related positions from a diverse set of companies and locations. In this study we will be specifically looking at three of those companies which are Amazon, Microsoft, and Google. Our goal is to measure the change in yearly compensation among tech company employees from the years before COVID-19 to the years during which were affected by the worldwide pandemic.

In this context, yearly compensation refers to the total amount of money that an individual received in the given year from one of the three companies, including bonuses. We will take the average yearly compensation for the years 2018 to 2019, representing the period before the pandemic's effects, and compare it to the average from the years 2020 to 2021, representing the period affected by the pandemic.

To answer our question, we are analyzing the data for any change in these yearly compensation averages. This means we are looking to see if there is any significant difference between these numbers. To accomplish this we have chosen to use linear regression and visualizations because of their ability to model the relationship between the two time periods, providing the needed insight to analyze the changes in the average yearly compensation.

Data

The data was cleaned and filtered to ensure accuracy and eliminate inconsistencies within the dataset. The data was reformatted from timestamp to year format. Then the data was aggregated in order to measure the change in total yearly compensation across three companies: Microsoft, Google, and Amazon and across two different time periods: pre-pandemic years (2018-2019) and pandemic years (2020-2021). We conducted a Random Forest Regressor model

on the data. The Mean Squared Error for the Random Forest Regressor is 10245910740.42606 and the R-squared statistic is 0.2744555325282706.

We created visualizations based on the data obtained from SQL queries to better understand the compensation trends. One of the visualizations we generated is a bar chart comparing the distribution of yearly compensation for different positions across the three companies during the pre-pandemic and pandemic periods.

Figure #1

Figure #2
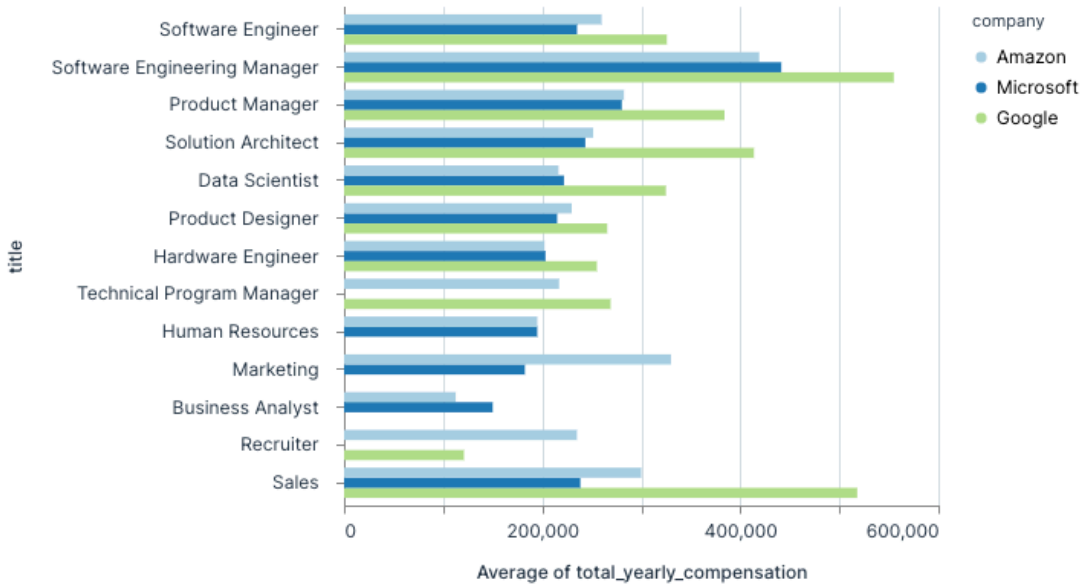
In comparing the pre-pandemic (Figure #1) and pandemic (Figure #2) compensation levels, several key observations emerge. Firstly, Software Engineering Managers received the highest yearly compensation across all three companies during both time periods. For many technical roles like Software Engineers, Product Managers, and Data Scientists, compensation levels increased during the pandemic compared to pre-pandemic levels.

The difference between the highest-paying company and the others widened for certain roles like Software Engineers and Product Managers during the pandemic. Non-technical roles such as Sales, Marketing, Human Resources, and Business Analysts generally displayed lower compensation levels, consistent with pre-pandemic patterns. The pandemic data introduced some new roles like Recruiters and Management Consultants, likely indicating heightened demand for these positions.

Overall, the data suggests that tech companies responded to the pandemic by rewarding their technical talent with higher compensation, possibly due to increased demand for digital transformation. These compensation increases appear more pronounced for certain high-demand roles and at specific companies across the two time periods.

Figure #3

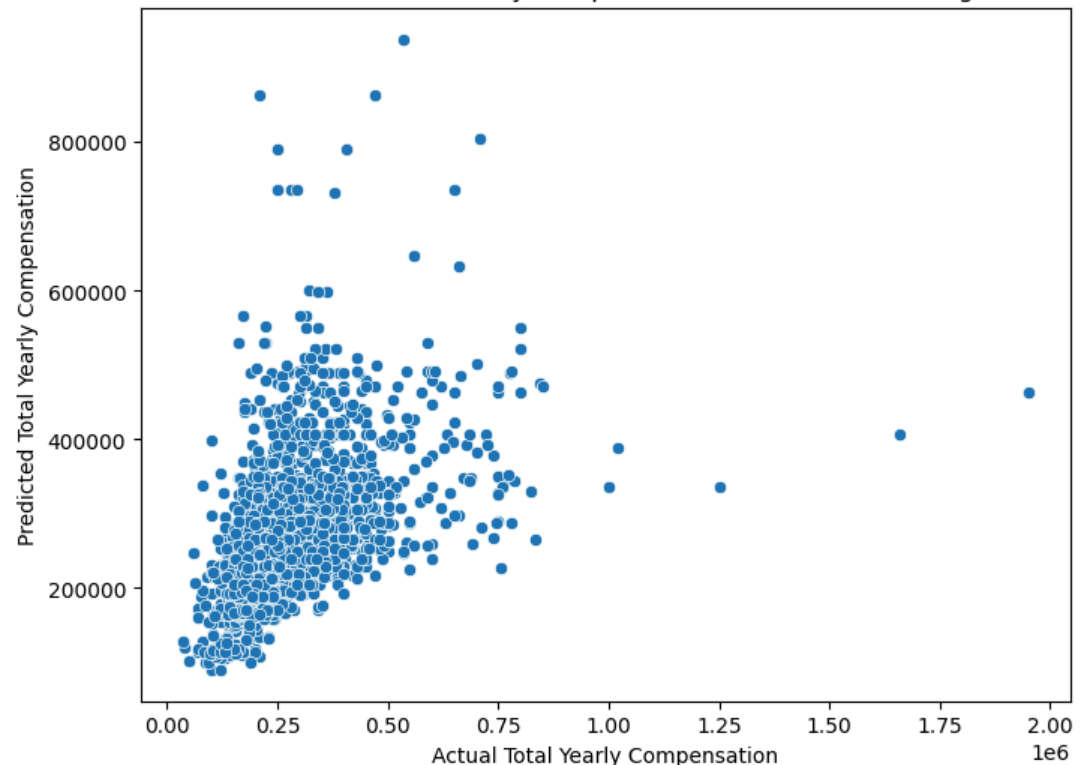Actual vs Predicted Total Yearly Compensation (Random Forest Regression)

Figure #3 shows how well a Random Forest Regression model predicts total yearly compensation based on available data. The points on the plot should be along a diagonal line if the model is accurate, but they're scattered, indicating some deviation between predicted and actual values. The model's Mean Squared Error is high, suggesting significant deviation from true values. The R-squared statistic is low, indicating only 27% of variance can be explained by the dataset's features. The dataset has some limitations as it lacks information on gender, race, and education level, which could improve the model's predictive performance if included.

This graph is an honest representation of how well the model has performed. It can help us understand the findings and show that we need more comprehensive data and modeling approaches to better understand how tech compensation trends have been affected during the COVID-19 pandemic.

Conclusion

In summary, we found through analysis that the trends in total yearly compensation shifted across job titles and companies throughout the pre-pandemic and pandemic years. Technical roles like Software Engineering seemed to stay steady throughout the societal changes that we witnessed during the pandemic, and Software Engineering specifically remained the top-earning role throughout the companies studied. The non-technical roles such as Sales had a decline in earnings, likely due to pandemic quarantine protocols that prevented many of these interactive roles from seeing the success that was possible in the pre-pandemic years.

The pandemic did have a transformative impact on the total yearly compensation in Tech companies according to our findings. The pandemic caused an increased demand in tech products, such as AI and robotics in the hospitality sector and in social settings as a response to social distancing and touch-free protocols (Zeng, Chen, & Lew, 2020, p. 724). Robotics specifically saw a surge in utilization during the pandemic as they took on tasks in sectors such

as healthcare, hospitality, transportation, and recreation that were previously conducted by humans (Zeng, Chen, & Lew, 2020, p. 725).

Our studies were limited by missing gender, race, and level of education data in the data set. Perhaps with more robust data and the study of more features in our regression model we could see the impact that the pandemic had on the tech field salaries while accounting for location, company, year, job title, race, gender, and level of education. The features of the regression model were restricted and future studies could uncover more insights into the question. The study was also constrained by the lack of sources regarding tech company salaries in the timeframe of the data set (2017-2021).

Perhaps future studies could explore the impact the pandemic had by looking at a wider range of time for both before the pandemic and during/after the pandemic. Another potential avenue of research would be analyzing how the total yearly compensation packages were structured before vs during the pandemic. (i.e. Researching if the the benefits included in the compensation packages differed pre-pandemic from during/post-pandemic.)

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