Is there a statistically significant gender pay gap among US developers with similar experience levels?

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Abstract:

According to the Stack Overflow Annual Developer Survey from 2022, there is not a

statistically significant gender wage gap in US Developers. However there is a significant

difference in the proportion of genders within the sample, with 93% men and 7% women, which

is statistically nonrepresentative of women developers in the United States as a whole. According

to the survey, men are paid 2.86% higher than women, with a median salary for men of $140,000

and a median salary for women of $136,000. Due to the statistically significant difference in the

sample sizes of genders, its outliers may have overestimated the salaries for women which could

create a biased interpretation. The answer to the question of a significant gender wage gap is

rejected, however, it is important to note how the proportions of genders are statistically

significant. DEI initiatives and pay equity audits have a large influence on improving the gender

wage gap in the US, contributing to the relatively similar distributions of salary for both genders.

Introduction:

The question posed is whether there is a significant gender pay gap between US developers with similar experience levels. Utilizing the Stack Overflow Annual Developer Survey, the survey from 2022 was examined to answer the question of if a significant pay gap exists between genders in the field, exploring how large the pay gap was in addition to whether these pay gaps differ between different roles and years of experience. The null hypothesis is that there is no significant gender wage gap, making the alternative hypothesis having a significant gender wage gap. This is relevant to ensure that individuals in similar roles and experience are receiving fair and equal pay and therefore upholding standards of pay equity. After cleaning data to ensure the data compared is fair (same job title, years of experience), the data must also be analyzed on how it relates to DEI practices, ethical considerations, talent acquisition, and industry benchmarking.

Data and Methods:

From the 2022 survey, the data from this survey was saved and uploaded to Python in order to begin data cleaning. The data was further filtered to only include observations from the United States, removing incomplete data observations in regards to salary. The dataset was further filtered to include only employed, full-time developers to ensure the salaries examined are all from working individuals who work the same amount of time in the course of a year. To remove extreme outliers, the dataset was then filtered to only include salaries from 30,000 to 500,000. Due to how years of experience are relevant to pay and the question regarding similar experience, the data was further filtered by including the years of professional coding experience to between 1 and 30 years.

After cleaning the observations to include relevant information, the data was cleaned again to only show variables that are relevant to the question posed; the variables that were filtered from the dataset were gender, yearly salary, years of coding experience, and the job position type. The dataset was then divided into two separate datasets to make comparison possible, filtering the first dataset to include all observations from women and the second dataset including all observations from men. The years experience was further filtered to 1-30 years in order to make the dataset more relevant to the question and remove extreme outliers.

Once these initial cleaning steps were completed to filter the dataset to include complete and relevant observations and variables to the question, the methods for uncovering the results were performed. This included filtering respondents to those that identified as either man or woman and grouping only those respondents who have experience levels between 5-10 years to guarantee a clear analysis on the desired variables.

Results and Discussion:

By performing a t-test at a 95 % confidence level, it was concluded there is not a statistically significant gender wage gap amongst US developers with 5-10 years experience due to the p-value of 0.61 which accepts the null hypothesis. However, there is a statistically significant difference in proportion of genders within the US developer job field, indicated by a p-value of zero that rejects the null hypothesis of an equal distribution of genders.

Table 1. Descriptive Statistics

Statistic	Men's Salary	Women's Salary
Count	2,217	176
Median	$140,000	$136,000
Standard Deviation	$72,522	$71,044
Range	$470,000	$456,000

| IQR	$70,000	$65,875
Coefficient of Variation	51.8	52.2
Skewness	1.75	1.95
Kurtosis	4.26	6.12

The summary statistics provided in Table 1 indicate a very similar distribution between men and women's annual salary in terms of central tendency and variability. The median salary for men, which was used in order to avoid being affected by outliers, was $4,000 greater than the women's salary. The interquartile range is also quite similar, sharing the 25th percentile value of $110,000 and 75th percentiles only differing approximately by $5,000. The measures of variability are all similar, indicating that the salaries are dispersed similarly for men and women. Both distributions are skewed to the right, where the women's data has slightly higher skewness and kurtosis which indicates more extreme outliers due to the significantly smaller sample size.
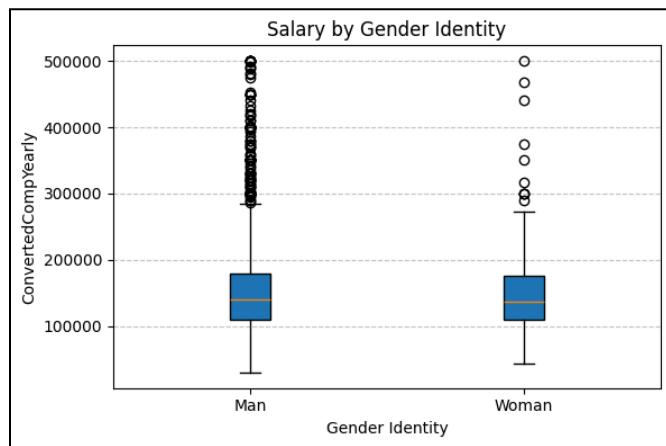
Figure 1. Salary Distribution by Gender Identity

From the boxplot in figure 1, the distributions for both genders are relatively the same, however, you see there are far more outliers in the men's distribution due the significantly larger sample size. Therefore, the outliers present in the women's distribution skew the data much more

than the outliers present in the men's sample. The median and IQR could actually be much less

for the population due to the under-representation of women developers in the sample.
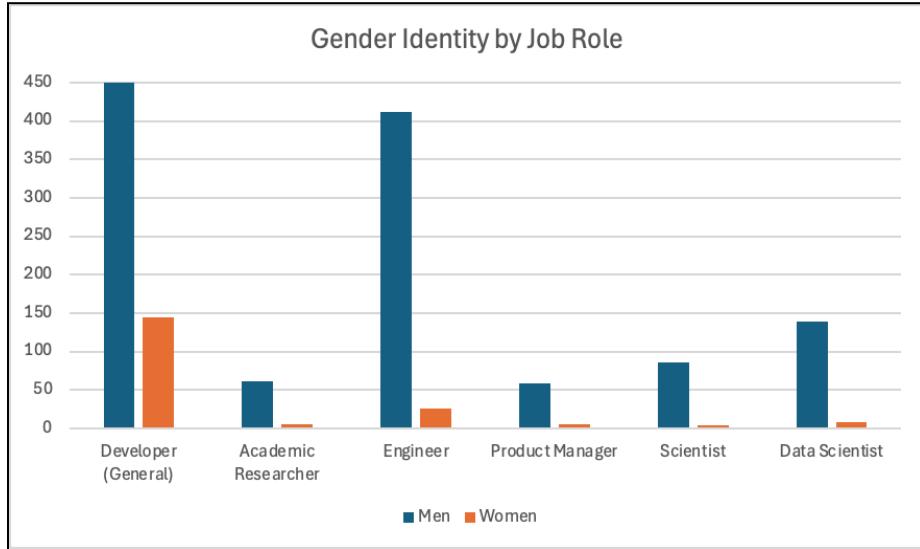
Figure 2. Gender Distribution in Developer Job Roles

The clustered bar chart in Figure 2 illustrates the under-representation of women in

developer job roles in the US. For each category of job role there were far less women however,

women actually made more in their role. In order of the roles presented in Figure 2, starting from

left to right, women make 14.53%, 5.10%, 22.5%, 35.53%, and 30.86% more than men.

Limitations and Implications:

Despite the rejection of a significant salary gap between genders, exploring this dataset

poses another question for further hypotheses and tests on whether the proportions of genders are

representative in the sample population. The data results proved that there is a statistically

significant gap for the proportions between genders. This statistical finding of the

underrepresentation of women in the study poses the question of current DEI initiatives of

companies for US developers to ensure they are practicing fair business practices for hiring and

retaining employees who are women. From Data USA, a statistic was pulled to compare to the

2022 Stack Overflow Annual Developer Survey to see how many software developers are

women and how many are men (Data USA, 2023). This report shows that women make up

18.4% of developers in the United States, which is drastically lower than the population of

women in the United States overall. Further, this is drastically different from the survey data we

cleaned and analyzed, as women only made up 7% of the workforce in the sample population.

After conducting a z-test to compare to the national average, even this gap has been concluded as

statistically significant based on a p-value of 0.0. This would indicate a gap between the sample

population and population, which can indicate methods that need to be improved to increase the

number of developers who identify as a woman to take the survey to better match the

representation of women in the developer workforce in the United States. The

underrepresentation of women who took the survey in comparison to the amount of women

developers in the US is recommended to be studied further in other hypotheses.

Conclusion:

Overall, in spite of the fact that there is not a significant gender based wage gap among

U.S developers with around 5 to 10 years of experience, there is a significant gap in the number

of women within the field of developers in general as well as the number of women within the

dataset. Despite the lack of women within this field, after cleaning the dataset, we concluded

that even with the same amount of experience, female developers still made less than male

developers with men making 2.86% more than women in this field. As previously stated, after

filtering and analyzing the data, it is clear that women are underrepresented in this study.

The implications of this observation begs the larger, more overarching question of not only how

well technology and/or software development companies are performing when it comes to

retaining their female developers, but also how well they are doing in being equitable and

inclusive in their vetting processes.

References:

Data USA. (2023). *Software Developers*. [Data set].

https://datausa.io/profile/soc/software-developers

Stack Overflow. (2022). *Stack Overflow Annual Developer Survey* [Data set] Stack Overflow.

https://insights.stackoverflow.com/survey