M08 Pandas Assessment Project Report

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September 4, 2022

Introduction:

For this project, our group explored data from the United States Census Bureau's Annual Business Survey (ABS) of 2019. The 2019 ABS published data on business-related demographics and categories collected in the preceding year, 2018 . We used the four datasets that constitute the responses to this incarnation of the ABS–Company Summary, Characteristics of Businesses, Characteristics of Business Owners, and Technology Characteristics of Businesses–to examine trends for American businesses, employers and workers.

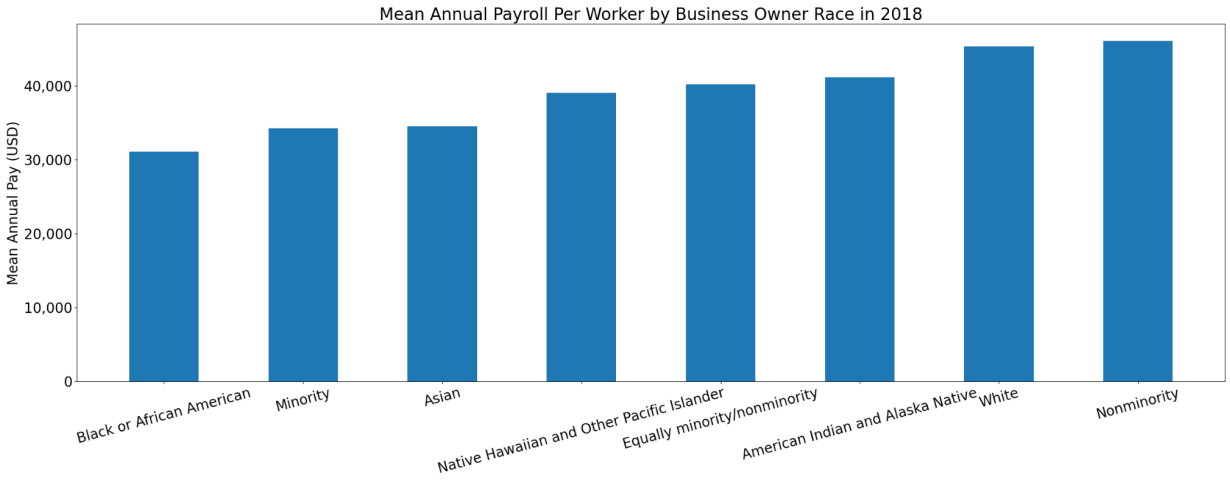
Our report is divided into four main sections: Section I, where we answer questions about pay and industry of employment based on the race and gender of business owners at the national level; Section II, where we answer questions about business ownership rates among different sub-groups of veterans at the national level; Section III, where we answer questions about which emerging technologies are being used by businesses and how these technologies affect workforces at the state level; and Section IV, where we answer questions about the relationships between education level of business owners and annual payrolls.

We have included visualizations in each section to help illustrate our answers. We will examine each question in detail below.

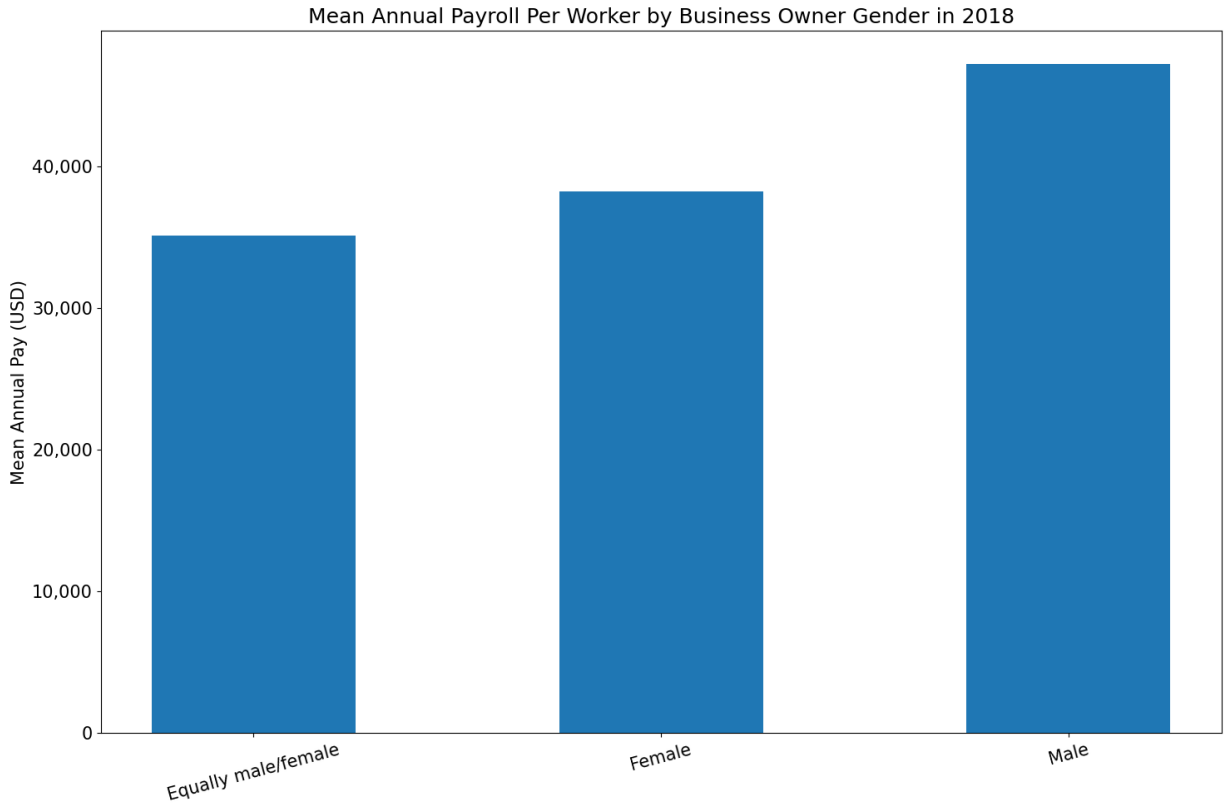
Section I: Characteristics of Workers and Business Owners

How does worker pay vary by business owner race and gender?

The 2018 ABS provides estimates of the count of employees and total payroll for businesses in the United States. We calculated the mean payroll per worker from these estimates in the following charts to see how worker pay varies by business owner race and gender.



There were clear differences between mean payroll per worker when comparing firms by owner race. White and Nonminority-owned businesses had the highest mean payroll. The Nonminority group had the highest mean payroll with $46,089, and the Black or African American group had the lowest mean payroll with $31,072. Mean payroll per worker for Nonminority owners ($46,089) was 35% higher than Minority owners ($34,248).

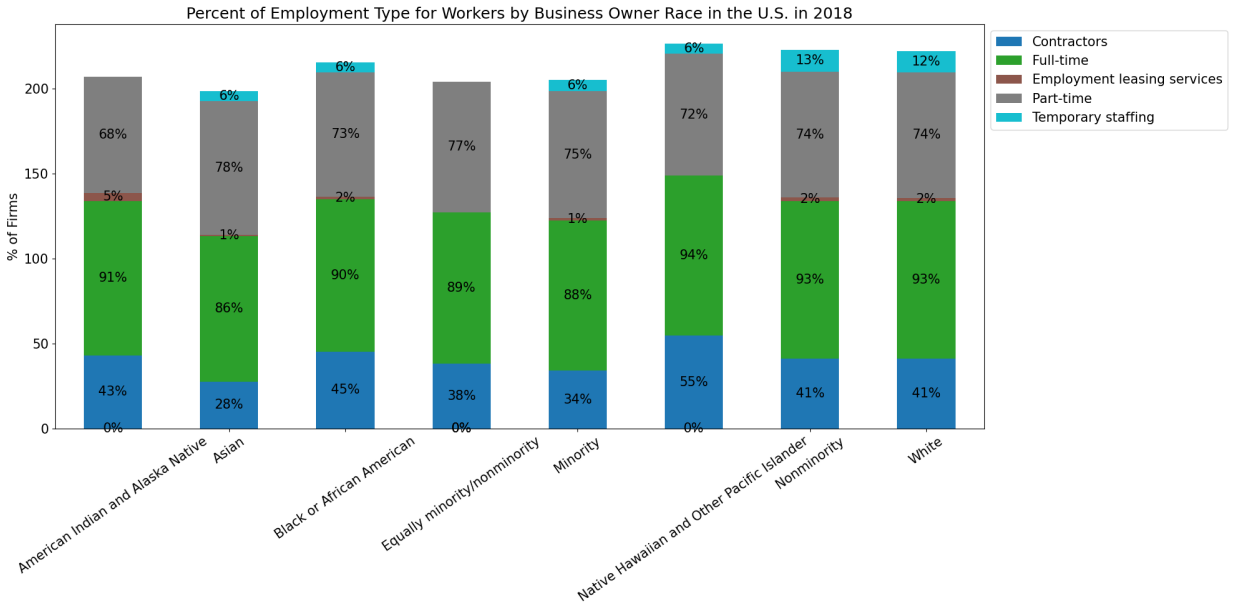


There were clear differences in the mean payroll by business owner gender. Male-owned businesses had a mean payroll of $47,203. Female-owned businesses and equally male/female owned businesses had mean payrolls of $38,238 and $35,113 respectively. Male-owned businesses mean payroll was 23% higher than Female-owned businesses.

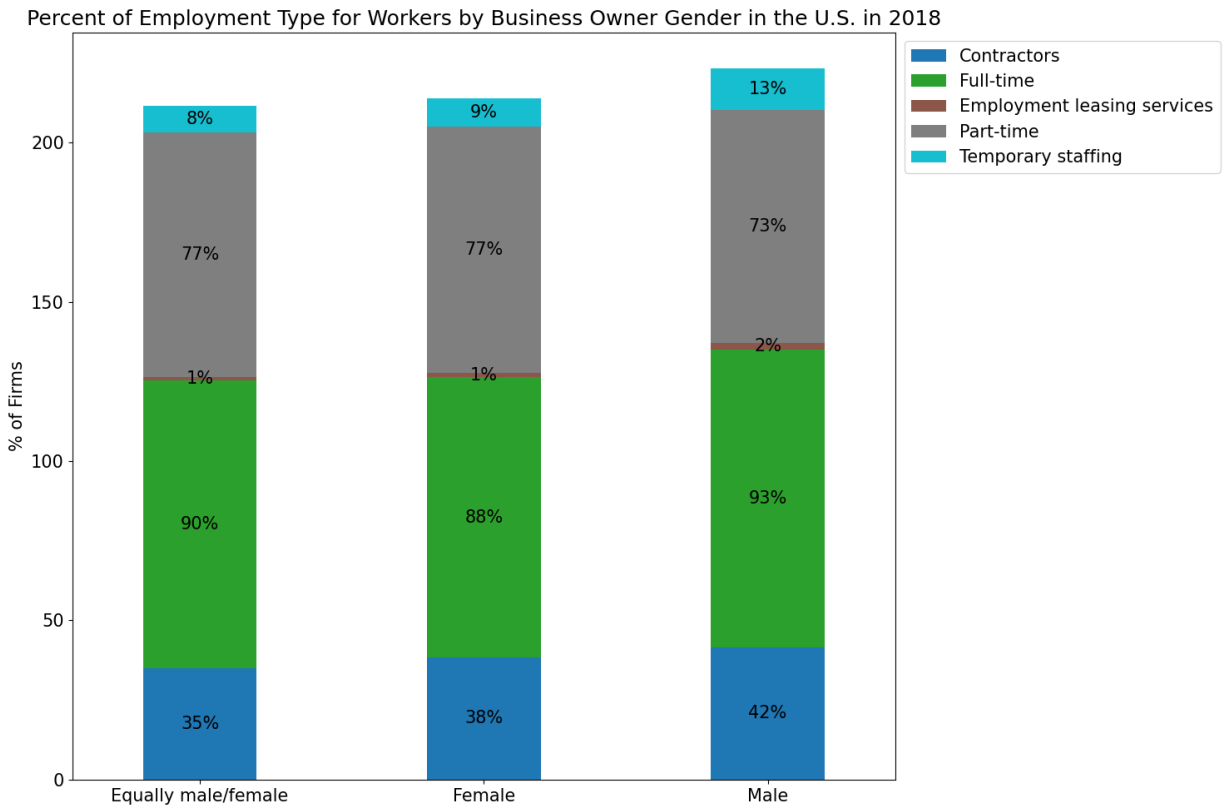
Overall, we found large disparities when comparing mean payroll per worker by business owner race and gender. Male-owned businesses mean payroll was 23% higher than Female-owned businesses, and Nonminority owned businesses mean payroll was 35% higher than Minority-owned businesses. For further research, it would be interesting to look at the breakdown of industries reported by business owner race, to investigate whether certain industries are more associated with specific owner races.

How does employment type for workers vary by business owner race and gender?

The 2018 ABS provides estimates of the type of employment firms used to employ workers. We used these estimates to visualize types of employment used by firms by business owner race and gender.



Business owners who identified as Native Hawaiian and Other Pacific Islander had the highest percentage for contracted employees, with 55% of firms responding that they used contractors. Business owners who identified as Asian had the lowest, with 28% of firms responding that they used contracted employees. The percentage of firms using full-time employment was the highest employment type reported for all owner races, with the lowest being Asian-owned firms (86%) and the highest being Native Hawaiian and Pacific Islander-owned firms (94%). Employment leasing services was the lowest reported employment type for all business owner race groups, with the highest being American Indian and Alaska Native-owned firms at 5%. Part-time work was the second-highest percentage for all firms across all race groups. Non-minority and White-owned firms reported that they used part-time workers the most, with 13% and 12% respectively.



Male-owned firms reported using contractors at the highest rate, with 42% reporting that they used contractors. Male-owned firms reported using full-time workers at the highest rate with 93%. Female-owned and equally male/female owned firms reported using part-time employment at a higher rate than male-owned firms, with 77%. Male-owned firms reported using temporary staffing and employment leasing services at the highest rate, with 13% and 2% respectively.

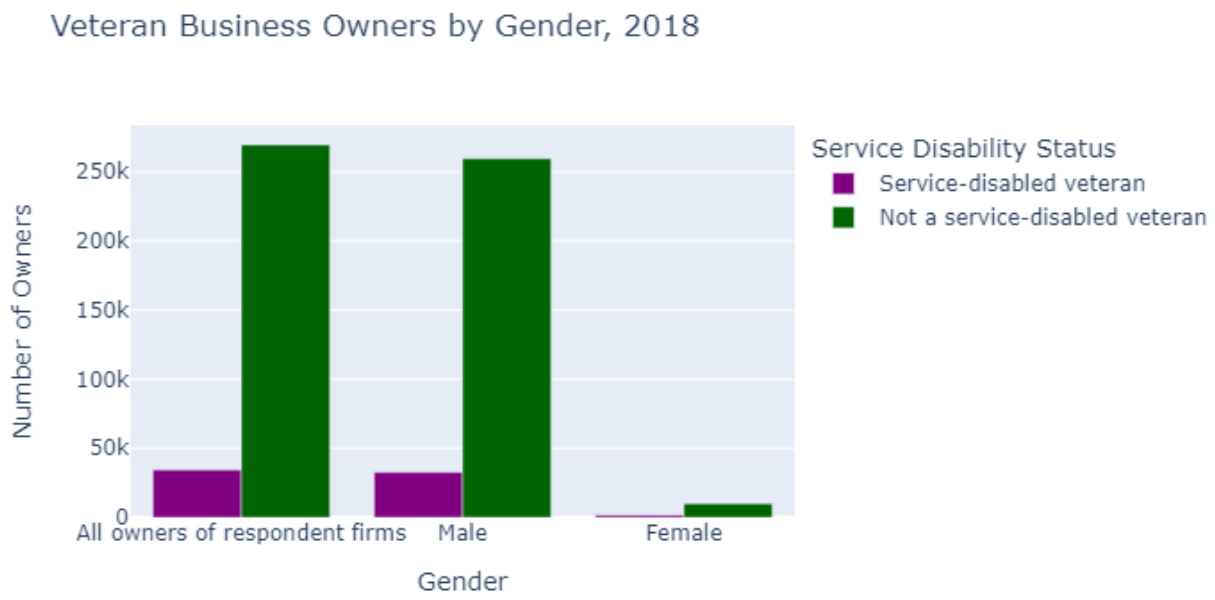
Overall, the employment type reported by firms were in similar proportions across business owner race and gender. One notable exception was in the use of contract services. Asian-owned businesses reported use of contractors at the lowest rate (28%), compared to Native Hawaaian and Other Pacific Islander-owned businesses with the highest rate (55%). The most frequently reported labor types were full-time employment, part-time employment and contractors.

Section II: Business Ownership Trends among Veterans

We decided to investigate the details the Census Annual Business Survey collected about veteran business owners. First, we examined veteran ownership by industry among service-disabled and non-service-disabled veterans. Next, we compared business ownership by race among two groups of veterans: those who had served active duty after the September 11th attacks, and those who had served active duty in 2018, the reference year for the annual survey we used.

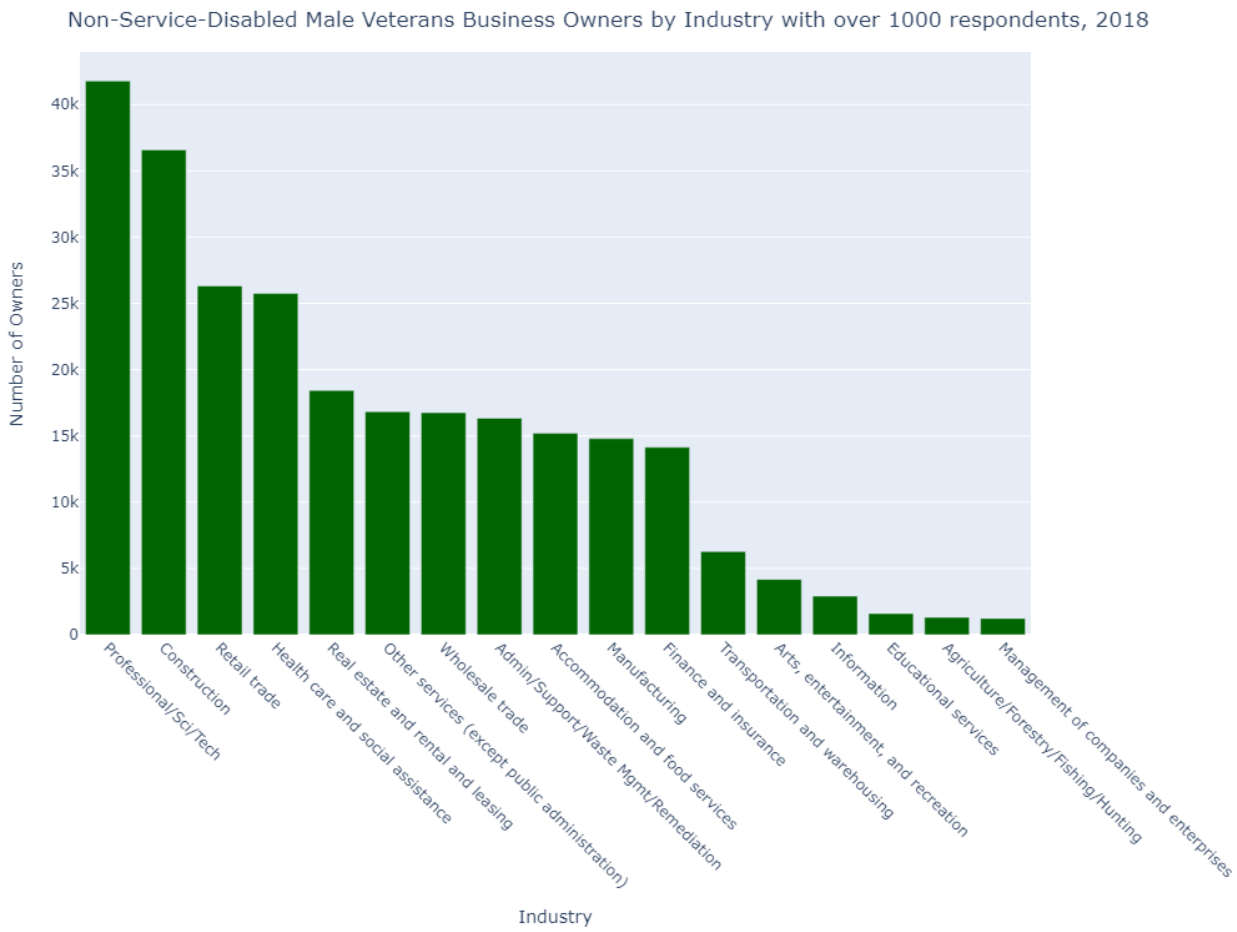
How does veteran business ownership vary by gender and service-disability status?

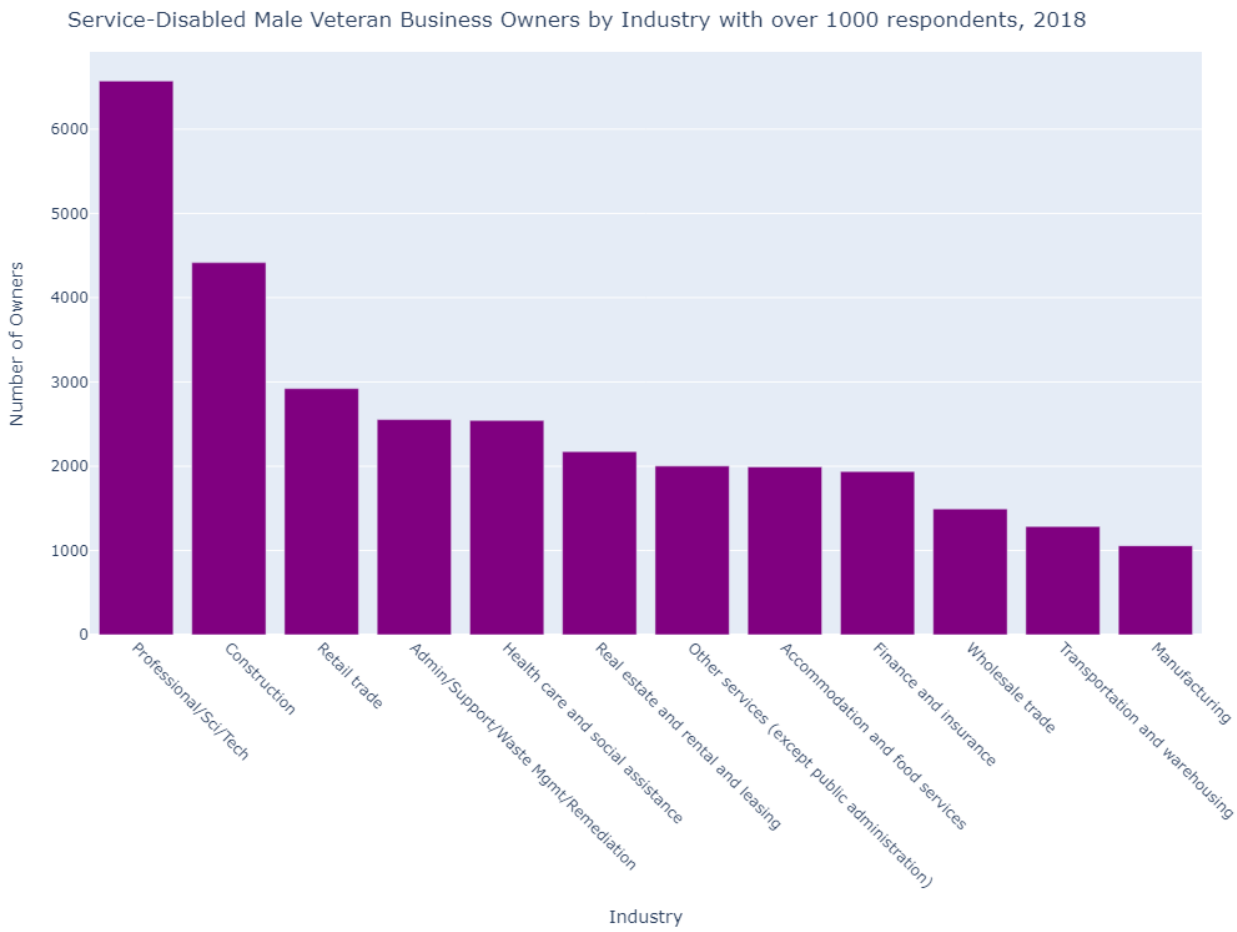
As we compared business ownership rates by industry for service-disabled and non-service-disabled veterans, we noticed male veterans of both categories vastly outnumbered female veterans:



What are the trends in business ownership by industry among male service-disabled and non-service-disabled veterans?

Due to a much greater number of respondents, we chose to investigate business ownership rates for male service-disabled and non-service-disabled veterans. We identified some commonalities among these two groups. Professional, scientific, and technical firms were the most owned type of business for both groups, followed by construction and retails firms. The two graphs below display number of business owners per industry for both groups where the number of respondents was greater than 1000:

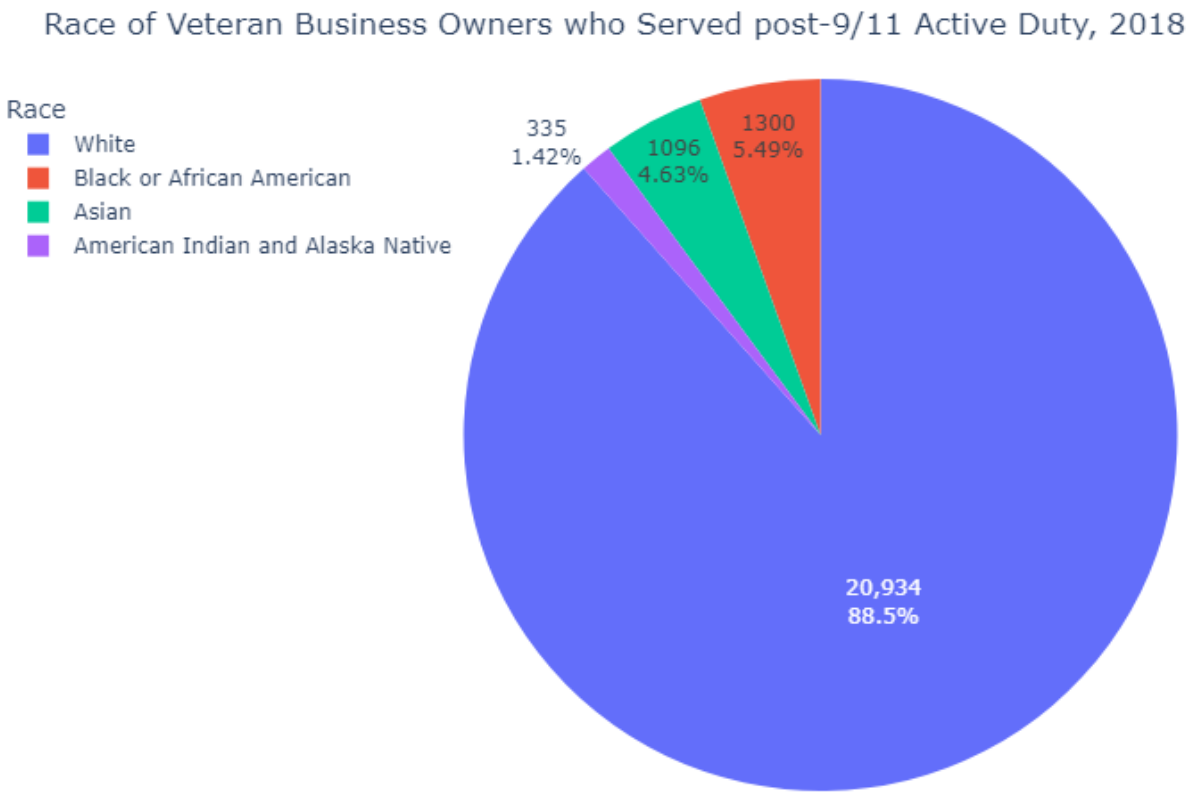

Non-Service-Disabled Male Veterans Business Owners by Industry with over 1000 respondents, 2018
Number of Owners
40k
35k
30k
25k
20k
15k
10k
5k
0
Professional/Sci/Tech
Construction
Retail trade
Health care and social assistance
Real estate and rental and leasing
Other services (except public administration)
Wholesale trade
Admin/Support/Waste Mgmt/Remediation
Accommodation and food services
Manufacturing
Finance and insurance
Transportation and warehousing
Arts, entertainment, and recreation
Information
Educational services
Agriculture/Forestry/Fishing/Hunting
Management of companies and enterprises
Industry



How does veteran business ownership vary across race and sub-groupings of veterans?

We also investigated the race of owners for veteran business owners. Since the business survey for this year did not break down the rates of service-disability by race, we determined that we would inspect racial demographics of different sub-groupings of veterans. We therefore decided to look at veterans who had served active duty in two periods: firstly, those who had served anytime post-September 11th, 2001, and secondly those who had served anytime within the year of 2018. We included veterans of all genders in these groupings.

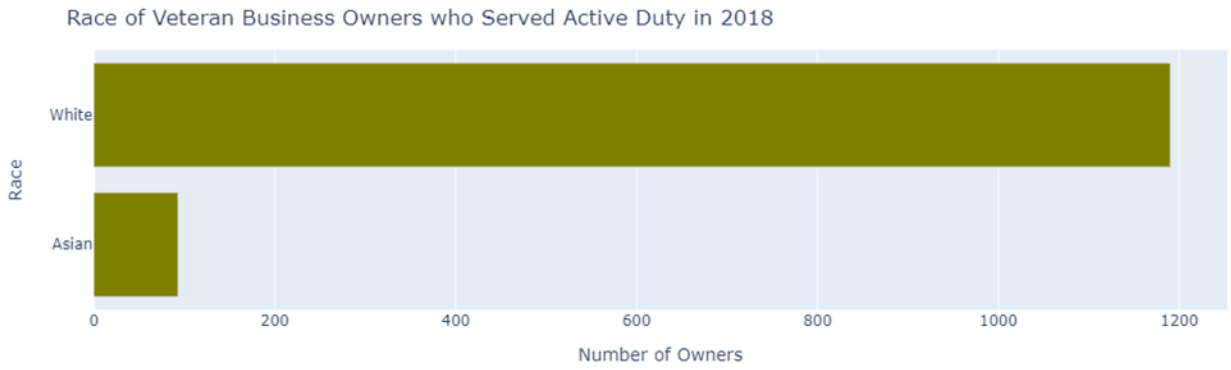
Veteran business owners who had served active duty anytime since September 11th, 2001 were 88.5% white:



According to the United States Department of Veterans Affairs, 73.87% of veterans were white by 2019 (Office of Health Equity, 2020). This data suggests whites are over-represented among veteran business owners, while non-whites are correspondingly underrepresented.

Along with the disproportionate business-ownership of white veterans, other data points we found notable were the difference in reported business ownership between the American Indian and Alaska Native group and the Native Hawaiian and Other Pacific Islander group, the latter of which had no reported business owners at the time of the survey and were therefore omitted from the pie chart above. This difference could be a starting point for future research into business ownership trends and opportunities among different indigenous groups in the United States.

Veteran business owners who had served activity duty in 2018 consisted only of white and Asian business owners:



Throughout our analysis of veteran business ownership, we were challenged by the discontinuities between sub-groupings of veterans and other demographic categories. As we mentioned above, not every sup-grouping had a full breakdown of demographic categories. The data we did analyze, however, can be used by veterans and their advocates to identify industries disabled and non-disabled veterans have had success in as leaders. This data can also be used to identify growth areas for veteran business ownership, particularly in terms of promoting business creation and ownership for non-white veterans.

Section III: Use of Technology Across Businesses

How is technology used across businesses?

The Annual Business Survey (ABS) provided the dataset “Technology of Characteristics of Businesses” for 2018 with a variety of categories that includes technology use and production. One of the focuses that we conducted was to see how technology has been utilized.

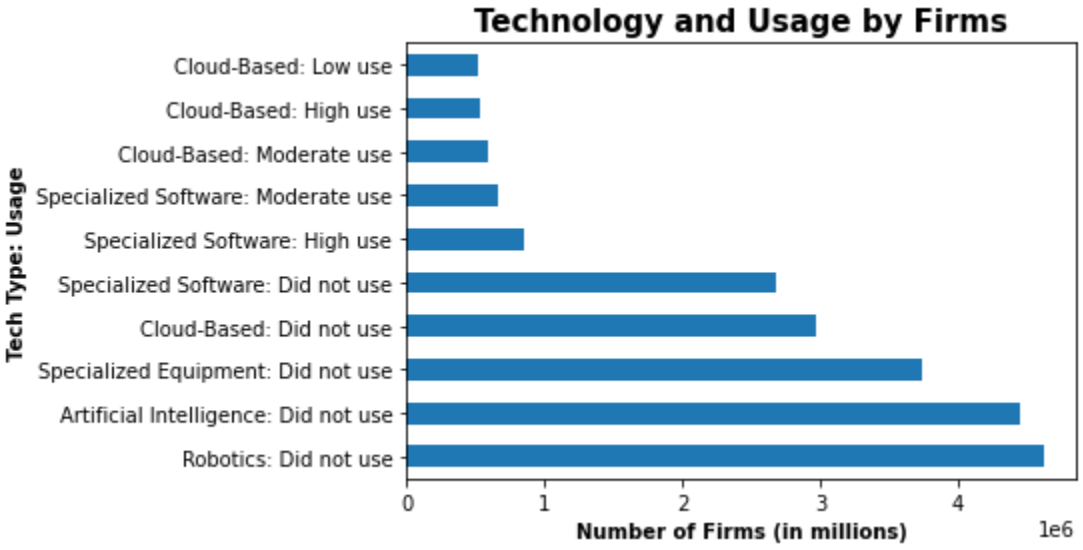


Figure: Technology and Usage by Firms

I created this figure to show the top 10 responses of the type of technology and its use across all businesses that responded to the ABS. The results show that the first half has businesses that do not utilize the categories at all while the latter half shows two distinct categories that have been implemented: Specialized Software and Cloud-Based tech. At varying levels of usage, it can be seen that the two categories implemented are of vital importance to businesses as a whole. This can stem from the fact that Specialized Software and Cloud-Based tech are easily more accessible when compared to the other categories of tech from the survey: Robotics, Artificial Intelligence and Specialized Equipment. Although specialized software is a broad category, this can include various applications such as Amazon Web Services, Tableau, MatLab that can make work easier. The affordable costs of these applications help make businesses operate with a budget that can fit their needs.

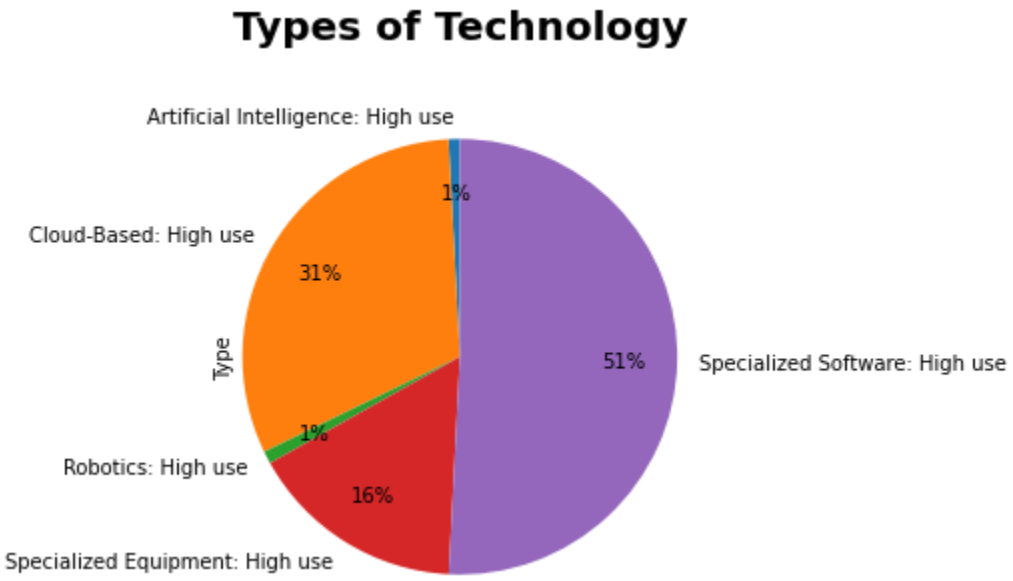


Figure: Types of Technology

While the previous figure showed the top two categories that were used, I thought it would be interesting to see how they compare to the rest of the tech types. The above figure shows the percentage of total responses of high usage among the various types of technology. The high usage is used for consistency when compared to the other responses along with the implication of the 'High use' meaning: that technology is being used to such a high degree that it is making the job easier and increasing productivity. The specialized software has the biggest slice from the pie chart at 51%. At the opposite end of the chart are both robotics and artificial intelligence with 1%. Both of these can be due to high costs to maintain and use them. It could also stem from the fact that those categories of technology are not applicable to a business at all.

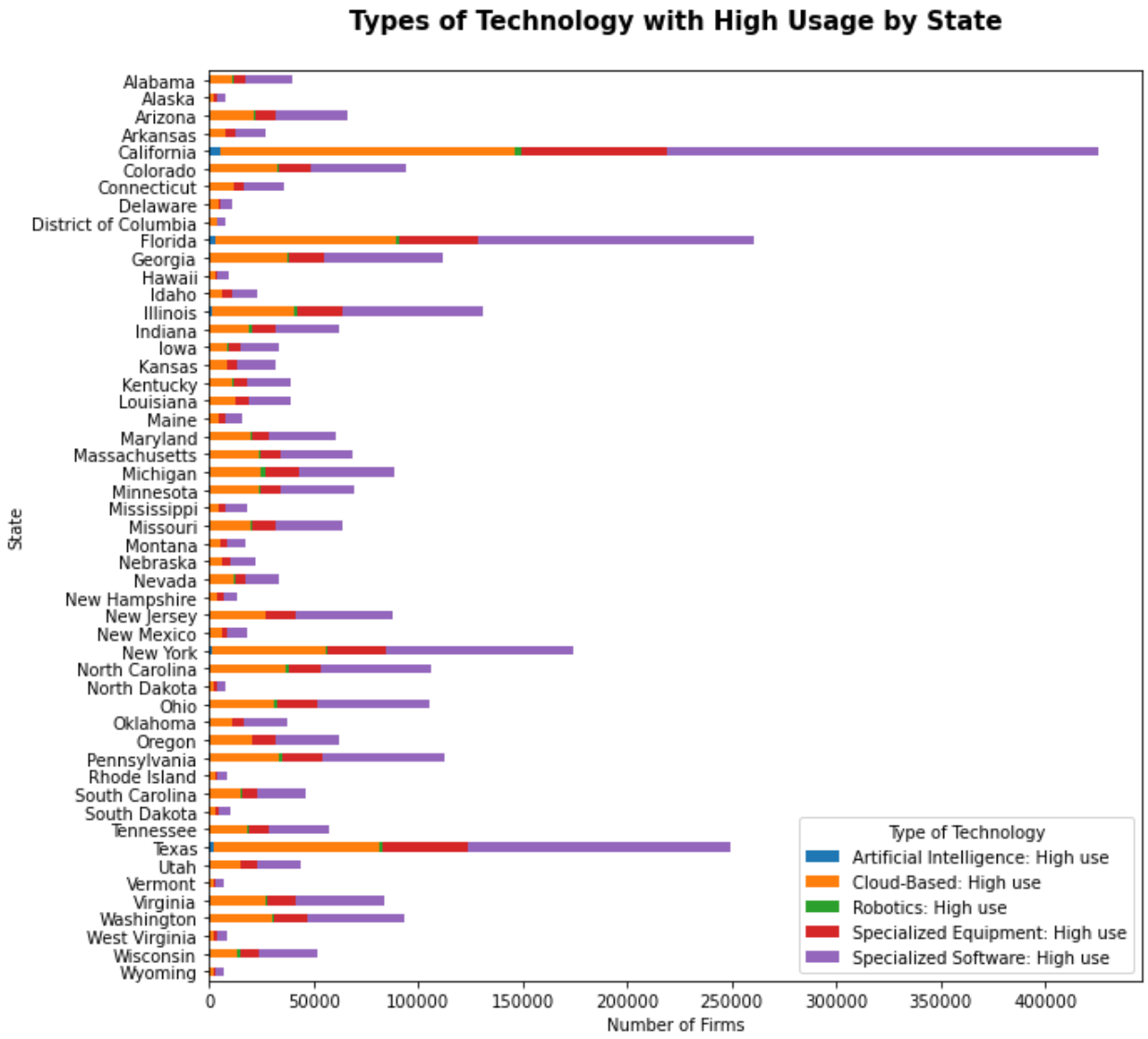


Figure: Types of Technology with High Usage by State

This next figure that I created is to see how these types of technology are highly used by each state. This can go along with the pie chart in that you can clearly see the Specialized Software and Cloud-Based categories are the most utilized by each state. The results show that the top 3 states that have heavy use of technology are California, Texas, and Florida. California is the highest with over 400 million businesses having a high usage of tech. This makes sense in the context that California has Silicon Valley where a lot of major companies such as Meta, Google, and Apple are located. Florida and Texas are surprising in that these states are not particularly known for having huge tech hubs like California does. Although this data is from 2018, a follow up would be needed for the current year to see how much tech usage has grown. Especially with the rise of COVID and remote jobs (working from home), I'm sure that these numbers would rise and we would be able to see if these top states still retain the position that they already have.

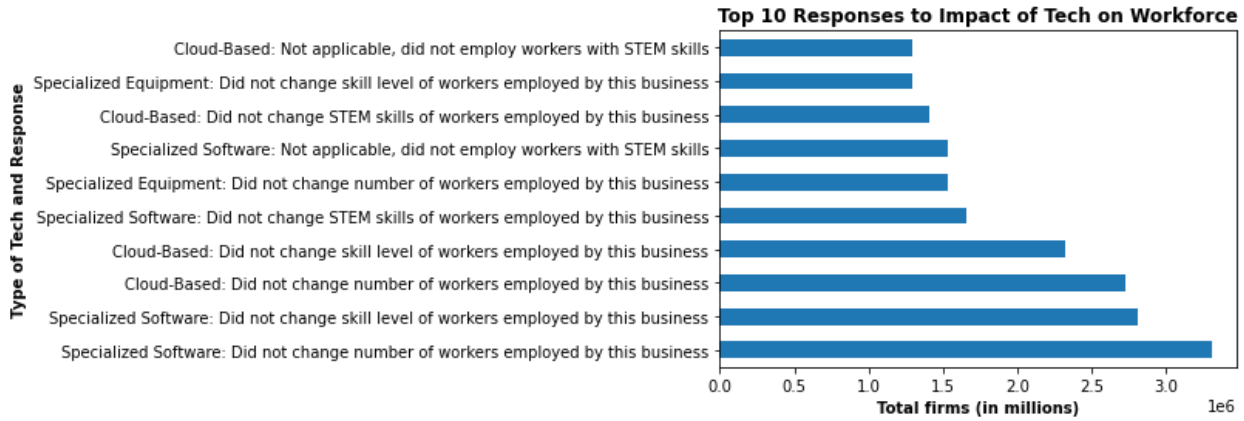


Figure: Top 10 Responses to Impact of Tech on Workforce

I created this last figure to see how the usage of technology has affected the workforce within businesses. As there were a lot of subcategories of the response to go with each tech category, I wanted to focus only on the top 10 responses. As shown by the previous figures, it would make sense to see that the top responses included specialized software and cloud-based technologies. The top response was that specialized software usage did not change the number of workers that were employed by the business. This can mean that specialized software, as a whole, proved beneficial to a company by making the work easier. It can also go along with the second response that specialized software usage did not change the skill level of workers. When combining these two responses, it can be seen that this type of technology means that they can be implemented easily by employees and used as a part of their work tasks without requiring much training. The same can also be seen by the third and fourth place spots with cloud-based technology.

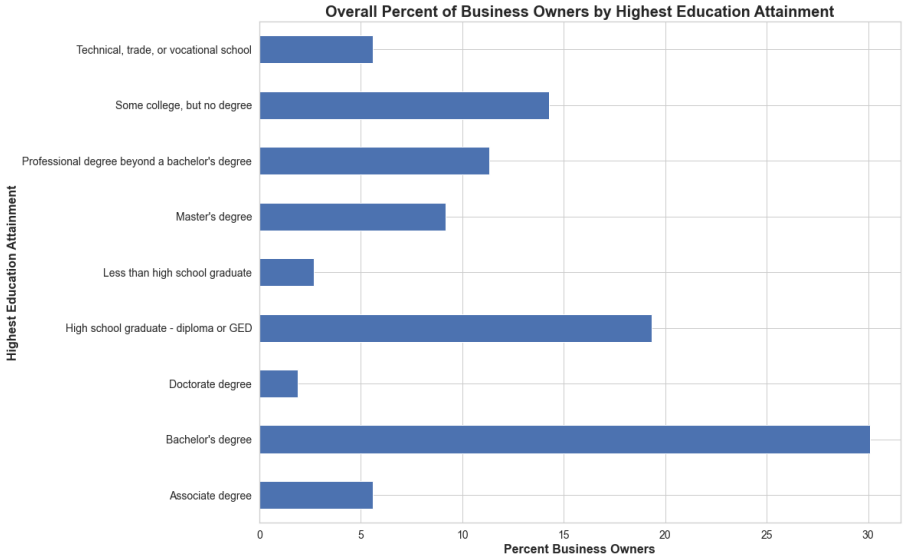
The analysis of this dataset showed that specialized software and cloud-based technology are the most used categories of tech. This can be seen in the way that they are easily accessible and implemented into businesses with little to no training. The states that utilize technology the most are California, Texas, and Florida. Further analysis would be needed to see how many states adopted the other categories when compared to this 2018 data.

Section IV: Owner Education Attainment & Annual Payroll

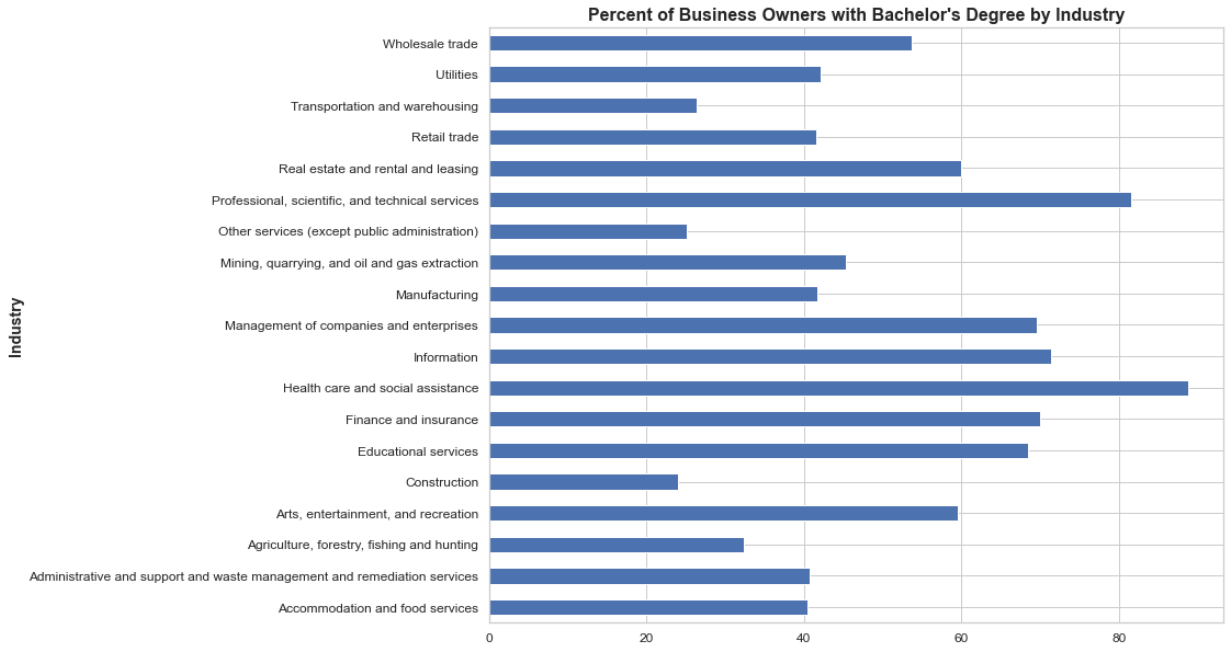
In this section, I will discuss my visualizations and findings to answer the question: how does business owner education attainment relate to the amount of annual payroll among businesses in various industries?

To begin, I will start with my first visualization (shown below), showing the percentage of business owners who have achieved various levels of education across all industries. This horizontal bar chart shows us that the highest percentage of business owners across all industries have Bachelor's degrees while the lowest percentage of owners have Doctorate degrees. To note, this data is for highest degree

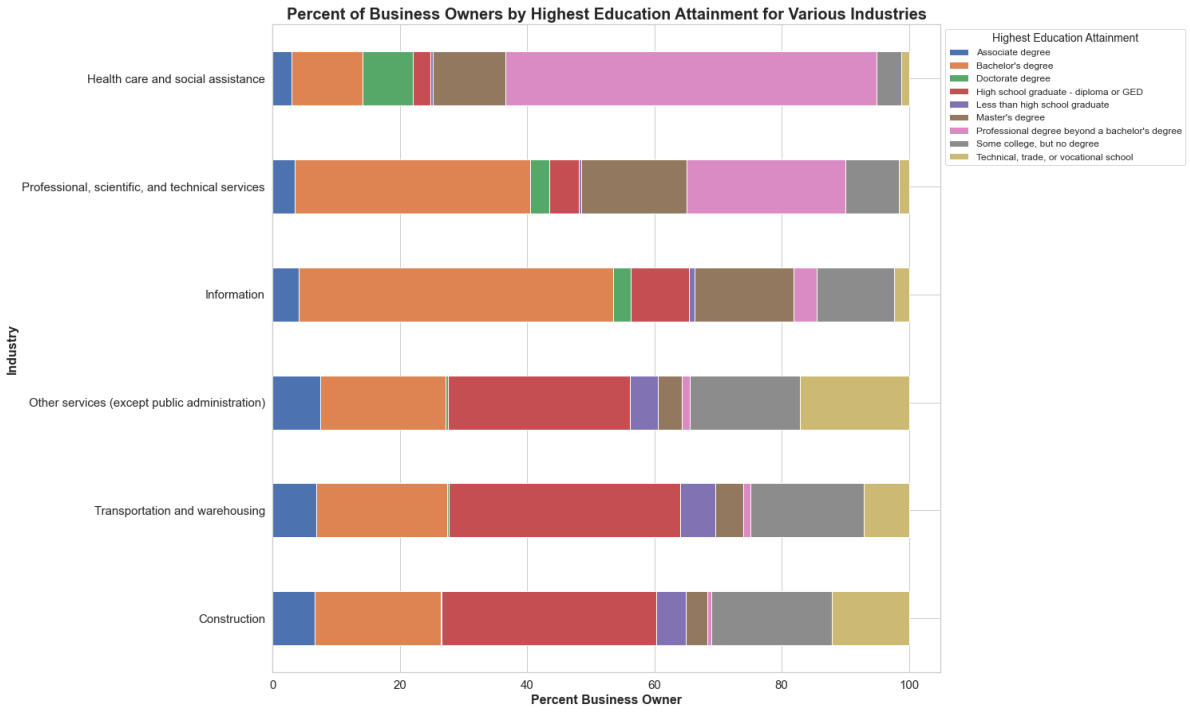
achieved, so owners with Doctorate degrees are not also included in the data of owners with Bachelor's degrees. It is surprising to see that roughly 20% of business owners have any education beyond high school, with an additional 14% only having some college experience but no degree. Altogether, about 52% of business owners have at least a Bachelor's degree.



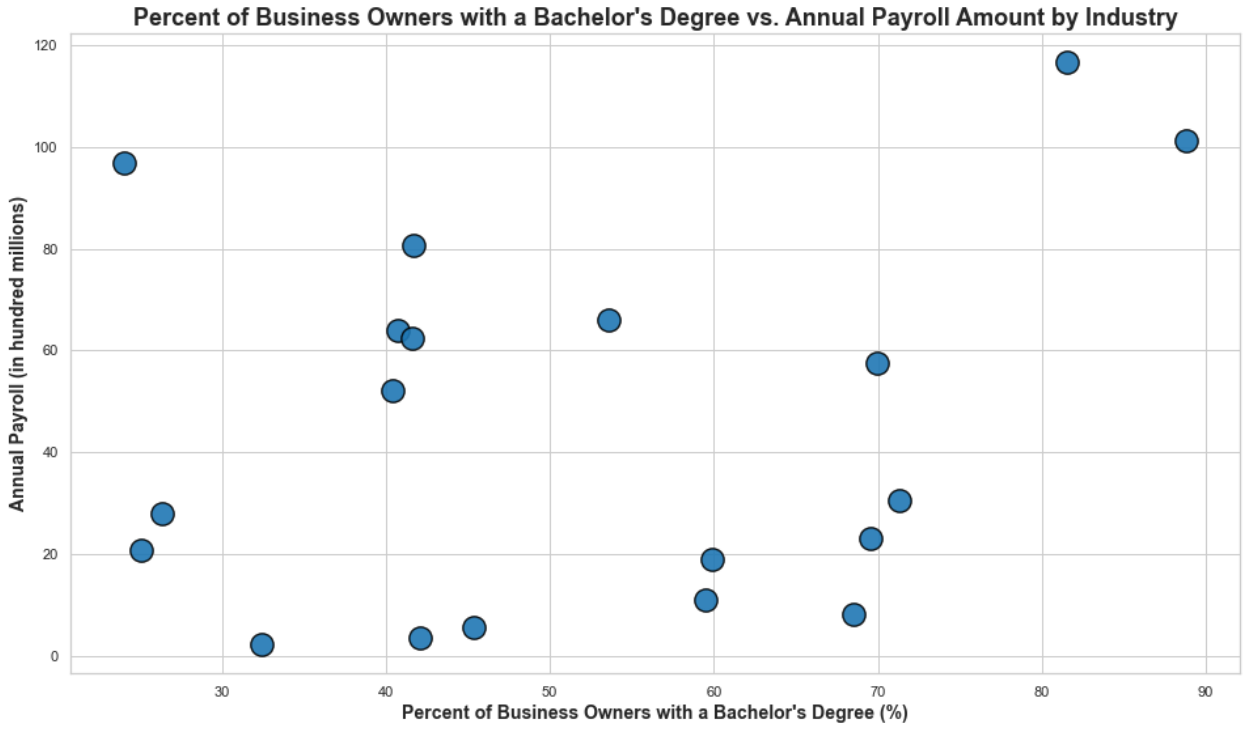
Next, I narrowed my focus to look at the percent of business owners who have a Bachelor's degree across various industries. For this data, I summed together all percentages of owners who had obtained a Bachelor's degree, Master's degree, professional degree beyond a bachelor's degree, and a Doctorate degree. This means that the percentages shown represent business owners in those industries who have obtained *at least* a Bachelor's degree. The industries health care and social assistance and professional, scientific, and technical services had the highest percentage of Bachelor's degrees while the industries construction and other services (except public administration) had the lowest percentages. This makes sense in considering the type of education required for employees within these industries.



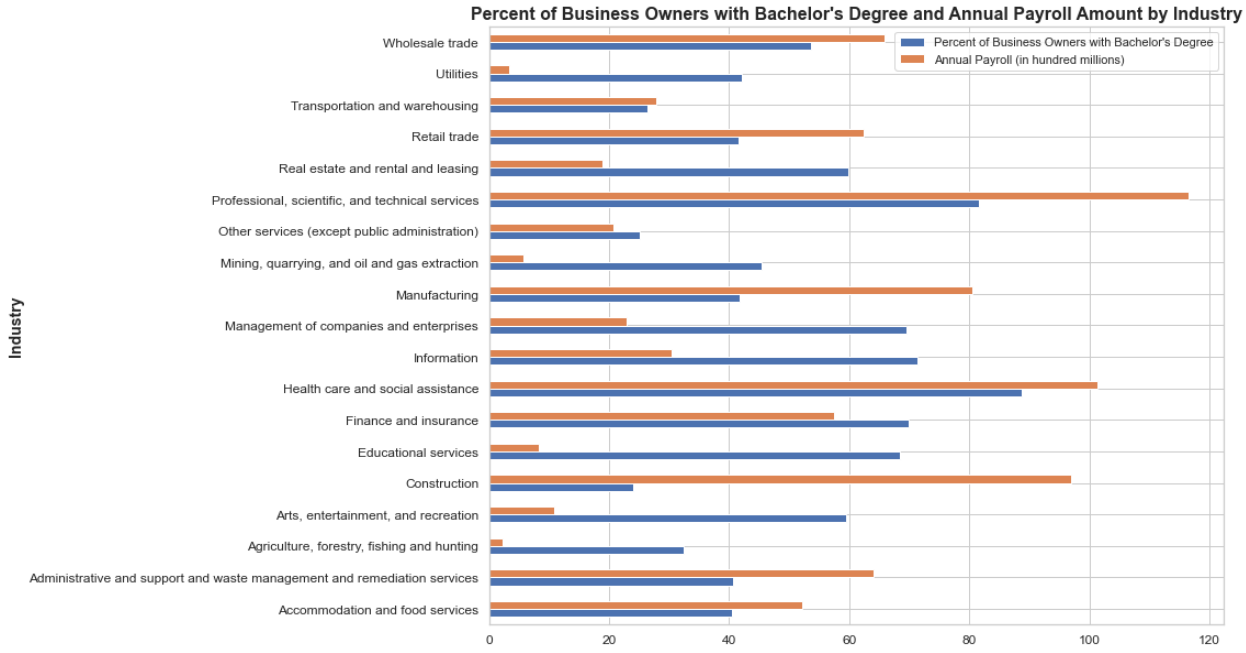
Next, I narrowed my focus onto the three industries with the highest percentages of Bachelor's degrees and the three industries with the lowest to create a full breakdown of education attainment for business owners. The three industries with the highest percentages of owner Bachelor's degrees were health care and social assistance, professional, scientific, and technical services, and information. The three industries with the lowest were other services (except public administration), transportation and warehousing, and construction. Within these breakdowns, it is clear that the highest three industries have larger percentages of owners with Master's, professional, and doctorate degrees whereas the lowest three have larger percentages of owners with high school diplomas and only some college (but no degree). Again, this breakdown dovetails with educational requirements for workers within these fields.



After exploring how education attainment varies for business owners across different industries, I then turned my attention to how this variation might affect business performance or size. Unfortunately, there was no data available on the amount of sales broken down by industry, so I used Annual Payroll as a means of representing company performance and size by industry. I created a scatter plot that plotted percent of business owners with a Bachelor's degree (or at least a Bachelor's degree) within each industry against total Annual Payroll for businesses in that industry(in the hundred millions). Each point represented an industry's data values. As evidenced below, there appears to be a slight upward trend or positive correlation between percent of business owners with a Bachelor's degree within an industry and the total amount of Annual Payroll in an industry. This means as the percentage of business owners with a Bachelor's degree increases, so too does the amount of Annual Payroll. Of course, this correlation does not appear to be entirely strong as there exist notable outliers. There are some points with a low percentage of business owners with Bachelor's and high Annual Payrolls and vice versa. Nonetheless, it stands to reason that there is at least a slight positive correlation between these two factors. This makes sense as more educated business owners will likely make better decisions to the financial benefit and growth of their companies.



Finally, I created a grouped horizontal bar chart to see what industries seemed to follow the pattern of high percentage of owners with Bachelor's degrees correlating with higher Annual Payrolls, and which did not. From the graph, we can see that Construction is clearly an outlier. Although it has a low percentage of business owners with Bachelor's degrees, it also has a relatively high Annual Payroll compared to other industries. This goes against the correlation graphed above. Educational services also goes against this pattern, though in the opposite way. While this industry has a high percentage of business owners with Bachelor's degrees, it has a low Annual Payroll. Tragically, as a former teacher, I know this to be true (although it should not be!!). Nonetheless, there are some industries that demonstrate this positive correlation. Wholesale trade has a relatively average percentage of owners with Bachelor's degrees and a similarly relatively average Annual Payroll. Some industries follow the correlation while others remain outliers for various reasons.



Although not definitive, there does in fact appear to be a slight positive correlation between business owner education attainment and amount of Annual Payroll within various industries.

Conclusion

The ABS has a lot of data to pull from these 4 datasets. There's a bunch of questions that can be posed, but we decided to focus on these specific ones as they sparked our interest. We focused on characteristics of workers and business owners. We found that the majority of businesses had large disparities with the mean payroll per work when looking at the owners' race and gender. Male-owned businesses had a higher payroll of 23% when compared to female-owned. Non-Minority owned businesses had a payroll that was 35% higher than minority-owned businesses. When looking at how employment types for workers vary by business owners' race and gender, we find that they are pretty similar regardless of these characteristics. However, there are some notable exceptions with Asian-owned businesses having a low contracted rate of 28% while also having a high rate of 55% for Native Hawaaian and Other Pacific Island-owned businesses.

When exploring the veteran status of business owners, there was the issue of the veteran status by demographic categories. The results that were available, however, helped provide insight into how advocating for business ownership among non-white veterans can be incorporated going into the foreseeable future.

Looking at technology dataset, we focus specifically on how technology use has impacted businesses and how the usage varied among states. Our results show that California, Texas, and Florida had the highest amount of businesses that employed a high usage of technology. Among all states, however, there's a clear indication that the types of technology that businesses are using are specialized software and cloud-based technology. The results of utilizing these has had businesses reporting that they did not decrease the amount of workers employed by the business as well as not changing the skill level of workers. This can be seen as that these types of tech are easily implemented into the workplace with minimal training for everyday use.

Finally, we explored the last question of how the education attainment of business owners relates to the amount of the annual payroll among businesses in the various industries present in this census data. Our visuals that we have shown point to a slight positive correlation between the education status of business owners and the annual payroll in that the higher the education, the more money that resulted.

Citations

- Office of Health Equity. (2020, July 9). *Racial and Ethnic Minority Veterans* [Data set]
    - https://www.va.gov/HEALTHEQUITY/Race_Ethnicity.asp#data Accessed on September 5, 2022
- U.S. Census Bureau.(2019). *Annual Business Survey (ABS): Characteristics of Businesses* [Data set].
    - https://api.census.gov/data/2018/abscb.html Accessed on 09/03/2022
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    - https://api.census.gov/data/2018/abscbo.html Accessed on 09/03/2022
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    - https://api.census.gov/data/2018/abstcb.html Accessed on 09/03/2022