CS432/532: Final Project Report

Project Title: Impact of COVID-19 and layoff rates on the Company's financial performance and employee morale.

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/* Your project will be graded based on the significance of the project and the success of the demo and the clarity of your report. Your final report excluding the references and source code should not exceed 3 pages. */

/* Please organize your report well for clarity, and always check spelling and grammar. An excellent style manual for science writers is [2].

I. Problem

/* Briefly and clearly describe what problem you have worked on for this project. Clearly describe your N+1 data analysis tasks/queries. If you used a public dataset, reference it. */

The COVID-19 pandemic has caused massive disruptions to the global economy, leading to unprecedented challenges for businesses of all sizes and industries. Companies are facing financial instability, workforce reductions, and a myriad of other challenges that have made it difficult to maintain their operations and keep their employees motivated and engaged. As a result, there is a growing need for businesses to understand the impact of the pandemic on their financial performance and employee morale, and identify strategies that can help them navigate through these challenging times.

The report consists of three data-driven analyses. The first analysis examines the funding and acquisition rates of companies with high funding and low layoff rates during the pandemic, with the objective of identifying successful strategies adopted by these companies to achieve sustained growth and maintain financial stability. The second analysis investigates the vulnerability of low-funding companies to bankruptcy, using factors such as layoff rates and COVID-19 cases to predict their bankruptcy rates after the pandemic. Finally, the third analysis aims to understand the impact of COVID-19 on employee sentiments by calculating the employee morale of companies based on funding, layoff rates, COVID-19 cases, and funding stage data. Overall, this report provides valuable insights for businesses facing the challenges of the COVID-19 pandemic, helping them understand the factors that contribute to financial instability and employee morale and providing them with strategies to navigate through these uncertain times.

II. Software Design and Implementation

/* Briefly describe how you designed and implemented your software. Describe which No-SQL database and any tools you used. Also, describe which parts you implemented. */

A. Software Design and NoSQL-Database and Tools Used

For this project, we are using NoSQL as the primary programming language. We are using document structure provided by MongoDB and have hosted a Mongo Atlas Cluster for this analysis. Other data analysis tools and libraries used are Python along with pymongo, scipy.stats, matplotlib, and numpy.

To work with MongoDB, we are using the MongoDB Atlas cluster, which is a cloud-based, fully managed database service that allows us to deploy, operate, and scale our MongoDB databases with ease. We have imported the necessary data into the cluster for analysis.

We are also using pymongo, a Python library for working with MongoDB, which provides an interface between Python and MongoDB, allowing us to execute queries and manage data in MongoDB from within our Python code.

Matplotlib is also being used for data visualization, allowing us to create charts and graphs to better understand the data.The scipy.stats library is particularly useful for statistical analysis, enabling us to perform advanced calculations and make data-driven decisions.

B. Parts that you have implemented

Analysis

1. Analyzing Funding and Acquisition Rates of Companies During COVID-19:

The objective of this analysis is to gain insights into the impact of the COVID-19 pandemic on companies with high

funding, and low layoff rates, even during covid and early stage of funding. We obtained the data from the "covid_layoff_analysis" collection in a database. The dataset includes information on the stage of funding, funds raised, industry, total employees, laid-off count, and COVID-19 cases for each company. Our analysis pipeline focused on identifying companies with high funding, and low layoff rates, even during COVID-19, and early stages of funding. We selected companies in Series A, Series B, Series C, Seed, and Growth stages of funding, which had raised funds greater than 80% of the average funds raised by all companies in the dataset. We then grouped the data by company, stage of funding, funds raised, and industry. We calculated the COVID-19 cases, employee count, layoff count, and average layoff percentage for each group. We filtered the data to include only companies with COVID-19 cases greater than or equal to 20,000, total employees, less than or equal to 5,000, and average layoff percentage less than or equal to 5.

We then sorted the data by average layoff percentage in ascending order and projected the relevant fields. Finally, we obtained the results by executing the aggregation pipeline. Formula used to calculate the company acquisition rate.

*company_acquisition_rate = [((d['employee_total_count'] * (1 - (1/d['funds_raised'])) * (100 - d['avg_layoff_percentage'])) / d['covid_cases']) * 300 for d in result_1]*

2. Investigating the Vulnerability of Low-Funding Companies to Bankruptcy During the COVID-19 Pandemic:

In this analysis, we aim to explore the impact of COVID-19 on low-funding companies with a high layoff rate, despite low COVID-19 cases. It uses the MongoDB aggregation pipeline to filter and group the data in different stages. The pipeline starts with a $match stage that filters companies that have not been in the Seed, Series A, Series B, Series C, Acquired, Bankruptcy, Discontinued, or Growth stages and have raised less than 80% of the average funds raised by the remaining companies. The pipeline then groups the remaining companies by company, stage, funds_raised, and industry, and calculates the sum of COVID-19 cases, maximum employee count, maximum layoff count, and average layoff percentage.

In the next stage, the pipeline filters companies that have had no more than 20,000 COVID-19 cases and an average layoff percentage of at least 5. The pipeline then sorts the results by average layoff percentage in descending order and projects only the relevant fields.

Finally, the pipeline is executed using the aggregate method of the covid_layoff_analysis collection, and the results are printed.

The code then creates plots based on the results of the analysis. It scales down the COVID-19 cases by multiplying them by 0.005 and creates lists for the scaled COVID-19 cases, employee count, and layoff count. It then uses the scatter function of the matplotlib.pyplot module to create a scatter plot of employee count vs. COVID-19 cases and another scatter plot of layoff count vs. COVID-19 cases.
Given below is the formula used to calculate the company bankruptcy rate.

*company_bankruptcy_rate = [((d['employee_total_count'] * (1 - (1/d['funds_raised'])) * (100 - d['avg_layoff_percentage'])) / d['covid_cases']) * 50 for d in result_2]*

3. A Data-Driven Analysis of COVID-19's Impact on Employee Sentiments:

In this analysis, we propose to calculate the employee morale of companies during the pandemic using funding, employee layoff rate, COVID-19 cases, and funding stage data. We will use NoSQL databases to collect and store the data required for this analysis. The objective of this analysis is to understand the impact of the pandemic, company performance and it's layoff rate on the mental well-being of employees. The analysis uses a pipeline to match companies that are not in certain stages (Discontinued, Acquired, Bankruptcy, Growth, Private Equity, Private or Public) and have more than 0 employees. It then groups the data by company, stage, and funds raised and calculates the sum of COVID-19 cases, the maximum number of employees, the maximum number of layoffs, and the average layoff percentage. Finally, it adds a field for employee morale which is determined using a switch statement with multiple conditions based on funds raised, layoff percentage, and COVID-19 cases.

III. Project Outcome

/* Provide easy-to-understand graphs (preferred) or tables and brief explanations of your data analysis results */

A. Analyzing Funding and Acquisition Rates of Companies During COVID-19:

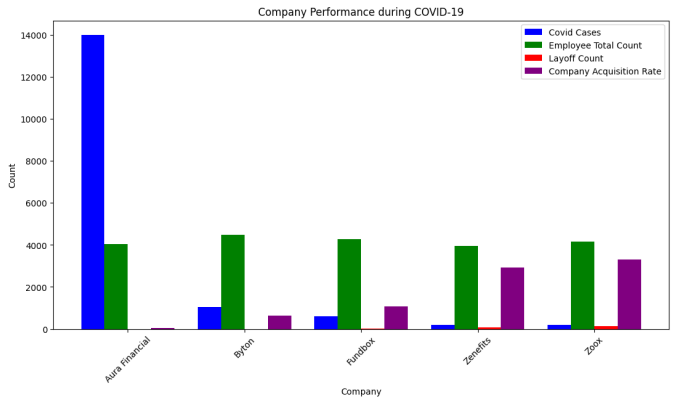

Fig A.1 Analyzing Funding and Acquisition Rates of Companies During COVID-19

The analysis pipeline identified five companies that met our criteria: Byton, Aura Financial, Fundbox, Zenefits, and Zoox. Byton and Aura Financial had high funding, low layoff rates, and no COVID-19 cases. Fundbox had a high funding rate, low COVID-19 cases, and a layoff rate of 0.33. Zenefits had a moderate funding rate, moderate COVID-19 cases, and a layoff rate of 2.21. Zoox had a high funding rate, moderate COVID-19 cases, and a layoff rate of 2.64.

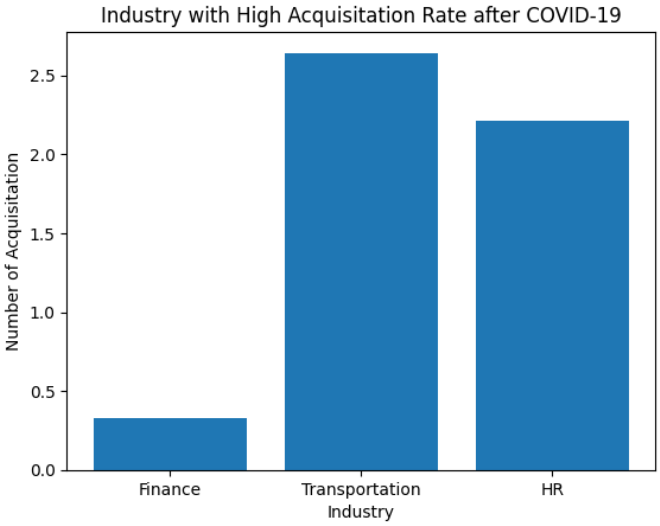

Fig A.2 Analyzing Industries with high Acquisition Rates during/after COVID-19

B. Investigating the Vulnerability of Low Funding Companies to Bankruptcy During the COVID-19 Pandemic:

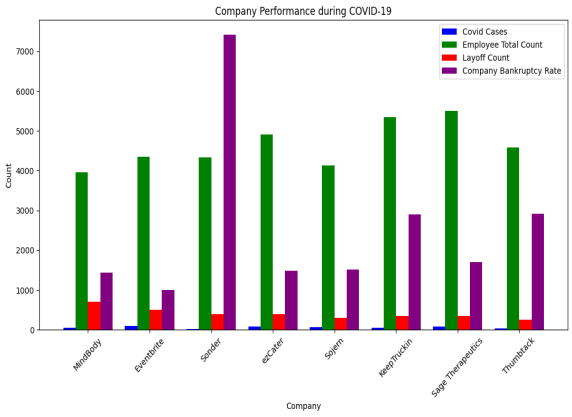

Fig B.1 Low Funding Companies to Bankruptcy During the COVID-19 Pandemic

The analysis identified several companies with high bankruptcy rates after COVID-19. These companies had low funding, high layoff rates, and low COVID-19 cases. The companies identified were MindBody, Eventbrite, Sonder, ezCater, Sojern, KeepTruckin, Sage Therapeutics, and Thumbtack. MindBody had the highest average layoff percentage of 17.71%, followed by Eventbrite with an average layoff percentage of 11.49%.

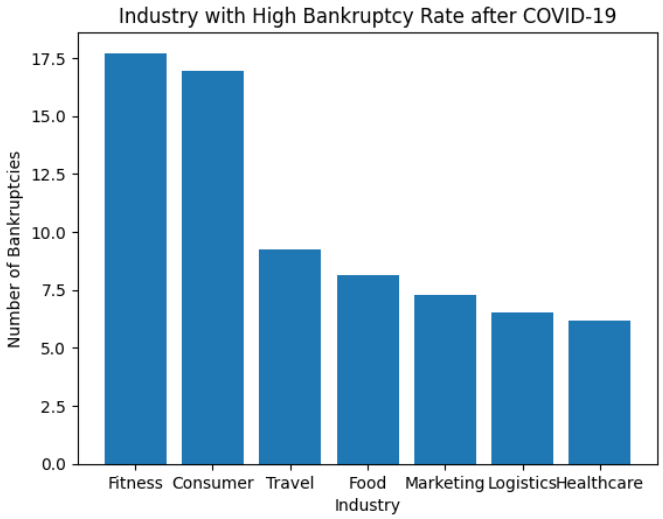

Fig B.2 Analyzing Industries with high Bankruptcy Rates during/after COVID-19

C. A Data-Driven Analysis of COVID-19's Impact on Employee Sentiments:

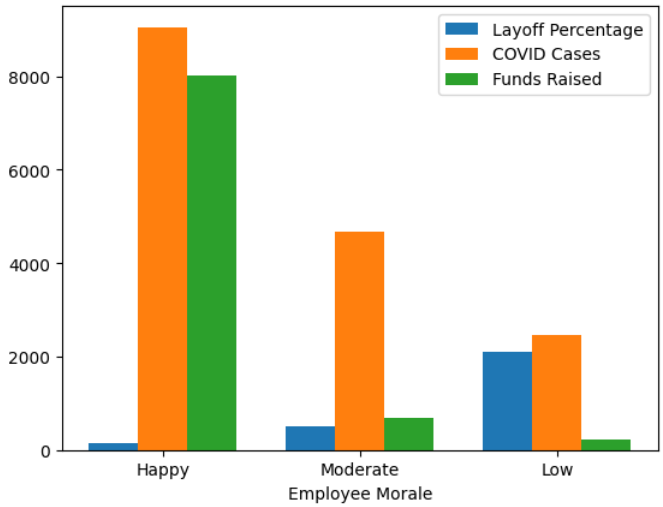

Fig C.1 Data-Driven Analysis of COVID-19's Impact on Employee Sentiments

This analysis show the calculated employee morale for each company based on the factors mentioned above. The morale is categorized as “happy”, “moderate”, “low” or “unknown” depending on the conditions met.

References

[1] Layoff dataset-https://layoffs.fyi/
[2] Covid Dataset- https://github.com/nytimes/covid-19-data (2020 to 2023)