Final Project Report

Predictive Probability and Statistical Analysis of Recession - Layoffs

Team-4:- *Srinikhil Reddy, Krupa Deshmukh, Swaraj Mane, Rohit Salunke, Darshit Merwana, Santosh.R*

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Professor Rehab Ali

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1. INTRODUCTION

In the wake of the COVID-19 pandemic, businesses across the world are grappling with the economic fallout, including job losses and recessionary pressures. Companies like Twitter, Highland Software, Indeed, Wayfair, Salesforce, Cisco, Goldman Sachs, Google, PayPal, McKinsey, Dell, Microsoft, Disney, Accenture, Amazon, and Walmart are no exception.

To mitigate the negative impact of the pandemic on their businesses, these companies have had to adapt to new ways of operating, including remote work, cost-cutting measures, and reevaluating their overall business strategies. However, with the pandemic continuing to disrupt economies worldwide, it is essential for these companies to have a clear understanding of the likelihood of layoffs and potential recessions in the coming years..

This is where predictive probability and statistical analysis come in. By using advanced analytical techniques, companies can gain insights into the statistics of layoffs and the likelihood of recession in the near future. By leveraging this information, they can take proactive measures to mitigate the risks and prepare for potential challenges.

It is crucial to stress and emphasize that this study is NOT a diagnostic method to assist pupils in comprehending and learning about a possible future employment or economic downturn. The project's sole goal is to correlate several industries that have an impact on both US businesses and the country as a whole. This study's stage is to determine what influences recession.

Key factors for Recession:

Various factors can affect the occurrence and severity of recessions in the United States, including monetary policy decisions by the Federal Reserve, government spending and taxation policies, shifts in consumer behavior, disruptions to the financial system, and external factors such as global economic conditions, trade policies, and geopolitical events. These factors can impact economic growth, inflation, and employment levels

- Monetary policy
- Fiscal policy
- Financial system
- Consumer behavior
- External factors

2. **DATA COLLECTION**:-

The following Data represents the name of companies, total number of employees laid off, the total number of employees and the percentage of total no of employees to the number of employees laid off

	A	B	C	D
1	Company	Lay off	Number of Employees	Percentage
2	Coinbase	950	4,510	21.06%
3	Credit Suisse	9000	47860	18.80%
4	Jumia	900	4484	20.07%
5	TripAdvisor	900	4194	21.46%
6	Ericsson	8500	101322	8.39%
7	Salesforce	8000	79824	10.02%
8	Disney	7000	223000	3.14%
9	DocuSign	700	7338	9.54%
10	Lyft	683	4369	15.63%
11	Dell	6600	133000	4.96%
12	Hewlett Packard	6000	58000	10.34%
13	Philips	6000	75000	8.00%
14	Spotify	600	10,151	5.91%
15	Walmart	600	2,100,000	0.03%
16	eBay	500	13300	3.76%
17	Groupon	500	3,500	14.29%
18	TomTom	500	4500	11.11%
19	Micron	5,000	48,000	10.42%
20	ZipRecruiter	492	1000	49.20%
21	Crypto . com	490	4,000	12.25%
22	Compass	450	513,707	0.09%
23	Cisco	4000	41,163	9.72%
24	Electrolux	4000	48652	8.22%
25	Carvana	4,000	16,600	24.10%
26	IBM	3900	345,000	1.13%
27	Peloton	3825	8,662	44.16%
28	Twitter	3700	7500	49.33%
29	Robinhood	340	2,400	14.17%
30	Stitch Fix	330	7,920	4.17%
31	Goldman Sachs	3200	40,000	8.00%
32	Booking . com	3000	19,400	15.46%

Fig 2.1: No.of employees laid off and their equivalent percentage.

The data was collected to showcase the respective hiring rate and layoffs in order to get the accurate reading of the statistical analysis. By studying the ongoing recession and the respective layoffs the data collected was with respect to each company and the positions that have been laid off. The excel shown below shows us the Statistics of each month(2019-2021) and the Gdp of the USA. With this we start the drop of GDP in this country which gives us the insights of the statistical data.

11	Frequency: Monthly				Frequency: Quarterly	
12	Date	Layoff	Hires	Fed rates	Time Frame	Gdp
13	2019-06-01	33	103	2.4	01-01-2019	21013.085
14	2019-07-01	58	106	2.4	01-04-2019	21272.448
15	2019-08-01	35	93	2.41	01-07-2019	21531.839
16	2019-09-01	34	93	2.42	01-10-2019	21706.532
17	2019-10-01	34	111	2.39	01-01-2020	21538.032
18	2019-11-01	28	86	2.38	01-04-2020	19636.731
19	2019-12-01	55	70	2.4	01-07-2020	21362.428
20	2020-01-01	38	88	2.13	01-10-2020	21704.706
21	2020-02-01	26	86	2.04	01-01-2021	22313.85
22	2020-03-01	188	61	1.83	01-04-2021	23046.934
23	2020-04-01	170	35	1.55	01-07-2021	23550.42
24	2020-05-01	34	77	1.55	01-10-2021	24349.121
25	2020-06-01	43	64	1.55	01-01-2022	24740.48
26	2020-07-01	21	94	1.58	01-04-2022	25248.476
27	2020-08-01	27	96	0.65	01-07-2022	25723.941
28	2020-09-01	19	106	0.05	01-10-2022	26137.992
29	2020-10-01	31	145	0.05		
30	2020-11-01	27	79	0.08		
31	2020-12-01	36	52	0.09		
32	2021-01-01	31	106	0.1		
33	2021-02-01	21	84	0.09		
34	2021-03-01	23	88	0.09		
35	2021-04-01	27	111	0.09		
36	2021-05-01	25	117	0.09		
37	2021-06-01	38	116	0.09		
38	2021-07-01	25	123	0.08		

Fig 2.2: Statistics of each month(2019-2021) and the Gdp of USA

The following data is of the number of layoffs, hires, and federal rate from January 2022 to December 2023.The border table data is for the Gdp of the USA from January 2019 to October 2022.(Table 2.1)
The collected data shows the statistical analysis of recession and its representative layoffs which gives us an insight on how it started and how its ending with respect to the companies and their target positions. Data for Layoff , hires , federal rate and GDp from time period 1st january
The data was taken from various sources that shows us how many layoffs have happened from the mentioned companies. The target companies were the multinational companies which gives us a better understanding of the reasons behind the mass layoffs.

3. DATA VISUALISATION :-

```
16
17  par(mfrow=c(1,1))
18  barplot(main_data$Percentage~main_data$Company,las=2,ylab="Percentage",xlab="",
19          cex.lab=1.0,ylim=c(0,50),cex.names=0.5,col=rainbow(5),
20          main="Bar Plot for Companies with layoff Percentage ",
21          cex.main=1.0)
22
```

Fig 3.1: R Code for the plot of companies with layoffs.

The mfrow and mfcol parameters allow you to create a matrix of plots in one plotting space. Both parameters take a vector of length two as an argument, corresponding to the number of rows and columns

The bar graph represents the percentage of employees laid off in the companies. Each company has its own layoff percentage which gives us the insights of the respective drop in the recession.

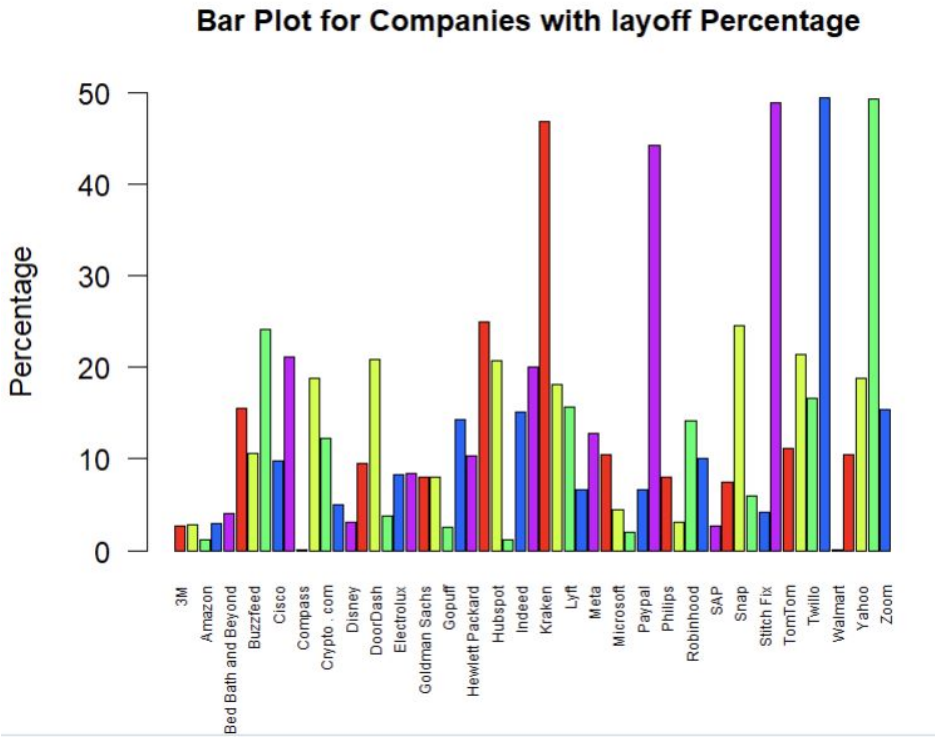

Fig 3.2 : Data of each company with their respective layoff percentage in bar graph.

Correlation:

The correlation between layoff percentage and layoff number can be negative. This means that as the layoff percentage increases, the layoff number can decrease. In other words, the more employees a company lays off as a percentage of its total workforce, the fewer employees it will lay off in total.

There are a number of reasons why this correlation can exist. First, companies may lay off employees in order to improve their efficiency. If a company has too many employees, it may be able to operate

more efficiently by laying off some of them. This can lead to a lower layoff percentage, as well as a lower layoff number.

Second, companies may lay off employees in order to change their business strategy. If a company is changing the way it does business, it may need to lay off employees who are no longer needed. This can also lead to a lower layoff percentage, as well as a lower layoff number.

Finally, companies may lay off employees in order to improve their financial performance. If a company is losing money, it may need to reduce its workforce in order to save money. This can lead to a lower layoff percentage, as well as a lower layoff number.

It is important to note that the correlation between layoff percentage and layoff number is not perfect. There are a number of factors that can affect the number of layoffs that a company makes, even if the layoff percentage is the same. For example, a company may lay off more employees in one year than in another year, even if the layoff percentage is the same.

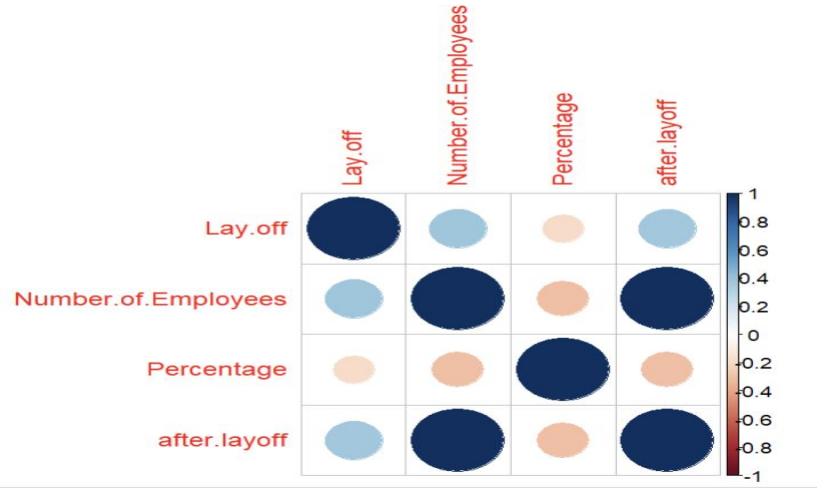

Fig 3.3: Correlation Table

```r
main_data<-read.csv("FINAL DATA.csv")
main_data<-na.omit(main_data)
main_data$Percentage<-gsub("%","",as.character(main_data$Percentage))
main_data$Percentage<-as.numeric(main_data$Percentage)
summary(main_data)
main_data<-na.omit(main_data)
corTable <- cor(main_data[sapply(main_data, is.numeric)])
corTable
corrplot(corTable)
```

Fig 3.4 : R Code for Correlation.

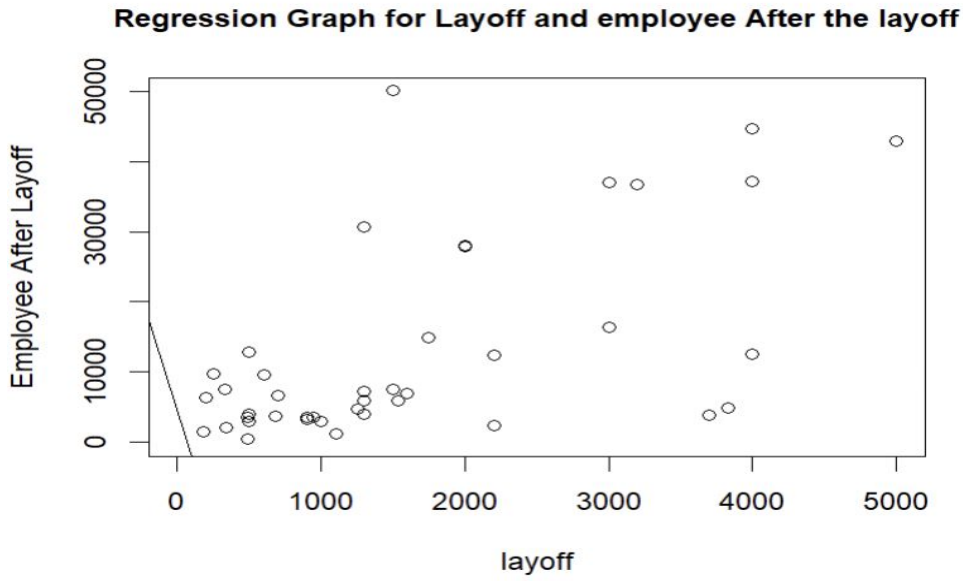

Fig 3.5 : Regression graph for Layoff

The regression graph shows us the explicit representation of the employment after layoffs with respect to the top companies under the recession data.

```r
plot(main_data$after.layoff~main_data$Lay.off,xlim=c(0,5000),ylim=c(0,50000))
model<-lm(main_data$Lay.off~main_data$Percentage)
model
abline(lm(main_data$Lay.off~main_data$Percentage))
```

Fig 3.6 : R code the represent the scatter plot of layoffs

GDP:-

Fig 3.7 : Graph for layoff vs hires during recent time and its analysis

Layoffs can significantly affect GDP (Gross Domestic Product) since they may result in lower consumer spending. Consumer spending may fall when people lose their jobs since they normally have less money to spend. Businesses might see a drop in sales as a result, which might result in more layoffs or even bankruptcy. This could start a negative spiral that has a big effect on the economy as a whole.

```
# Create a data frame from the sample data
df <- data.frame(
  date = as.Date(c("2022-01-01", "2022-02-01", "2022-03-01", "2022-04-0
  value1 = c(77, 8, 17, 32, 28, 39, 33, 56, 29, 45, 39, 54, 61, 47, 80,
  value2 = c(136, 70, 94, 102, 122, 131, 115, 125, 108, 123, 106, 63, 8
)

# Set up the plot with a larger size
plot(df$date, df$value1, type="l", col="blue", lwd=2, ylim=c(0,150), xl
lines(df$date, df$value2, type="l", col="red", lwd=2)

# Add more positions to x-axis
axis(1, at=seq(as.Date("01-01"), as.Date("12-01"), by="month"), format=

# Add a legend
legend("topright", legend=c("value1", "value2"), col=c("blue", "red"),
```

Fig 3.8 : Data set for layoff and hires vs time.

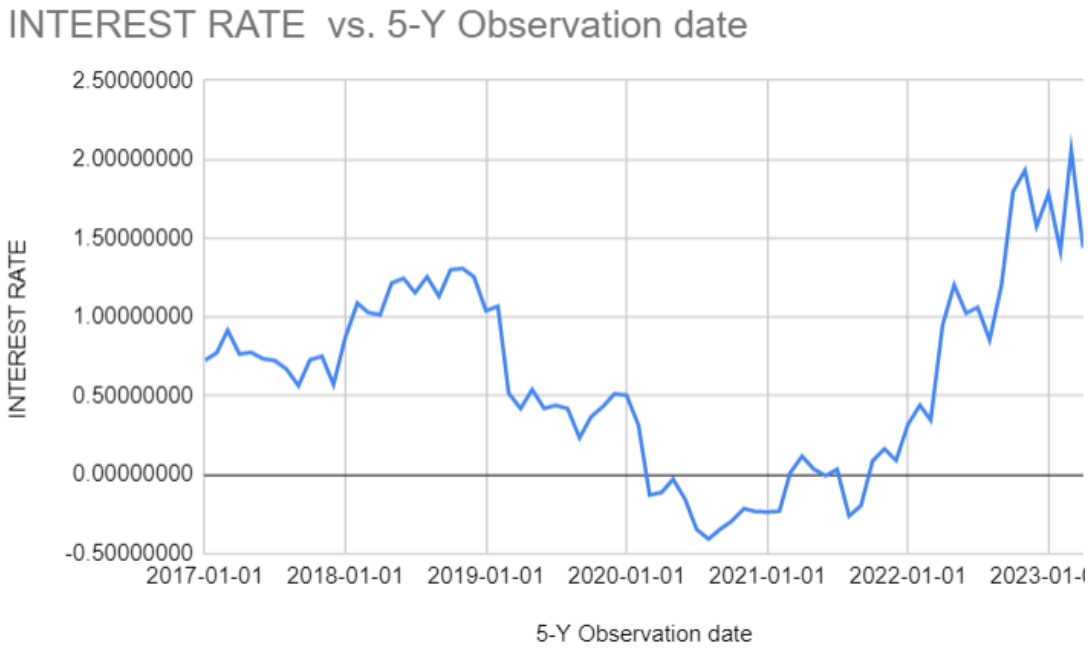

Fig. 3.9: Graph shows 5Years interest rates

According to the Federal Reserve, when inflation hit the economy hard in June 2022, consumers experienced price rises of 9.1% as opposed to the average yearly rate of 2% for sustained inflation. The U.S. Bureau of Labor Statistics (BLS) reports that the inflation rate in 2022 was the highest in 40 years. As consumers began to buy fewer goods in order to meet these increased prices, the economy weakened. Interest rates were increased by the Federal Reserve seven times in 2022, and they may be increased again in 2023. Because of higher costs, higher interest rates have an impact on how much a corporation wants to borrow.. When the economy's future is uncertain, businesses do not want to make investments in riskier sectors. Companies rethink their employment and expansion strategies as a result.

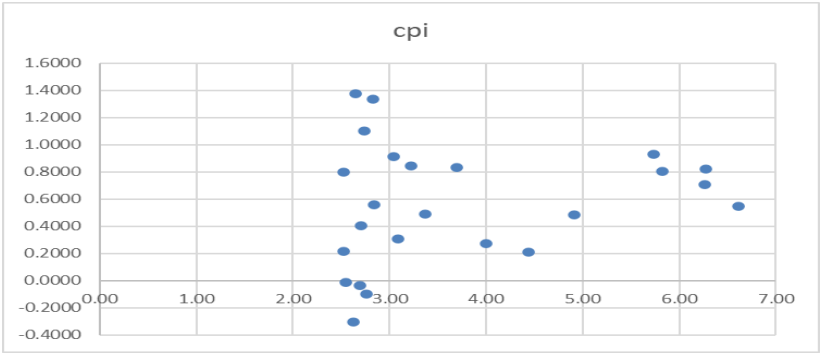

Fig 3.10 : CPI vs FED rate and its correlation to the layoff

Unemployment Reflecting the expected slowdown in economic growth, the overall rate of unemployment is projected to rise from 3.6 percent in the fourth quarter of 2022 to 5.1 percent by the end of 2023, averaging 4.7 percent for 2023 as a whole. Thereafter, the unemployment rate is projected to decline gradually beginning in the second quarter of 2024, falling to 4.5 percent by the end of 2027.

4. STATISTICAL ANALYSIS

4.1) Hypothesis testing:-

```
> #t-test
> t.test(main_data$Lay.off,main_data$after.layoff,paired=TRUE,conf.level=0.9)

        Paired t-test

data:  main_data$Lay.off and main_data$after.layoff
t = -2.5811, df = 58, p-value = 0.0124
alternative hypothesis: true mean difference is not equal to 0
90 percent confidence interval:
 -192677.54  -41210.59
sample estimates:
mean difference
      -116944.1
```

Fig 4.1: Hypothesis Result

The two-sample t-test is used to test the null hypothesis that the means of the two groups are equal. The alternative hypothesis is that the means of the two groups are not equal. The test statistic is a t-statistic, which is calculated by dividing the difference between the means of the two groups by the standard error of the difference in means.

The p-value is the probability of obtaining a t-statistic that is at least as extreme as the one that was calculated, assuming that the null hypothesis is true. If the p-value is less than the significance level, then the null hypothesis is rejected.

The assumptions of the two-sample t-test are that the data is normally distributed, that the variances of the two groups are equal, and that the samples are independent.

4.2) Confidence Interval:

Considering the sample size (n = 59), we found the CI for layoffs. The area under the standard normal curve lies between -1.64 and +1.64 for confidence intervals taken at confidence level 0.90.
CI is given by the following formula:
$(\bar{X} - 1.64 * \sigma/\sqrt{n}), (\bar{X} + 1.64* \sigma/\sqrt{n})$
We calculated the confidence interval in following categories:

1. **Total Layoffs**

Sample size (n) = 59
Sample mean ($\bar{X}$) = 3394
Std deviation(σ) = 4071.709
For this problem, the Lower value is 2525 and Upper Value is 4260.

2. **Number of employees**

Sample size (n) = 59
Sample mean ($\bar{X}$) = 123732
Std deviation(σ) = 351084.2
For this problem, the Lower value is 48772 and Upper Value is 198692.

3. **Number of employees after layoffs**

Sample size (n) = 59
Sample mean ($\bar{X}$) = 120338
Std deviation(σ) = 349527.6
For this problem, the Lower value is 45710 and Upper Value is 194967.

4. **Percentage of number of employees to layoffs**

Sample size (n) = 59
Sample mean ($\bar{X}$) = 13.53
Std deviation(σ) = 12.48
For this problem, the Lower value is 10.865 and Upper Value is 16.19.

We have found the mean, median, min, max of total layoffs, total no of employees in a company, percentage of no of employees to that of layoff and number of employees after the layoff

4.3) Mean, Median, Min/Max:-

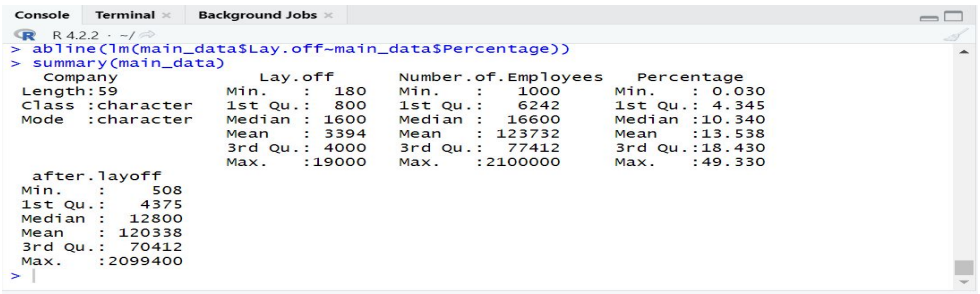

Fig 4.2 : mean, median, min max of total layoffs, total no.of employees laid off

4.4) Variance:-

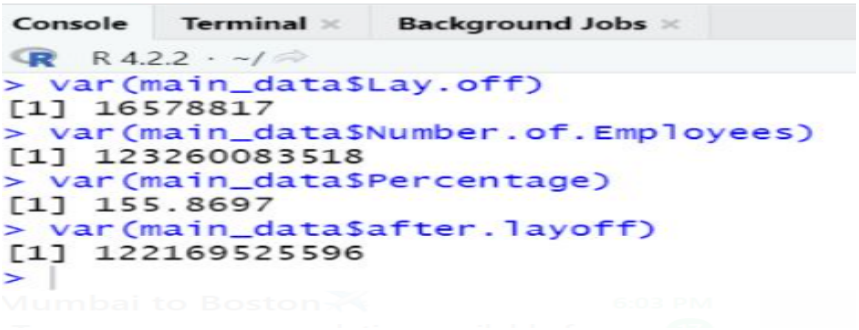

Fig 4.3 : variance

Conclusion:

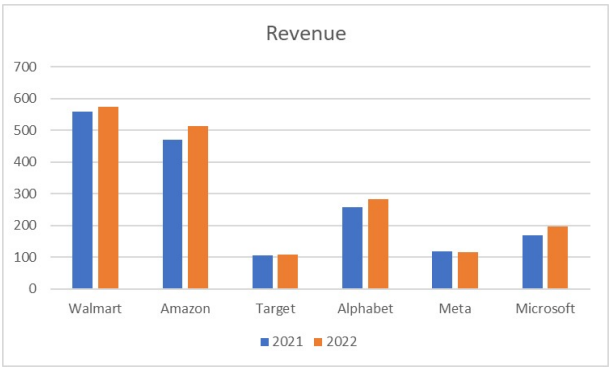

Fig: 4.4 Total Revenue of companies

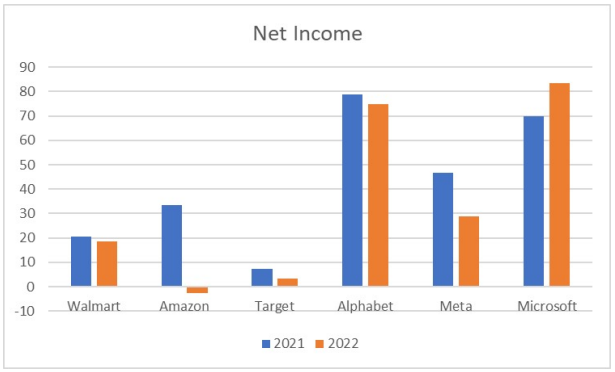

Fig:4.5 Net Income of companies

The two graphs represent the revenue and net income of the companies. Comparing these two graphs, we can see that there is significant change in the total income of some of the companies whereas the revenue changes slightly. Hence, we can say that this is a potential reason for companies to layoff employees and may continue till the profit increases.

In conclusion, integrating statistical analysis and predictive probability may assist companies in recognizing possible dangers and getting ready for issues in the future. Companies may make data-driven decisions to reduce risks like layoffs or recession by utilizing previous data and recognizing patterns and trends. Recognizing that predicted probability is not a guarantee and that unforeseen occurrences might still happen is crucial. Hence, to maintain their sustainability and success, businesses should regularly assess their strategy and make any necessary adjustments like Apple who didn't lay off any employees and Walmart which laid off very few employees in comparison to their workforce.

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