FRA Project (Milestone-2)

By Akansha Pruthi

PGP – DSBA JAN 2021

Credit Risk and Market Risk Analysis

Objective

Milestone-2 of the FRA project will cover the model comparison for credit risk and a case study on market risk.

Problem Statement

Problem Statement

Credit Risk

Businesses or companies can fall prey to default if they are not able to keep up their debt obligations. Defaults will lead to a lower credit rating for the company which in turn reduces its chances of getting credit in the future and may have to pay higher interests on existing debts as well as any new obligations. From an investor's point of view, he would want to invest in a company if it can handle its financial obligations, can grow quickly, and is able to manage the growth scale.

A balance sheet is a financial statement of a company that provides a snapshot of what a company owns, owes, and the amount invested by the shareholders. Thus, it is an important tool that helps evaluate the performance of a business.

Data that is available includes information from the financial statement of the companies for the previous year (2015). Also, information about the Net worth of the company in the following year (2016) is provided which can be used to drive the labelled field.

Market Risk

The dataset contains 6 years of information (weekly stock information) on the stock prices of 10 different Indian Stocks. Calculate the mean and standard deviation on the stock returns and share insights.

Data Dictionary for credit risk:

Field Name	Description
Co_Code	Company Code
Co_Name	Company Name
Networth Next Year	Value of a company as on 2016 - Next Year(difference between the value of total assets and total liabilities)
Equity Paid Up	Amount that has been received by the company through the issue of shares to the shareholders
Networth	Value of a company as on 2015 - Current Year
Capital Employed	Total amount of capital used for the acquisition of profits by a company
Total Debt	The sum of money borrowed by the company and is due to be paid
Gross Block	Total value of all of the assets that a company owns

Net Working Capital	The difference between a company's current assets (cash, accounts receivable, inventories of raw materials and finished goods) and its current liabilities (accounts payable).
Current Assets	All the assets of a company that are expected to be sold or used as a result of standard business operations over the next year.
Current Liabilities and Provisions	Short-term financial obligations that are due within one year (includes amount that is set aside cover a future liability)
Total Assets/Liabilities	Ratio of total assets to liabailities of the company
Gross Sales	The grand total of sale transactions within the accounting period
Net Sales	Gross sales minus returns, allowances, and discounts
Other Income	Income realized from non-business activities (e.g. sale of long term asset)
Value Of Output	Product of physical output of goods and services produced by company and its market price
Cost of Production	Costs incurred by a business from manufacturing a product or providing a service
Selling Cost	Costs which are made to create the demand for the product (advertising expenditures, packaging and styling, salaries, commissions and travelling expenses of sales personnel, and the cost of shops and showrooms)
PBIDT	Profit Before Interest, Depreciation & Taxes
PBDT	Profit Before Depreciation and Tax
PBIT	Profit before interest and taxes
PBT	Profit before tax
PAT	Profit After Tax
Adjusted PAT	Adjusted profit is the best estimate of the true profit
Retained Earning	Earnings after adjusting to dividends, mergers ,etc
CP	Commercial paper , a short-term debt instrument to meet short-term liabilities.
Revenue earnings in forex	Revenue earned in foreign currency
Revenue expenses in forex	Expenses due to foreign currency transactions
Capital expenses in forex	Long term investment in forex
Book Value (Unit Curr)	Net asset value
Book Value (Adj.) (Unit Curr)	Book value adjusted to reflect asset's true fair market value
Market Capitalisation	Product of the total number of a company's outstanding shares and the current market price of one share
CEPS (annualised) (Unit Curr)	Cash Earnings per Share, profitability ratio that measures the financial performance of a company by calculating cash flows on a per share basis
Cash Flow From Operating Activities	Use of cash from ongoing regular business activities
Cash Flow From Investing Activities	Cash used in the purchase of non-current assets–or long-term assets– that will deliver value in the future

Cash Flow From Financing Activities	Net flows of cash that are used to fund the company (transactions involving debt, equity, and dividends)
ROG-Net Worth (%)	Rate of Growth - Networth
ROG-Capital Employed (%)	Rate of Growth - Capital Employed
ROG-Gross Block (%)	Rate of Growth - Gross Block
ROG-Gross Sales (%)	Rate of Growth - Gross Sales
ROG-Net Sales (%)	Rate of Growth - Net Sales
ROG-Cost of Production (%)	Rate of Growth - Cost of Production
ROG-Total Assets (%)	Rate of Growth - Total Assets
ROG-PBIDT (%)	Rate of Growth- PBIDT
ROG-PBDT (%)	Rate of Growth- PBDT
ROG-PBIT (%)	Rate of Growth- PBIT
ROG-PBT (%)	Rate of Growth- PBT
ROG-PAT (%)	Rate of Growth- PAT
ROG-CP (%)	Rate of Growth- CP
ROG-Revenue earnings in forex (%)	Rate of Growth - Revenue earnings in forex
ROG-Revenue expenses in forex (%)	Rate of Growth - Revenue expenses in forex
ROG-Market Capitalisation (%)	Rate of Growth - Market Capitalisation
Current Ratio[Latest]	Liquidity ratio, company's ability to pay short-term obligations or those due within one year
Fixed Assets Ratio[Latest]	Solvency ratio, the capacity of a company to discharge its obligations towards long-term lenders indicating
Inventory Ratio[Latest]	Activity ratio, specifies the number of times the stock or inventory has been replaced and sold by the company
Debtors Ratio[Latest]	Measures how quickly cash debtors are paying back to the company
Total Asset Turnover Ratio[Latest]	The value of a company's revenues relative to the value of its assets
Interest Cover Ratio[Latest]	Determines how easily a company can pay interest on its outstanding debt
PBIDTM (%)[Latest]	Profit before Interest Depreciation and Tax Margin
PBITM (%)[Latest]	Profit Before Interest Tax Margin
PBDTM (%)[Latest]	Profit Before Depreciation Tax Margin
CPM (%)[Latest]	Cost per thousand (advertising cost)
APATM (%)[Latest]	After tax profit margin
Debtors Velocity (Days)	Average days required for receiving the payments
Creditors Velocity (Days)	Average number of days company takes to pay suppliers
Inventory Velocity (Days)	Average number of days the company needs to turn its inventory into sales
Value of Output/Total Assets	Ratio of Value of Output (market value) to Total Assets
Value of Output/Gross Block	Ratio of Value of Output (market value) to Gross Block

Stock Companies in the given data set are:

Infosys	Indian Hotel	Mahindra & Mahindra	Axis Bank	SAIL	Shree Cement	Sun Pharma	Jindal Steel	Idea Vodafone	Jet Airways

Brief Information about Credit risk data set:

- 3586 rows and 67 columns.
- 103 missing values in 64th column.
- Data types are object, int and float.
- No duplicate values.
- Missing values treated using imputation.
- Outliers present and treat using capping method (explained in FRA 1)
- Transformed target variable into 0 and 1.
- Split the data into train and test data set with ratio 67:33 and random state = 42.

Random Forest Model on Train Dataset

Decision tree in Python can take only numerical / categorical columns. It cannot take string/object types.

The following code loops through each column and checks if the column type is object, then converts those columns into categorical with each distinct value becoming a category or code.

Checking info of the data:

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3586 entries, 0 to 3585
Data columns (total 67 columns):
 #   Column                              Non-Null Count  Dtype
---  ------                              --------------  -----
 0   Co_Code                             3586 non-null   float64
 1   Networth_Next_Year                  3586 non-null   float64
 2   Equity_Paid_Up                      3586 non-null   float64
 3   Networth                            3586 non-null   float64
 4   Capital_Employed                    3586 non-null   float64
 5   Total_Debt                          3586 non-null   float64
 6   Gross_Block                         3586 non-null   float64
 7   Net_Working_Capital                 3586 non-null   float64
 8   Current_Assets                      3586 non-null   float64
 9   Current_Liabilities_and_Provisions  3586 non-null   float64
 10  Total_Assets_by_Liabilities         3586 non-null   float64
 11  Gross_Sales                         3586 non-null   float64
 12  Net_Sales                           3586 non-null   float64
 13  Other_Income                        3586 non-null   float64
 14  Value_Of_Output                     3586 non-null   float64
 15  Cost_of_Production                  3586 non-null   float64
 16  Selling_Cost                        3586 non-null   float64
 17  PBIDT                               3586 non-null   float64
 18  PBDT                                3586 non-null   float64
 19  PBIT                                3586 non-null   float64
 20  PBT                                 3586 non-null   float64
 21  PAT                                 3586 non-null   float64
 22  Adjusted_PAT                        3586 non-null   float64
 23  CP                                  3586 non-null   float64
 24  Revenue_earnings_in_forex           3586 non-null   float64
 25  Revenue_expenses_in_forex           3586 non-null   float64
 26  Capital_expenses_in_forex           3586 non-null   float64
 27  Book_Value_Unit_Curr                3586 non-null   float64
 28  Book_Value_Adj_Unit_Curr            3586 non-null   float64
 29  Market_Capitalisation               3586 non-null   float64
 30  CEPS_annualised_Unit_Curr           3586 non-null   float64
 31  Cash_Flow_From_Operating_Activities 3586 non-null   float64
 32  Cash_Flow_From_Investing_Activities 3586 non-null   float64
 33  Cash_Flow_From_Financing_Activities 3586 non-null   float64
 34  ROG Net Worth perc                  3586 non-null   float64
```

```
rfcl = RandomForestClassifier(n_estimators = 501)
rfcl = rfcl.fit(X_train, train_labels)
```

Ensemble Random Forest Classifier

```
GridSearchCV(cv=3, estimator=RandomForestClassifier(),
             param_grid={'max_depth': [7, 10], 'max_features': [4, 6],
                         'min_samples_leaf': [50, 100],
                         'min_samples_split': [150, 300],
                         'n_estimators': [301, 501]})
```

Grid Search – Best parameters on train data set

```
{'max_depth': 7,
 'max_features': 6,
 'min_samples_leaf': 50,
 'min_samples_split': 300,
 'n_estimators': 501}
```

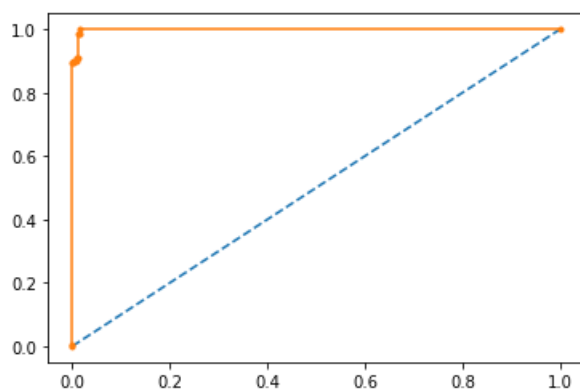# Validating the model on test data set:

Confusion Matrix:
```
array([[1038,    3],
       [  14,  129]], dtype=int64)
```

Classification Matrix:

	precision	recall	f1-score	support
0	0.99	1.00	0.99	1041
1	0.98	0.90	0.94	143
accuracy			0.99	1184
macro avg	0.98	0.95	0.97	1184
weighted avg	0.99	0.99	0.99	1184

AOC & ROC Curve on test data set:

AUC: 0.999

Building LDA Model on train data set.

```
clf = LinearDiscriminantAnalysis()
model=clf.fit(X_train,y_train)
model
```

```
LinearDiscriminantAnalysis()
```

Validating the LDA model

Confusion Matrix:
```
array([[3192,    6],
       [ 387,    1]], dtype=int64)
```

Classification Report:

|	precision	recall	f1-score	support
0	0.89	1.00	0.94	3198
1	0.14	0.00	0.01	388
accuracy			0.89	3586
macro avg	0.52	0.50	0.47	3586
weighted avg	0.81	0.89	0.84	3586

2.1 Draw Stock Price Graph (Stock Price vs Time) for any 2 given stocks with inference

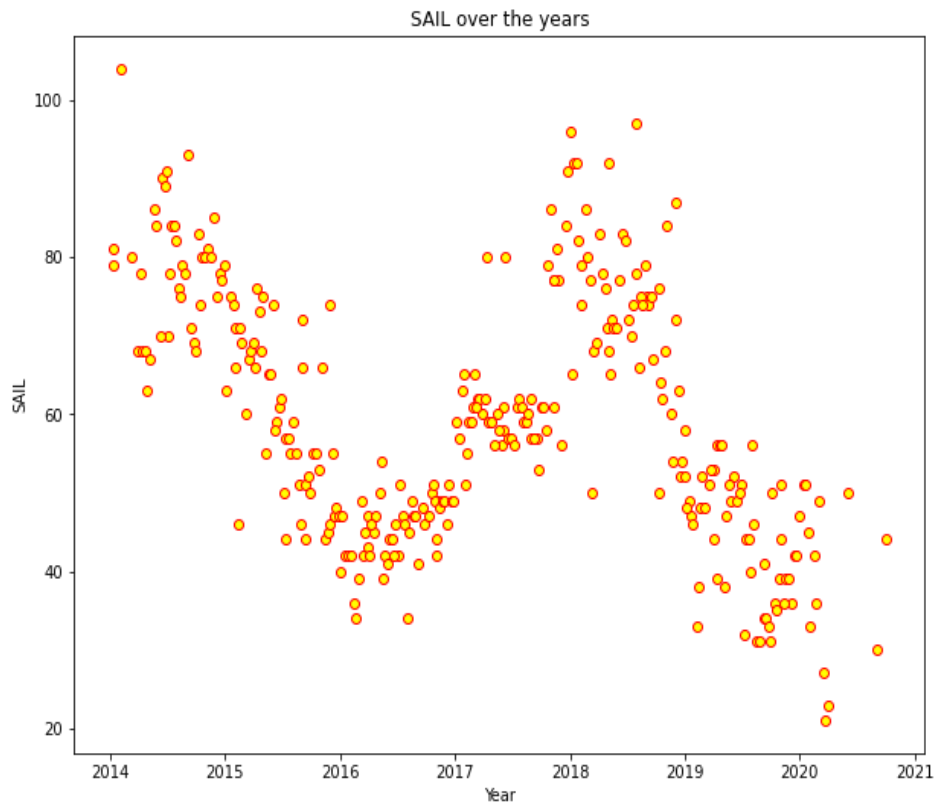Basic EDA of Market risk data set:

- 314 rows and 11 columns
- Zero missing values
- 1 column is object data type and 10 are int data type.
- It has date column.

Plotting graph (stock price vs Time) for any 2 companies:

1. Infosys

Infosys over the years

2. SAIL

SAIL over the years
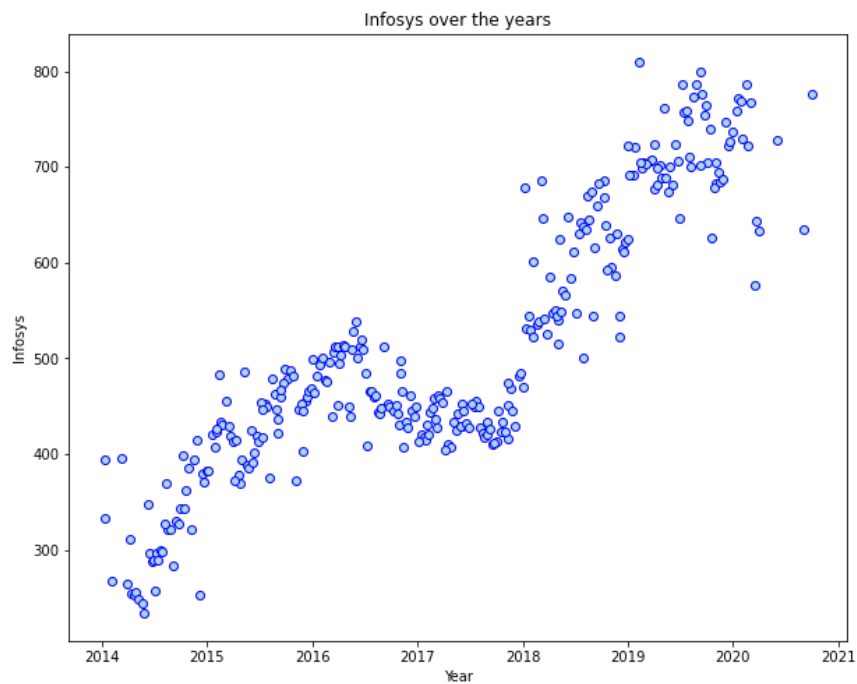
Inferences:

1. Infosys – has the increasing trend with the seasonality. Stock prices fall in 2018 and then again goes up as seen in the above graph. Also, we can see that in 2021 graph scattered in a broad range.

2. SAIL – has the decreasing trend in average. But it has the highest stock prices in year 2014 and then in 2018. After that its falling. It also has the seasonality.

2.2. **Calculate Returns for all stocks with inference.**
2.3. **Calculate Stock Means and Standard Deviation for all stocks with inference**

Steps for calculating returns from prices:

- Take logarithms
- Take differences

Firstly, we drop the date column from the data set to analyse the returns.

Let's look at the data info after dropping the date column:

	Infosys	Indian_Hotel	Mahindra_&_Mahindra	Axis_Bank	SAIL	Shree_Cement	Sun_Pharma	Jindal_Steel	Idea_Vodafone	Jet_Airways
0	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1	-0.026873	-0.014599	0.006572	0.048247	0.028988	0.032831	0.094491	-0.065882	0.011976	0.086112
2	-0.011742	0.000000	-0.008772	-0.021979	-0.028988	-0.013888	-0.004930	0.000000	-0.011976	-0.078943
3	-0.003945	0.000000	0.072218	0.047025	0.000000	0.007583	-0.004955	-0.018084	0.000000	0.007117
4	0.011788	-0.045120	-0.012371	-0.003540	-0.076373	-0.019515	0.011523	-0.140857	-0.049393	-0.148846

We now look at Means & Standard Deviations of these returns

Stock Means: Average returns that the stock is making on a week-to-week basis

Stock Standard Deviation: It is a measure of volatility meaning the more a stock's returns vary from the stock's average return, the more volatile the stock

Calculating stock means

```
Infosys                 0.002794
Indian_Hotel            0.000266
Mahindra_&_Mahindra    -0.001506
Axis_Bank               0.001167
SAIL                   -0.003463
Shree_Cement            0.003681
Sun_Pharma             -0.001455
Jindal_Steel           -0.004123
Idea_Vodafone          -0.010608
Jet_Airways            -0.009548
dtype: float64
```
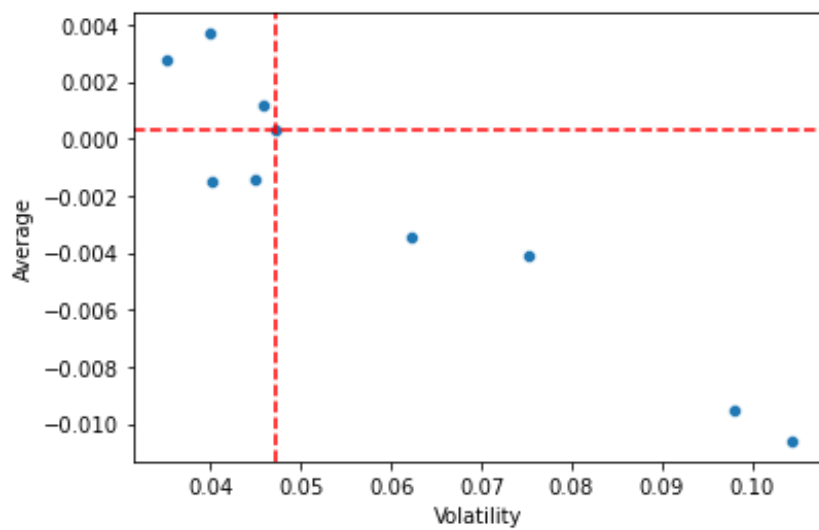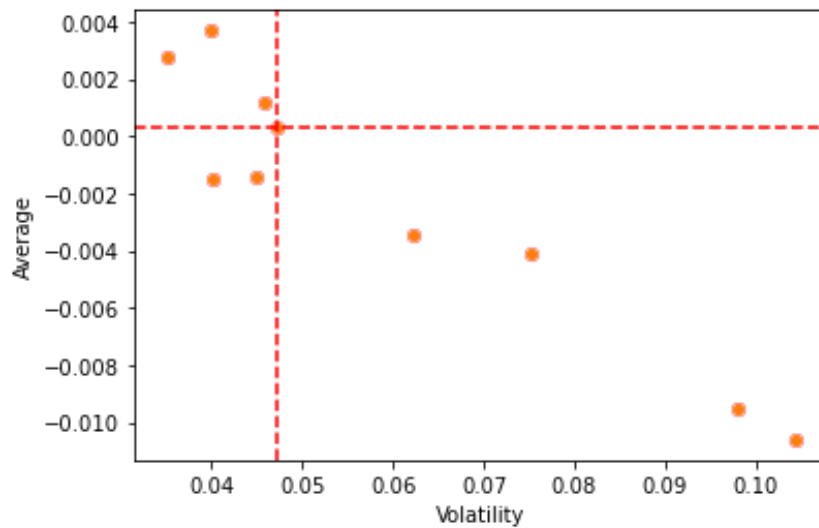
Calculating stock standard deviation

```
Infosys                 0.035070
Indian_Hotel            0.047131
Mahindra_&_Mahindra     0.040169
Axis_Bank               0.045828
SAIL                    0.062188
Shree_Cement            0.039917
Sun_Pharma              0.045033
Jindal_Steel            0.075108
Idea_Vodafone           0.104315
Jet_Airways             0.097972
dtype: float64
```

Returns:

	Average	Volatility
Infosys	0.002794	0.035070
Indian_Hotel	0.000266	0.047131
Mahindra_&_Mahindra	-0.001506	0.040169
Axis_Bank	0.001167	0.045828
SAIL	-0.003463	0.062188
Shree_Cement	0.003681	0.039917
Sun_Pharma	-0.001455	0.045033
Jindal_Steel	-0.004123	0.075108
Idea_Vodafone	-0.010608	0.104315
Jet_Airways	-0.009548	0.097972

2.4 Draw a plot of Stock Means vs Standard Deviation

	Average	Volatility
Infosys	0.002794	0.035070
Shree_Cement	0.003681	0.039917
Axis_Bank	0.001167	0.045828

Conclusion:

Stock with a lower mean & higher standard deviation do not play a role in a portfolio that has competing stock with more returns & less risk. Thus, for the data we have here, we are only left few stocks:

- Ones with higher return for a comparative or lower risk are considered better

THE END