EXPOSYS DATA LABS

INTERNSHIP PROJECT REPORT On

ML MODEL WHICH CAN PREDICT THE PROFIT VALUE OF A COMPANY

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ABSTRACT

Predicting the profit value of a company is a crucial aspect of business planning and decision-making. Machine learning (ML) offers a powerful approach to developing predictive models that can accurately forecast a company's financial performance based on various factors, including research and development (R&D) spend, administration costs, and marketing expenditures. In this paper, we explore the potential of ML models to predict company profit based on R&D spend, administration costs, and marketing expenditures. We discuss the theoretical underpinnings of ML regression models and present a case study of applying multiple linear regression to predict the profit of a sample of companies. The results demonstrate that the ML model can effectively predict company profit with a high degree of accuracy. This suggests that ML models can be valuable tools for businesses seeking to make informed decisions about R&D investments, administrative expenses, and marketing strategies to maximize profitability.

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Introduction

This Profit Prediction Model aims at predicting the profit of the start-up based on the values of Administration Spend, R&D Spend, Marketing Spend and Location using different machine learning algorithms. The dataset consists of the data of 50 start-ups. The dataset consists of the values of four parameters which are R&D Spend, Marketing Spend, Administration Spend in which the start-up is located. The selected dataset is then fed for further processing. Data Pre processing including data cleaning and outlier removal is Profit Prediction Model using Machine learning Algorithms done. The pre-processed data is then trained and tested. Out of the complete dataset, 30% of the dataset is used for testing purpose and the remaining 70% precent of the dataset is used for training.

This Model will be helpful for the people willing to set up their new business firms and for the investors as well. It will be helpful for the owners of the start-up to analyse the links between the success parameters and the criteria.

Key Components of the ML Model:

1. **Data Collection and Preprocessing:**
   - Gathering relevant financial and operational data, including revenue, expenses, market trends, and key performance indicators (KPIs).
   - Cleaning and preprocessing the data to handle missing values, outliers, and ensure consistency.
2. **Feature Selection:**
   - Identifying the most influential features that contribute to a company's profitability.
   - Considering variables such as sales growth, cost structures, market conditions, and industry benchmarks.
3. **Algorithm Selection:**
   - Choosing appropriate ML algorithms based on the nature of the data and the prediction task.
   - Common algorithms include linear regression, decision trees, random forests, and neural networks.
4. **Training the Model:**
   - Splitting the dataset into training and testing sets to evaluate the model's performance.
   - Training the ML model on historical data, allowing it to learn the relationships between input features and profit outcomes.
5. **Validation and Optimization:**
   - Validating the model's accuracy using unseen data to ensure it generalizes well.
   - Fine-tuning hyperparameters and optimizing the model for better performance.
6. **Interpretability and Explainability:**
   - Ensuring the model's predictions can be understood by stakeholders.

- Providing insights into which factors contribute most significantly to profit predictions.

7. **Integration and Deployment:**
   - Integrating the ML model into the company's decision-making processes.
   - Developing a user-friendly interface for stakeholders to interact with the predictions.

Existing Method

NAME OF PAPER NAME	YEAR OF PUBLICATION	NAME OF AUTHOR(S)
Startup Profit Predictor Using Machine Learning Techniques	September 2022	Manasi Chhibber
Profit Prediction Model using Machine learning Algorithms	July 2022	Riya Verma, Satyam Gupta
Predicting customer retention and profitability by using random forests and regression forests techniques	August 2005	Dirk Van den Poel

PROPOSED METHODOLOGY

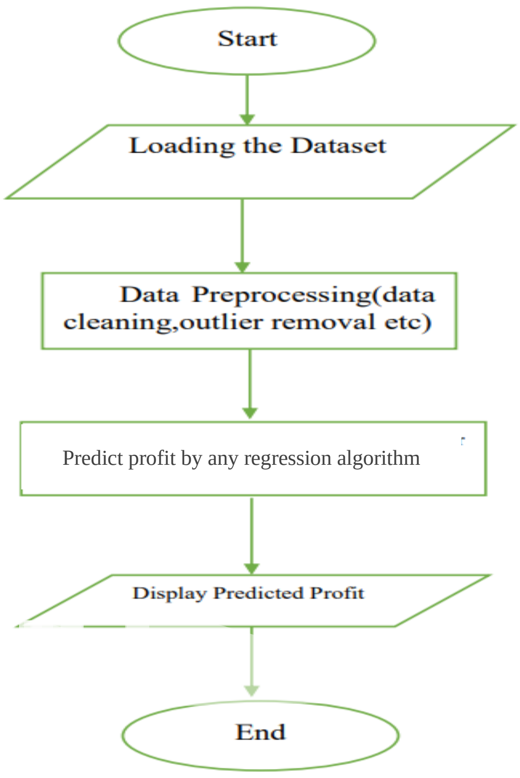
Proposed Methodology consists of the following steps: -

1. **Data Gathering: -** This is the first step involved in the process of making profit prediction. The dataset used in this model is taken from the website of Kaggle. It consists of the data values of thousand start-up companies

2. **Data Pre-processing: -** Data Pre-processing is done after loading the dataset. This step involves optimizing the dataset by removing the outliers and unnecessary details from the dataset to provide most accurate results. Since location does not has any continuous relationship with the value of profit therefore the location column has been dropped from the dataset for further steps. The entire dataset is split in the ratio of 3:7 for testing and training the model respectively.

3. **Selecting a Model: -** Random Forest and Multiple Linear Regression are the machine learning algorithms implemented in this model to predict the profit.Random Forest Regression is majorly used to compute a variety of prediction problems where company needs a prediction of continuous value such as prediction of future prices, comparison of performances etc.

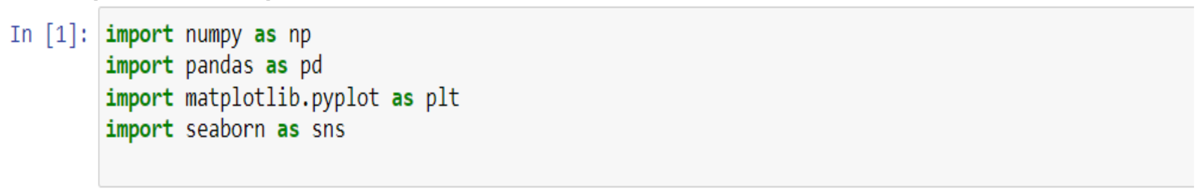
4. **Prediction of Profit: -** One of the above-mentioned models can be used to make prediction of profit by providing the values of the required variables. These parameters include money spent for different causes such as R&D, Marketing and Administration purpose.


Start
Loading the Dataset
Data Preprocessing(data cleaning,outlier removal etc)
Predict profit by any regression algorithm
Display Predicted Profit
End

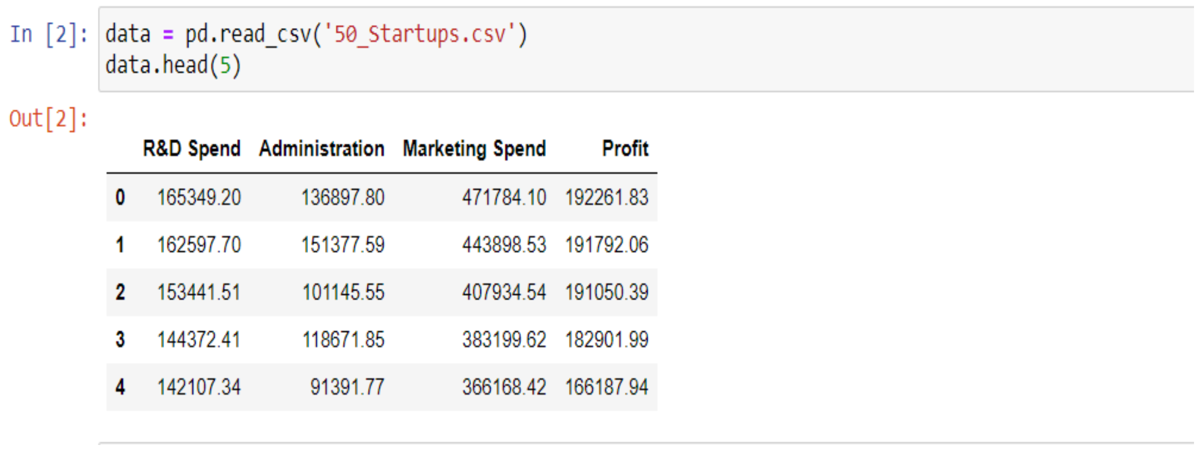
Flow methodology

Implementation

- **Loading and reading the datasets**



```
In [1]: import numpy as np
        import pandas as pd
        import matplotlib.pyplot as plt
        import seaborn as sns
```

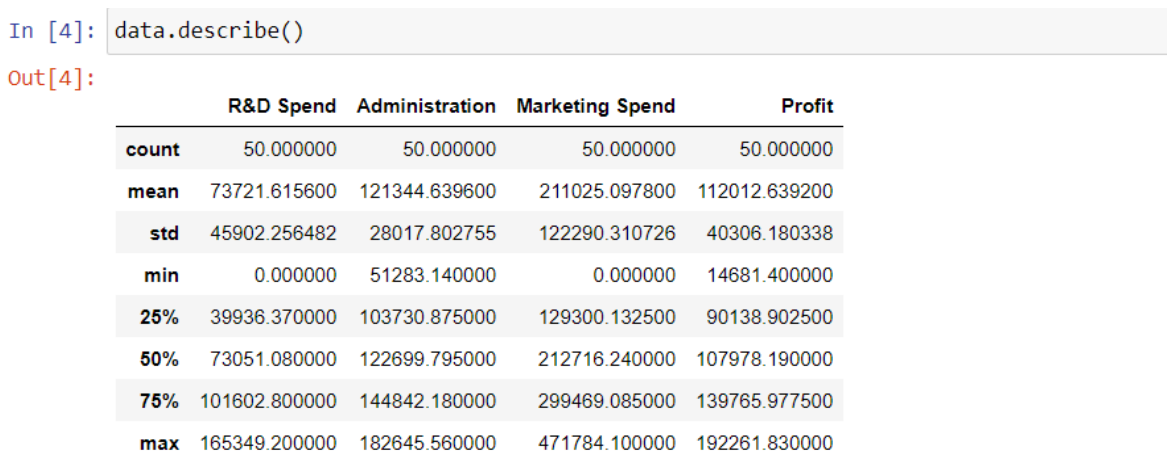


```
In [2]: data = pd.read_csv('50_Startups.csv')
        data.head(5)
```

Out[2]:

	R&D Spend	Administration	Marketing Spend	Profit
0	165349.20	136897.80	471784.10	192261.83
1	162597.70	151377.59	443898.53	191792.06
2	153441.51	101145.55	407934.54	191050.39
3	144372.41	118671.85	383199.62	182901.99
4	142107.34	91391.77	366168.42	166187.94

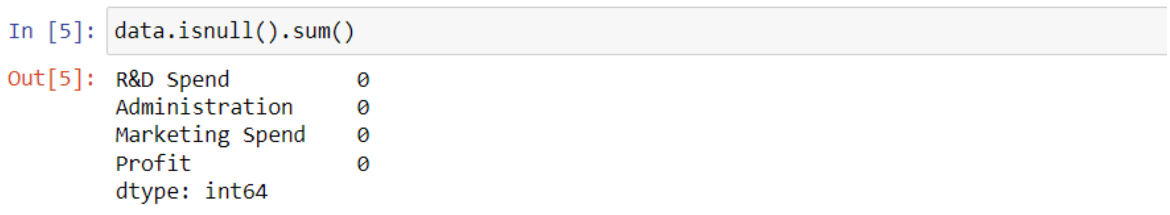
- **Getting Summary Statistics and Check for null**



```
In [4]: data.describe()
```

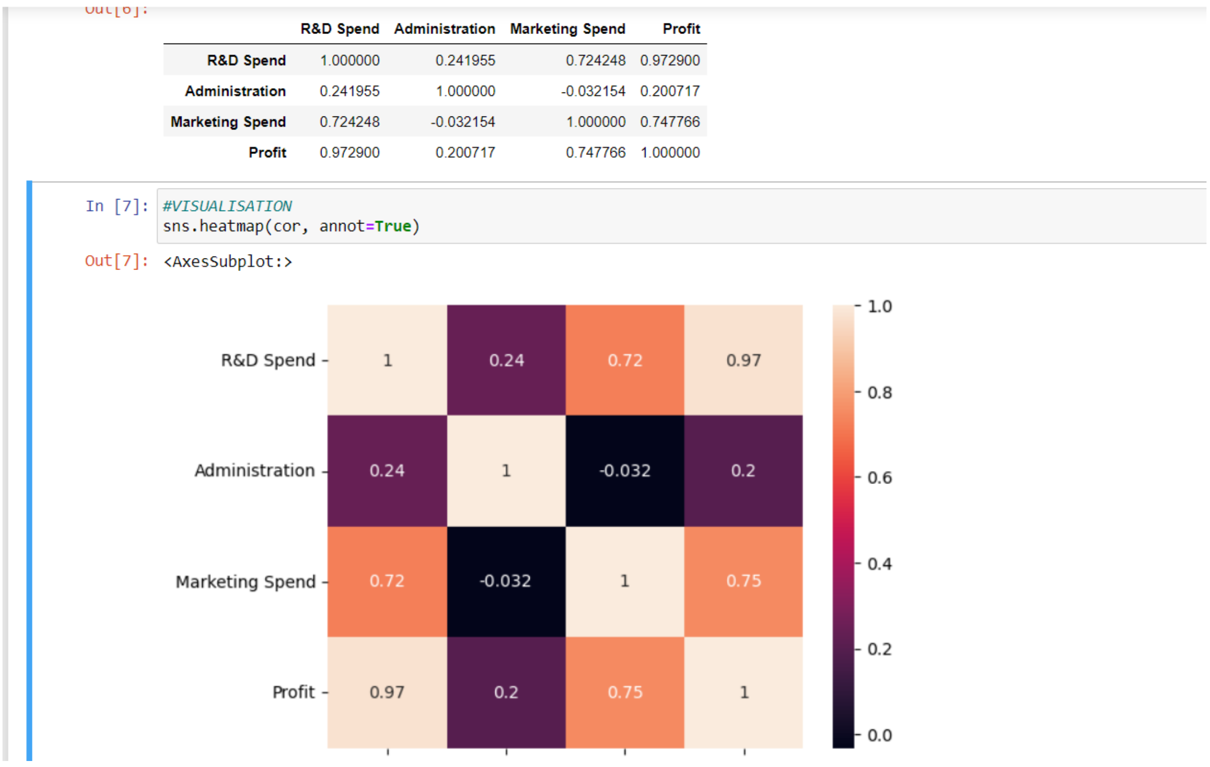
Out[4]:

	R&D Spend	Administration	Marketing Spend	Profit
count	50.000000	50.000000	50.000000	50.000000
mean	73721.615600	121344.639600	211025.097800	112012.639200
std	45902.256482	28017.802755	122290.310726	40306.180338
min	0.000000	51283.140000	0.000000	14681.400000
25%	39936.370000	103730.875000	129300.132500	90138.902500
50%	73051.080000	122699.795000	212716.240000	107978.190000
75%	101602.800000	144842.180000	299469.085000	139765.977500
max	165349.200000	182645.560000	471784.100000	192261.830000



```
In [5]: data.isnull().sum()

Out[5]: R&D Spend          0
        Administration     0
        Marketing Spend    0
        Profit             0
        dtype: int64
```

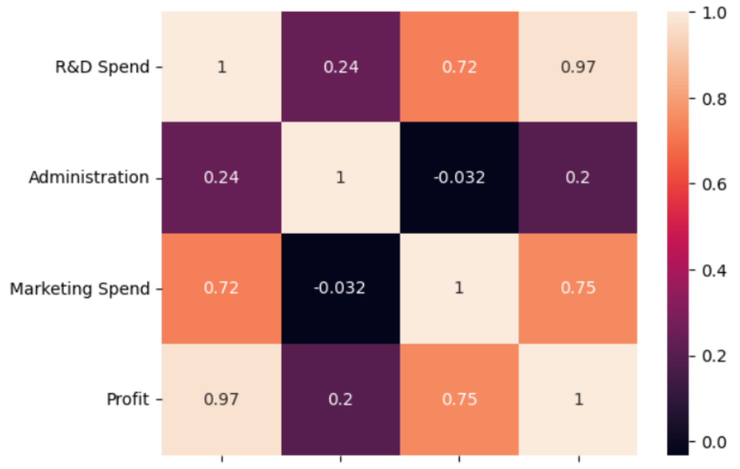
- **Correlation Matrix With Heat Map**
  correlation matrix as a table that summarises the correlation between each feature in a metric called correlation coefficient & heatmap is a visual representation where the strength of each correlation is displayed using colors.



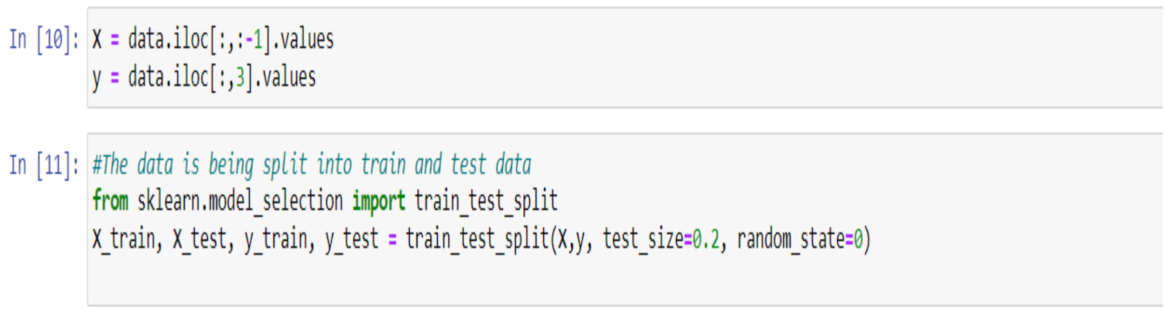
Out[6]:

	R&D Spend	Administration	Marketing Spend	Profit
R&D Spend	1.000000	0.241955	0.724248	0.972900
Administration	0.241955	1.000000	-0.032154	0.200717
Marketing Spend	0.724248	-0.032154	1.000000	0.747766
Profit	0.972900	0.200717	0.747766	1.000000

```
In [7]: #VISUALISATION
        sns.heatmap(cor, annot=True)

Out[7]: <AxesSubplot:>
```



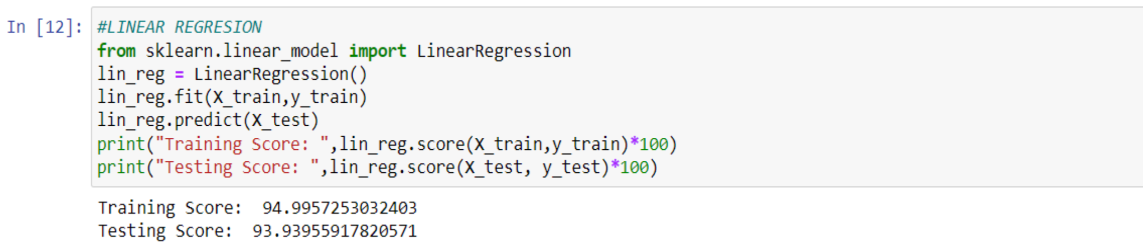
- **Train Test Split**



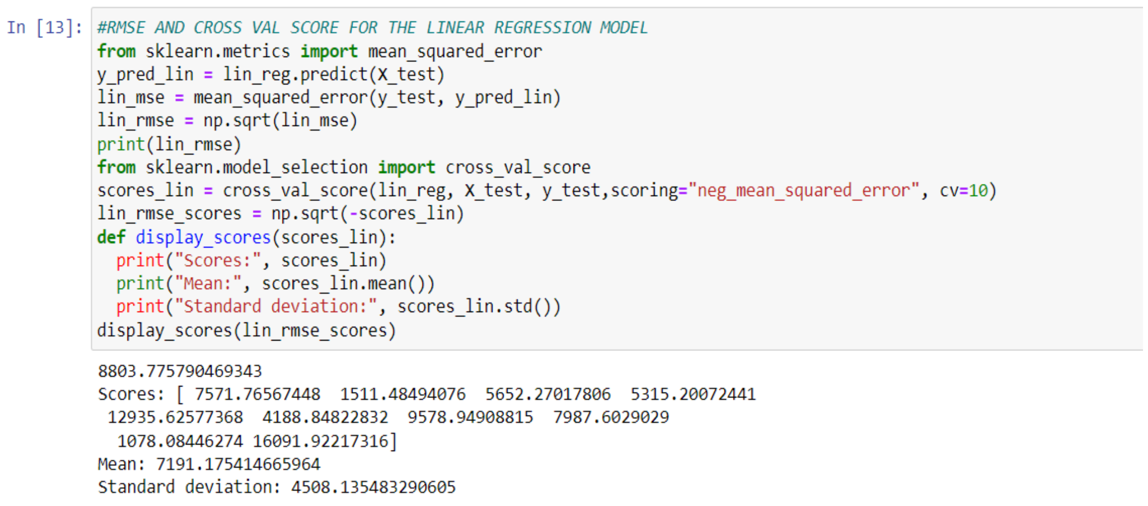
```
In [10]: X = data.iloc[:,:-1].values
         y = data.iloc[:,3].values

In [11]: #The data is being split into train and test data
         from sklearn.model_selection import train_test_split
         X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.2, random_state=0)
```

- **Selecting Model Architecture & Training:**
  In this model I have used algorithms like linear regression, random forest, ridge regression and decision tree regression for training and testing.
  The algorithm is provided by sklearn library and we are going to use it by first defining the model and then calling the model.fit() method.

➢ Linear regression

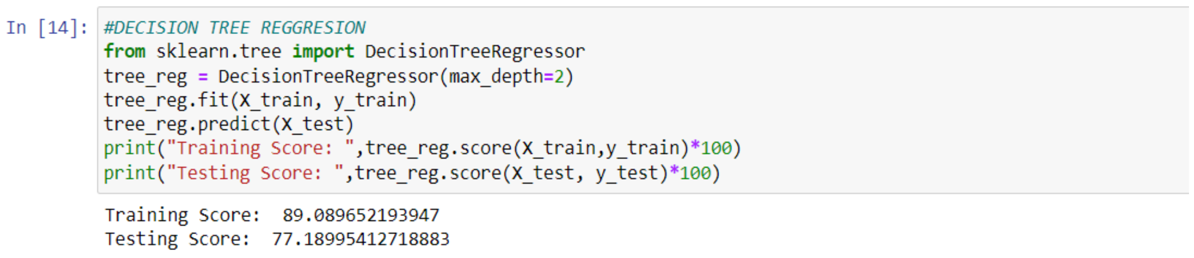


```
In [12]: #LINEAR REGRESION
         from sklearn.linear_model import LinearRegression
         lin_reg = LinearRegression()
         lin_reg.fit(X_train,y_train)
         lin_reg.predict(X_test)
         print("Training Score: ",lin_reg.score(X_train,y_train)*100)
         print("Testing Score: ",lin_reg.score(X_test, y_test)*100)

         Training Score:  94.9957253032403
         Testing Score:  93.93955917820571
```

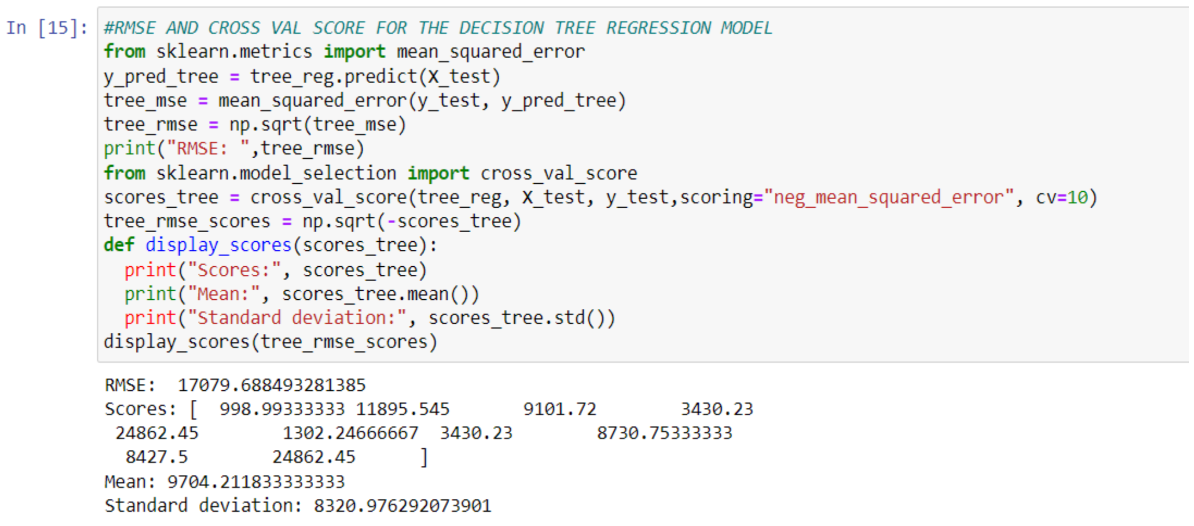


```
In [13]: #RMSE AND CROSS VAL SCORE FOR THE LINEAR REGRESSION MODEL
         from sklearn.metrics import mean_squared_error
         y_pred_lin = lin_reg.predict(X_test)
         lin_mse = mean_squared_error(y_test, y_pred_lin)
         lin_rmse = np.sqrt(lin_mse)
         print(lin_rmse)
         from sklearn.model_selection import cross_val_score
         scores_lin = cross_val_score(lin_reg, X_test, y_test,scoring="neg_mean_squared_error", cv=10)
         lin_rmse_scores = np.sqrt(-scores_lin)
         def display_scores(scores_lin):
           print("Scores:", scores_lin)
           print("Mean:", scores_lin.mean())
           print("Standard deviation:", scores_lin.std())
         display_scores(lin_rmse_scores)

         8803.775790469343
         Scores: [ 7571.76567448  1511.48494076  5652.27017806  5315.20072441
          12935.62577368  4188.84822832  9578.94908815  7987.6029029
           1078.08446274 16091.92217316]
         Mean: 7191.175414665964
         Standard deviation: 4508.135483290605
```

➢ Decision tree

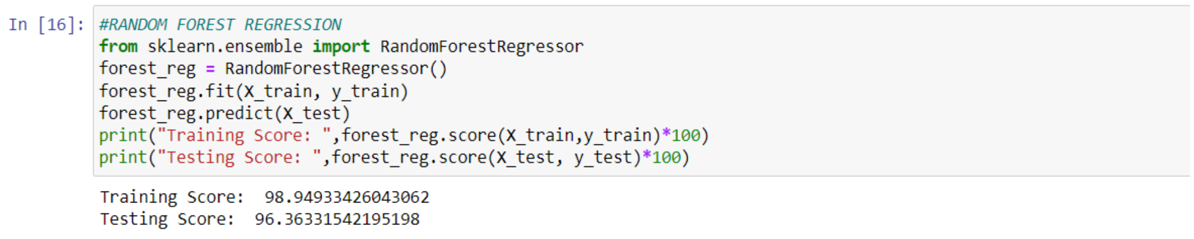


```
In [14]: #DECISION TREE REGGRESION
         from sklearn.tree import DecisionTreeRegressor
         tree_reg = DecisionTreeRegressor(max_depth=2)
         tree_reg.fit(X_train, y_train)
         tree_reg.predict(X_test)
         print("Training Score: ",tree_reg.score(X_train,y_train)*100)
         print("Testing Score: ",tree_reg.score(X_test, y_test)*100)

         Training Score:  89.089652193947
         Testing Score:  77.18995412718883
```

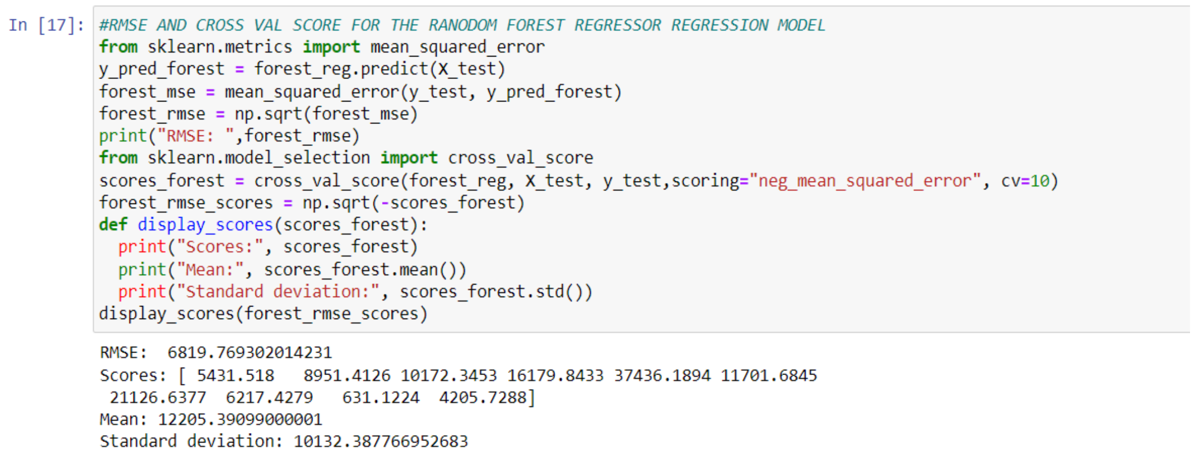


```
In [15]: #RMSE AND CROSS VAL SCORE FOR THE DECISION TREE REGRESSION MODEL
         from sklearn.metrics import mean_squared_error
         y_pred_tree = tree_reg.predict(X_test)
         tree_mse = mean_squared_error(y_test, y_pred_tree)
         tree_rmse = np.sqrt(tree_mse)
         print("RMSE: ",tree_rmse)
         from sklearn.model_selection import cross_val_score
         scores_tree = cross_val_score(tree_reg, X_test, y_test,scoring="neg_mean_squared_error", cv=10)
         tree_rmse_scores = np.sqrt(-scores_tree)
         def display_scores(scores_tree):
           print("Scores:", scores_tree)
           print("Mean:", scores_tree.mean())
           print("Standard deviation:", scores_tree.std())
         display_scores(tree_rmse_scores)

         RMSE:  17079.688493281385
         Scores: [  998.99333333 11895.545       9101.72        3430.23
          24862.45        1302.24666667  3430.23        8730.75333333
           8427.5        24862.45      ]
         Mean: 9704.211833333333
         Standard deviation: 8320.976292073901
```

➢ Random Forest

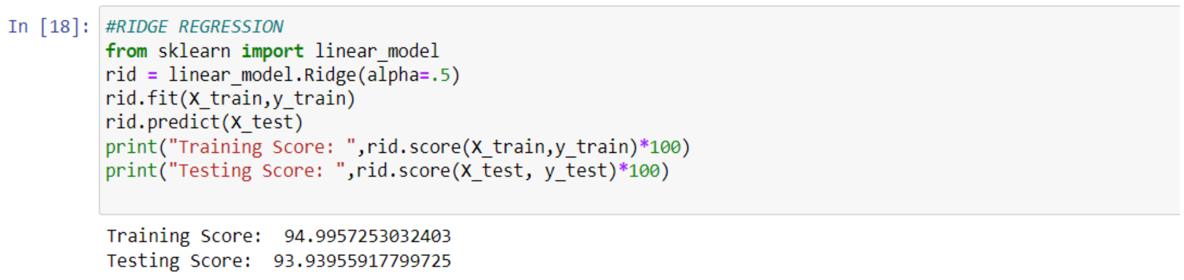


```
In [16]: #RANDOM FOREST REGRESSION
         from sklearn.ensemble import RandomForestRegressor
         forest_reg = RandomForestRegressor()
         forest_reg.fit(X_train, y_train)
         forest_reg.predict(X_test)
         print("Training Score: ",forest_reg.score(X_train,y_train)*100)
         print("Testing Score: ",forest_reg.score(X_test, y_test)*100)

         Training Score:  98.94933426043062
         Testing Score:  96.36331542195198
```

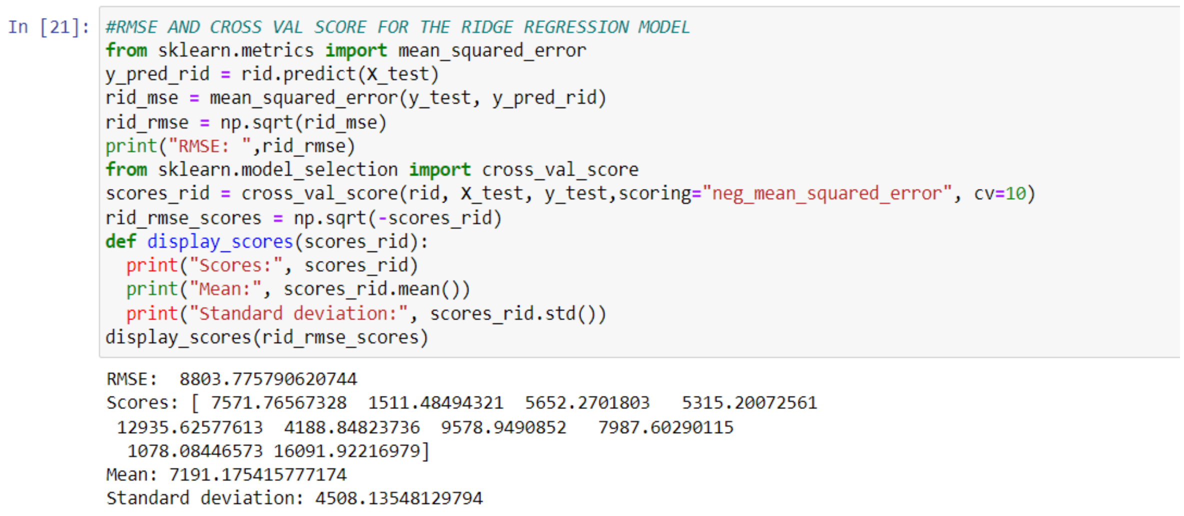


```
In [17]: #RMSE AND CROSS VAL SCORE FOR THE RANODOM FOREST REGRESSOR REGRESSION MODEL
         from sklearn.metrics import mean_squared_error
         y_pred_forest = forest_reg.predict(X_test)
         forest_mse = mean_squared_error(y_test, y_pred_forest)
         forest_rmse = np.sqrt(forest_mse)
         print("RMSE: ",forest_rmse)
         from sklearn.model_selection import cross_val_score
         scores_forest = cross_val_score(forest_reg, X_test, y_test,scoring="neg_mean_squared_error", cv=10)
         forest_rmse_scores = np.sqrt(-scores_forest)
         def display_scores(scores_forest):
           print("Scores:", scores_forest)
           print("Mean:", scores_forest.mean())
           print("Standard deviation:", scores_forest.std())
         display_scores(forest_rmse_scores)

         RMSE:  6819.769302014231
         Scores: [ 5431.518    8951.4126 10172.3453 16179.8433 37436.1894 11701.6845
          21126.6377  6217.4279   631.1224  4205.7288]
         Mean: 12205.39099000001
         Standard deviation: 10132.387766952683
```

➢ Ridge regression



```
In [18]: #RIDGE REGRESSION
         from sklearn import linear_model
         rid = linear_model.Ridge(alpha=.5)
         rid.fit(X_train,y_train)
         rid.predict(X_test)
         print("Training Score: ",rid.score(X_train,y_train)*100)
         print("Testing Score: ",rid.score(X_test, y_test)*100)

         Training Score:  94.9957253032403
         Testing Score:  93.93955917799725
```



```
In [21]: #RMSE AND CROSS VAL SCORE FOR THE RIDGE REGRESSION MODEL
         from sklearn.metrics import mean_squared_error
         y_pred_rid = rid.predict(X_test)
         rid_mse = mean_squared_error(y_test, y_pred_rid)
         rid_rmse = np.sqrt(rid_mse)
         print("RMSE: ",rid_rmse)
         from sklearn.model_selection import cross_val_score
         scores_rid = cross_val_score(rid, X_test, y_test,scoring="neg_mean_squared_error", cv=10)
         rid_rmse_scores = np.sqrt(-scores_rid)
         def display_scores(scores_rid):
           print("Scores:", scores_rid)
           print("Mean:", scores_rid.mean())
           print("Standard deviation:", scores_rid.std())
         display_scores(rid_rmse_scores)

         RMSE:  8803.775790620744
         Scores: [ 7571.76567328  1511.48494321  5652.2701803   5315.20072561
          12935.62577613  4188.84823736  9578.9490852   7987.60290115
           1078.08446573 16091.92216979]
         Mean: 7191.175415777174
         Standard deviation: 4508.13548129794
```

CONCLUSION

Profit prediction model is able to provide an overview to the people willing to set up a startup or are already running a startup about the value of profit that could be achieved based on the values of money spent on different factors. The prediction of profit across 50 startups is found using four different regression model. The four models are Linear regression, Decision Tree regression and Random forest. It is observed that Random Forest Regression works well as compared to rest regression algorithm for the prediction of the value of profit. Therefore, the best model is the Random forest as the score of the model is around 96% which is the best compared to the rest