**Detailed Project Report**

**Stores Sales Prediction**

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# **1. Introduction**

# **1.1 Abstract**

Machine Learning is a category of algorithms that allows software applications to become more accurate in predicting outcomes without being explicitly programmed. The basic premise of machine learning is to build models and employ algorithms that can receive input data and use statistical analysis to predict an output while updating outputs as new data becomes available. These models can be applied in different areas and trained to match the expectations of management so that accurate steps can be taken to achieve the organization’s target. In this paper, the case of Big Mart, a one-stop-shopping- center, has been discussed to predict the sales of different types of items and for understanding the effects of different factors on the items’ sales. Taking various aspects of a dataset collected for Big Mart, and the methodology followed for building a predictive model, results with high levels of accuracy are generated, and these observations can be employed to make decisions to improve sales.

**1.2 Machine Learning**

The data available is increasing day by day and such a huge amount of unprocessed data is needed to be analyzed precisely, as it can give very informative and finely pure gradient results as per current standard requirements. It is not wrong to say as with the evolution of Artificial Intelligence (AI) over the past two decades, Machine Learning (ML) is also on a fast pace for its evolution. ML is an important mainstay of IT sector and with that, a rather central, albeit usually hidden, part of our life. As the technology progresses, the analysis and understanding of data to give good results will also increase as the data is very useful in current aspects.

In machine learning, one deals with both supervised and unsupervised types of tasks and generally a classification type problem accounts as a resource for knowledge discovery. It generates resources and employs regression to make precise predictions about future, the main emphasis being laid on making a system self-efficient, to be able to do computations and analysis to generate much accurate and precise results. By using statistic and probabilistic tools, data can be converted into knowledge. The statistical inferencing uses sampling distributions as a conceptual key.

ML can appear in many guises. In this paper, firstly, various applications of ML and the types of data they deal with are discussed. Next, the problem statement addressed through this work is stated in a formalized way.

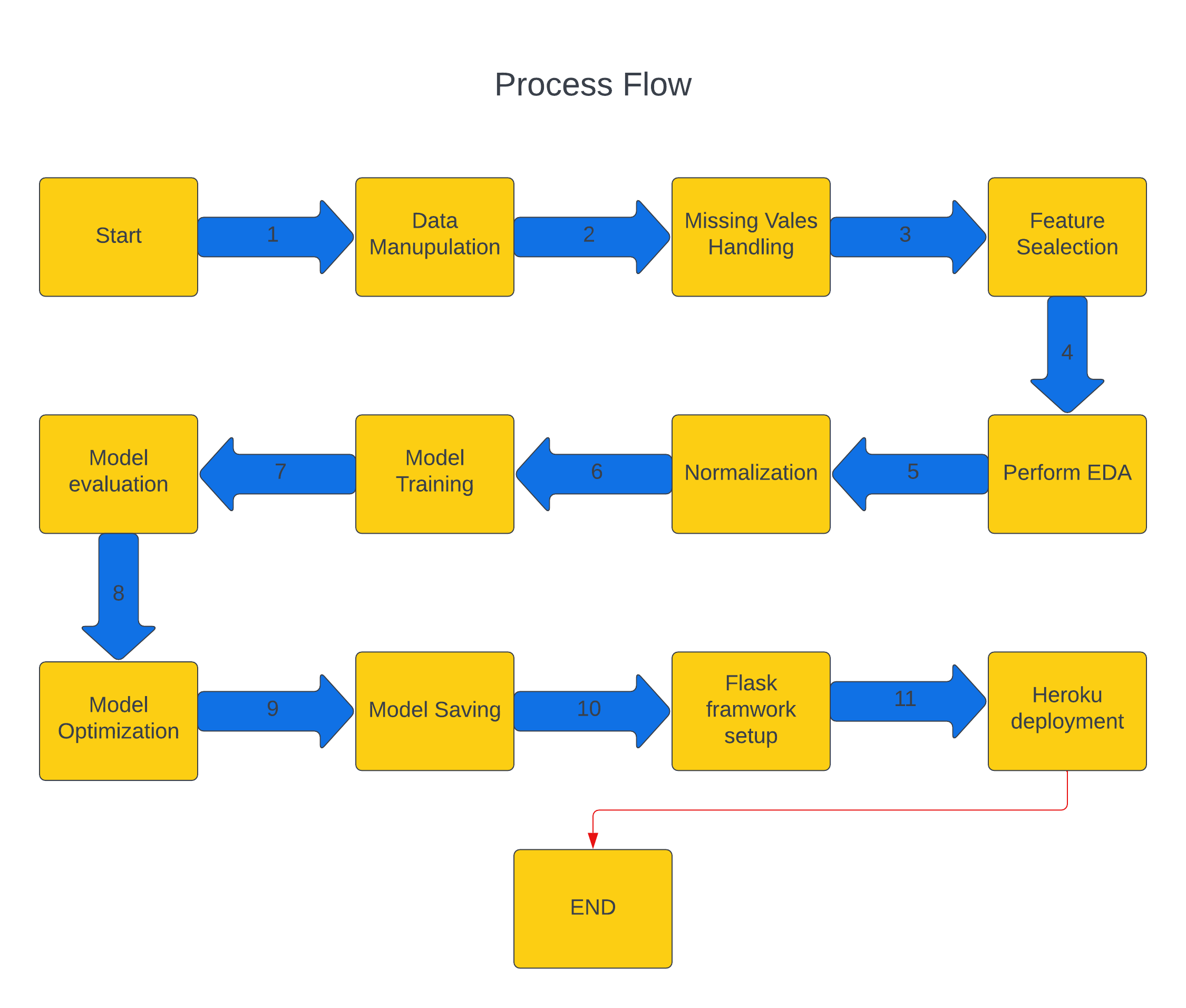
## 1.3 Problem Statement

“To find out what role certain properties of an item play and how they affect their sales by understanding Big Mart sales.”

In order to help Big Mart, achieve this goal, a predictive model can be built to find out the sale of every item for every store. Also, the key factors that can increase their sales and what changes could be made to the product or store’s characteristics.

**2. Architecture:**

Following workflow was followed during the entire project.



**2.1 Data gathering:**

Data source: <https://www.kaggle.com/brijbhushannanda1979/bigmart-sales-data>

Train and Test data are stored in .csv format.

**2.2 Raw Data Validation:**

After data is loaded, various types of validation are required before we proceed further for any operation. Validations like checking for zero standard deviation for all the columns, checking for complete missing values in any columns, etc. These are required because The attributes which contains these are of no use. It will not play role in contributing the sales of an item from respective outlets.

Like if any attribute is having zero standard deviation, it means that’s all the values are same, its mean is zero. Which indicate that either the sale is increase or decrease that attribute will remain the same. Similarly, if any attribute is having full missing values, then there is no use of taking that attribute into an account for operation. It’s unnecessary increasing the chances of dimensionality curse.

**2.3 Data Transformation**

Before sending the data into the database, data transformation is required so that data are converted into such form with which it can easily insert into the database. Here, ‘Item Weight’ and “Outlet Type’ attributes contain the missing values. So, they are filled in both train set as well as test set with supported appropriate data types. Missing data in the training data set can reduce the power / fit of a model or can lead to a biased model because we have not analyzed the behavior and relationship with other variables correctly. It can lead to wrong prediction.

**2.5 New Feature Generation**

We can derive new item category from Outlet\_years

**2.6 Data preprocessing**

In data preprocessing all the process required before sending the data for model building are performed. Like, here the ‘Item Visibility’ attributes are having some values equal to 0, which is not appropriate because if item is present in the market, then how its visibility can be 0. So, it has been replaced with the average value of the item visibility of respective ‘Item Identifier’ category. New attributes were added named ‘’Outlet years”, where given establishment year is subtracted from the current year. New “Item Type” attribute was added which just take first two character of the Item Identifier which indicates the types of the items.

**2.7 Feature Engineering:**

After preprocessing it was found that some of the attributes are not important to the item sales for the particular outlet. So those attributes are removed. Even one hot encoding is also performed to convert the categorical features into numerical features.

**2.8 Parameter tunning:**

Parameters are tunned using Randomized searchCV. The parameters of random forest regressor are tuned and passed into the model.

**2.9 Model building:**

After doing all kinds of preprocessing operations mention above and performing scaling and hyper parameter tunning, data set is passed into Random Forest regressor. It was found that Gradient boost performs best with smallest RMSE value i.e. 1052.26 and highest R2 score equals to 0.59. So ‘Random Forest ’performed well in this problem.

**2.10 Model saving:**

Model is then saved using pickle library in. pkl format.

**2.11 Flask setup for data extraction:**

After saving the model in .pkl file format we then create an app.py flask web framework (Written in python) and then we render the home.html template and use request to extract all the form selection selected by the user and then we predict the sale price by using the selected records by the user.

**2.12 Git Hub**

The whole project directory will be pushed into the GitHub repository.

GitHub Project link: <https://github.com/shashankb07/Big-Mart-Prediction-And-Deployment>

**2.13Deployment:**

The cloud environment was set up and the project was deployed from GitHub into the Heroku cloud platform.

WebApp link - <https://big-mart-pred.herokuapp.com/>

**3. Data set description**

Big Mart’s data scientists collected sales data of their 10 stores situated at different locations with each store having 1559 different products as per data collection. Using all the observations it is inferred what role certain properties of an item play and how they affect their sales. The dataset looks like as follow:





The data set consists of various data types from integer to float to object as shown in Fig.



In the raw data, there can be various types of underlying patterns which also gives an in-depth knowledge about subject of interest and provides insights about the problem. But caution should be observed with respect to data as it may contain null values, or redundant values, or various types of ambiguity, which also demands for pre-processing of data. Dataset should therefore be explored as much as possible.

Various factors important by statistical means like mean, standard deviation, median, count of values and maximum value etc. are shown below for numerical attributes.



Preprocessing of this dataset includes doing analysis on the independent variables like checking for null values in each column and then replacing or filling them with supported appropriate data types, so that analysis and model fitting is not hindered from its way to accuracy. Shown above are some of the representations obtained by using Pandas tools which tells about variable count for numerical columns and model values for categorical columns. Maximum and minimum values in numerical columns, along with their percentile values for median, plays an important factor in deciding which value to be chosen at priority for further exploration tasks and analysis. Data types of different columns are used further in label processing and one-hot encoding scheme during the model building.

# **4. Implementation and Results**

In this section, the programming language, libraries, implementation platform along with the data modeling and the observations and results obtained from it are discussed

## 4.1 Implementation Platform and Language

Python is a general purpose, interpreted-high level language used extensively nowadays for solving domain problems instead of dealing with complexities of a system. It is also termed as the ‘batteries included language’ for programming. It has various libraries used for scientific purposes and inquiries along with number of third-party libraries for making problem solving efficient.

In this work, the Python libraries of NumPy, for scientific computation, and Matplotlib, for 2D plotting have been used. Along with this, Pandas tool of Python has been employed for carrying out data analysis. Random forest regressor is used to solve tasks by ensembling random forest method. As a development platform, Jupyter Notebook, which proves to work great due to its excellence in ‘literate programming’, where human friendly code is punctuated within code blocks, has been used

## 4.2 Observations

## 

## 4.4 Metrics for Data Modelling

* For model selection we had used different evaluation techniques such as:
* R-Squared: R-squared is a statistical measure that represents the proportion of the variance for a dependent variable that's explained by an independent variable or variables in a regression model.
* MAE: The mean absolute error (MAE) is a measure of errors between paired observations expressing the same phenomenon.
* MSE: The mean squared error tells you how close a regression line is to a set of points. It does this by taking the distances from the points to the regression line (these distances are the “errors”) and squaring them.
* So, based on the best performance evaluation score evaluated by these Metrics we will be selecting that particular ML Model.
* After doing all kinds of pre-processing operations mention above and performing scaling and hyperparameter tuning data is passed to Random Forest model It was found that it performs best with the Average RandomForestRegressor () score: 0.55. Random forest clearly wins as the average score is 0.54 While Linear Regression and lasso has a score of 0.51. So Random forest performed well in this problem.

## 4.5 Prediction results

After doing all kinds of pre-processing operations mention above and performing scaling and hyperparameter tuning data is passed to Random Forest model It was found that it performs best with the Average RandomForestRegressor () score: 0.55. Random forest clearly wins as the average score is 0.54 While Linear Regression and lasso has a score of 0.51So Random forest performed well in this problem.

## 5. Conclusion

In this project, basics of machine learning and the associated data processing and modeling algorithms have been described, followed by their application for the task of sales prediction in Big Mart shopping centers at different locations. On implementation, the prediction results show the correlation among different attributes considered and how a particular location of medium size recorded the highest sales, suggesting that other shopping locations should follow similar patterns for improved sales.

## Also, Item\_MRP clearly maximizes the Outlet sales.

## Outlet Type being Supermarket or Grocery Store also depicts the Outlet Sales.

## Years Established will also tend to have loyal customers and that's how the sales margin can be achieved.

## 6. Future Scope

Multiple instances parameters and various factors can be used to make this sales prediction more innovative and successful. Accuracy, which plays a key role in prediction-based systems, can be significantly increased as the number of parameters used are increased. Also, a look into how the sub-models work can lead to increase in productivity of system. The project can be further

collaborated in a web-based application or in any device supported with an in-built intelligence by virtue of Internet of Things (IoT), to be more feasible for use. Various stakeholders concerned with sales information can also provide more inputs to help in hypothesis generation and more instances can be taken into consideration such that more precise results that are closer to real world situations are generated. When combined with effective data mining methods and properties, the traditional means could be seen to make a higher and positive effect on the overall development of corporation’s tasks on the whole. One of the main highlights is more expressive regression outputs, which are more understandable bounded with some of accuracy. Moreover, the flexibility of the proposed approach can be increased with variants at a very appropriate stage of regression model-building. There is a further need of experiments for proper measurements of both accuracy and resource efficiency to assess and optimize correctly.

**7. Q & A:**

**Q1) What’s the source of data?**

Ans. The data for training is provided by the client from:

<https://www.kaggle.com/brijbhushannanda1979/bigmart-sales-data>

**Q 2) What was the type of data?**

Ans. The data was the combination of numerical and Categorical values.

**Q 3) What’s the complete flow you followed in this Project?**

Ans. Refer the Architecture section for this.

**Q 4) After the File validation what you do with incompatible file or files which didn’t pass the validation?**

Ans. Files like these are moved to the Achieve Folder and a list of these files has been shared with the client and we removed the bad data folder.

**Q 5) What techniques were you using for data pre-processing?**

* + Removing unwanted attributes
  + Visualizing relation of independent variables with each other and output variables
  + Checking and changing Distribution of continuous values
  + Removing outliers
  + Cleaning data and imputing if null values are present.
  + Converting categorical data into numeric values.
  + Scaling the data

**Q 6) How training was done or what models were used?**

* Before diving the data in training and validation set, we performed clustering over fit to divide the data into clusters.
* As per cluster the training and validation data were divided.
* The scaling was performed over training and validation data.
* Different algorithms approach and Finalized algorithm is Random Forest.

**Q 7) How Prediction was done?**

Ans. The testing files are shared by the client. We pass its data to the best model which we have saved in pickle format and get the prediction.

**Q 8) Where the model was deployed?**

Ans. When the model is ready, we deploy it in Heroku platform. This model is a web application where user can enter the data and these data gets extracted in the backend and user gets the prediction result.