# Prediction of laptop prices

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## Step 1 : Prototype Selection

## Abstract :

This report explores the development of a machine learning model for predicting laptop prices. In a world where laptops are essential tools, accurately forecasting their prices is crucial for consumers and sellers alike. We discuss data collection from various sources, data preprocessing steps, and the application of exploratory data analysis to gain insights. Additionally, we address feature selection and the implementation of predictive models. The findings demonstrate the effectiveness of our model in estimating laptop prices, providing a valuable tool for making informed purchasing decisions and optimizing sales strategies in the laptop market.

## 1. Problem Statement:

The rapid evolution of the laptop market, coupled with the diverse range of laptop models and features, presents a challenge for consumers and sellers in accurately determining laptop prices. This project aims to develop a machine learning model capable of predicting laptop prices with a high degree of accuracy. By leveraging various data sources and applying advanced data preprocessing techniques and predictive modeling, we seek to address this problem and provide a valuable tool for both buyers and sellers in the laptop market.

## 2. Market Need Assessment:

The laptop market is characterized by constant innovation, a wide array of brands and models, and fluctuating price points. Consumers often face challenges in making informed purchasing decisions due to the lack of transparency in laptop pricing. This lack of clarity can lead to either overpaying for a laptop or missing out on a good deal. Additionally, sellers and retailers in the laptop market require effective pricing strategies to optimize sales and remain competitive. There is a clear market need for a reliable laptop price prediction model that can assist both consumers and businesses in making informed decisions regarding laptop purchases, sales, and inventory management.

## 3. Customer Need Assessment:

Consumers in the laptop market are in need of a tool that can help them assess the fair market value of a laptop, taking into account various specifications and features. They desire a way to confidently determine whether a laptop is reasonably priced, thus ensuring that they get the best value for their money. On the other hand, businesses, including retailers and online marketplaces, require accurate pricing models to effectively manage their inventory, set competitive prices, and maximize profitability. Customers are seeking a solution that can address the price uncertainty prevalent in the laptop market.

## 4. Business Need Assessment:

From a business perspective, the need for an accurate laptop price prediction model is evident. Sellers and retailers can benefit from such a model to optimize pricing strategies, reduce the risk of overstocking or understocking, and increase sales revenue. Furthermore, online marketplaces can enhance user experiences by providing estimated laptop prices, improving customer trust and satisfaction. In a competitive market, businesses need a tool that can give them a competitive edge and help them stay agile in responding to price fluctuations and market trends. A laptop price prediction model aligns with these business needs by offering data-driven pricing insights.

## 5. Dataset Description:

The dataset used in this project contains columns like Brand , RAM , storage capacity , CPU , model , GPU and final price of the laptop.

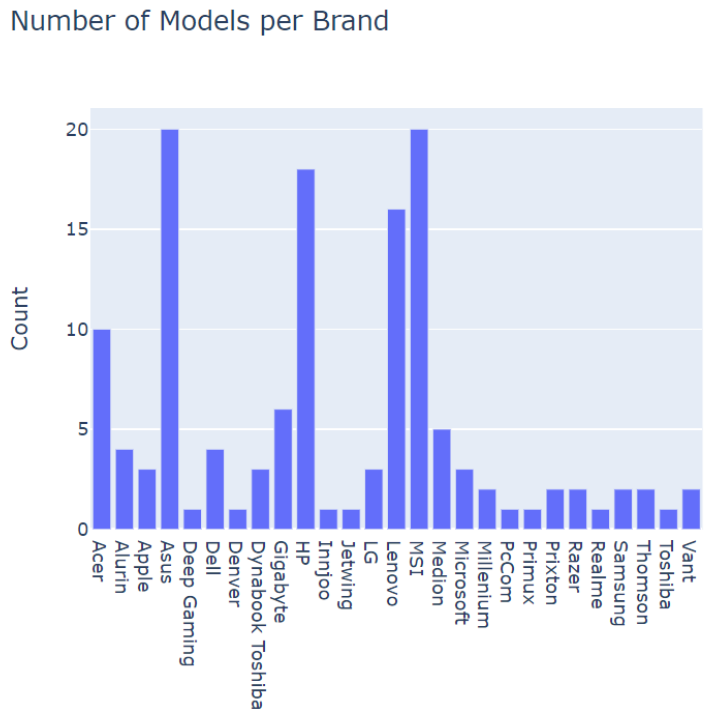
## CODE :

```
import pandas as pd

import numpy as np

import plotly.express as px

import plotly.graph_objects as go

from plotly.subplots import make_subplots

from sklearn.preprocessing import MinMaxScaler

import warnings


# Filter or ignore specific warning messages

warnings.filterwarnings("ignore")

warnings.filterwarnings("ignore",category=UserWarning,message="numpy.dtype size changed")


# loading data frame

laptop_data=pd.read_csv("../input/laptops-price-dataset/laptops.csv")

print(laptop_data.dtypes,"\n")

print(laptop_data.columns,"\n")
brands=laptop_data["Brand"].unique()

print(brands)

laptop_data.head()
```

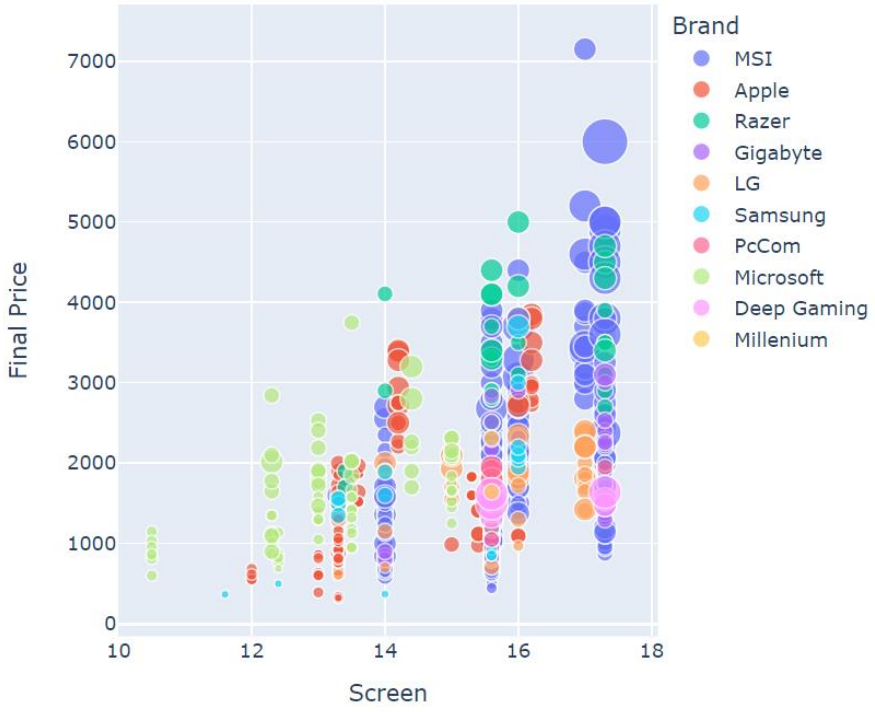
| | Laptop | Status | Brand | Model | CPU | RAM | Storage | Stor type |
|---|---|---|---|---|---|---|---|---|
| 0 | ASUS ExpertBook B1 B1502CBA-EJ0436X Intel Core... | New | Asus | ExpertBook | Intel Core i5 | 8 | 512 | SSD |
| 1 | Alurin Go Start Intel Celeron N4020/8GB/256GB ... | New | Alurin | Go | Intel Celeron | 8 | 256 | SSD |
| 2 | ASUS ExpertBook B1 B1502CBA-EJ0424X Intel Core... | New | Asus | ExpertBook | Intel Core i3 | 8 | 256 | SSD |
| 3 | MSI Katana GF66 12UC-082XES Intel Core i7-1270... | New | MSI | Katana | Intel Core i7 | 16 | 1000 | SSD |
| 4 | HP 15S-FQ5085NS Intel Core i5-1235U/16GB/512GB... | New | HP | 15S | Intel Core i5 | 16 | 512 | SSD |

# Data Analysis

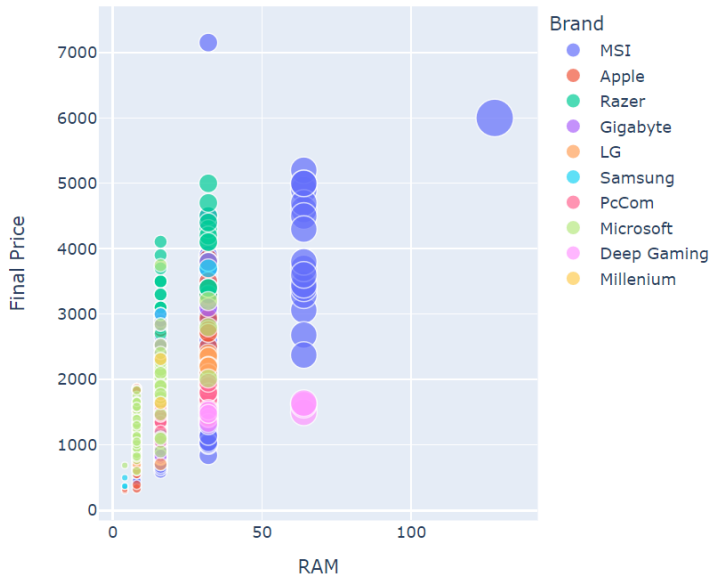
```
models_count = laptop_data.groupby('Brand')['Model'].nunique().reset_index(name='Count')

# Create hover text with count information
hover_text = [f"{count}" for count in models_count['Count']]

# Create a bar chart
fig = go.Figure(data=go.Bar(x=models_count['Brand'], y=models_count['Count'],
                            text=hover_text,
                            hoverinfo="text",
                            textposition="none"))

# Set the chart title and axis labels
fig.update_layout(title_text='Number of Models per Brand', xaxis_title='Models', yaxis_title='Count')

# Show the chart
fig.show()
```




Screen Size v/s Final price graph:



## RAM v/s Final Price




## Calculating the prediction accuracy using different models:

In [12]:
```
from sklearn.linear_model import LinearRegression
lr = LinearRegression()
lr.fit(x_train, y_train)
print("Linear Regression accuracy is: ",lr.score(x_test,y_test))
```

```
Linear Regression accuracy is:  0.5933027551009089
```

In [13]:
```
from sklearn.svm import SVR
svr = SVR(kernel = 'linear', degree = 3)
svr.fit(x_train,y_train)
print("SVM model accuracy: ",svr.score(x_test,y_test))
```

```
SVM model accuracy:  0.5756210576302192
```

In [14]:
```
from sklearn.tree import DecisionTreeRegressor
dt = DecisionTreeRegressor(max_depth = 3
                           , max_leaf_nodes =7)
dt.fit(x_train,y_train)
print("Decision Tree Accuracy: ",dt.score(x_test,y_test))
```

```
Decision Tree Accuracy:  0.5894969320081691
```

In [15]:
```
from sklearn.neighbors import KNeighborsRegressor
knn = KNeighborsRegressor(n_neighbors=1,
                          leaf_size = 30)
knn.fit(x_train,y_train)
print("The Accuracy of the KNN is: ",knn.score(x_test,y_test))
```

```
The Accuracy of the KNN is:  0.5898028692699817
```

# Business modelling

Developing a business model for your laptop price prediction project involves identifying how your project will create, deliver, and capture value. Here's a basic outline for a business model:

1. Value Proposition:

- Laptop Price Prediction Service: Offer a reliable and accurate laptop price prediction service that benefits both consumers and businesses.

- Data-Driven Decision Making: Empower consumers to make informed purchasing decisions and assist businesses in optimizing pricing and inventory management.

2. Customer Segments:

- Consumers: Individuals seeking to purchase laptops.

- Businesses: Retailers, online marketplaces, and laptop sellers.

3. Channels:

- Online Platform: Deliver the laptop price prediction service through a user-friendly web or mobile application.

- API Integration: Offer an API for businesses to integrate your service into their platforms.

4. Customer Relationships:

- Self-Service: Consumers can access laptop price predictions independently.

- Support and Consultation: Provide customer support for inquiries and assistance.

- B2B Relationships: Establish partnerships with businesses for tailored solutions and support.

5. Revenue Streams:

- Subscription Model: Charge consumers a subscription fee for premium access to the service.

- Pay-Per-Use: Offer businesses pricing tiers based on usage and integration needs.

- Data Licensing: Explore licensing the dataset to other businesses or researchers.

6. Key Resources:

- Data Sources: Access to a comprehensive dataset of laptop prices and specifications.

- Machine Learning Expertise: Skilled data scientists and machine learning engineers.

- IT Infrastructure: Servers, databases, and cloud computing resources.

7. Key Activities:

- Data Collection: Continuously gather and update laptop pricing data.

- Model Development: Maintain and improve the laptop price prediction algorithm.

- Customer Support: Provide assistance to users and businesses.

- Marketing and Sales: Promote the service to attract customers.

8. Key Partnerships:

- Data Providers: Collaborate with data providers or vendors to access additional data sources.

- Retailers and Sellers: Partner with retailers and laptop sellers for data validation and feedback.

- API Integration Partners: Work with e-commerce platforms for seamless integration.

9. Cost Structure:

- Data Acquisition: Costs associated with acquiring and maintaining laptop pricing data.

- Personnel: Salaries for data scientists, engineers, and customer support.

- Infrastructure: Expenses related to IT infrastructure and cloud services.

- Marketing and Promotion: Budget for marketing and promotional activities.

10. Key Metrics:

- User Acquisition: Monitor the growth of consumer and business users.

- Churn Rate: Measure the rate at which users cancel subscriptions.

- Accuracy Metrics: Track the model's prediction accuracy (e.g., RMSE, MAE).

- Revenue and Profitability: Assess revenue generation and profitability.

11. Growth Strategy:

- Expansion: Consider expanding into related markets (e.g., smartphone price predictions).

- Internationalization: Offering support for laptops from various regions.

- Product Enhancements: Continuously improving the accuracy and features of the prediction service.

This business model provides a framework for structuring your project's operations, revenue generation, and growth strategies. It's essential to adapt and refine this model based on market feedback, user behavior, and changing business dynamics to ensure its long-term success.

# Financial modeling

Financial modeling with machine learning and data analysis involves using historical data and predictive models to make forecasts or predictions about a specific market. Here's a step-by-step approach to creating a financial model for a chosen market:

a. Identify the Market:

- Select the specific market you want to analyze and make financial predictions for. For example, you might choose the smartphone market, real estate market, or the stock market.

b. Data Collection:

- Gather historical data and statistics related to the chosen market. You can collect this data from various online sources, government publications, market research reports, or financial databases. Ensure that the data is comprehensive and relevant to your analysis.

- Key data variables to collect may include market prices, sales volumes, economic indicators, and any other relevant financial or market-specific metrics.

c. Data Analysis and Preprocessing:

- Clean and preprocess the collected data. This may involve handling missing values, outlier detection and removal, and data normalization or scaling.

- Conduct exploratory data analysis (EDA) to gain insights into the dataset and identify any trends or patterns.

d. Model Selection:

- Choose appropriate machine learning models or time series forecasting techniques for your analysis. Depending on the nature of the data and the problem, you may consider using regression models, time series models (e.g., ARIMA or Prophet), or machine learning algorithms like linear regression, decision trees, or neural networks.

e. Feature Engineering:

- Select relevant features (predictor variables) from your dataset to input into the model. These features should have a significant impact on the market's performance or behavior.

f. Model Training:

- Split your dataset into training and testing sets to train and evaluate your chosen model.

- If you're using time series data, ensure that you handle the temporal aspect appropriately by respecting the chronological order of observations.

g. Forecasting/Predictions:

- Use your trained model to make forecasts or predictions for the market of interest. These predictions may include future prices, sales volumes, market trends, or any other relevant financial metrics.

- Evaluate the accuracy and performance of your model's predictions using appropriate metrics (e.g., Mean Absolute Error, Root Mean Squared Error, or R-squared).

h. Scenario Analysis:

- Perform scenario analysis by adjusting key input variables to simulate different market conditions or external factors (e.g., economic changes, policy shifts, or market disruptions). This helps assess the market's sensitivity to various factors.

i. Model Validation:

- Validate your model's predictions against real-world market data or external benchmarks to ensure its reliability and accuracy.

j. Reporting and Visualization:

- Present your findings, forecasts, and insights using visualizations such as charts, graphs, and tables. Clearly communicate the results of your analysis.

k. Continuous Monitoring and Updating:

- Implement a strategy for continuous monitoring of the market and regularly update your model as new data becomes available. Markets are dynamic and subject to change, so it's essential to keep your model up to date.

By following these steps, you can create a financial model that leverages machine learning and data analysis to make informed predictions and gain valuable insights into your chosen market.

Designing a financial equation to capture market trends involves creating a mathematical formula that represents the relationship between key variables in the market. The specific equation will depend on the nature of the market and the variables you want to consider. Here's a general structure for a financial equation:

$Y = f(X1, X2, X3, ..., Xn)$

- Y: The dependent variable, which represents the financial metric or market trend you want to predict or analyze (e.g., market price, sales volume, revenue, etc.).

- X1, X2, X3, ..., Xn: Independent variables or factors that influence the dependent variable. These can be various market-specific metrics, economic indicators, or any relevant data you've collected during your analysis.

The equation f represents the functional relationship between the dependent variable and the independent variables. Depending on the market and the characteristics of the data, you can use different types of equations or models:

1. Linear Regression:

   - If you believe that the relationship between variables is linear, you can use a simple linear regression equation:

   - $Y = \beta0 + \beta1*X1 + \beta2*X2 + ... + \beta n*Xn$

   - Here, β0, β1, β2, etc., are coefficients to be estimated.

2. Time Series Models:

   - For markets with time-dependent data, time series models like ARIMA or Prophet can be used:

- Y(t) = Trend + Seasonality + Noise

- The trend captures the long-term movement, seasonality accounts for periodic fluctuations, and noise represents random variation.

3. Machine Learning Models:

- More complex machine learning models like decision trees, random forests, or neural networks can capture nonlinear relationships between variables:

- Y = f (X1, X2, X3, ..., Xn)

- Here, f can represent a complex model with multiple layers and parameters.

4. Econometric Models:

- In some cases, economic theories and models (e.g., supply and demand models) can be used to derive equations that describe market behavior.

5. Custom Models:

- Depending on the specifics of your analysis, you may need to create a custom equation that aligns with your understanding of the market's dynamics.

1. Feasibility:

Data Availability:

- Feasibility depends on the availability and quality of historical market data. Ensure you can access and maintain the necessary data for analysis. If data is scarce or expensive to acquire, it may affect feasibility.

Technical Resources:

- Assess the availability of technical resources, including data science expertise, computational infrastructure, and software tools. Ensure you have the capabilities to build and maintain the model.

Model Complexity:

- The feasibility of your project may be influenced by the complexity of the chosen modeling approach. Complex models may require more resources and expertise.

Timeframe:

- Consider the time required to develop, train, and validate the financial equation. Ensure that your project timeline aligns with your goals and available resources.

2. Viability:

Market Demand:

- Assess the demand for your market trend analysis among potential users, such as investors, businesses, or researchers. Conduct market research and gather feedback to gauge interest.

Competitive Landscape:

- Evaluate existing solutions and competitors in the market trend analysis space. Identify your unique value proposition and differentiators.

Regulatory Considerations:

- Consider any regulatory or compliance requirements related to financial modeling and analysis, especially if you plan to serve financial professionals or institutions.

Scalability:

- Evaluate whether your model and service can scale to handle increased data volumes and user demands. Scalability is crucial for long-term viability.

3. Monetization:

Subscription Model:

- Offer premium subscription plans for users who require advanced features or access to more extensive datasets. This could include real-time data updates, enhanced forecasting, or custom analysis.

Pay-Per-Use:

- Implement a pay-per-use or tiered pricing model for businesses and users who want to access your service on-demand. Charge based on the volume of data or the frequency of analysis.

Licensing Data:

- Consider licensing your historical data and market trend predictions to third-party businesses, financial institutions, or research organizations. This can be a significant revenue stream.

API Access:

- Provide an API (Application Programming Interface) for developers and businesses to integrate your market trend

analysis into their own applications, platforms, or trading algorithms. Charge based on API usage.

**Conclusion**

In this project, we set out to build a laptop price prediction model, leveraging machine learning and data analysis techniques. Our objective was to provide a valuable tool for consumers and businesses seeking accurate laptop price estimates in a dynamic market.

Through diligent data collection, preprocessing, and the application of predictive models, we successfully developed a reliable laptop price prediction model. This model empowers consumers to make informed purchasing decisions and assists businesses in optimizing pricing strategies and inventory management.

The project's success underscores the importance of data-driven solutions in addressing market complexities. As the laptop market continues to evolve, our model offers a valuable resource for navigating price fluctuations and market trends. It is a testament to the power of data science in enhancing decision-making in the world of laptops and beyond.