Project Title: Laptop Price Prediction for SmartTech Co.

Project Overview:

SmartTech Co. has partnered with our data science team to develop a robust machine learning model that predicts laptop prices accurately. As the market for laptops continues to expand with a myriad of brands and specifications, having a precise pricing model becomes crucial for both consumers and manufacturers.

Client's Objectives:

Accurate Pricing: Develop a model that can accurately predict laptop prices based on various features, helping our clients stay competitive in the market.

Market Positioning: Understand how different features contribute to pricing, enabling SmartTech Co. to strategically position its laptops in the market.

Brand Influence: Assess the impact of brand reputation on pricing, providing insights into brand perception and market demand.

Key Challenges:

Diverse Specifications: The dataset encompasses laptops with diverse specifications. Our challenge is to build a model that generalizes well across a wide range of features.

Real-time Prediction: The model should have the capability to predict prices for newly released laptops, reflecting the fast-paced nature of the tech industry.

Interpretability: It is crucial to make the model interpretable, allowing SmartTech Co. to understand the rationale behind pricing predictions.

Project Phases:

1. Data Exploration and Understanding:

Dive into the dataset to understand the landscape of laptop specifications.

Visualize trends in laptop prices and identify potential influential features.

2. Data Preprocessing:

Handle missing values, outliers, and encode categorical variables.

Ensure the dataset is ready for model training.

3. Feature Engineering:

Extract meaningful features to enhance model performance.

Consider creating new features that capture the essence of laptop pricing.

4. Model Development:

Employ machine learning algorithms such as Linear Regression, Random Forest, and Gradient Boosting to predict laptop prices.

Evaluate and choose the model that aligns best with the project's objectives.

5. Real-time Predictions:

Implement a mechanism for the model to make predictions for new laptops entering the market.

6. Interpretability and Insights:

Uncover insights into which features play a pivotal role in pricing decisions.

Ensure that SmartTech Co. can interpret and trust the model's predictions.

7. Client Presentation:

Present findings, model performance, and insights to SmartTech Co. stakeholders.

Address any questions or concerns and gather feedback for potential model improvements.

Expected Outcomes:

1. A reliable machine learning model capable of predicting laptop prices with high accuracy.

2. Insights into the factors influencing laptop prices, empowering SmartTech Co. in market positioning and strategy.

Questions to Explore:

1. Which features have the most significant impact on laptop prices?
2. Can the model accurately predict the prices of laptops from lesser-known brands?
3. Does the brand of the laptop significantly influence its price?
4. How well does the model perform on laptops with high-end specifications compared to budget laptops?
5. What are the limitations and challenges in predicting laptop prices accurately?
6. How does the model perform when predicting the prices of newly released laptops not present in the training dataset?

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns


from sklearn.compose import ColumnTransformer
from sklearn.pipeline import Pipeline
from sklearn.preprocessing import OneHotEncoder
from sklearn.metrics import r2_score,mean_absolute_error


from sklearn.linear_model import LinearRegression,Ridge,Lasso
from sklearn.neighbors import KNeighborsRegressor
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor,GradientBoostingRegressor,AdaBoostRegressor,ExtraTreesRegressor
from sklearn.svm import SVR
from xgboost import XGBRegressor
```

```
df = pd.read_csv("/content/laptop.csv")
```

```
df.head(3)
```

	Unnamed: 0.1	Unnamed: 0	Company	TypeName	Inches	ScreenResolution	Cpu	Ram	Memory	Gpu	OpSys	Weight	Price
0	0	0.0	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 2.3GHz	8GB	128GB SSD	Intel Iris Plus Graphics 640	macOS	1.37kg	71378.6832
1	1	1.0	Apple	Ultrabook	13.3	1440x900	Intel Core i5 1.8GHz	8GB	128GB Flash Storage	Intel HD Graphics 6000	macOS	1.34kg	47895.5232
							Intel						

Next steps: Generate code with df View recommended plots New interactive sheet

```
df.shape
```

```
(1303, 13)
```

Total Rows = 1303 and Column = 13

Removing the "Unnamed: 0.1","Unnamed: 0" column which is of no use.

```
df.drop(["Unnamed: 0.1","Unnamed: 0"], axis=1,inplace= True)
```

```
df.head(3)
```

	Company	TypeName	Inches	ScreenResolution	Cpu	Ram	Memory	Gpu	OpSys	Weight	Price
0	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 2.3GHz	8GB	128GB SSD	Intel Iris Plus Graphics 640	macOS	1.37kg	71378.6832
1	Apple	Ultrabook	13.3	1440x900	Intel Core i5 1.8GHz	8GB	128GB Flash Storage	Intel HD Graphics 6000	macOS	1.34kg	47895.5232
2	HP	Notebook	15.6	Full HD 1920x1080	Intel Core i5 7200U 2.5GHz	8GB	256GB SSD	Intel HD Graphics 620	No OS	1.86kg	30636.0000

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```
df.isnull().sum()
```

	0
Company	30
TypeName	30
Inches	30
ScreenResolution	30
Cpu	30
Ram	30
Memory	30
Gpu	30
OpSys	30
Weight	30
Price	30

Droping the Null value

```
df.dropna(inplace=True)
```

```
df.isnull().sum()
```

	0
Company	0
TypeName	0
Inches	0
ScreenResolution	0
Cpu	0
Ram	0
Memory	0
Gpu	0
OpSys	0
Weight	0
Price	0

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1273 entries, 0 to 1302
Data columns (total 11 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   Company           1273 non-null   object
 1   TypeName          1273 non-null   object
 2   Inches            1273 non-null   object
 3   ScreenResolution  1273 non-null   object
 4   Cpu               1273 non-null   object
 5   Ram               1273 non-null   object
 6   Memory            1273 non-null   object
 7   Gpu               1273 non-null   object
 8   OpSys             1273 non-null   object
 9   Weight            1273 non-null   object
 10  Price             1273 non-null   float64
dtypes: float64(1), object(10)
memory usage: 119.3+ KB
```

```
df.duplicated().sum()
```

```
np.int64(29)
```

Deleting the Duplicate values.

```
df.drop_duplicates(inplace=True)
```

```
df.duplicated().sum()
```

```
np.int64(0)
```

```
df.shape
```

```
(1244, 11)
```

After deleting duplicate and null value and unwanted column we have total of :

1. Rows = 1244
2. Column = 11

```
df.head(3)
```

	Company	TypeName	Inches	ScreenResolution	Cpu	Ram	Memory	Gpu	OpSys	Weight	Price
0	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 2.3GHz	8GB	128GB SSD	Intel Iris Plus Graphics 640	macOS	1.37kg	71378.6832
1	Apple	Ultrabook	13.3	1440x900	Intel Core i5 1.8GHz	8GB	128GB Flash Storage	Intel HD Graphics 6000	macOS	1.34kg	47895.5232
2	HP	Notebook	15.6	Full HD 1920x1080	Intel Core i5 7200U 2.5GHz	8GB	256GB SSD	Intel HD Graphics 620	No OS	1.86kg	30636.0000

Next steps: Generate code with df View recommended plots New interactive sheet

Removing the GB from Ram and kg from Weight

```
df["Ram"] =  df["Ram"].str.replace("GB","")
```

```
df["Weight"].unique()
```

```
array(['1.37kg', '1.34kg', '1.86kg', '1.83kg', '2.1kg', '2.04kg', '1.3kg',
       '1.6kg', '2.2kg', '0.92kg', '1.22kg', '2.5kg', '1.62kg', '1.91kg',
       '2.3kg', '1.35kg', '1.88kg', '1.89kg', '1.65kg', '2.71kg', '1.2kg',
       '1.44kg', '2.8kg', '2kg', '2.65kg', '2.77kg', '3.2kg', '1.49kg',
       '2.4kg', '2.13kg', '2.43kg', '1.7kg', '1.4kg', '1.8kg', '1.9kg',
       '3kg', '1.252kg', '2.7kg', '2.02kg', '1.63kg', '1.96kg', '1.21kg',
       '2.45kg', '1.25kg', '1.5kg', '2.62kg', '1.38kg', '1.58kg',
       '1.85kg', '1.23kg', '2.16kg', '2.36kg', '7.2kg', '2.05kg',
       '1.32kg', '1.75kg', '0.97kg', '2.56kg', '1.48kg', '1.74kg',
       '1.1kg', '1.56kg', '2.03kg', '1.05kg', '5.4kg', '4.4kg', '1.90kg',
       '1.29kg', '2.0kg', '1.95kg', '2.06kg', '1.12kg', '3.49kg',
       '3.35kg', '2.23kg', '?', '2.9kg', '4.42kg', '2.69kg', '2.37kg',
       '4.7kg', '3.6kg', '2.08kg', '4.3kg', '1.68kg', '1.41kg', '4.14kg',
       '2.18kg', '2.24kg', '2.67kg', '4.1kg', '2.14kg', '1.36kg',
       '2.25kg', '2.15kg', '2.19kg', '2.54kg', '3.42kg', '5.8kg',
       '1.28kg', '2.33kg', '1.45kg', '2.79kg', '8.23kg', '1.26kg',
       '1.84kg', '0.0002kg', '2.6kg', '2.26kg', '3.25kg', '1.59kg',
       '1.13kg', '1.42kg', '1.78kg', '1.10kg', '1.15kg', '1.27kg',
       '1.43kg', '2.31kg', '1.16kg', '1.64kg', '2.17kg', '1.47kg',
       '3.78kg', '1.79kg', '0.91kg', '1.99kg', '4.33kg', '1.93kg',
       '1.87kg', '2.63kg', '3.4kg', '3.14kg', '1.94kg', '1.24kg', '4.6kg',
       '4.5kg', '8.4kg', '2.73kg', '1.39kg', '2.29kg', '2.59kg', '2.94kg',
       '11.1kg', '1.14kg', '3.8kg', '6.2kg', '3.31kg', '1.09kg', '3.21kg',
       '1.19kg', '1.98kg', '1.17kg', '4.36kg', '1.71kg', '2.32kg',
       '4.2kg', '1.55kg', '0.81kg', '1.18kg', '2.72kg', '1.31kg',
       '0.920kg', '3.74kg', '1.76kg', '1.54kg', '2.83kg', '2.07kg',
       '2.38kg', '3.58kg', '1.08kg', '2.20kg', '0.98kg', '2.75kg',
       '1.70kg', '2.99kg', '1.11kg', '2.09kg', '4kg', '3.0kg', '0.99kg',
       '0.69kg', '3.52kg', '2.591kg', '2.21kg', '3.3kg', '2.191kg',
       '2.34kg', '4.0kg'], dtype=object)
```

```
df["Weight"] = df["Weight"].str.replace("kg","")
df["Weight"] = df["Weight"].str.replace("?","0")
```

```
df.head()
```

	Company	TypeName	Inches	ScreenResolution	Cpu	Ram	Memory	Gpu	OpSys	Weight	Price
0	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 2.3GHz	8	128GB SSD	Intel Iris Plus Graphics 640	macOS	1.37	71378.6832
1	Apple	Ultrabook	13.3	1440x900	Intel Core i5 1.8GHz	8	128GB Flash Storage	Intel HD Graphics 6000	macOS	1.34	47895.5232
2	HP	Notebook	15.6	Full HD 1920x1080	Intel Core i5 7200U 2.5GHz	8	256GB SSD	Intel HD Graphics 620	No OS	1.86	30636.0000
3	Apple	Ultrabook	15.4	IPS Panel Retina Display 2880x1800	Intel Core i7 2.7GHz	16	512GB SSD	AMD Radeon Pro 455	macOS	1.83	135195.3360
4	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 3.1GHz	8	256GB SSD	Intel Iris Plus Graphics 650	macOS	1.37	96095.8080

Next steps: Generate code with df View recommended plots New interactive sheet

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1244 entries, 0 to 1273
Data columns (total 11 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   Company           1244 non-null   object 
 1   TypeName          1244 non-null   object 
 2   Inches            1244 non-null   object 
 3   ScreenResolution  1244 non-null   object 
 4   Cpu               1244 non-null   object 
 5   Ram               1244 non-null   object 
 6   Memory            1244 non-null   object 
 7   Gpu               1244 non-null   object 
 8   OpSys             1244 non-null   object 
 9   Weight            1244 non-null   object 
 10  Price             1244 non-null   float64
dtypes: float64(1), object(10)
memory usage: 116.6+ KB
```

```
df["Ram"] = df["Ram"].astype("int32")
df["Weight"] = df["Weight"].astype("float")
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1244 entries, 0 to 1273
Data columns (total 11 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   Company           1244 non-null   object 
 1   TypeName          1244 non-null   object 
 2   Inches            1244 non-null   object 
 3   ScreenResolution  1244 non-null   object 
 4   Cpu               1244 non-null   object 
 5   Ram               1244 non-null   int32  
 6   Memory            1244 non-null   object 
 7   Gpu               1244 non-null   object 
 8   OpSys             1244 non-null   object 
 9   Weight            1244 non-null   float64
 10  Price             1244 non-null   float64
```

```
dtypes: float64(2), int32(1), object(8)
memory usage: 111.8+ KB
```

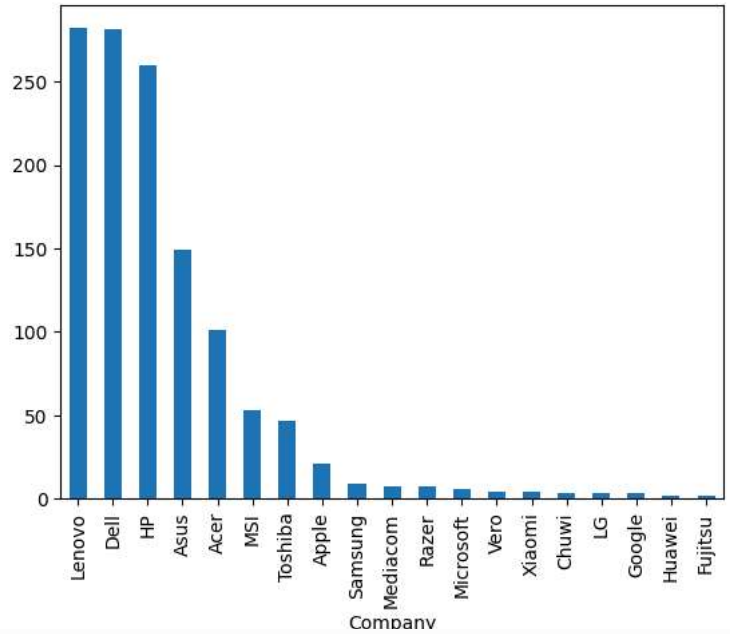
Data Analysis

```
df["Company"].value_counts()
```

Company	count
Lenovo	282
Dell	281
HP	260
Asus	149
Acer	101
MSI	53
Toshiba	47
Apple	21
Samsung	9
Mediacom	7
Razer	7
Microsoft	6
Vero	4
Xiaomi	4
Chuwi	3
LG	3
Google	3
Huawei	2
Fujitsu	2

```
df["Company"].value_counts().plot(kind="bar")
```

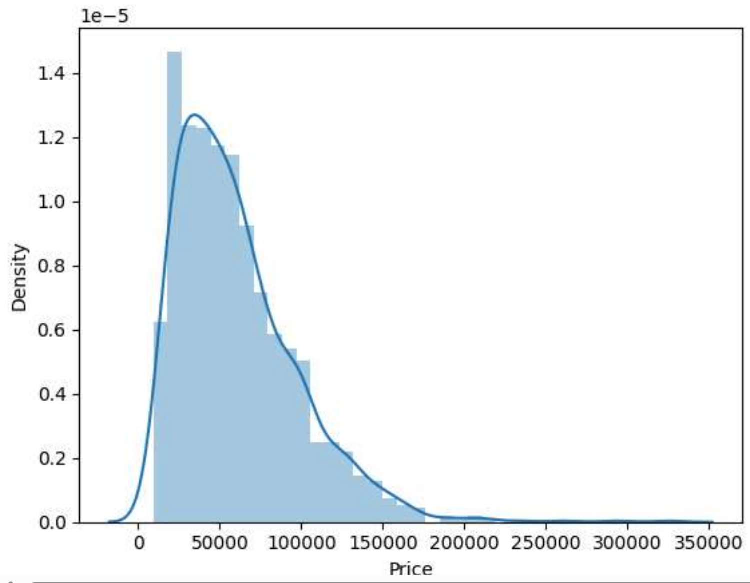
```
<Axes: xlabel='Company'>
```



Lenovo have highest in no. of laptop selled.

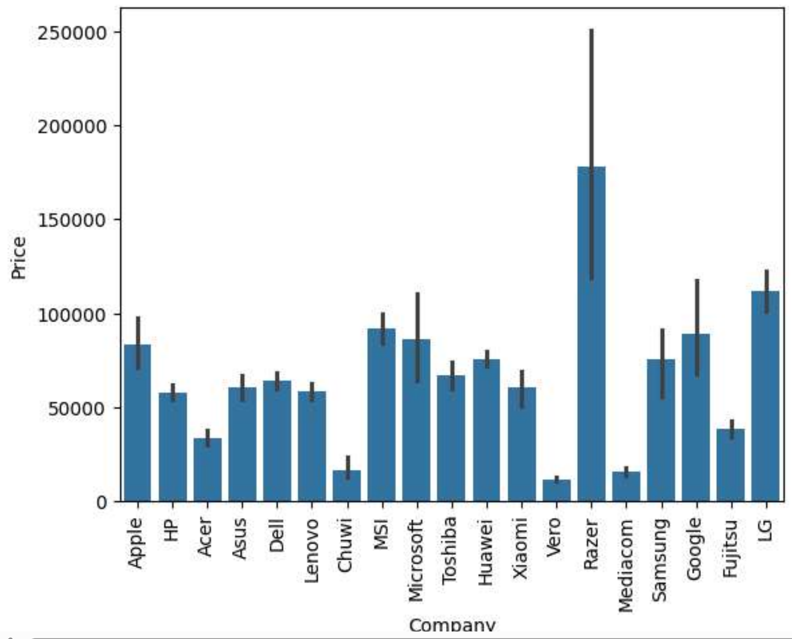
```
sns.distplot(df["Price"])
plt.show()
```

```
/tmp/ipython-input-26-3178995481.py:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df["Price"])
```



Mostly selled laptops price lies under Price 50000.

```
sns.barplot(x = df['Company'],y=df['Price'], data=df)
plt.xticks(rotation = "vertical")
plt.show()
```



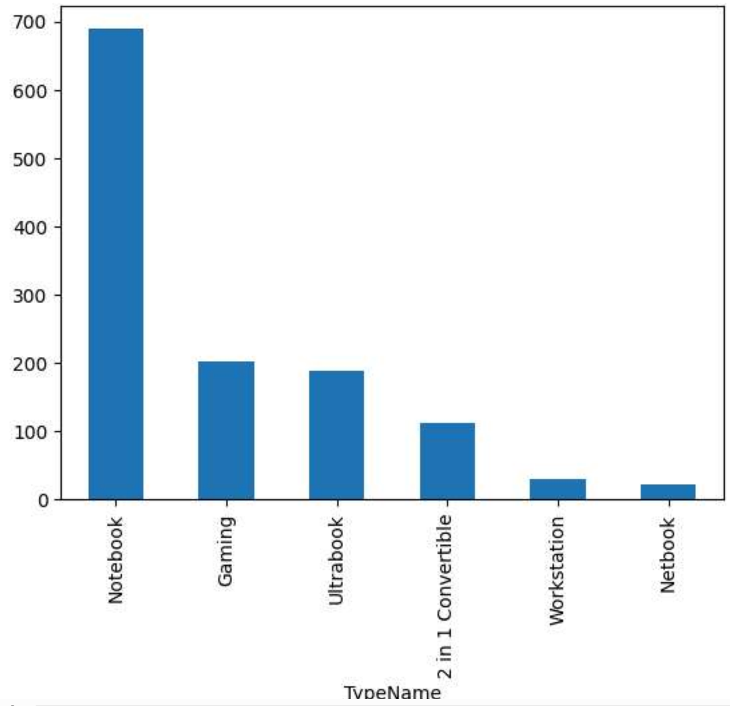
Brands do affect the price of laptops.

```
df["TypeName"].value_counts()
```

TypeName	count
Notebook	689
Gaming	203
Ultrabook	189
2 in 1 Convertible	112
Workstation	29
Netbook	22

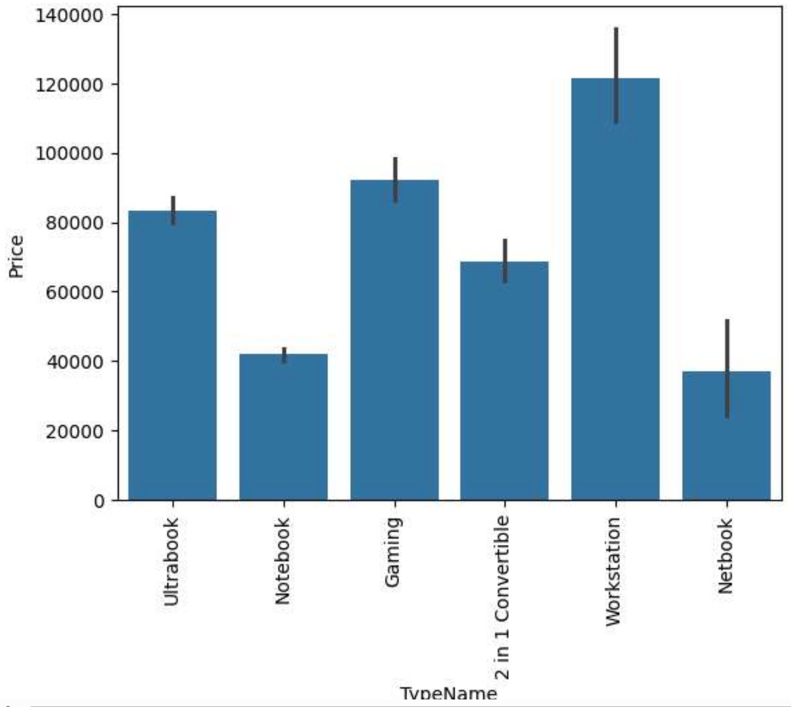
```
df["TypeName"].value_counts().plot(kind="bar")
```

```
<Axes: xlabel='TypeName'>
```



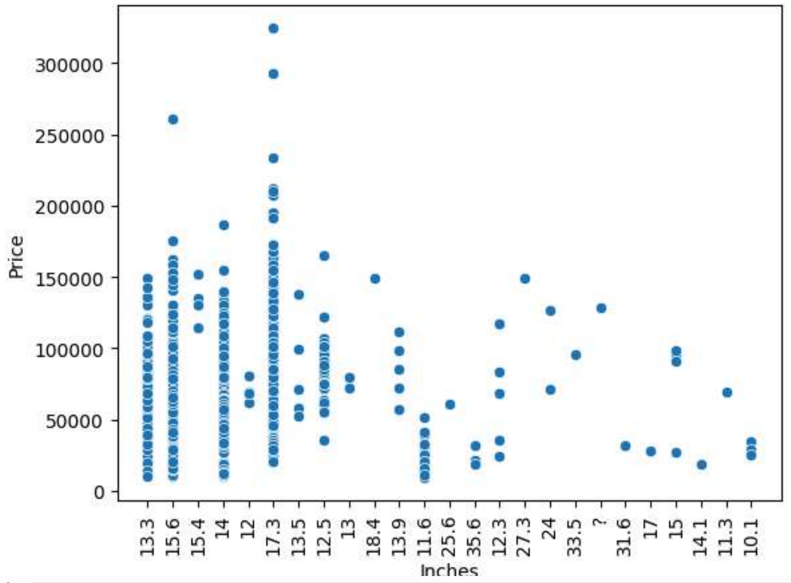
Notebook type of laptop is sold more and Netbook is least sold.

```
sns.barplot(x = df['TypeName'],y=df['Price'], data=df)
plt.xticks(rotation = "vertical")
plt.show()
```



workstation is costs more price followed by gaming laptops

```
sns.scatterplot(x=df['Inches'],y=df['Price'])
plt.xticks(rotation = "vertical")
plt.show()
```



As laptop screen size increasing prices also increase

```
df["ScreenResolution"].value_counts()
```

ScreenResolution	count
Full HD 1920x1080	493
1366x768	255
IPS Panel Full HD 1920x1080	222
IPS Panel Full HD / Touchscreen 1920x1080	50
Full HD / Touchscreen 1920x1080	45
1600x900	23
Touchscreen 1366x768	16
Quad HD+ / Touchscreen 3200x1800	14
IPS Panel 4K Ultra HD 3840x2160	12
IPS Panel 4K Ultra HD / Touchscreen 3840x2160	11
4K Ultra HD / Touchscreen 3840x2160	9
IPS Panel 1366x768	7
4K Ultra HD 3840x2160	7
Touchscreen 2560x1440	6
IPS Panel Retina Display 2304x1440	6
IPS Panel Retina Display 2560x1600	6
Touchscreen 2256x1504	6
IPS Panel Touchscreen 2560x1440	5
1440x900	4
IPS Panel Retina Display 2880x1800	4
IPS Panel Quad HD+ / Touchscreen 3200x1800	4
IPS Panel 2560x1440	4
Touchscreen 2400x1600	3
IPS Panel Quad HD+ 2560x1440	3
IPS Panel Touchscreen 1920x1200	3
IPS Panel Touchscreen 1366x768	3
Quad HD+ 3200x1800	3
2560x1440	3
1920x1080	3
IPS Panel Quad HD+ 3200x1800	2
IPS Panel Touchscreen / 4K Ultra HD 3840x2160	2
IPS Panel Full HD 2160x1440	2
IPS Panel Full HD 2560x1440	1
IPS Panel Full HD 1366x768	1
Touchscreen / Quad HD+ 3200x1800	1
IPS Panel Retina Display 2736x1824	1
Touchscreen / Full HD 1920x1080	1
IPS Panel Full HD 1920x1200	1
Touchscreen / 4K Ultra HD 3840x2160	1
IPS Panel Touchscreen 2400x1600	1

```
df["Touchscreen"] = df["ScreenResolution"].apply(lambda x:1 if "Touchscreen" in x else 0)
```

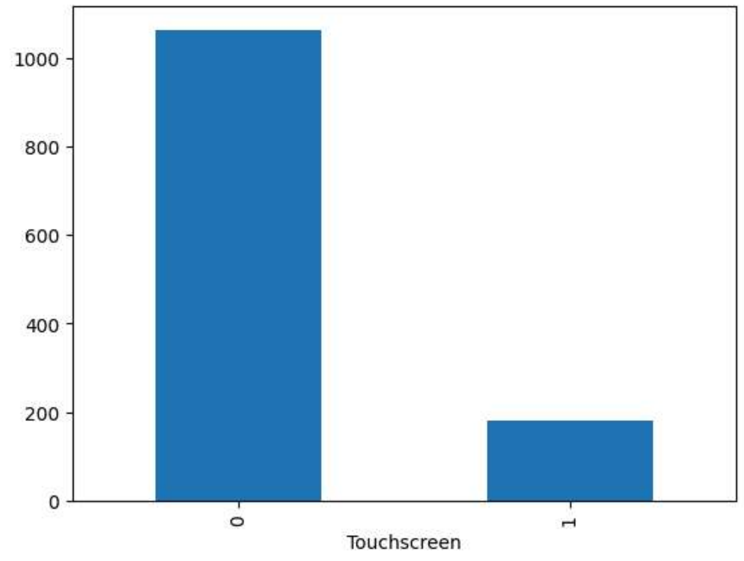
```
df["Touchscreen"].value_counts()
# 1 means Touchscreen
# 0 means Not a Touch screen
```

	count
Touchscreen	
0	1063
1	181

dtype: int64

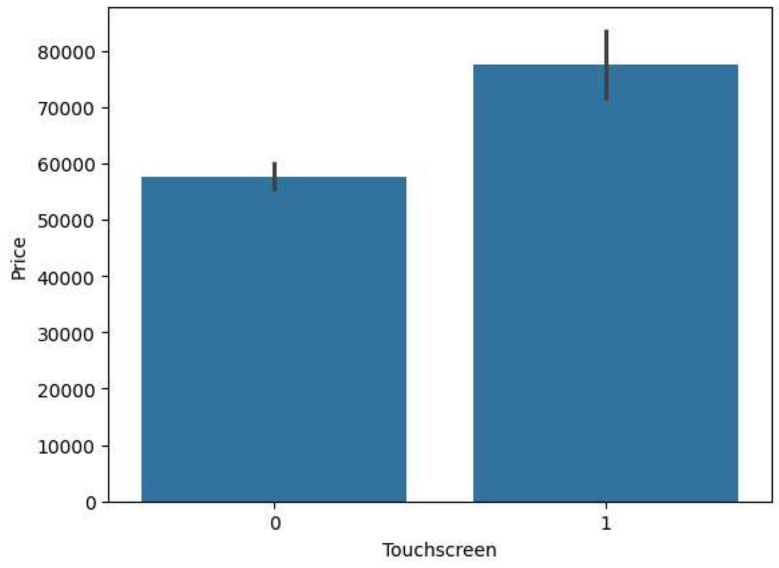
```
df["Touchscreen"].value_counts().plot(kind="bar")
```

```
<Axes: xlabel='Touchscreen'>
```



```
Start coding or generate with AI.
```

```
sns.barplot(x=df["Touchscreen"],y=df["Price"])
plt.show()
```

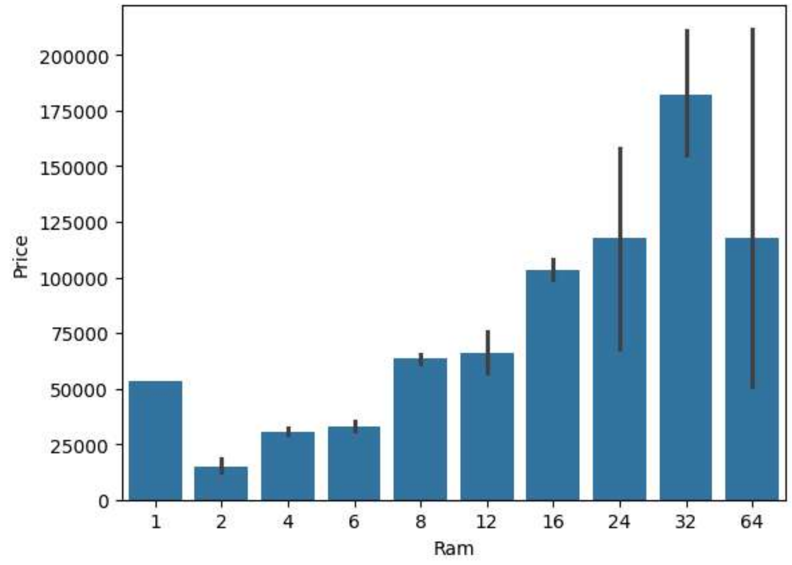


Price of Touchscreen laptop is higher.

```
sns.barplot(x= df["Ram"],y=df["Price"])
plt.show
```

```
matplotlib.pyplot.show
def show(*args, **kwargs) -> None
```

```
/usr/local/lib/python3.11/dist-packages/matplotlib/pyplot.py
Display all open figures.

Parameters
----------
block : bool, optional
```



As RAM size is increasing price is increasing

```
df.head(3)
```

	Company	TypeName	Inches	ScreenResolution	Cpu	Ram	Memory	Gpu	OpSys	Weight	Price	Touchscreen
0	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 2.3GHz	8	128GB SSD	Intel Iris Plus Graphics 640	macOS	1.37	71378.6832	0
1	Apple	Ultrabook	13.3	1440x900	Intel Core i5 1.8GHz	8	128GB Flash Storage	Intel HD Graphics 6000	macOS	1.34	47895.5232	0
					Intel Core i5		256GB	Intel HD				

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As here we are about to implement ML for pice prediction . Here it can be seen that output data which is Price is a liner regression

Train and test

```
x = df.iloc[:,:-2]
x
```

	Company	TypeName	Inches	ScreenResolution	Cpu	Ram	Memory	Gpu	OpSys	Weight
0	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 2.3GHz	8	128GB SSD	Intel Iris Plus Graphics 640	macOS	1.37
1	Apple	Ultrabook	13.3	1440x900	Intel Core i5 1.8GHz	8	128GB Flash Storage	Intel HD Graphics 6000	macOS	1.34
2	HP	Notebook	15.6	Full HD 1920x1080	Intel Core i5 7200U 2.5GHz	8	256GB SSD	Intel HD Graphics 620	No OS	1.86
3	Apple	Ultrabook	15.4	IPS Panel Retina Display 2880x1800	Intel Core i7 2.7GHz	16	512GB SSD	AMD Radeon Pro 455	macOS	1.83
4	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 3.1GHz	8	256GB SSD	Intel Iris Plus Graphics 650	macOS	1.37
...	...	...	...	...	...	...	...	...	...	...
1269	Asus	Notebook	15.6	1366x768	Intel Core i7 6500U 2.5GHz	4	500GB HDD	Nvidia GeForce 920M	Windows 10	2.20
1271	Lenovo	2 in 1 Convertible	13.3	IPS Panel Quad HD+ / Touchscreen 3200x1800	Intel Core i7 6500U 2.5GHz	16	512GB SSD	Intel HD Graphics 520	Windows 10	1.30
1272	Lenovo	Notebook	14	1366x768	Intel Celeron Dual Core N3050 1.6GHz	2	64GB Flash Storage	Intel HD Graphics	Windows 10	1.50
1273	HP	Notebook	15.6	1366x768	Intel Core i7 6500U 2.5GHz	6	1TB HDD	AMD Radeon R5 M330	Windows 10	2.19

Next steps: Generate code with x View recommended plots New interactive sheet

```
y = df["Price"]
y
```

	Price
0	71378.6832
1	47895.5232
2	30636.0000
3	135195.3360
4	96095.8080
...	...
1269	38378.6496
1270	33992.6400
1271	79866.7200
1272	12201.1200
1273	40705.9200

1244 rows × 1 columns

dtype: float64

```
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=2)
```

```
x_train
```

	Company	TypeName	Inches	ScreenResolution	Cpu	Ram	Memory	Gpu	OpSys	Weight
517	Asus	Gaming	15.6	Full HD 1920x1080	Intel Core i7 7700HQ 2.8GHz	24	512GB SSD	Nvidia GeForce GTX1080	Windows 10	2.24
941	Asus	Notebook	17.3	1600x900	Intel Pentium Quad Core N3710 1.6GHz	4	1TB HDD	Nvidia GeForce 920MX	Windows 10	2.80
1211	Asus	Notebook	15.6	Full HD 1920x1080	Intel Core i7 7700HQ 2.8GHz	16	128GB SSD + 1TB HDD	Nvidia GeForce GTX 1060	Windows 10	2.20
984	Toshiba	Notebook	14	1366x768	Intel Core i5 6200U 2.3GHz	4	500GB HDD	Intel HD Graphics 520	Windows 10	1.75
929	HP	Notebook	14	1366x768	Intel Core i5 6200U 2.3GHz	4	500GB HDD	Intel HD Graphics 520	Windows 10	1.95