INNOMATICS
RESEARCH LABS

LAPTOPS PRICE ANALYSIS

ABOUT ME :

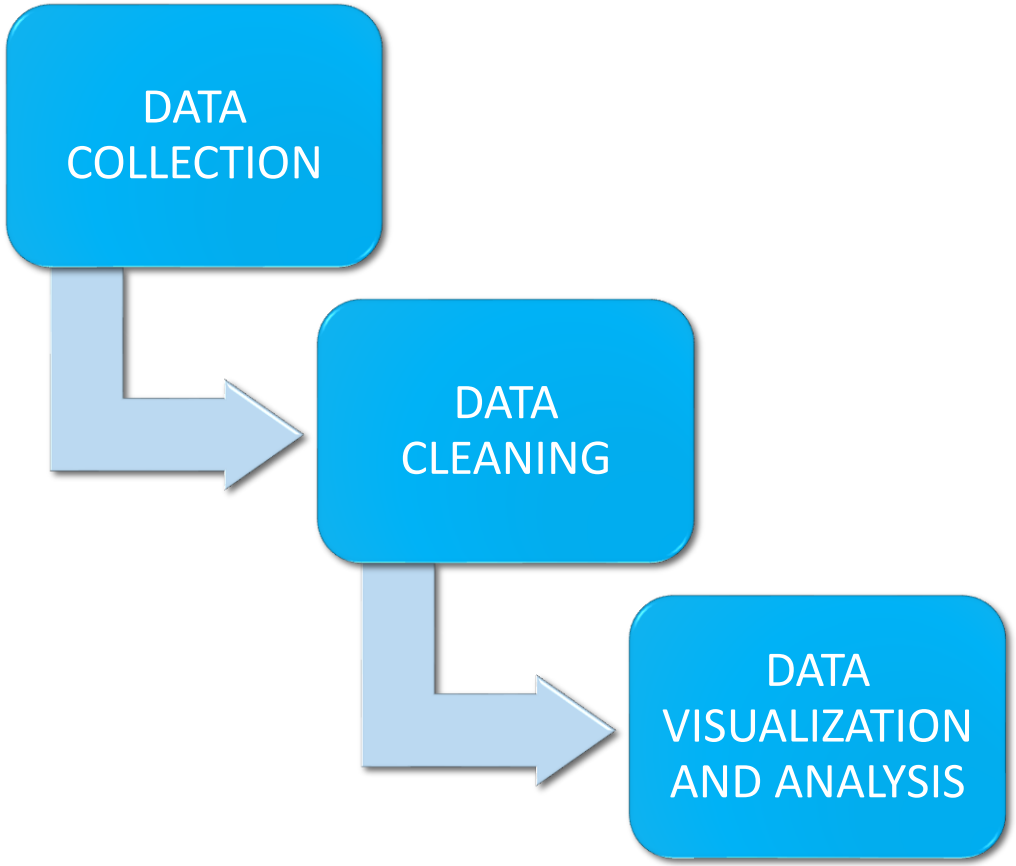
- ✓ **RITIKA KALYANI** (B-tech In Computer science and engineering)
- ✓ I want to study data science for career transition and to build a base for my masters studies.
- ✓ 8 months work experience as Systems Engineer in INFOSYS.
- ✓ People at Innomatics are polite and generous and they motivate us to reach greater heights with their teaching and interactive skills and they are ready to assist us whenever we need any help.

- ✓ **VIDYADHARI PEDDINTI** (BCA and pursuing M-Tech from BITS PILANI)
- ✓ I want to develop my skills and reach greater heights as a good data scientist in IT Industry.
- ✓ 1 year work experience as Systems Engineer in WIPRO LIMITED.
- ✓ People at Innomatics are polite and generous and they motivate us to reach greater heights with their teaching and interactive skills and they are ready to assist us whenever we need any help.

PROBLEM STATEMENT:

Laptop price analysis based on various features like RAM, Processor, Screen size, Storage, Operating System and Brands.

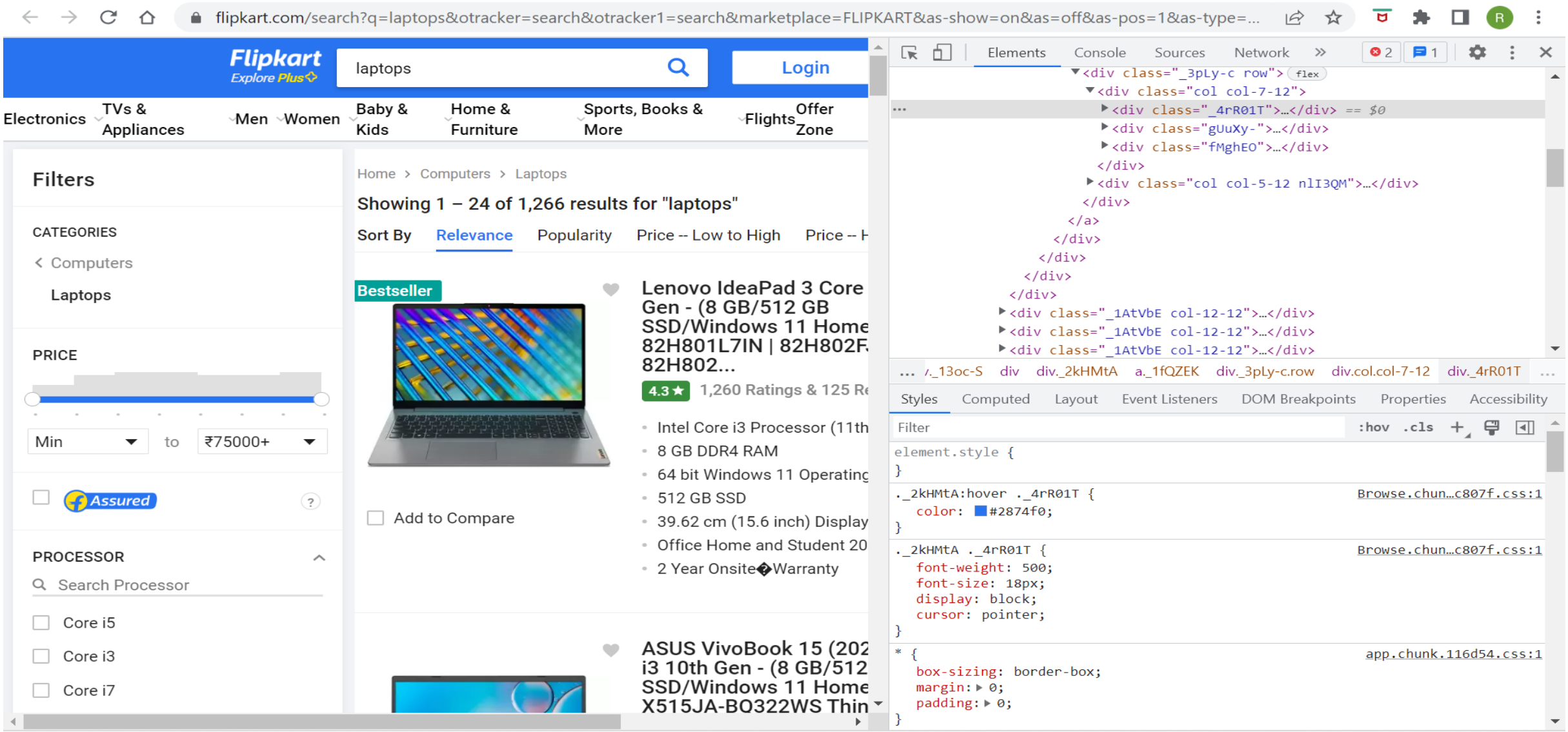
STAGES OF DATA ANALYSIS:



DATA COLLECTION:

- **WEBSITE NAME:** FLIPKART
- **LINK:**”https://www.flipkart.com/search?q=laptops&otracker=search&otracker1=search&marketplace=FLIPKART&as-show=on&as=off&as-pos=1&as-type=HISTORY&page=“
- **LIBRARIES USED:**
  - **Data Visualization:** SEABORN,PLOTLY
  - **Data Cleaning:** PANDAS,RE
  - **Data Collection:** REQUESTS,BEAUTIFULSOUP,PANDAS,NUMPY,RE(REGULAR EXPRESSIONS)

WEB SCRAPPING:



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Process of data collection:

- First step was to extract links from each page which was done using **requests.get()** and **beautifulsoup** with help of for loop.
- Second step was to extract features which was done using **soup.find_all()** and class names from website's inspect page and using **regular expressions** then storing them in empty lists.
- After storing results in lists to remove empty elements from lists we used **if** conditions.
- Third step was to check whether all the lists were of same length so as to form a data frame.
- If there were any list with missing values we used **append** method and filled them using **NAN** values.
- Finally we created a data frame using all lists as columns and elements stored in rows with 432 rows and 10 columns.

COLLECTED DATA:

```
In [52]: df
```

Out[52]:

	Brands	Models	Prices	ROM	RAM	Size	Processor	Operating System	Warranty	Ratings
0	acer	acer Extensa 15	₹29,790	256 GB SSD	4 GB DDR4	(15.6 inch)	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	1 Year International Travelers Warranty	[4.2]
1	Lenovo	Lenovo IdeaPad 1	₹19,990	256 GB SSD	4 GB DDR4	(11.6 Inch)	Intel Celeron Dual Core Processor	64 bit Windows 11	1 Year Onsite Warranty	[3.4]
2	DELL	DELL	₹58,390	512 GB SSD	8 GB DDR4	(14 inch)	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	1 Year Onsite Warranty	[4.3]
3	HP	HP	₹40,990	512 GB SSD	8 GB DDR4	(14 Inch)	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	1 Year Onsite Warranty	[4.3]
4	HP	HP	₹36,990	256 GB SSD	8 GB DDR4	(14 inch)	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	1 Year Onsite Warranty	[4.3]
...	...	...	...	...	...	...	...	...	...	...
427	acer	acer Aspire 5	₹50,990	NaN	8 GB DDR4	(15.6 Inch)	Intel Core i5 Processor (11th Gen)	64 bit Windows 11	NaN	NaN
428	ASUS	ASUS ZenBook 13	₹83,990	NaN	8 GB LPDDR3	(13.3 inch)	Intel Core i7 Processor (8th Gen)	64 bit Windows 10	NaN	NaN
429	Lenovo	Lenovo ThinkBook 13s	₹59,990	NaN	8 GB DDR4	(13 inch)	Intel Core i5 Processor (11th Gen)	64 bit Windows 10	NaN	NaN
430	ASUS	ASUS ROG Strix G15	₹82,990	NaN	8 GB DDR4	(15.6 inch)	Intel Core i5 Processor (10th Gen)	64 bit Windows 10	NaN	NaN
431	Lenovo	Lenovo Legion 5	₹1,33,999	NaN	16 GB DDR4	(15.6 inch)	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	NaN	NaN

432 rows × 10 columns

```
In [53]: df.to_csv(r"C:\Users\ritika\Desktop\DATA SCIENCE\Project\finaldata.csv")
```

DATA CLEANING:

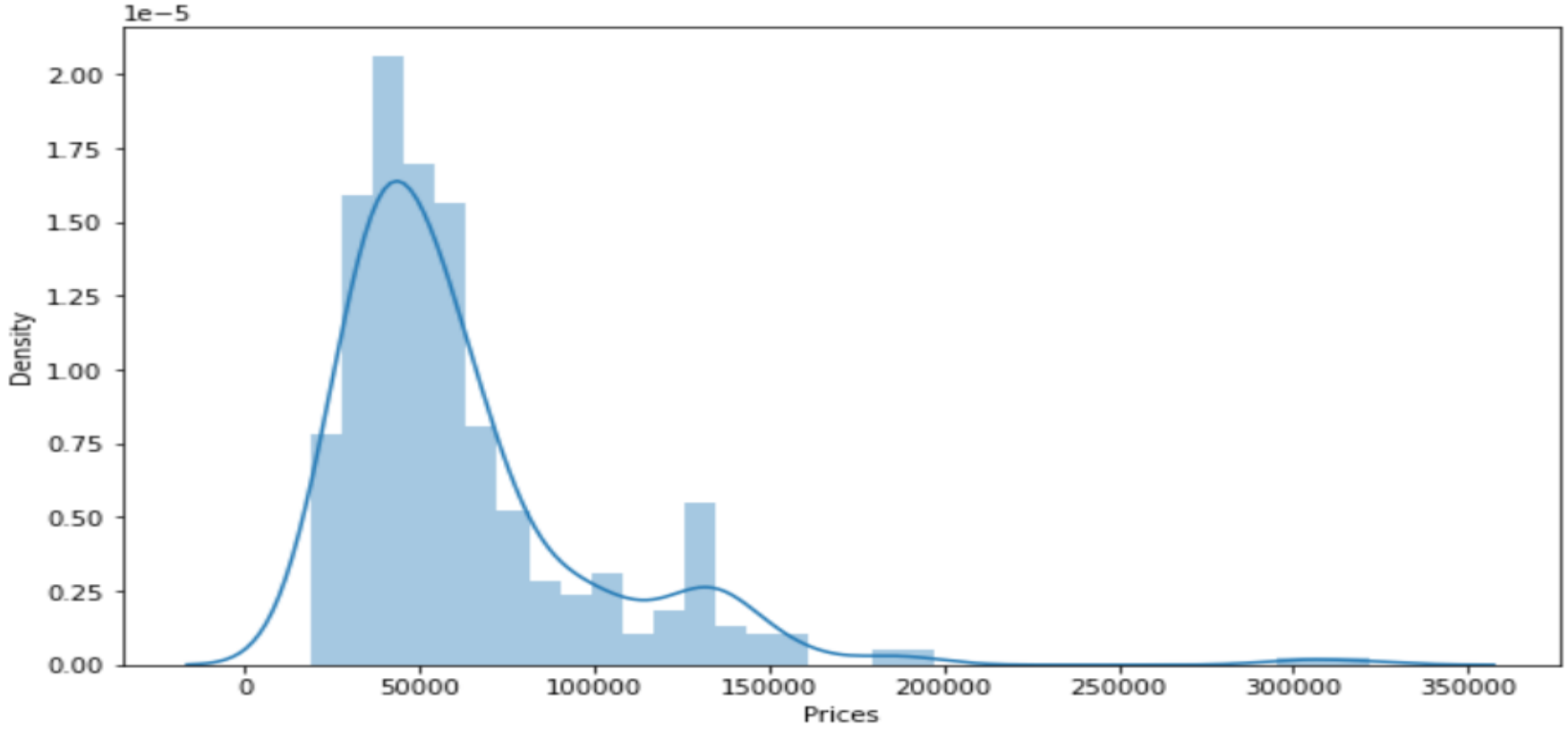
- To remove special characters from **PRICES** column we used **re.sub()** method from regular expressions and substituted them with empty character.
- Then to remove characters from **SIZE** column we used **re.sub()** method and substituted them with empty character.
- Similarly to remove special characters from **WARRANTY** column we used **re.sub()** method and also removed characters from the column using **split()** method to make the column numerical.
- **ROM** and **WARRANTY** columns had NAN values which were filled with **mode** of the data and **RATINGS** column NAN values were filled with **mean** of data.
- Change the data type using **astype().**
- Split the **RAM** column into **RAM** and **RAM Type**.
- Renamed **ROM** column to **Storage(GB)** using rename method.
- Finally clean data was obtained.

CLEANED DATA:

	Brands	Models	Prices	Storage(GB)	RAM	RAM Type	Size	Processor	Operating System	Warranty	Ratings
0	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.2
1	Avita	Avita SATUS ULTIMUS S111	21490.0	128	4	DDR4	14.1	Intel Celeron Dual Core Processor	64 bit Windows 11	1.0	4.1
2	HP	HP	36990.0	256	8	DDR4	14.0	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	1.0	4.3
3	Lenovo	Lenovo IdeaPad 3	39490.0	512	8	DDR4	15.6	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	2.0	4.3
4	Lenovo	Lenovo IdeaPad 3	47241.0	512	8	DDR4	15.6	Intel Core i5 Processor (11th Gen)	64 bit Windows 10	2.0	4.2
5	ASUS	ASUS	29990.0	256	8	DDR4	15.6	AMD Ryzen 3 Dual Core Processor	64 bit Windows 10	1.0	4.3
6	Lenovo	Lenovo IdeaPad 3	36990.0	256	8	DDR4	14.0	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	2.0	4.3
7	Lenovo	Lenovo IdeaPad 3	33490.0	256	8	DDR4	15.6	Intel Core i3 Processor (10th Gen)	Windows 11	2.0	4.3
8	HP	HP	40990.0	512	8	DDR4	14.0	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	1.0	4.3
9	HP	HP	33990.0	256	8	DDR4	15.6	AMD Ryzen 3 Dual Core Processor	64 bit Windows 11	1.0	4.3
10	HP	HP	40990.0	512	8	DDR4	15.6	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	1.0	4.2
11	Lenovo	Lenovo IdeaPad	37990.0	512	8	DDR4	15.6	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	2.0	4.3
12	ASUS	ASUS VivoBook 15 (2022)	33990.0	512	8	DDR4	15.6	Intel Core i3 Processor (10th Gen)	64 bit Windows 11	1.0	4.5
13	HP	HP Pavilion	54990.0	512	8	DDR4	15.6	AMD Ryzen 5 Hexa Core Processor	64 bit Windows 10	1.0	4.6
14	DELL	DELL	40990.0	1000	8	DDR4	15.6	AMD Ryzen 3 Dual Core Processor	64 bit Windows 11	1.0	4.6
15	Lenovo	Lenovo IdeaPad	45990.0	512	8	DDR4	14.0	AMD Ryzen 5 Hexa Core Processor	64 bit Windows 10	1.0	4.1
16	Lenovo	Lenovo IdeaPad 3	27999.0	256	4	DDR4	14.0	Intel Celeron Dual Core Processor (4th Gen)	64 bit Windows 10	1.0	4.3

DATA ANALYSIS

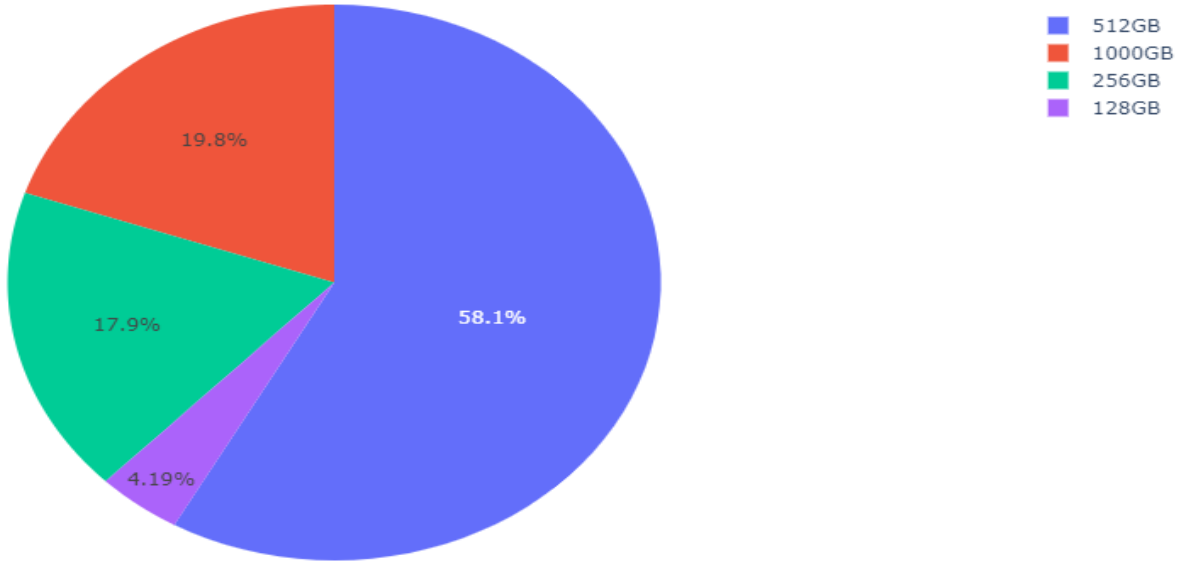
DENSITY OF PRICE:



As seen from the above graph the distribution of the price variable is right skewed which shows that laptops with less price are sold and purchased more.

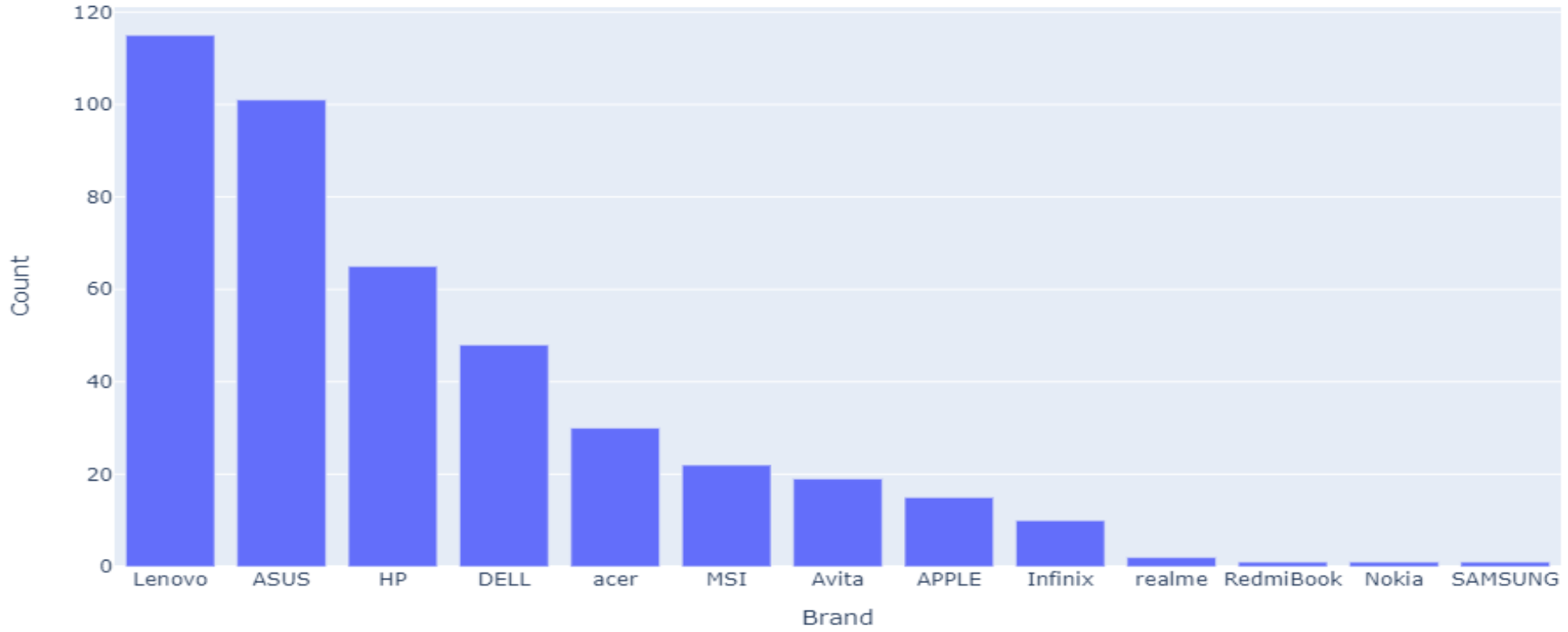
UNIVARIATE ANALYSIS:

STORAGE IN GB:



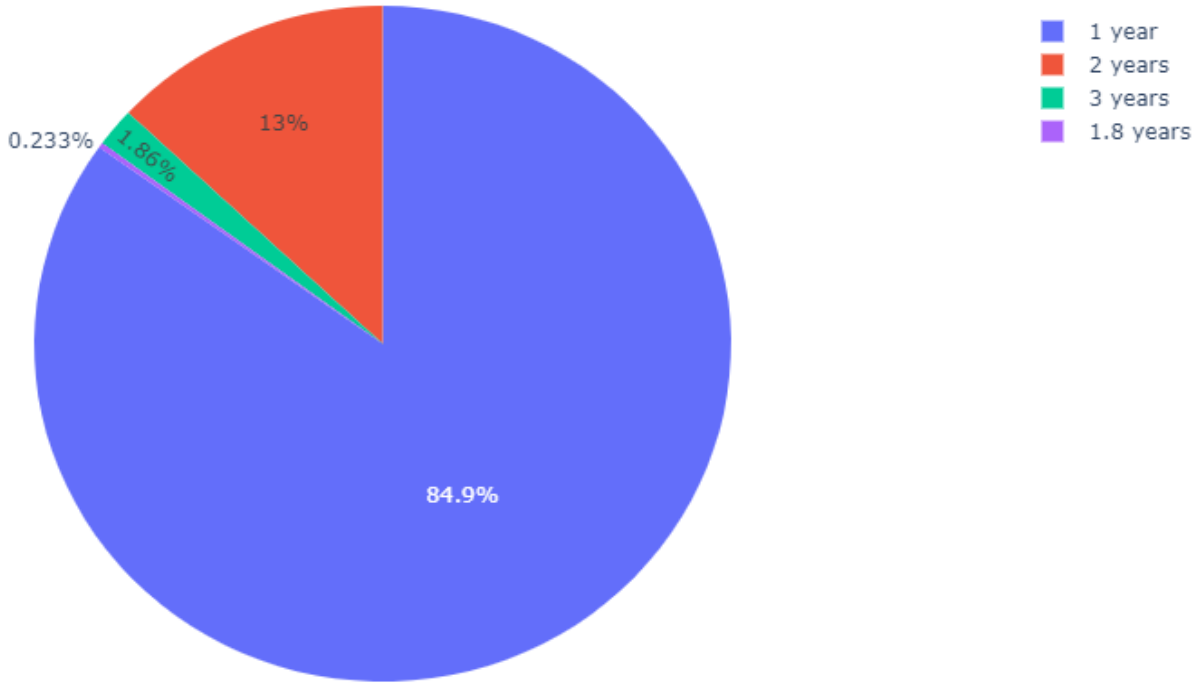
From the above graph it is clear that the laptops with 512 GB storage are sold more when compared to 1000GB(1TB),128GB,256GB.

BRANDS:



From the above graph we can infer that the laptops of brands LENOVO,ASUS,HP,DELL are in high number respectively when compared to other brands.

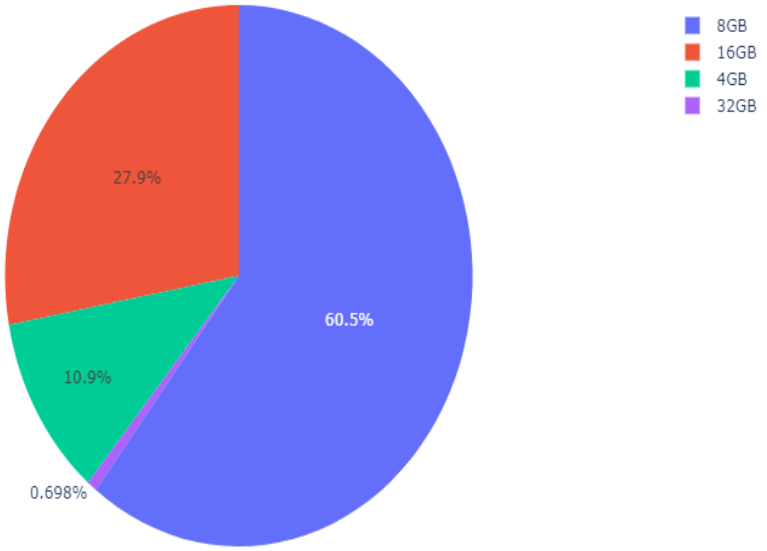
WARRANTY:



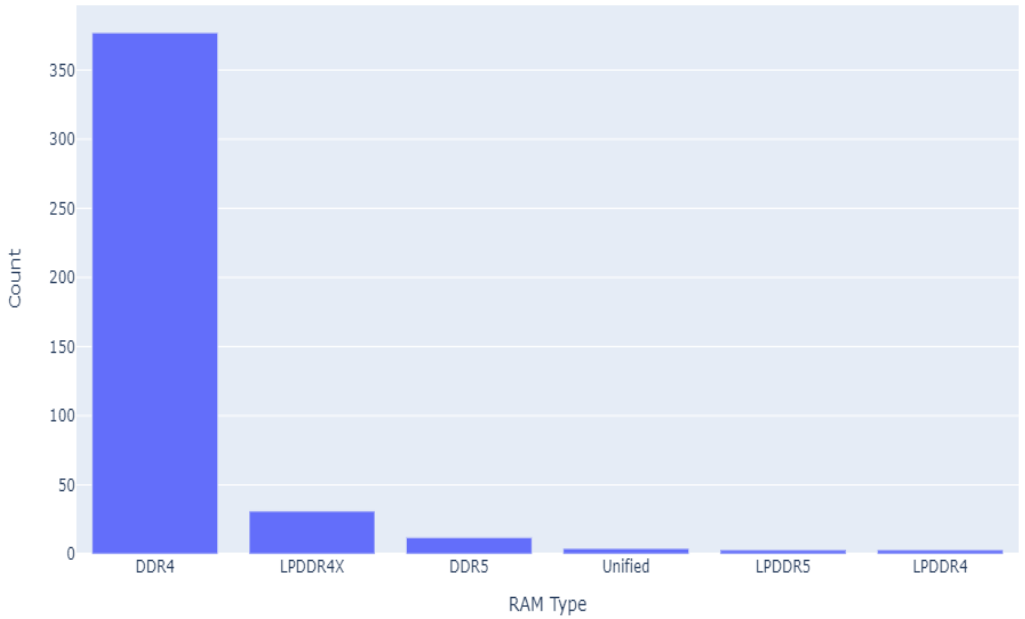
From the above graph it is clear that most of the laptops sold are of 1 YEAR WARRANTY.

RAM:

RAM(GB)

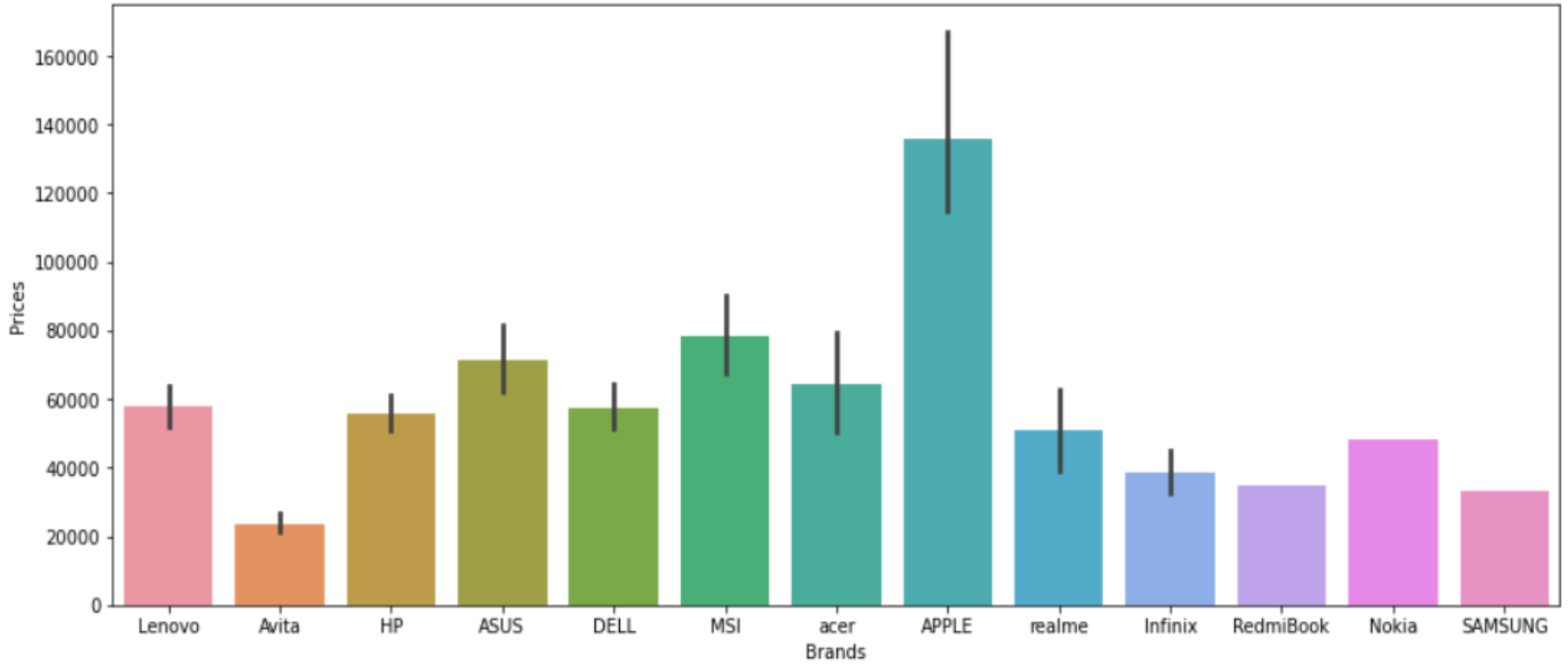


RAM TYPE



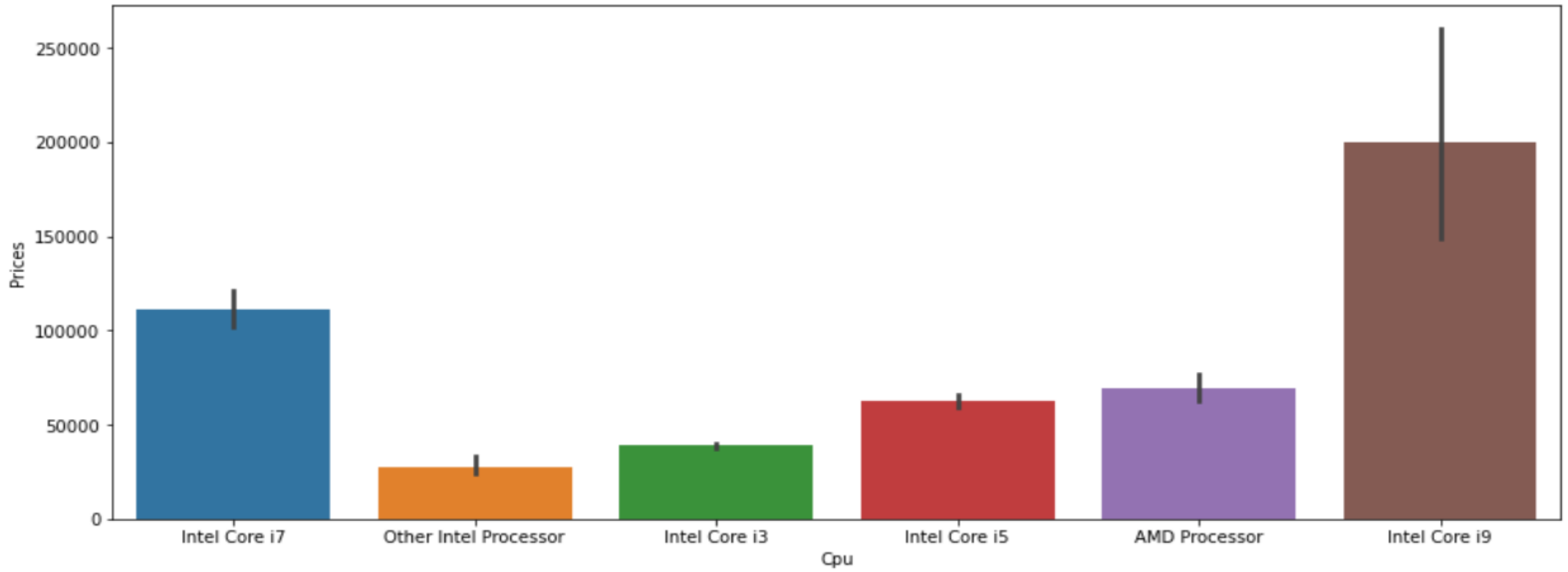
From the above two graphs the laptops with 8GB RAM and RAM TYPE as DDR4 are high in number and are mostly preferred as 8GB RAM is enough for smooth performance of a laptop.

BIVARIATE ANALYSIS:
BRANDS VS PRICES:



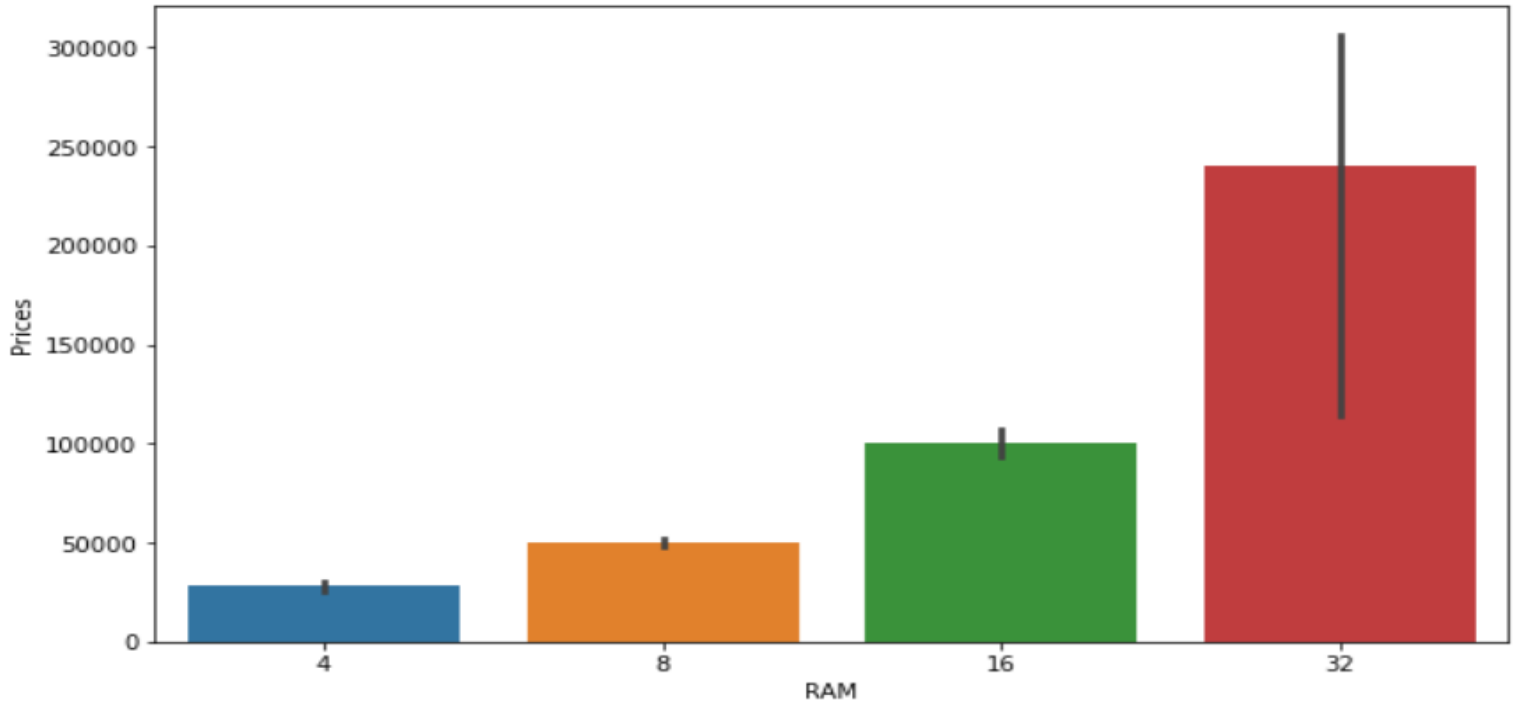
From the above comparison we can conclude that the laptops from brands APPLE,MSI,ASUS,ACER are expensive and others are in budget range.

PROCESSOR VS PRICE:



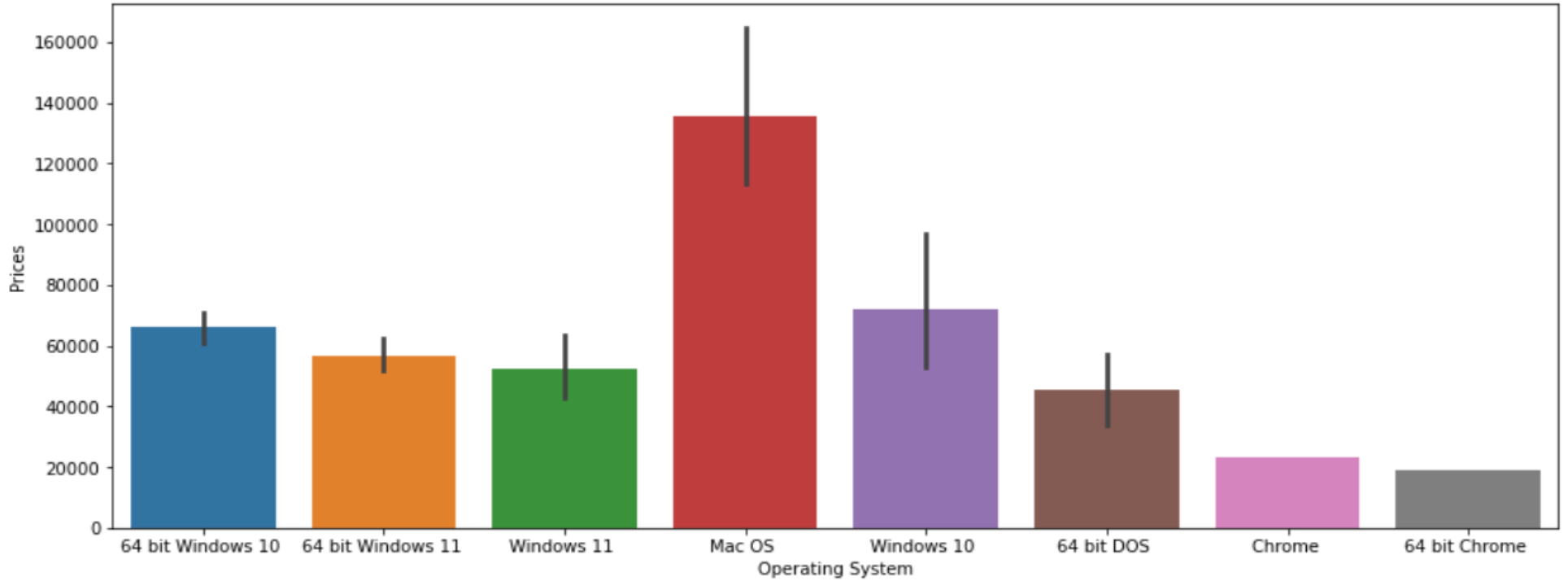
From the above comparison it is understood that the prices of laptops with INTEL CORE I9 processor are high followed by INTEL CORE I7 and others are in budget.

RAM VS PRICES:



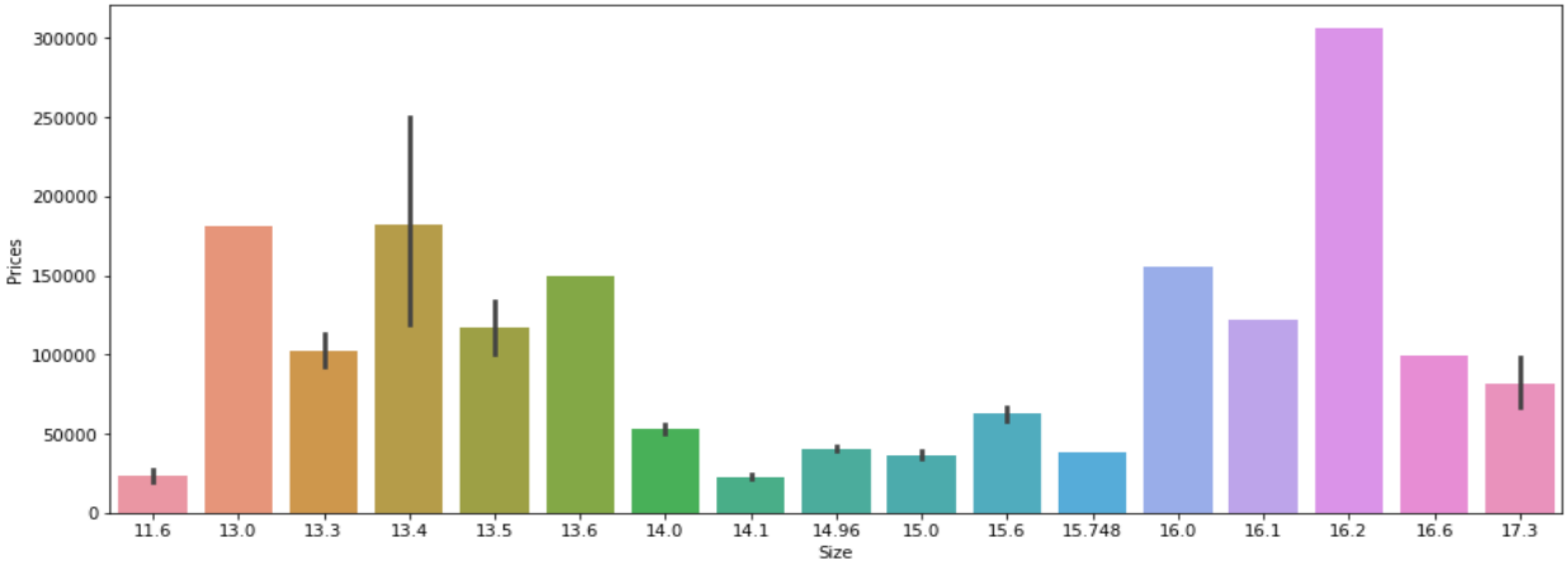
From the above comparison it is clear that the prices of laptops is having linear relation with RAM and laptops with 32GB RAM are expensive followed by 16GB RAM and others are way to cheaper compared to them.

OPERATING SYSTEM VS PRICES:



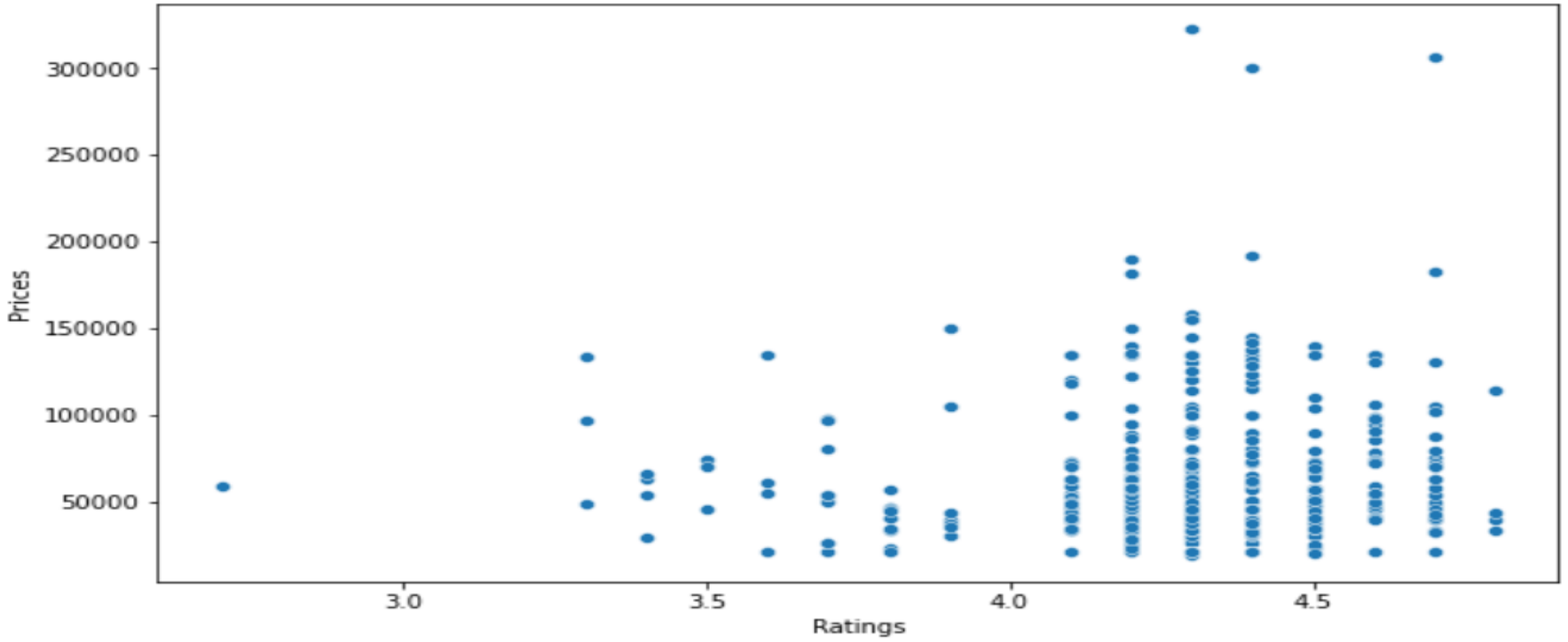
From the above comparison it is understood that the prices of laptops with MAC operating system and WINDOWS 10 OS are high WINDOWS 11 and DOS and others are in budget.

LAPTOP SIZE VS PRICES:



From the comparison above it is well understood that the laptops with screen size 13.4,17.3,13.5,13.3 inches respectively are expensive while the others are affordable and cheaper.

RATINGS AND PRICES:



From the above graph it is understood that there is a relationship but not a strong relationship between price and ratings.

BRANDS VS RATINGS:

From the comparison between brands and ratings we can infer that the brands APPLE,LENOVO,ASUS have higher ratings compared to other brands.

CORRELATION:

From the above graph we see that Prices and RAM are highly correlated whereas Storage and RAM and also Storage and Size are moderately related.

MULTIVARIATE ANALYSIS:

If a person wants to buy a laptop which has ratings greater than 4.5 and meet his budget requirement less than Rs.50,000 then she/he can consider the below laptops:

	Brands	Models	Prices	Storage(GB)	RAM	RAM Type	Size	Processor	Operating System	Warranty	Ratings	Cpu
14	DELL	DELL	40990.0	1000	8	DDR4	15.6	AMD Ryzen 3 Dual Core Processor	64 bit Windows 11	1.0	4.6	AMD Processor
47	Lenovo	Lenovo IdeaPad	45990.0	512	8	DDR4	14.0	AMD Ryzen 5 Hexa Core Processor	64 bit Windows 10	1.0	4.6	AMD Processor
51	Avita	Avita SATUS ULTIMUS S111	21490.0	128	4	DDR4	14.1	Intel Celeron Dual Core Processor	64 bit Windows 11	1.0	4.7	Other Intel Processor
77	HP	HP	47990.0	512	8	DDR4	15.6	AMD Ryzen 5 Hexa Core Processor	64 bit Windows 11	1.0	4.7	AMD Processor
96	ASUS	ASUS VivoBook 15 (2022)	31990.0	256	4	DDR4	15.6	Intel Core i3 Processor (11th Gen)	Windows 10	1.0	4.7	Intel Core i3
100	ASUS	ASUS	33490.0	256	8	DDR4	15.6	AMD Ryzen 3 Quad Core Processor	Windows 11	1.0	4.7	AMD Processor
111	ASUS	ASUS	39990.0	512	8	DDR4	14.0	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	1.0	4.7	Intel Core i3
128	ASUS	ASUS VivoBook Flip 14	49990.0	512	8	LPDDR4X	14.0	Intel Core i3 Processor (11th Gen)	Windows 11	2.0	4.7	Intel Core i3
131	Lenovo	Lenovo IdeaPad 3	33490.0	256	8	DDR4	15.6	Intel Core i3 Processor (10th Gen)	Windows 11	1.0	4.8	Intel Core i3
143	Lenovo	Lenovo IdeaPad	45990.0	512	8	DDR4	14.0	AMD Ryzen 5 Hexa Core Processor	64 bit Windows 10	2.0	4.6	AMD Processor
147	Lenovo	Lenovo IdeaPad 3	39490.0	512	8	DDR4	15.6	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	2.0	4.7	Intel Core i3
150	HP	HP	39990.0	512	8	DDR4	15.6	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	1.0	4.6	Intel Core i3
160	Avita	Avita SATUS ULTIMUS S111	21490.0	128	4	DDR4	14.1	Intel Celeron Dual Core Processor	64 bit Windows 11	1.0	4.6	Other Intel Processor
175	Lenovo	Lenovo IdeaPad 3	39490.0	512	8	DDR4	15.6	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	2.0	4.8	Intel Core i3
176	ASUS	ASUS Vivobook 15	42990.0	512	16	DDR4	15.6	AMD Ryzen 7 Quad Core Processor	64 bit Windows 11	1.0	4.8	AMD Processor
213	ASUS	ASUS	32585.0	256	4	DDR4	14.0	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	2.0	4.7	Intel Core i3
223	Lenovo	Lenovo IdeaPad 3	39490.0	512	8	DDR4	15.6	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	2.0	4.7	Intel Core i3
252	ASUS	ASUS	45990.0	1000	8	DDR4	15.6	Intel Core i5 Processor (10th Gen)	64 bit Windows 10	1.0	4.7	Intel Core i5
254	DELL	DELL Inspiron	40090.0	512	8	DDR4	15.6	Intel Core i3 Processor (10th Gen)	64 bit Windows 10	1.0	4.7	Intel Core i3
265	HP	HP 14s	42390.0	128	8	DDR4	14.0	Intel Core i3 Processor (11th Gen)	64 bit Windows 11	1.0	4.7	Intel Core i3

If a person wants to buy a laptop of brands APPLE,ASUS,LENOVO and of specifications with ratings higher than 4.5 and Size less than 14 inches then these are the options he/she can consider:

	Brands	Models	Prices	Storage(GB)	RAM	RAM Type	Size	Processor	Operating System	Warranty	Ratings	Cpu
44	APPLE	APPLE MacBook Air	104990.0	256	16	DDR4	13.3	Apple M1 Processor	Mac OS	1.0	4.7	AMD Processor
72	APPLE	APPLE 2020 Macbook Air	105990.0	512	8	DDR4	13.3	Apple M1 Processor	Mac OS	2.0	4.6	AMD Processor
142	APPLE	APPLE 2020 Macbook Air	86990.0	256	8	DDR4	13.3	Apple M1 Processor	Mac OS	1.0	4.7	AMD Processor
165	APPLE	APPLE 2022 MacBook Pro	129900.0	256	8	Unified	13.3	Apple M2 Processor	Mac OS	1.0	4.7	AMD Processor
166	ASUS	ASUS ROG Flow X13	113990.0	1000	32	LPDDR4X	13.4	AMD Ryzen 9 Octa Core Processor	64 bit Windows 10	1.0	4.8	AMD Processor
214	Lenovo	Lenovo Yoga 6	77990.0	512	16	DDR4	13.3	AMD Ryzen 7 Octa Core Processor	64 bit Windows 11	1.0	4.6	AMD Processor
266	ASUS	ASUS Zenbook 13 Intel EVO	71990.0	512	16	LPDDR4	13.3	Intel Core i5 Processor (11th Gen)	64 bit Windows 11	1.0	4.7	Intel Core i5
268	APPLE	APPLE MacBook Air	129990.0	512	16	DDR4	13.3	Apple M1 Processor	Mac OS	1.0	4.6	AMD Processor
333	ASUS	ASUS ROG Flow Z13 (2022)	181990.0	512	16	LPDDR5	13.4	Intel Core i9 Processor (12th Gen)	64 bit Windows 11	1.0	4.7	Intel Core i9

If a person wants to buy a laptop with only Intel Processor and of specifications with 512 GB storage space and 16 GB RAM then these are the options she/he can consider:

	Brands	Models	Prices	Storage(GB)	RAM	RAM Type	Size	Processor	Operating System	Warranty	Ratings	Cpu
0	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.2	Intel Core i7
43	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.2	Intel Core i7
65	MSI	MSI GF63 Thin	72990.0	512	16	DDR4	15.6	Intel Core i7 Processor (10th Gen)	64 bit Windows 10	2.0	4.3	Intel Core i7
67	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.6	Intel Core i7
91	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.1	Intel Core i7
145	MSI	MSI GF65 Thin	79990.0	512	16	DDR4	15.6	Intel Hexa Core i5 Processor (10th Gen)	64 bit Windows 10	1.0	3.7	Other Intel Processor
155	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.4	Intel Core i7
183	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.2	Intel Core i7
211	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.3	Intel Core i7
233	Infinix	Infinix INBook X1 Pro	50990.0	512	16	LPDDR4X	14.0	Intel Core i7 Processor (10th Gen)	64 bit Windows 11	1.0	4.5	Intel Core i7
235	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.6	Intel Core i7
286	Lenovo	Lenovo Yoga Slim 7 Intel EVO	102990.0	512	16	DDR4	14.0	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.3	Intel Core i7
307	Infinix	Infinix INBook X1 Pro	50990.0	512	16	LPDDR4X	14.0	Intel Core i7 Processor (10th Gen)	64 bit Windows 11	1.0	4.5	Intel Core i7
310	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	3.6	Intel Core i7
313	acer	acer Predator Helios 300	139990.0	512	16	DDR4	15.6	Intel Core i9 Processor (11th Gen)	64 bit Windows 11	1.0	4.2	Intel Core i9
319	ASUS	ASUS TUF Gaming F15	144990.0	512	16	DDR4	15.6	Intel Core i9 Processor (11th Gen)	64 bit Windows 10	1.0	4.4	Intel Core i9
322	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.5	Intel Core i7
327	ASUS	ASUS Vivobook S14 OLED (2022) Intel EVO	94990.0	512	16	DDR4	14.0	Intel Core i7 Processor (12th Gen)	Windows 11	1.0	4.6	Intel Core i7
332	ASUS	ASUS VivoBook 15 (2022)	57185.0	512	16	DDR4	15.6	Intel Core i7 Processor (10th Gen)	64 bit Windows 11	1.0	4.5	Intel Core i7
333	ASUS	ASUS ROG Flow Z13 (2022)	181990.0	512	16	LPDDR5	13.4	Intel Core i9 Processor (12th Gen)	64 bit Windows 11	1.0	4.7	Intel Core i9
357	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.1	Intel Core i7
362	Avita	Avita Liber	49990.0	512	16	DDR4	14.0	Intel Core i7 Processor (10th Gen)	64 bit Windows 10	2.0	4.6	Intel Core i7
367	acer	acer Predator Helios 300	189990.0	512	16	DDR5	15.6	Intel Core i7 Processor (12th Gen)	64 bit Windows 11	1.0	4.2	Intel Core i7
378	Lenovo	Lenovo Yoga 7	97490.0	512	16	DDR4	14.0	Intel Core i7 Processor (11th Gen)	64 bit Windows 11	1.0	4.6	Intel Core i7
379	HP	HP Spectre x360 14 Intel EVO	133490.0	512	16	LPDDR4X	13.5	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	3.3	Intel Core i7
380	Lenovo	Lenovo Thinkbook Convertible	84990.0	512	16	DDR4	14.0	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.4	Intel Core i7
393	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.3	Intel Core i7
410	acer	acer Predator Helios 300	154990.0	512	16	DDR5	15.6	Intel Core i7 Processor (12th Gen)	64 bit Windows 11	2.0	4.3	Intel Core i7
416	MSI	MSI	124990.0	512	16	DDR4	15.6	Intel Core i7 Processor (12th Gen)	64 bit Windows 11	1.0	4.3	Intel Core i7
419	MSI	MSI Prestige 15	113490.0	512	16	DDR4	15.6	Intel Core i7 Processor (10th Gen)	64 bit Windows 10	1.0	4.3	Intel Core i7
425	Lenovo	Lenovo Legion 5	133999.0	512	16	DDR4	15.6	Intel Core i7 Processor (11th Gen)	64 bit Windows 10	1.0	4.3	Intel Core i7

CONCLUSION:

By studying above data we get to analyse the prices of the laptops with regards to various features.

THANK YOU