

# Statistics

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# Introduction to Statistics

# What is Statistics?

- ▶ Statistics is the collection, organizing and analysing of data.

# Is Data Science Statistics in Disguise?

- ▶ Unlike Statistics, Data Science is an interdisciplinary field consisting of Mathematics, Statistics, Computer Science and Domain Knowledge.

# Types of Data

- ▶ Data can be classified into two types
  - ▶ Based on Measurement scale
  - ▶ Based on Time Period

# Based on Measurement Scale

- ▶ Qualitative Data
  - ▶ Nominal Data e.g sex
  - ▶ Ordinal Data e.g temperature level; High, Medium and Low
- ▶ Quantitative Data
  - ▶ Ratio e.g weight
  - ▶ Interval e.g temperature in degree celsius

## Based on Time Period

- ▶ Cross-Sectional Data e.g number of viewers for different youtube genres in the year 2021
- ▶ Time Series Data e.g number of viewers for Sport channels on youtube from the year 2014-Date.

# Types of Data

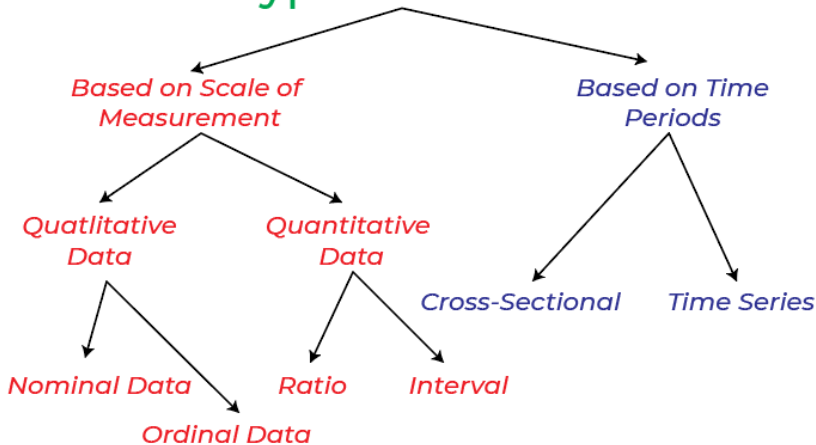


Figure 1: Types of Data



# Rectangular or Structured Data

	carat	cut	color	clarity	depth	table	price	x	y	z
1	0.23	Ideal	E	SI2	61.5	55.0	326	3.95	3.98	2.43
2	0.21	Premium	E	SI1	59.8	61.0	326	3.89	3.84	2.31
3	0.23	Good	E	VS1	56.9	65.0	327	4.05	4.07	2.31
4	0.29	Premium	I	VS2	62.4	58.0	334	4.20	4.23	2.63
5	0.31	Good	J	SI2	63.3	58.0	335	4.34	4.35	2.75
6	0.24	Very Good	J	VVS2	62.8	57.0	336	3.94	3.96	2.48
7	0.24	Very Good	I	VVS1	62.3	57.0	336	3.95	3.98	2.47
8	0.26	Very Good	H	SI1	61.9	55.0	337	4.07	4.11	2.53
9	0.22	Fair	E	VS2	65.1	61.0	337	3.87	3.78	2.49
10	0.23	Very Good	H	VS1	59.4	61.0	338	4.00	4.05	2.39
11	0.30	Good	J	SI1	64.0	55.0	339	4.25	4.28	2.73
12	0.23	Ideal	J	VS1	62.8	56.0	340	3.93	3.90	2.46
13	0.22	Premium	F	SI1	60.4	61.0	342	3.88	3.84	2.33
14	0.31	Ideal	J	SI2	62.2	54.0	344	4.35	4.37	2.71
15	0.20	Premium	E	SI2	60.2	62.0	345	3.79	3.75	2.27
16	0.32	Premium	E	I1	60.9	58.0	345	4.38	4.42	2.68
17	0.30	Ideal	I	SI2	62.0	54.0	348	4.31	4.34	2.68
18	0.30	Good	J	SI1	63.4	54.0	351	4.23	4.29	2.70
19	0.30	Good	J	SI1	63.8	56.0	351	4.23	4.26	2.71
20	0.30	Very Good	I	SI1	62.7	59.0	351	4.21	4.27	2.66

# Measures of Central Tendency

## Mean

- ▶ Sum of all values of observations divided by the number of observations
- ▶ Mathematically denoted as:  
$$\bar{a} = \frac{\sum_i^n x_i}{n}$$
- ▶ Sensitive to extreme or high values

## Median

- ▶ Center of an ordered observations
- ▶ Also known as the middle of the observations.
- ▶ Not sensitive to extreme values

## Mode

- ▶ Observation with the highest number of occurrence.

# Measures of Variation

## Standard Deviation and Variance

- ▶ Measures how far an observation is from the mean
- ▶ Mathematically defined as:

$$s = \sqrt{\frac{\sum_i^n (x_i - \bar{x})^2}{n}}$$

- ▶ Variance is defined as the square of the standard deviation:  
 $Variance = s^2$

## Range

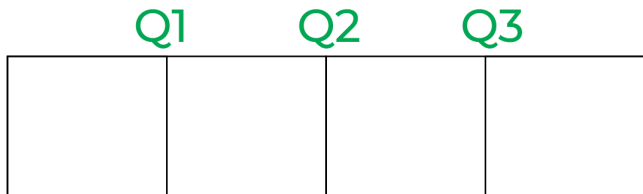
- ▶ Difference between the largest and smallest observations.
- ▶ Sensitive to extreme values

## Percentiles

- ▶ Expressing the sorted observations in percentage
- ▶ Not sensitive to extreme values

# Interquartile Range

- ▶ The interquartile range divides the observations into 4 equal part:
  - ▶ First Quartile: Q1
  - ▶ Second Quartile: Q2 (median)
  - ▶ Third Quartile: Q3



# Summary Statistics of the Diamond Data Set

carat		cut		color		clarity		depth	
Min.	:0.2000	Fair	: 1610	D: 6775	SI1	:13065	Min.	:43.00	
1st Qu.	:0.4000	Good	: 4906	E: 9797	VS2	:12258	1st Qu.	:61.00	
Median	:0.7000	Very Good	:12082	F: 9542	SI2	: 9194	Median	:61.80	
Mean	:0.7979	Premium	:13791	G:11292	VS1	: 8171	Mean	:61.75	
3rd Qu.	:1.0400	Ideal	:21551	H: 8304	VVS2	: 5066	3rd Qu.	:62.50	
Max.	:5.0100			I: 5422	VVS1	: 3655	Max.	:79.00	
				J: 2808	(Other):	2531			
table		price		x		y			
Min.	:43.00	Min.	: 326	Min.	: 0.000	Min.	: 0.000		
1st Qu.	:56.00	1st Qu.	: 950	1st Qu.	: 4.710	1st Qu.	: 4.720		
Median	:57.00	Median	: 2401	Median	: 5.700	Median	: 5.710		
Mean	:57.46	Mean	: 3933	Mean	: 5.731	Mean	: 5.735		
3rd Qu.	:59.00	3rd Qu.	: 5324	3rd Qu.	: 6.540	3rd Qu.	: 6.540		
Max.	:95.00	Max.	:18823	Max.	:10.740	Max.	:58.900		
z									
Min.	: 0.000								
1st Qu.	: 2.910								
Median	: 3.530								
Mean	: 3.539								
3rd Qu.	: 4.040								
Max.	:31.800								

Figure 3: Summary Statistics of the Diamond Data Set

# Graphical Representations of Data

- ▶ Bar Plot
- ▶ Histogram
- ▶ Density Plot
- ▶ Box Plot
- ▶ Scatter Plot

## Bar Plot

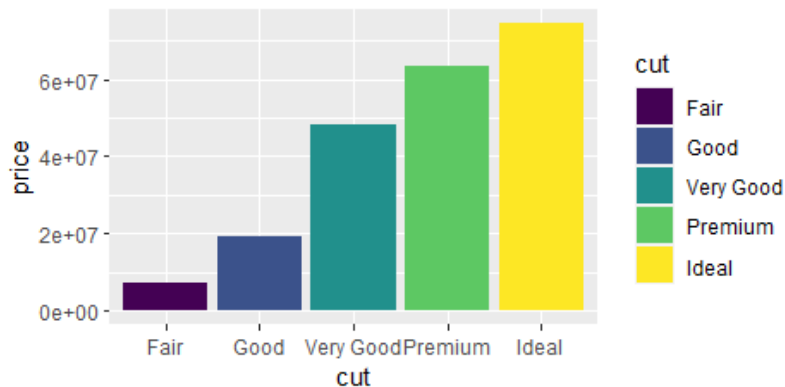


Figure 4: Prices of Various cuts of diamonds

# Histogram

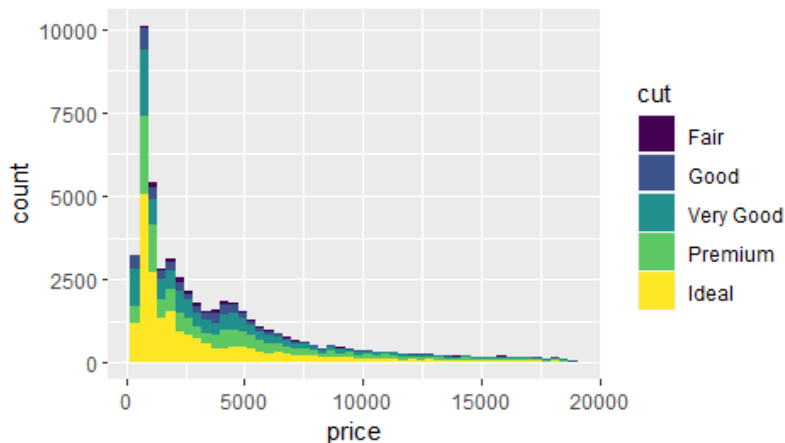


Figure 5: Histogram showing the various cut of diamonds



# Density Plot

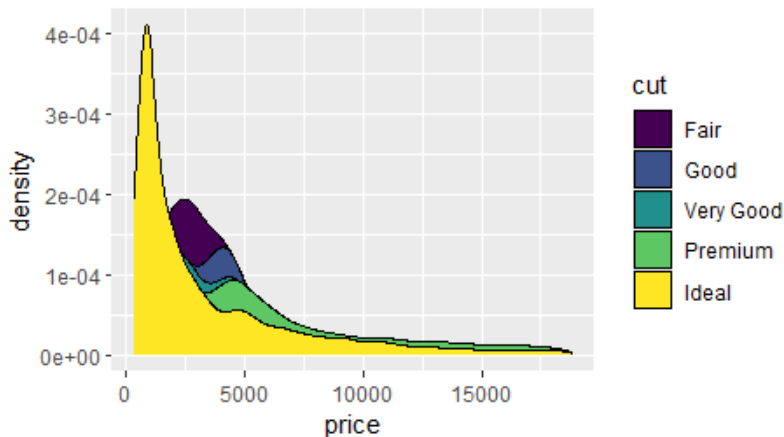


Figure 6: Density Plot of various diamond cut

# Box Plot

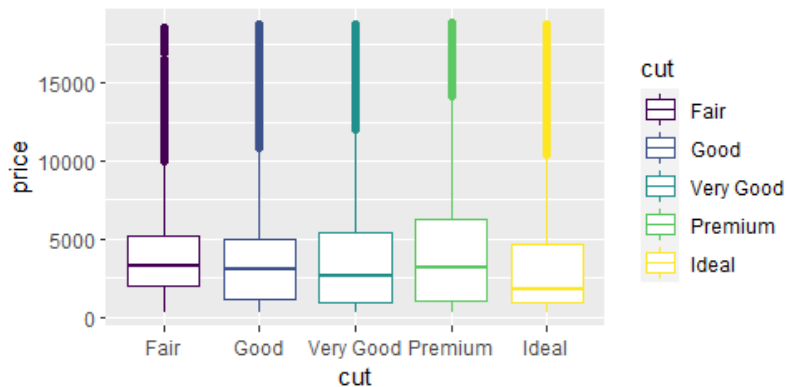


Figure 7: Box plot of various diamond cut

# Scatter Plot

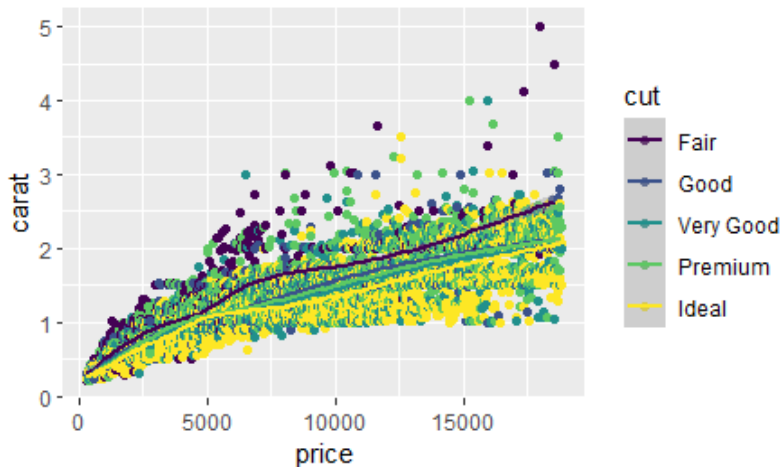


Figure 8: Scatter plot showing the relationship between carat and price