Introduction to Statistics and Statistical Measures

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June 25 2022

What is Statistics?

- Statistics is simply 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** e.g sex
  - **Ordinal** e.g temperature level; High, Medium and Low
- **Quantitative** Data
  - **Ratio** e.g weight
  - **Interval** e.g temperature in degreee 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.

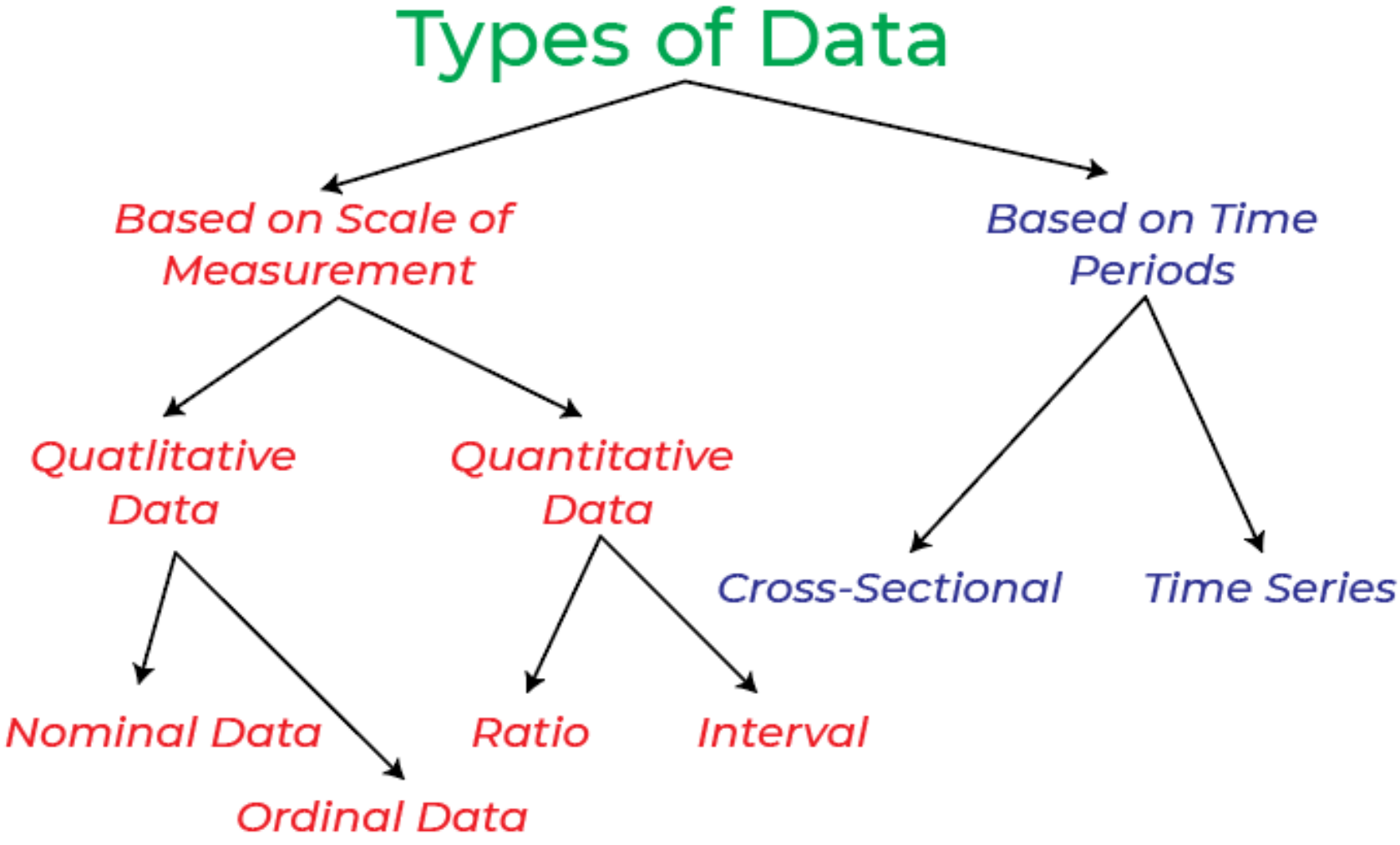


Figure 1: Types of Data

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	J	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 occurence.

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

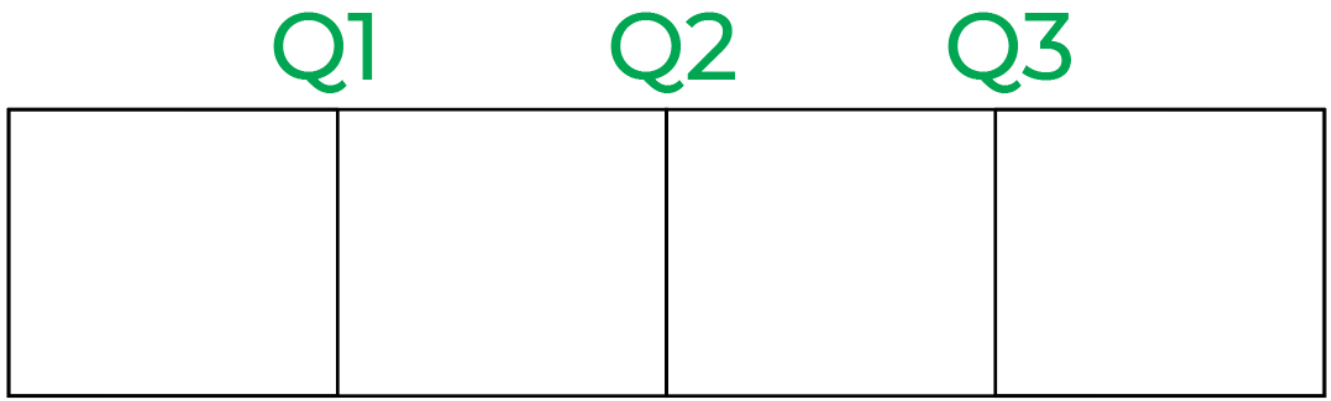
- Difference between the largest and smallest observations.
- Sensitive to extreme values

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 Quratile: Q2 (median)
  - Third Quratile: 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 Repreentations of Data

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

Bar Plot

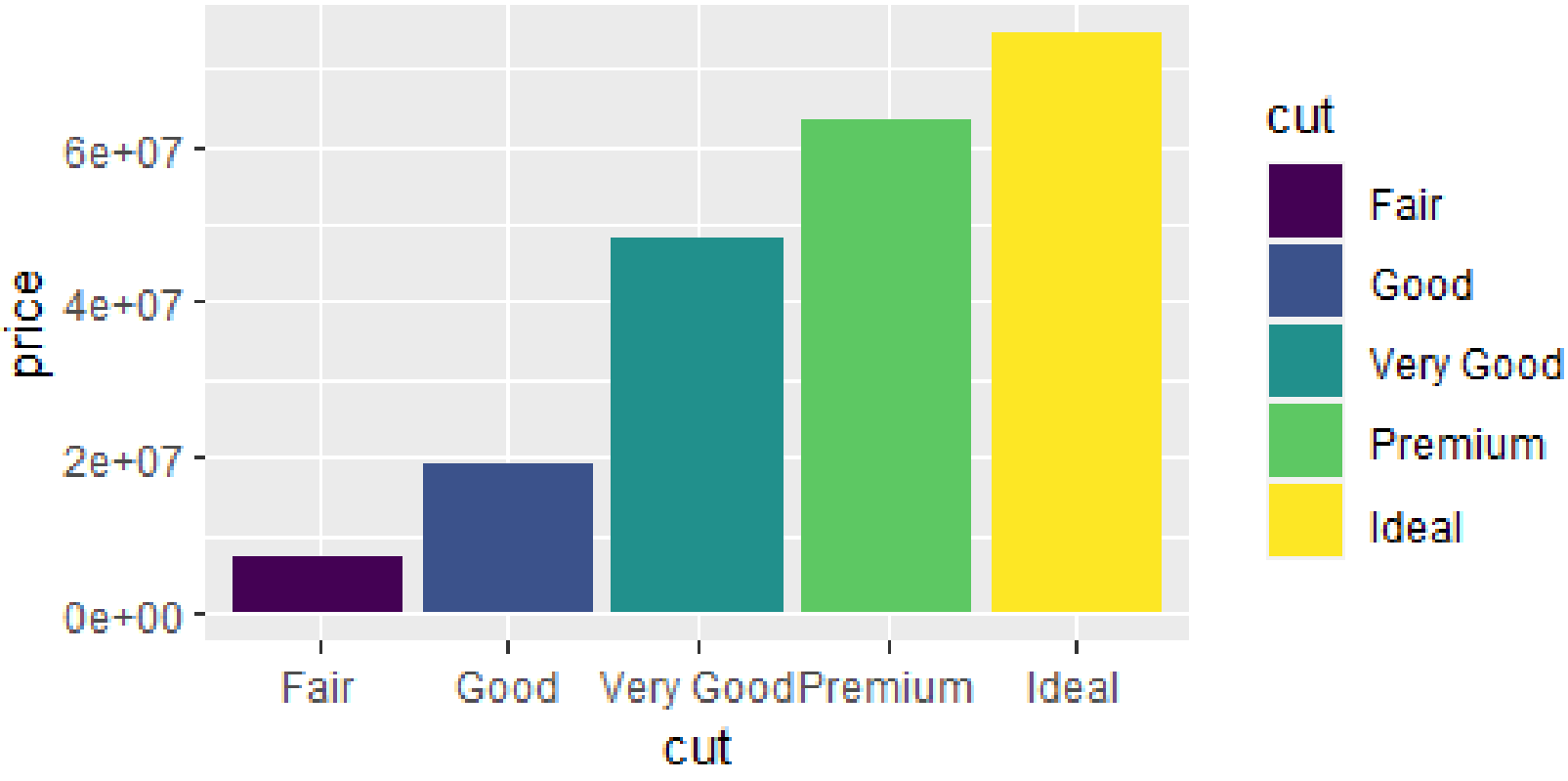


Figure 4: Prices of Various cuts of diamonds

Histogram

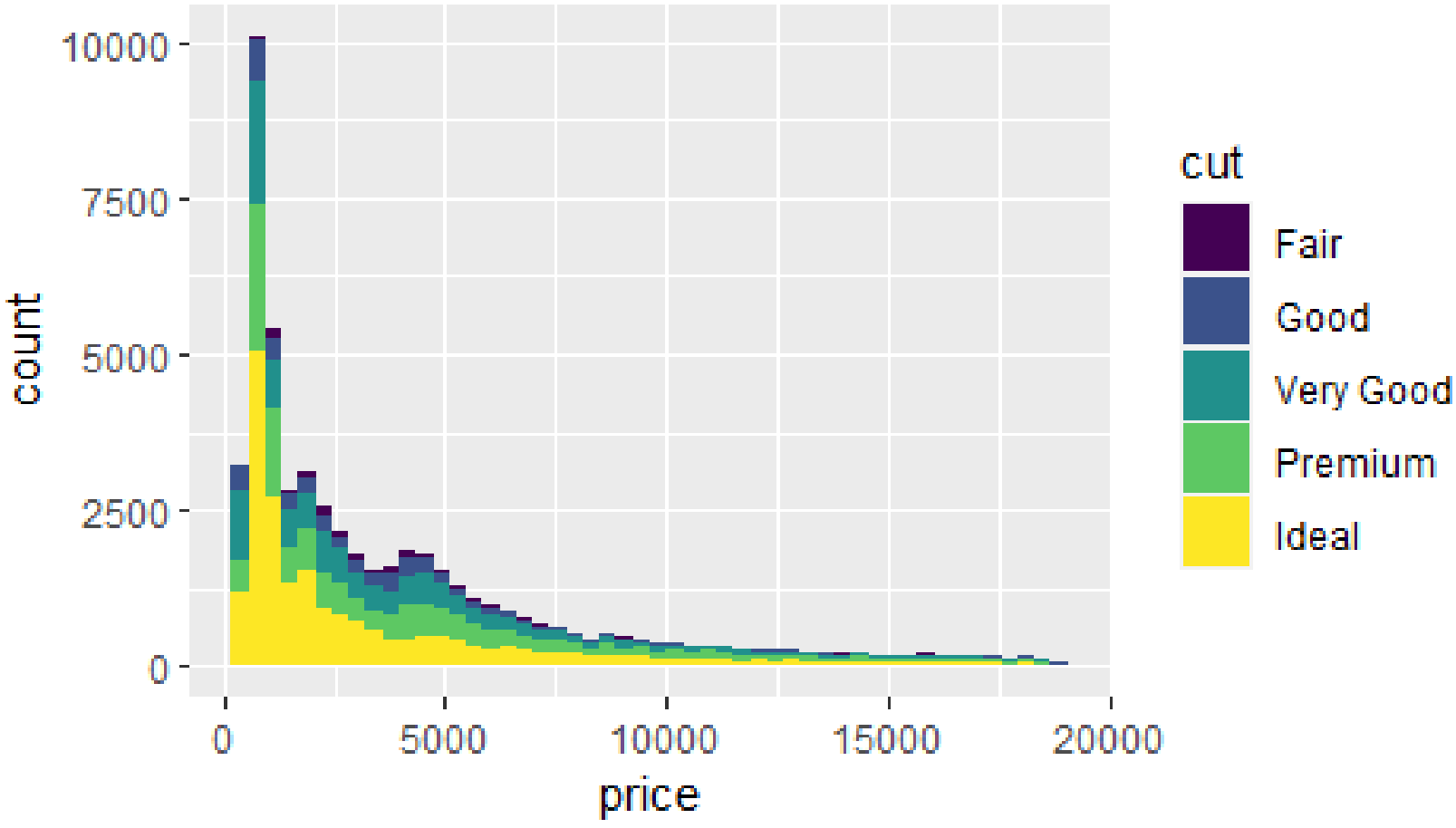


Figure 5: Histogram showing the various cut of diamonds

Density Plot

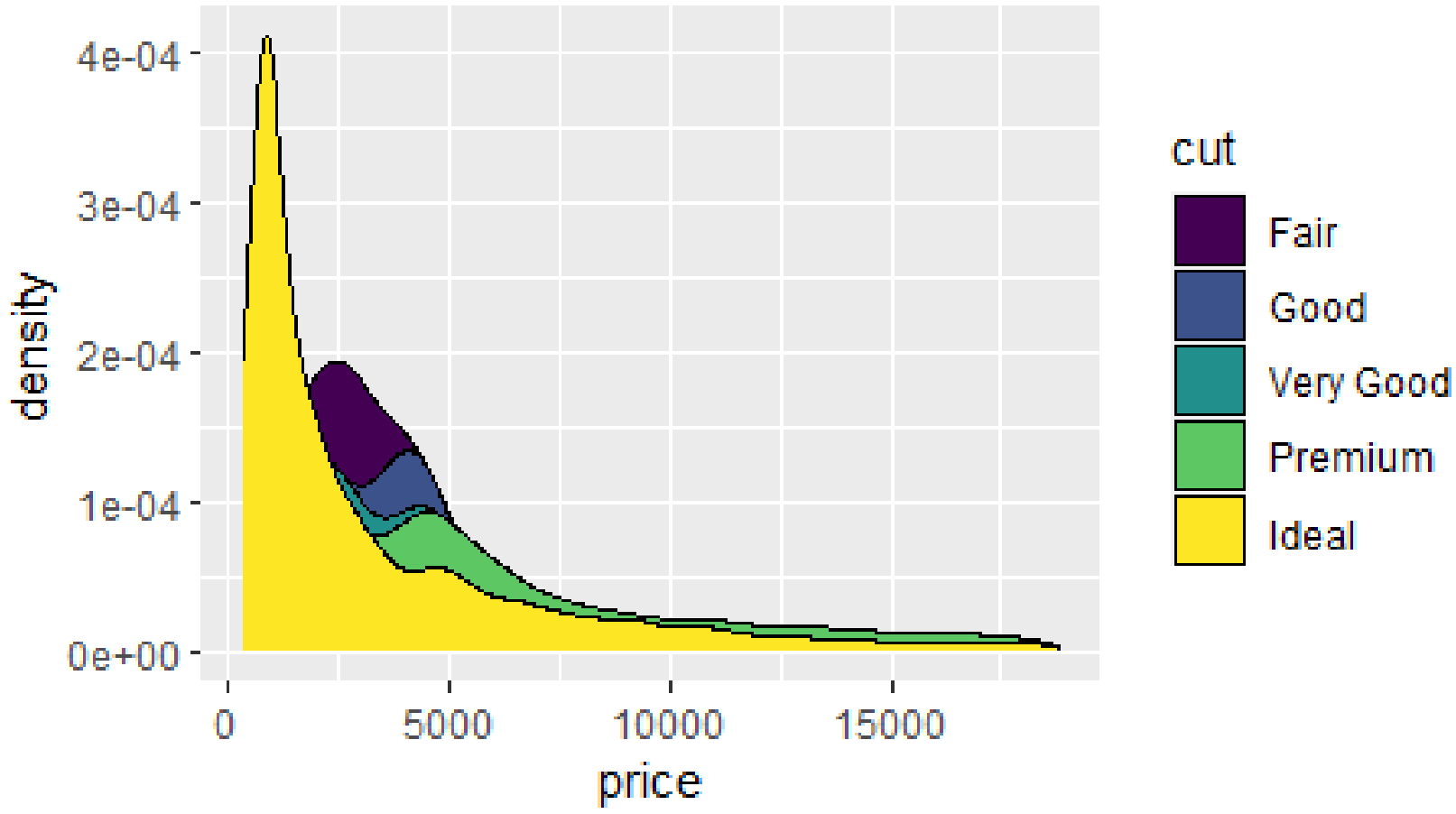


Figure 6: Density Plot of various diamond cut

Box Plot

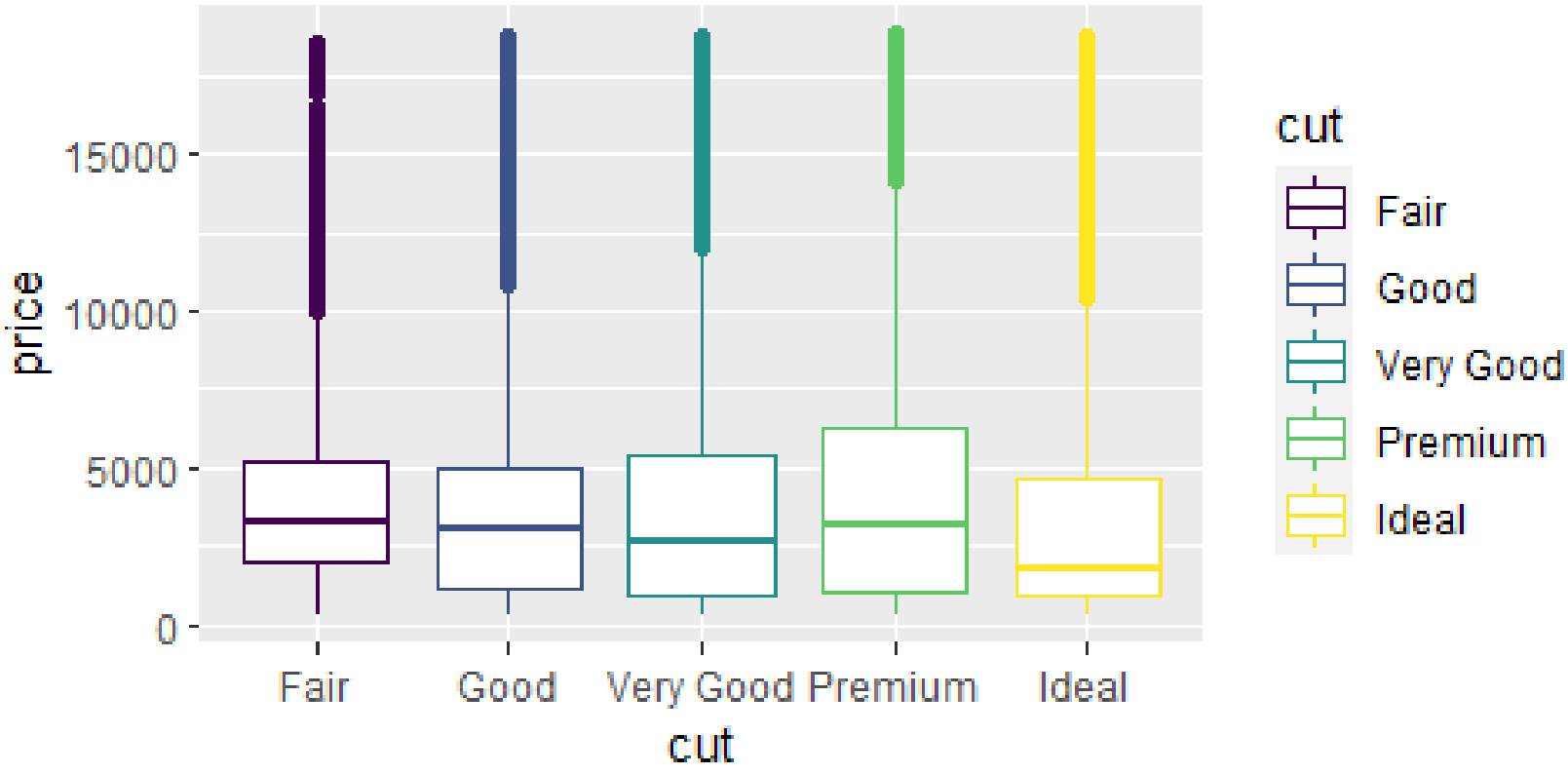


Figure 7: Box plot of various diamond cut

Scatter Plot

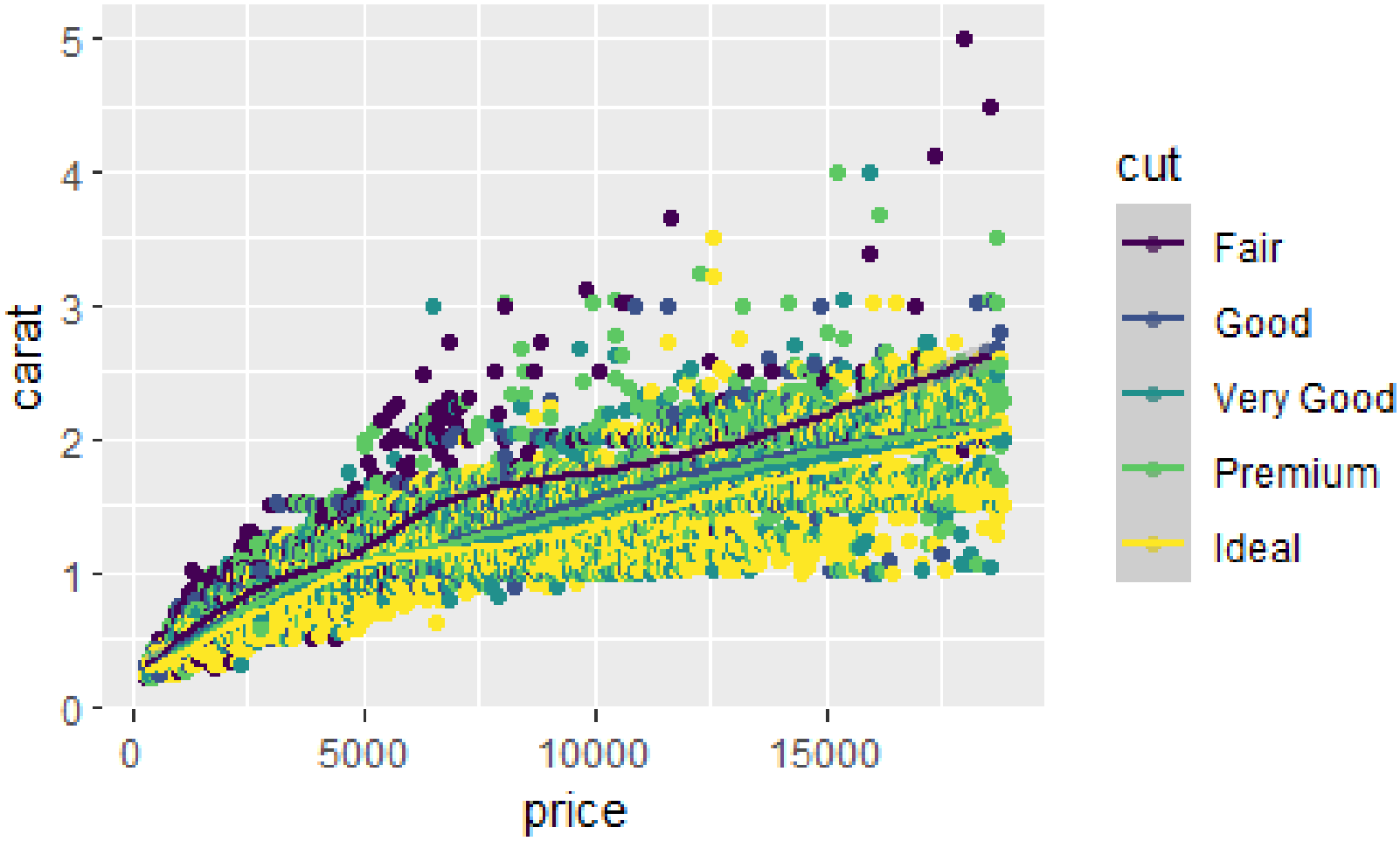


Figure 8: Scatter plot showing the relationship between carat and price

Challenge

- After marking 100 students exam scripts two students got above 90% while the remaining students got scores between 40% to 60%. What is the most appropriate measure of central tendency to use in this scenario and what's your view on the standard deviation given the scores of the two students were moderated.
- If the median weight of DevNet members is 55kg, what is the 50th percentile and hence find the 2nd Quartile.
- What is the best graph to use if I am interested in seeing how the weight of DevNet members is distributed.

References

- *Practical Statistics for Data Scientists by Peter Bruce and Andrew Bruce.*
- *The Diamond Dataset.*