Chapter summary

Statistics

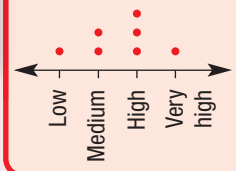
Data

Categorical
- Nominal (red, blue, ...)
- Ordinal (low, medium, ...)

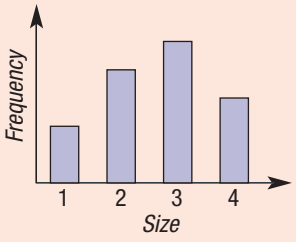
Numerical
- Discrete (1, 2, 3, ...)
- Continuous (0.31, 0.481, ...)

Graphs for a single set of categorical or discrete data

Dot plot



Column graphs



Stem-and-leaf plot

Stem	Leaf
0	1 6
1	2 7 9
2	3 8
3	4

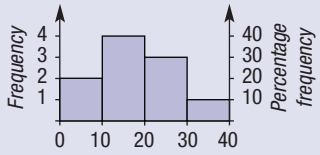
2|3 means 23

Frequency tables

Class interval	Frequency	Percentage frequency
0–	2	20%
10–	4	40%
20–	3	30%
30–40	1	10%
Total	10	100%

$$\text{Percentage frequency} = \frac{\text{frequency}}{\text{total}} \times 100$$

Histogram



Measures of centre

- Mean $(\bar{x}) = \frac{\text{sum of all values}}{\text{number of scores}}$
- Median (Q_2) = middle value of ordered data

odd number	even number
1 4 6 9 12	1 2 4 6 7 11
median	Median $= \frac{4+6}{2} = 5$

- Mode = most common value
- A data set with two modes is bimodal.

Measures of spread

- Range = max − min
- Interquartile range (IQR) = $Q_3 - Q_1$

Quartiles

Q_1: above 25% of the data (middle value of lower half)
Q_3: above 75% of the data (middle value of upper half)

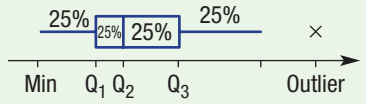
2 3 5 7 8 | 9 11 12 14 15

$Q_1 = 5$ $Q_2 = 8.5$ $Q_3 = 12$

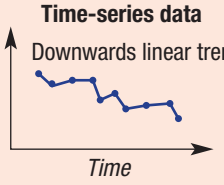
1 2 3 | 6 | 7 10 13

$Q_1 = 2$ Q_2 $Q_3 = 10$

Box plots

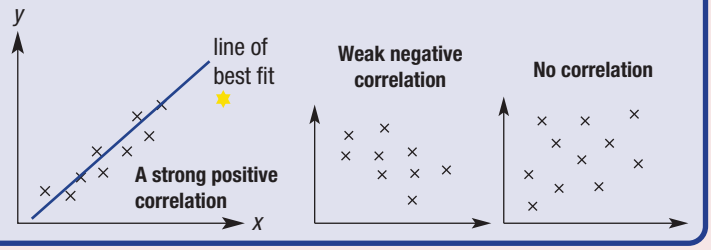


Time-series data



Bivariate data

- Two related variables
- Scatter plot



Outliers

- Single data set
  - less than $Q_1 - 1.5 \times \text{IQR}$ or more than $Q_3 + 1.5 \times \text{IQR}$
- Bivariate
  - not in the vicinity of the rest of the data

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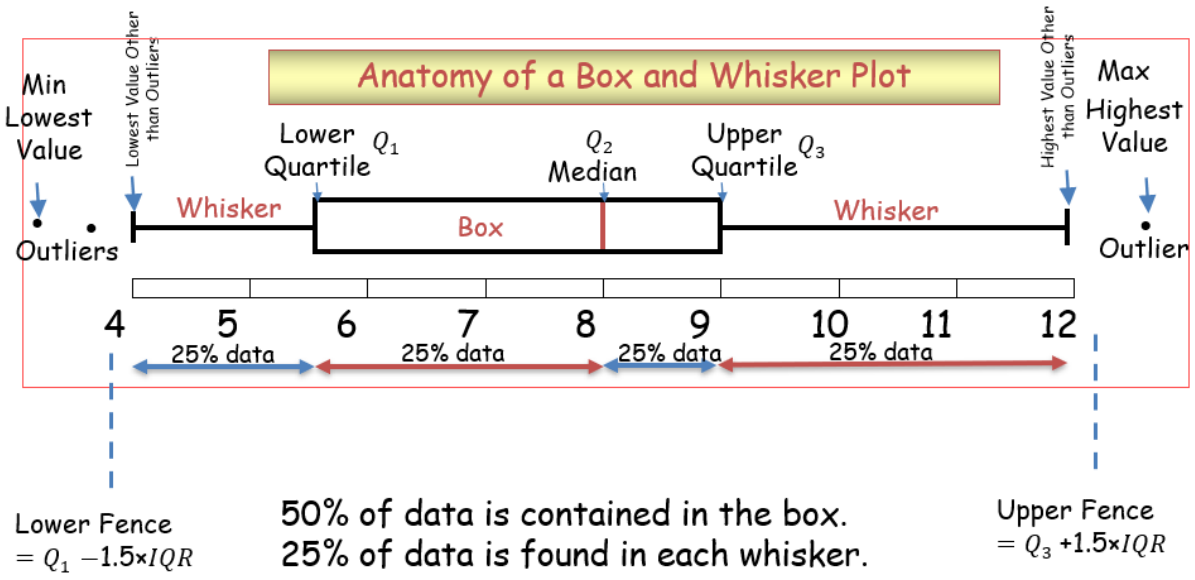
Box and Whisker Plots

Box plots are graphical representations of 5 number summary.



Lower Fence $= Q_1 - 1.5 \times IQR$

50% of data is contained in the box.
25% of data is found in each whisker.

Upper Fence $= Q_3 + 1.5 \times IQR$

The standard deviation

$$s^2 = \frac{\text{sum of all (data value} - \text{mean)}^2}{\text{total freqency} - 1} = \frac{\sum(x-\bar{x})^2}{n-1}, \qquad s = \sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$$

Example VCAA 2016 Sample Question 3 / VCAA 2014 Question 3

The mean, $\bar{x}$, and the standard deviation, s_x, of the variable, *distance*, for these seven drivers are closest to

***Distance* (km)**	$\boldsymbol{Distance - \bar{x}}$
4.2	$4.2 - 2.8 = 1.4$
0.8	$0.8 - 2.8 = -2$
3.9	$3.9 - 2.8 = 1.1$
5.6	$5.6 - 2.8 = 2.8$
0.9	$0.9 - 2.8 = -1.9$
1.7	$1.7 - 2.8 = -1.1$
2.5	$2.5 - 2.8 = -0.3$

$$\bar{x} = \frac{4.2 + 0.8 + 3.9 + 5.6 + 0.9 + 1.7 + 2.5}{7} = \frac{19.6}{7} = 2.8$$

$$s_x^2 = \frac{1.4^2 + (-2)^2 + 1.1^2 + 2.8^2 + (-1.9)^2 + (-1.1)^2 + (-0.3)^2}{7-1}$$

$$\Rightarrow s_x^2 = \frac{19.92}{6} = 3.32, \qquad \therefore s_x = \sqrt{3.32} = 1.82208671\ldots \approx 1.8$$

The mean distance travelled is 2.8 km and
the standard deviation from the mean is 1.8 km.