

STA13-B
Elementary Statistics
Fall 2007

Lecture 5

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Announcements

- Website has information about free software
- Issues with sections

Chapter 4

- Mode
- Five number summary
- Boxplots

Mode

The **most common value** in the data

Number of Classes	Frequency
1	2
2	1
3	5
4	8
5	2
Total	18

← **Mode = 4**

- Not always the center of the data
- Undefined if there is a tie

Median

The **middle value** in ordered data

1 1 2 3 3 3 3 3 4 | 4 4 4 4 4 4 4 5 5
 9 values 9 values

Median = average of middle two values = $(4+4)/2 = 4$

- Middle value if an odd number of data points
- Can be a value that is not observed
- Half the numbers are $>$ median and
Half the numbers are $<$ median

Five Number Summary

1 1 2 3 **3** 3 3 3 4 | 4 4 4 4 **4** 4 4 5 5
4 values 4 values 4 values 4 values

Minimum = 1

Lower quartile = 3

Median = 4

Upper quartile = 4

Maximum = 5

Quartiles are medians of the lower and upper halves of the data

Note: Quartiles are 25th and 75th percentiles

Measures of Variability

How spread out are the data values?

1 1 2 3 3 3 3 4 | 4 4 4 4 4 4 4 5 5

Range

$$\text{maximum} - \text{minimum} = 5 - 1 = 4$$

Inter-quartile range (IQR)

$$\text{upper quartile} - \text{lower quartile} = 4 - 3 = 1$$

Outliers

Data values that are unexpectedly far from the center of the data are called **outliers**.

- Measured based on distance from quartiles
- Mild outlier
 - < lower quartile - (1.5 x IQR) or
 - > upper quartile + (1.5 x IQR)
- Extreme outlier
 - < lower quartile - (3 x IQR) or
 - > upper quartile + (3 x IQR)

Outliers

1 1 2 3 3 3 3 3 4 | 4 4 4 4 4 4 4 5 5

Lower quartile = 3, Upper quartile = 4

$$\text{IQR} = 4 - 3 = 1$$

Mild outliers: 1 is a mild outlier

$$< 3 - (1.5 \times 1) = 1.5 \text{ or}$$

$$> 4 + (1.5 \times 1) = 5.5$$

Extreme outliers: no extreme outliers

$$< 3 - (3 \times 1) = 0 \text{ or}$$

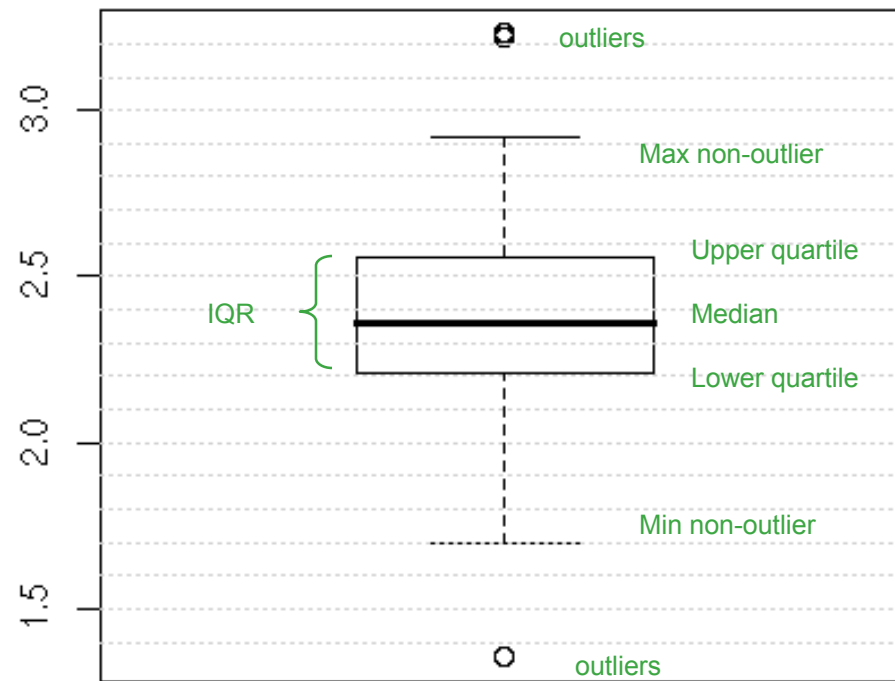
$$> 4 + (3 \times 1) = 7$$

Boxplots

Visualization of five number summary

- Rectangle for IQR
- Vertical line at the median
- Horizontal lines (“whiskers”) from quartiles to smallest and largest non-outlier values
- Circles for outliers, e.g.
 - Mild: solid circles
 - Extreme: open circles

Example Boxplot



Ash

Modifications of Boxplots

- Skeletal boxplot: does not show outliers, whiskers extend to min and max.
- Can be plotted either horizontally or vertically.
- Comparative boxplot, e.g. if you split up numeric data based on categories (see example 4.13 in the text).

Draw Boxplots