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Dept of Mathematics & Statistics

Section 4.3 – Key Ideas

1. Quartiles - Q1, Median(Q2), Q3
2. Interquartile Range (IQR)
3. Five-Number Summary
4. Boxplot
5. Parallel Boxplots

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1) Quartiles - Q1, Median(Q2), Q3
2) Interquartile Range (IQR)

Lower quartile(Q_1) = median of the lower half of dataset.
Upper Quartile(Q_3) = median of the upper half of dataset.

Interquartile range (IQR) = upper quartile – lower quartile
= Q3 – Q1

Resistant measures -are NOT sensitive to the influence of a few extreme observations.

- MEDIAN and IQR are resistant measures

EXAMPLE A – Find Q1, Median, Q3, IQR for

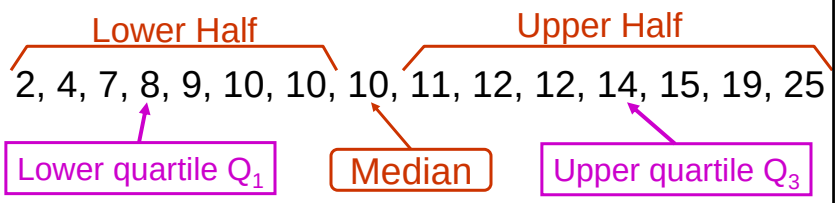
2, 4, 7, 8, 9, 10, 10, 10, 11, 12, 12, 14, 15, 19, 25

Example A: Quartiles, IQR, 5-Number Summary (odd sample size)

Median: With 15 data values, the median is the 8th Value because **(15+1)/2 = 8**. Therefore, the median is 10.

5-Number Summary is Minimum, Q1, Median, Q3, Maximum

•**Example A: Minimum (2), Q1 (8), Median (10), Q3 (14), Maximum (25).**



Lower quartile = 8 **Upper quartile = 14**

IQR = 14 - 8 = 6

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Example B: Quartiles, IQR, 5-Number Summary (even sample size)

Weekly TV-Viewing Times 20 people were randomly selected and reported weekly viewing times, in hours:

• 25 41 27 32 43 66 35 31 15 5 34 26 32 38 16 30 38 30 20 21

Step 1: Times Order data in increasing order. A stem-leaf graph is the easiest way to do this

```
0 | 5
1 | 5 6
2 | 0 1 5 6 7
3 | 0 1 2 2 4 5 8 8
4 | 1 3
5 |
6 | 6
```

Step 2: Now find the Quartiles, IQR, 5-Number Summary. Then check the next slide for the answer.

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Example B: Quartiles, IQR, 5-Number Summary (odd sample size)

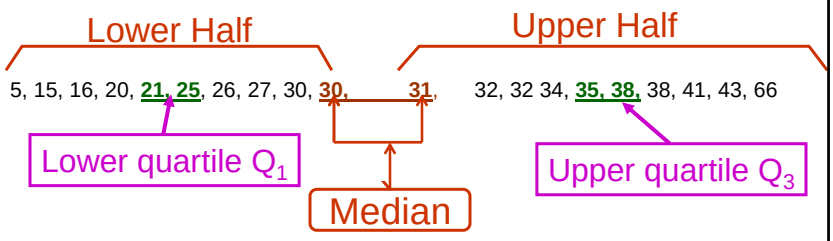
Median: With 20 data values, you average the middle terms - 10th & 11th with result **(20+1)/2 = 10.5**. Therefore, the **median is 30.5** because **(30+31)/2.**

Example B:

- **5-Number Summary**

MIN	Q1	Median	Q3	MAX
5	23	30.5	36.5	66

- **IQR** = *36.5 – 23* = **13.5hrs** **"The middle 50% of the TV-viewing times are spread over a 13.5-hr interval, roughly."** **IQR sets limits to identify outliers** →



Q1 = (21+25)/2 **Q3 = (35+38)/2**

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Outliers Based on IQR

Mild Outlier:
- Lower limit = Q1 – 1.5*IQR
- Upper limit = Q3 + 1.5*IQR

Extreme Outlier:
- Lower limit = Q1 – 3*IQR
- Upper limit = Q3 + 3*IQR

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Now, look at Example B and identify any Mild or Extreme Outliers:

- Mild Lower limit = Q1 – 1.5*IQR = 23-1.5*13.5= **2.75**
- Mild Upper limit = Q3 + 1.5*IQR = 36.5+1.5*13.5= **56.75**
- Extreme Lower limit = Q1 - 3*IQR = 23-3*13.5= **-17.5**
- Extreme Upper limit = Q3 + 3*IQR = 36.5+3*13.5= **77**

- **CONCLUSION: 66hrs is a mild outlier.**

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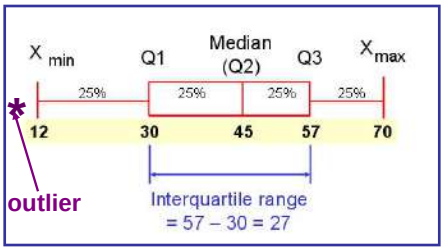
Box & Box-Whisker(modified) Plots

- **Box Plots graphically present the 5-Number Summary and IQR's.**



- **To Construct a Boxplot**
  1) Determine the quartiles
  2) Determine potential outliers and the adjacent values
  3) Draw a horizontal axis on which the numbers obtained in steps 1 & 2. Above this axis, mark the quartiles and the adjacent values with vertical lines,
  4) Connect he quartiles to make a box and then connect the box to the adjacent values with lines
  5) Plot each potential outlier with an asterisk (the whiskers).
  6) **Important to clearly mark the scale below the box plot!**

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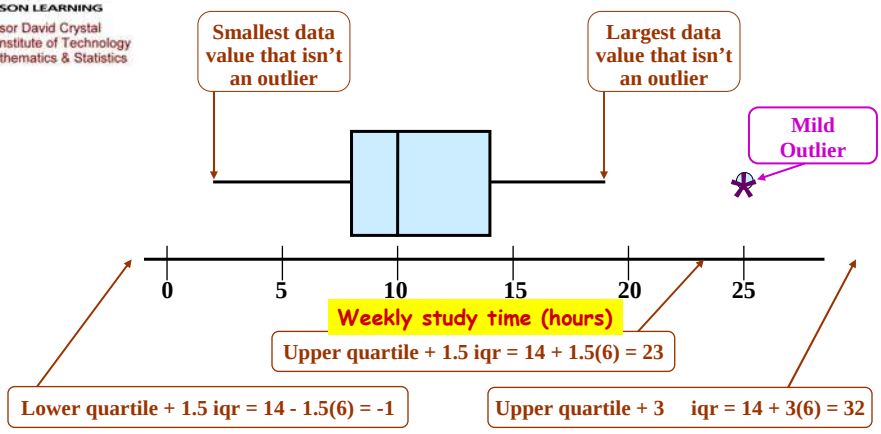
Example showing how to make a Box-Whisker Plots



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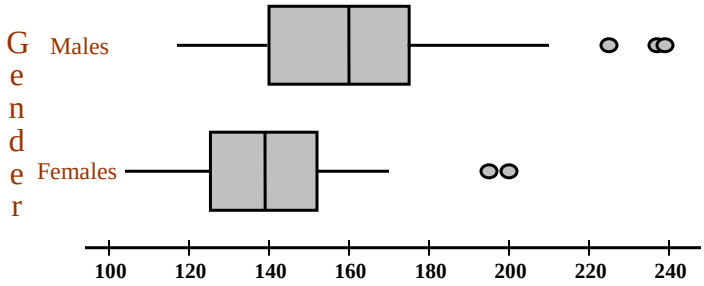
Comparative Boxplots

We can compare two separate groups or subgroups distributional behaviors with boxplots:

- **The plots must use the same scale.**
  - **Notice that the distributional pattern of female & male student weights have similar shapes,**
  - **Although the females are roughly 20 lbs lighter (as a group).**



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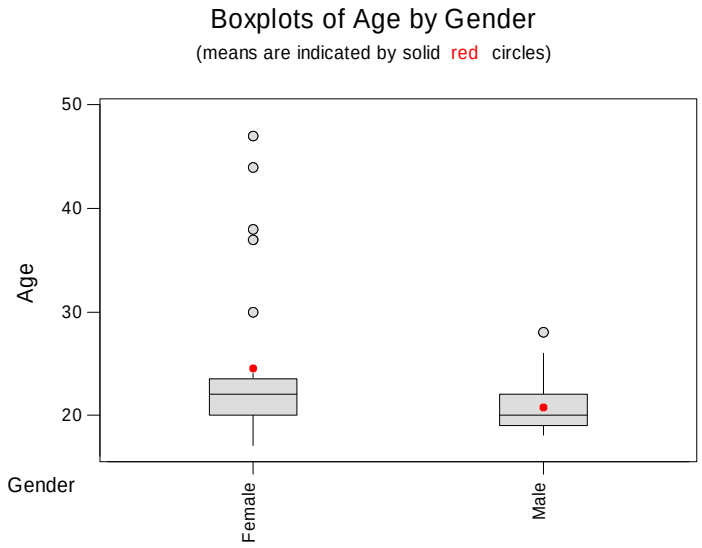
Boxplots can also be done Vertical



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