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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
= $Q_3 - Q_1$

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

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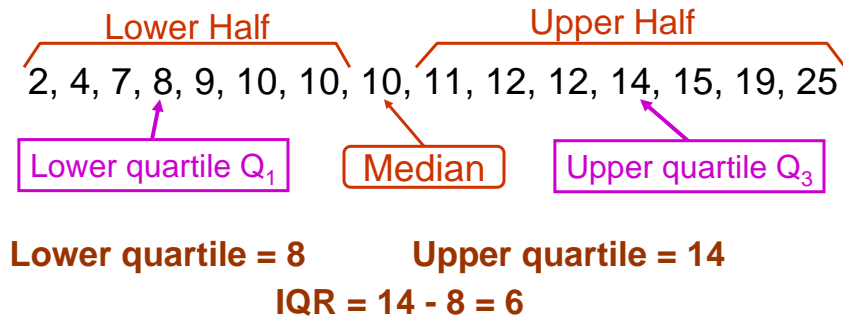


Example A: Quartiles, IQR, 5-Number Summary (odd sample size)

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).



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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)

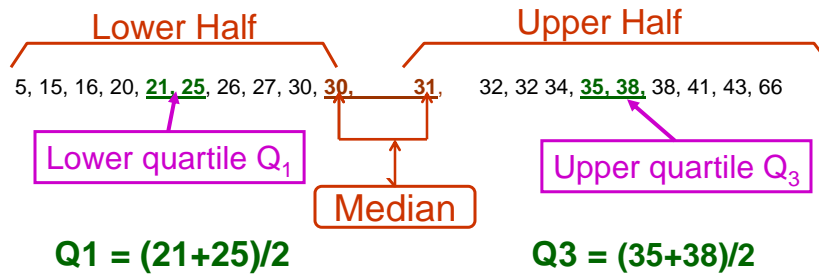
Median: With 20 data values, you average the middle terms - 10th & 11th with result $(20+1)/2 = 10.5$. Therefore, the **median is 30.5** because $(30+31)/2$.

Example B:

• 5-Number Summary

MIN	Q1	Median	Q3	MAX
5	23	30.5	36.5	66

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



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Outliers Based on IQR

Mild Outlier:

- Lower limit = $Q1 - 1.5 \cdot IQR$
- Upper limit = $Q3 + 1.5 \cdot IQR$

Extreme Outlier:

- Lower limit = $Q1 - 3 \cdot IQR$
- Upper limit = $Q3 + 3 \cdot IQR$

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

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

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

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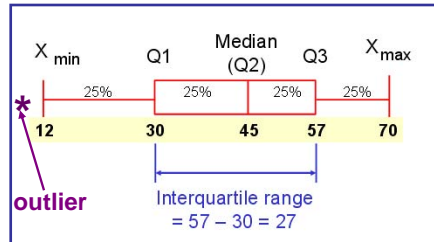
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Box & Box-Whisker(modified) Plots

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



- To Construct a Boxplot
 - Determine the quartiles
 - Determine potential outliers and the adjacent values
 - 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,
 - Connect the quartiles to make a box and then connect the box to the adjacent values with lines
 - Plot each potential outlier with an asterisk (the whiskers).
 - Important to clearly mark the scale below the box plot!**

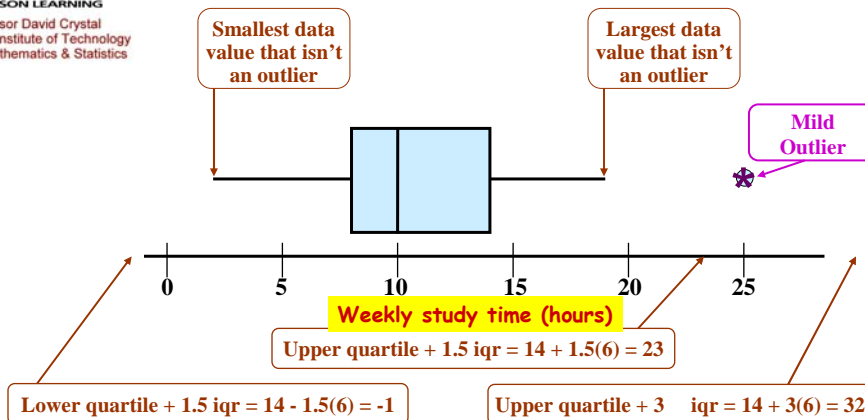
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Example showing how to make a Box-Whisker Plots



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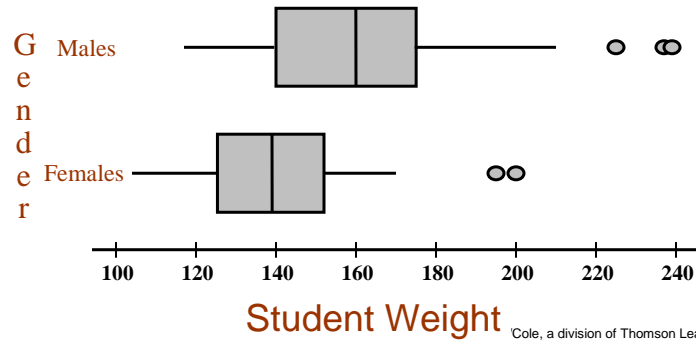


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Comparative Boxplots

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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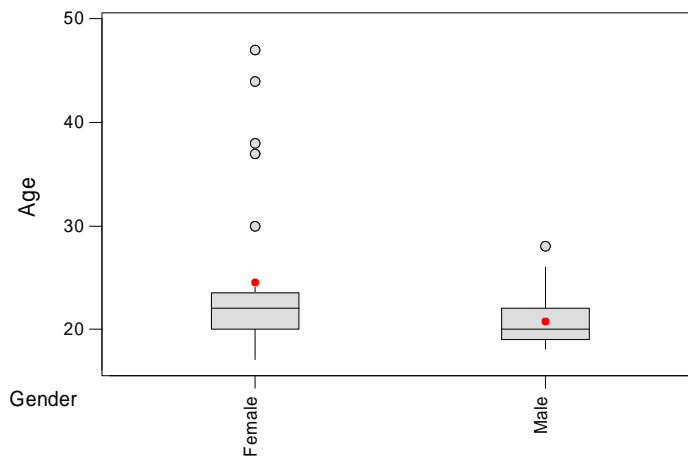
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Boxplots can also be done Vertical

Boxplots of Age by Gender
(means are indicated by solid red circles)



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