Quantitative Skills & Reasoning – Math 1001

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Data Analysis Unit
Five Number Summary
pp 271-278 in textbook

Quartiles

- The **lower quartile** (or first quartile) divides the lowest fourth (25%) of a data set from the upper three-fourths. It is the median of the data values in the *lower half* of a data set.

- The **middle quartile** (or second quartile) is the overall median (50%).

- The **upper quartile** (or third quartile) divides the lower three-fourths (75%) of a data set from the upper fourth. It is the median of the data values in the *upper half* of a data set.

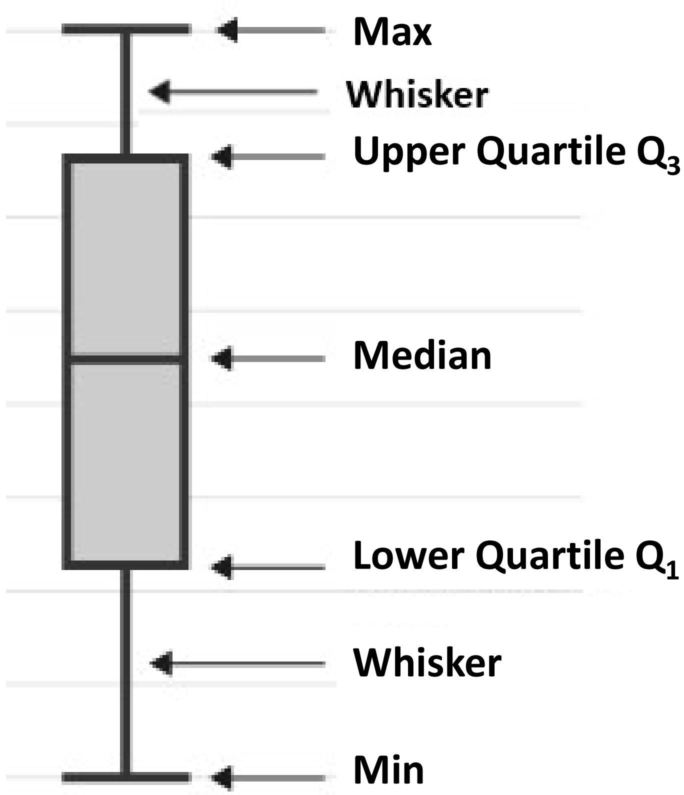
Five-Number Summary

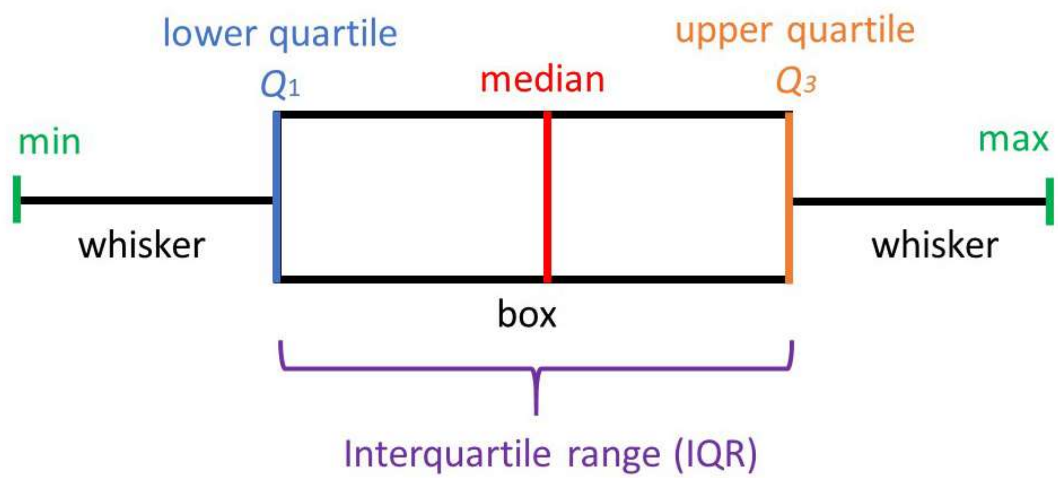
The **five-number summary** for a data set consists of the following five numbers:

lowest value   *lower quartile*   *median*   *upper quartile*   *highest value*

Boxplots

A **boxplot** shows the five-number summary visually, with a rectangular box enclosing the lower and upper quartiles, a line marking the median, and whiskers extending to the low and high values.


Max
Whisker
Upper Quartile Q_3
Median
Lower Quartile Q_1
Whisker
Min


lower quartile
Q_1
median
upper quartile
Q_3
min
max
whisker
whisker
box
Interquartile range (IQR)

Example 1

For the following dataset find complete the table below, then create a boxplot.

A group of students were asked how much they would pay for a meal. Their responses were: $7.50, $8.25, $9.00, $8.00, $7.25, $7.50, $8.00, $7.00.

n	**Mean ($\bar{x}$)**	**Low Value**	**Lower Quartile**	**Median**	**Upper Quartile**	**High Value**	**Standard Deviation**

Example 1 (cont.)

n = 8

\$7.00, \$7.25, \$7.50, **\$7.50, \$8.00,** \$8.00, \$8.25, \$9.00   Sorted Data

$\bar{x} = \frac{\$7.00+ \$7.25+\$7.50+\$7.50+\$8.00+\$8.00+\$8.25+\$9.00}{8}$ =\$7.81

Lowest value = \$7.00

Highest value = \$9.00

Median = $\frac{\$7.50+\$8.00}{2} = \frac{\$15.50}{2} = \$7.75$ (we do this because we have an even number of data values)

Example 1 (cont.)

n = 8

<u>\$7.00, \$7.25, \$7.50, \$7.50</u>, <u>\$8.00, \$8.00, \$8.25, \$9.00</u>

$\bar{x} = \frac{\$7.00+\$7.25+\$7.50+\$7.50+\$8.00+\$8.00+\$8.25+\$9.00}{8}$ =\$7.81

Lower quartile = $\frac{\$7.25+\$7.50}{2} = \frac{\$14.75}{2} = \$7.38$ (we do this because we have an even number of data values)

Upper quartile = $\frac{\$8.00+\$8.25}{2} = \frac{\$16.25}{2} = \$8.13$ (we do this because we have an even number of data values)

Example 1 (cont.)

$$\text{standard deviation} = \sqrt{\frac{\text{sum of (deviations from the mean)}^2}{\text{total number of data values} - 1}}$$

n = 8

$7.00, $7.25, $7.50, $7.50, $8.00, $8.00, $8.25, $9.00

$\bar{x}$ = $7.81

Standard Deviation

$$\mathbf{s} = \sqrt{\frac{2.86}{8-1}} = 0.64$$

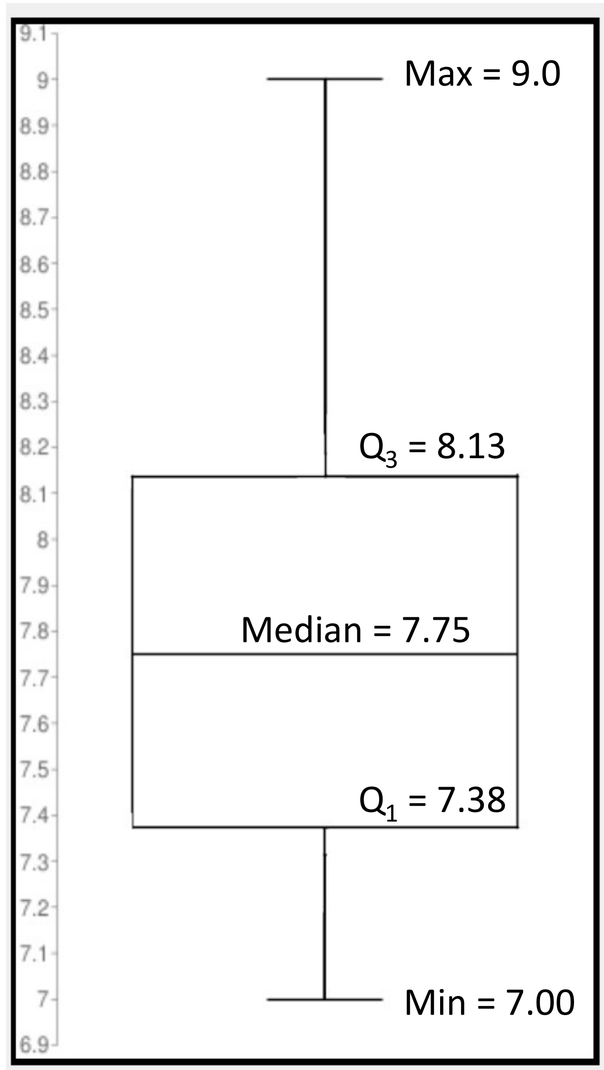
Data value	$(\mathbf{x} - \bar{\mathbf{x}})^2$
$7.00	$(7 - 7.81)^2 = 0.66$
$7.25	$(7.25 - 7.81)^2 = 0.31$
$7.50	$(7.5 - 7.81)^2 = 0.10$
$7.50	$(7.5 - 7.81)^2 = 0.10$
$8.00	$(8 - 7.81)^2 = 0.04$
$8.00	$(8 - 7.81)^2 = 0.04$
$8.25	$(8.25 - 7.81)^2 = 0.19$
$9.00	$(9 - 7.81)^2 = 1.42$
Total	**2.86**

Example 1 Continued

$7.00, $7.25, $7.50, **$7.50, $8.00,** $8.00, $8.25, $9.00 Sorted Data

n	**Mean ($\overline{x}$)**	**Low Value**	**Lower Quartile**	**Median**	**Upper Quartile**	**High Value**	**Standard Deviation**
8	$ 7.81	$7.00	$7.38	$7.75	$8.13	$9.00	$0.64

Pay For A Meal



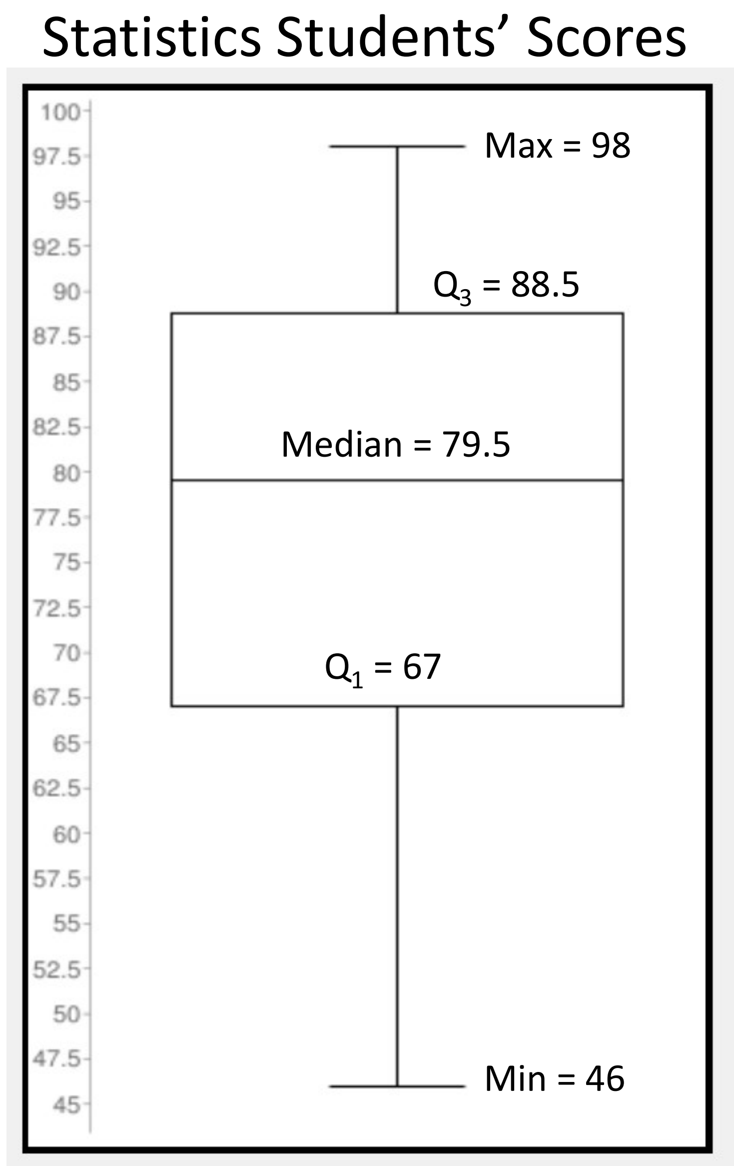
Example 2

For the following dataset find complete the table below, then create a boxplot.

Suppose that 20 statistics students' scores on an exam are as follows:

97, 92, 88, 75, 83, 67, 89, 55, 72, 78, 81, 91, 57, 63, 67, 74, 87, 84, 98, 46

n	**Mean ($\overline{x}$)**	**Low Value**	**Lower Quartile**	**Median**	**Upper Quartile**	**High Value**	**Standard Deviation**
20	77.2	46	67	79.5	88.5	98	14.52


Statistics Students' Scores
100
97.5
95
92.5
90
87.5
85
82.5
80
77.5
75
72.5
70
67.5
65
62.5
60
57.5
55
52.5
50
47.5
45
Max = 98
Q_3 = 88.5
Median = 79.5
Q_1 = 67
Min = 46

Quantitative Skills & Reasoning Test 1 Grades

17	70	95
36	70	95
38	75	100
40	77	100
45	78	100
52	80	100
57	83	100
63	85	100
64	85	100
65.5	90	
65.5	90	

Sample size: 31
Median: 78
Minimum: 17
Maximum: 100
First quartile: 63
Third quartile: 95
Interquartile Range: 32
Outliers: none