

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles

Example

The
Five-Number
Summary

Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

The Five-Number Summary

Lecture 16

Sections 5.3.1 - 5.3.3

Robb T. Koether

Hampden-Sydney College

Tue, Sep 23, 2008

Outline

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles
Example

The
Five-Number
Summary
Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

- 1 Homework Review
- 2 Percentiles and Quartiles
 - Example
- 3 The Five-Number Summary
 - Examples
- 4 TI-83 Five-Number Summary
- 5 The Interquartile Range
- 6 Percentiles in Excel
- 7 Assignment

The Five-Number Summary

Robb T.
Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

Exercise 5.7, p. 312.

- (a) The average (or mean) age for 10 adults in a room is 35 years. A 32-year-old adult new enters the room. Can you find the new average age for the 11 adults? If so, find it. If not, explain why not.
- (b) The median age for 10 adults in a room is 35 years. A 32-year-old adult new enters the room. Can you find the new median age for the 11 adults? If so, find it. If not, explain why not.

The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

Solution

- (a) If the average age of 10 adults is 35, then the total of their ages must be 350. The 32-year-old makes the total 382, so the new average is

$$\frac{382}{11} = 34.73.$$

The Five-Number Summary

Robb T.
Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

Solution

- (b)
- In this case, we cannot find the new median. We know that half the people in the room are 35 or less, but we do not know how their ages are distributed.
 - For example, if they are all 30, then the 32-year-old would be the new median.
 - On the other hand, if they were all 34, then the new median would be 34.

Percentiles and Quartiles

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles

Example

The
Five-Number
Summary

Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

Definition (p^{th} percentile)

The p^{th} percentile of a set of numbers is a number that divides the lower $p\%$ of the numbers from the rest.

Definition (1st quartile)

The 1st quartile, denoted Q_1 , of a set of numbers is the 25th percentile.

Definition (3rd quartile)

The 3rd quartile, denoted Q_3 , of a set of numbers is the 75th percentile.

Finding Quartiles

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles

Example

The
Five-Number
Summary

Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

- To find the quartiles, first find the position of the median.
- Then the 1st quartile is the median of all the numbers that are below that position.
- The 3rd quartile is the median of all the numbers that are above that position.

Example

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles

Example

The
Five-Number
Summary

Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

Example (Quartiles)

- Find the median and quartiles of the following sample.

5, 8, 10, 15, 17, 19, 20, 24, 25, 30, 32

Example

The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

Example (Quartiles)

- Find the median and quartiles of the following sample.

5, 8, 10, 15, 17, 19, 20, 24, 25, 30, 32



Median

Example

The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

TI-83 Five-Number Summary

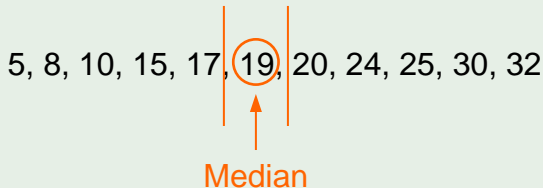
The Interquartile Range

Percentiles in Excel

Assignment

Example (Quartiles)

- Find the median and quartiles of the following sample.



Example

The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

TI-83 Five-Number Summary

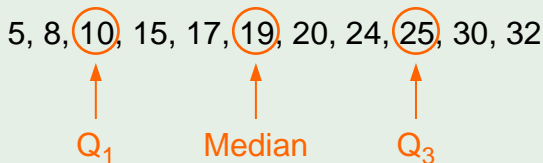
The Interquartile Range

Percentiles in Excel

Assignment

Example (Quartiles)

- Find the median and quartiles of the following sample.



Definition (Five-number summary)

The **five-number summary** of a set of numbers consists of the five quantities

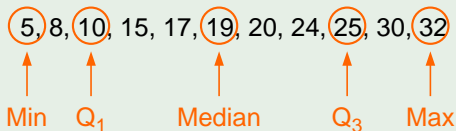
- Minimum
 - 1st quartile
 - Median
 - 3rd quartile
 - Maximum
-
- These five numbers divide the set of numbers into four groups of equal size, each containing one-fourth of the set.

Example

Example (Five-number summary)

- The five-number summary of the previous sample is

- Min= 5.
- $Q_1 = 10$.
- Med= 19.
- $Q_3 = 25$.
- Max= 32.



Practice

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles
Example

The
Five-Number
Summary
Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

Practice

- Find the five-number summary of the sample

5, 8, 10, 15, 17, 19, 20, 24, 25, 30, 32, 35.

TI-83 Five-Number Summary

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles

Example

The
Five-Number
Summary

Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

TI-83 Five-Number Summary

- Follow the same procedure that was used to find the mean.
- When the list of statistics appears, scroll down to the ones labeled
 minX , $Q1$, Med , $Q3$, maxX .
- They are the five-number summary.

TI-83 Five-Number Summary

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles

Example

The
Five-Number
Summary

Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

TI-83 Five-number summary

- Use the TI-83 to find the five-number summary of the rainfall data

2.82	24.18	0.20	15.60	22.04	7.44
5.16	9.14	37.36	10.19	2.16	17.50
28.12	11.23	8.66	7.24	6.50	4.88
13.08	4.01	11.28	1.96	12.09	2.92
7.67	4.39	6.60	6.50	25.43	0.74

Five-Number Summaries and Distributions

The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

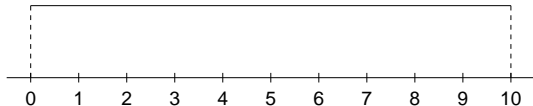
TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

- If the distribution were uniform from 0 to 10, what would be the five-number summary?



Five-Number Summaries and Distributions

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles

Example

The
Five-Number
Summary

Examples

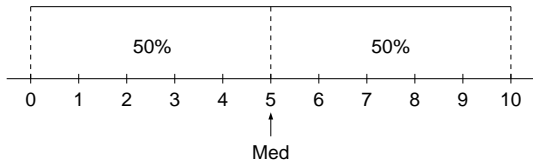
TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

- If the distribution were uniform from 0 to 10, what would be the five-number summary?



Five-Number Summaries and Distributions

The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

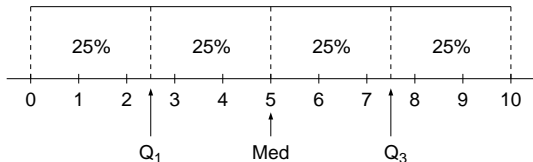
TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

- If the distribution were uniform from 0 to 10, what would be the five-number summary?



Five-Number Summaries and Distributions

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles

Example

The
Five-Number
Summary

Examples

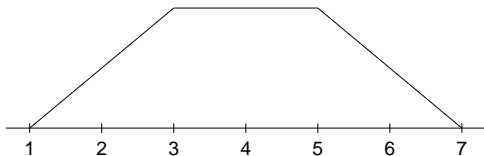
TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

- Where would the median and quartiles be in this symmetric non-uniform distribution?



Five-Number Summaries and Distributions

The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

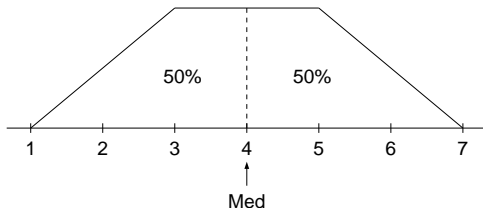
TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

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Five-Number Summaries and Distributions

The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

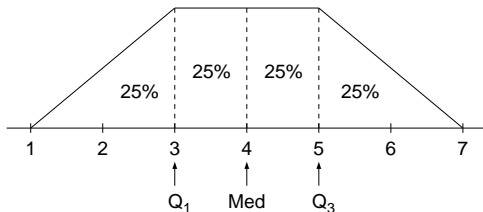
TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

- Where would the median and quartiles be in this symmetric non-uniform distribution?



Five-Number Summaries and Distributions

The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

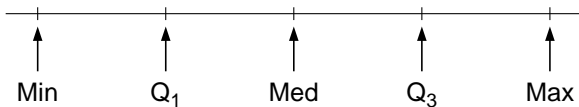
TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

- Describe the distribution.



Five-Number Summaries and Distributions

The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

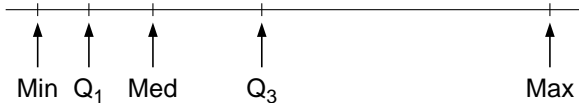
TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

- Describe the distribution.



Five-Number Summaries and Distributions

The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

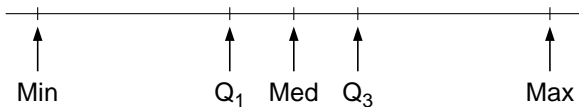
TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

- Describe the distribution.



Five-Number Summaries and Distributions

The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

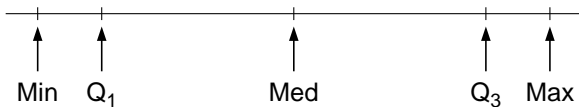
TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

- Describe the distribution.



The Interquartile Range

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles

Example

The
Five-Number
Summary

Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

Definition (Interquartile range)

The **interquartile range**, denoted IQR, is the difference between Q_3 and Q_1 .

- The IQR is a commonly used measure of spread, or variability.
- Like the median, it is not affected by extreme outliers.

The IQR

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles
Example

The
Five-Number
Summary

Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

Example (IQR)

- The IQR of

5, 8, 10, 15, 17, 19, 20, 24, 25, 30, 32

is

$$\begin{aligned}\text{IQR} &= Q_3 - Q_1 \\ &= 25 - 10 \\ &= 15\end{aligned}$$

The IQR

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles
Example

The
Five-Number
Summary
Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

Example (IQR)

- The IQR of

5, 8, 10, 15, 17, 19, 20, 24, 25, 30, 32, 35

is

$$\begin{aligned}\text{IQR} &= Q_3 - Q_1 \\ &= 27.5 - 12.5 \\ &= 15\end{aligned}$$

The IQR

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles
Example

The
Five-Number
Summary
Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

Example (IQR)

- The IQR of the rainfall data is is

$$\begin{aligned}\text{IQR} &= Q_3 - Q_1 \\ &= 13.08 - 4.39 \\ &= 8.69 \text{ cm}\end{aligned}$$

The IQR

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles
Example

The
Five-Number
Summary
Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

Practice

- Find the five-number summary and the IQR of the sample

5, 20, 30, 45, 60, 80, 100, 140, 175, 200, 240.

- Are the data skewed?

Salaries of School Board Chairmen

Practice

- Find the five-number summary of the following salaries of school board chairmen.

County/City	Salary	County/City	Salary
Henrico	20,000	Caroline	5,000
Chesterfield	18,711	Louisa	4,921
Richmond	11,000	Powhatan	4,800
Hanover	11,000	Hopewell	4,500
Petersburg	8,500	Charles City	4,500
Sussex	7,000	Prince George	3,750
New Kent	6,500	Cumberland	3,600
Goochland	5,500	King & Queen	3,000
Dinwiddie	5,120	King William	2,400
Colonial Hgts	5,100	West Point	0

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles

Example

The
Five-Number
Summary

Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

Five-Number Summaries and Stem-and-Leaf Displays

- It is possible to use a stem-and-leaf display to find a five-number summary, especially if the leaves are arranged in order.
- Find a five-number summary of the following January rainfall data.

Stem	Leaf
0	0 0 1 2 2 2 4 4 4
0	5 6 6 6 7 7 7 8 9
1	0 1 1 2 3
1	5 7
2	2 4
2	5 8
3	
3	7

- Note: 1|2 means 12.

Excel's Definition of Percentile

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles
Example

The
Five-Number
Summary
Examples

T1-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

- Microsoft's Excel uses a definition of the p^{th} percentile that is based on the *gaps* between the numbers rather than on the numbers themselves.

Definition (Excel's p^{th} percentile)

Excel's p^{th} percentile of a set of numbers is the number whose rank (position) is given by

$$r = 1 + \left(\frac{p}{100} \right) (n - 1).$$

If r is not a whole number, then interpolate between values.

Assignment

The
Five-Number
Summary

Robb T.
Koether

Homework
Review

Percentiles
and Quartiles
Example

The
Five-Number
Summary
Examples

TI-83
Five-Number
Summary

The
Interquartile
Range

Percentiles in
Excel

Assignment

Homework

- Read Section 5.3.1 - 5.3.2, pages 312 - 315.
- Work Example 5.4, page 314, as an exercise.