

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, Feb 10, 2009

# 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 5.6, p. 311.

- The salaries of superstar professional athletes receive much attention in the media.
- The million-dollar annual contract is becoming more commonplace among this elite group with each passing year.
- Nevertheless, rarely does a year pass without one or more of the players' associations negotiating with team owners for additional salary and fringe-benefit considerations for all players in their particular sports.

## 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 5.6, p. 311.

- (a) If the players' association wanted to support its argument for higher "average" salaries, which measure of center do you think it should use? Why?
- (b) To refute the argument, which measure of center should the owners apply to the players' salaries? Why?

## 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) The players' association should use the median. The distribution of salaries of professional athletes is skewed to the right (towards the larger values). Therefore, the median should be less than the mean.
- (b) The owners should use the mean because it should be greater than the median.

# 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 ( $p^{\text{th}}$ Percentile)

The  $p^{\text{th}}$  **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  $25^{\text{th}}$  percentile.

## Definition (3rd Quartile)

The **3rd quartile**, denoted  $Q_3$ , of a set of numbers is the  $75^{\text{th}}$  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

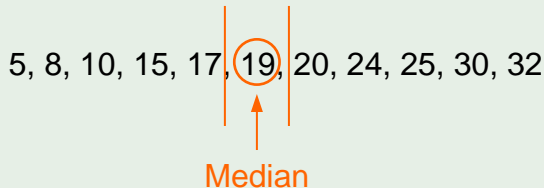
The Interquartile Range

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

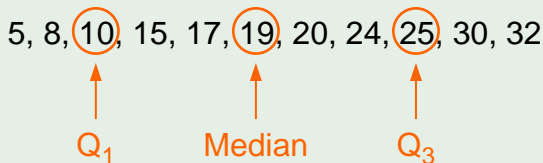
The Interquartile Range

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

# Example

## The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

T1-83 Five-Number Summary

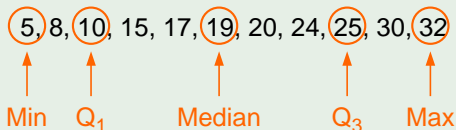
The Interquartile Range

Percentiles in Excel

Assignment

## 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  
 $\text{minX}$ ,  $Q1$ ,  $\text{Med}$ ,  $Q3$ ,  $\text{maxX}$ .
- 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

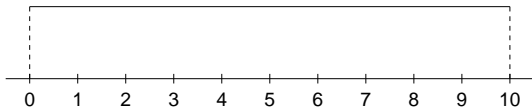
TI-83 Five-Number Summary

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

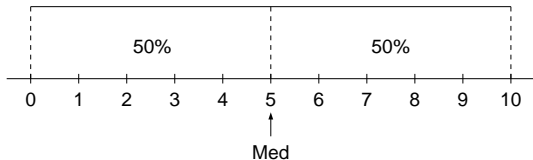
TI-83  
Five-Number  
Summary

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

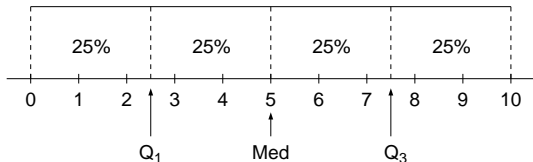
TI-83 Five-Number Summary

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

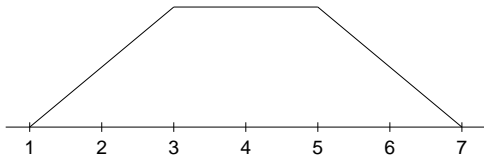
TI-83  
Five-Number  
Summary

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

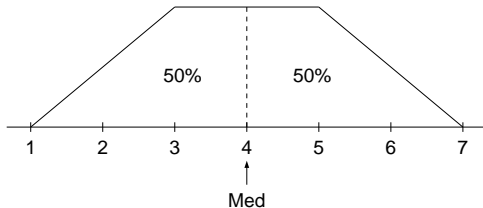
TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

- 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

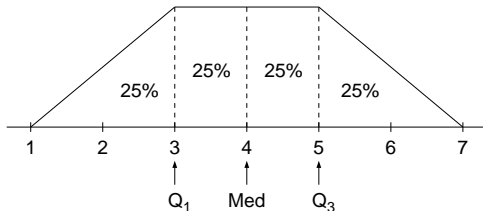
TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

- 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

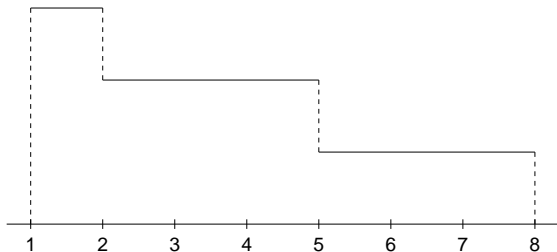
TI-83 Five-Number Summary

The Interquartile Range

Percentiles in Excel

Assignment

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

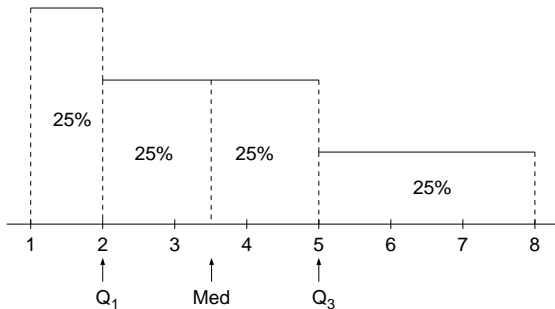


# Five-Number Summaries and Distributions

## The Five-Number Summary

Robb T. Koether

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



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 Distributions

## The Five-Number Summary

Robb T. Koether

Homework Review

Percentiles and Quartiles

Example

The Five-Number Summary

Examples

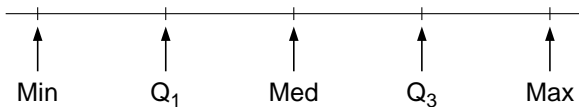
TI-83 Five-Number Summary

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

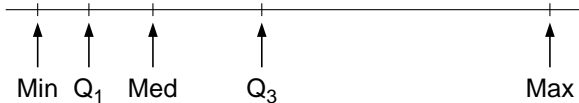
TI-83 Five-Number Summary

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

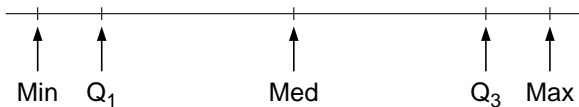
TI-83 Five-Number Summary

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

## 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?

# Five-Number Summaries and Stem-and-Leaf Displays

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

- 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.



# 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

# Excel's Definition of Percentile

## 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 (Excel's $p^{\text{th}}$ percentile)

Excel's  $p^{\text{th}}$  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.

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

# 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.