The Five-Number Summary
Lecture 16
Sections 5.3.1 - 5.3.3

Robb T. Koether
Hampden-Sydney College

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Outline

1. Homework Review
2. Percentiles and Quartiles
3. The Five-Number Summary
4. TI-83 Five-Number Summary
5. The Interquartile Range
6. Percentiles in Excel
7. Assignment
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A professor teaches two statistics classes. The morning class has 25 students, and their average on the first test was 82. The evening class has 15 students, and their average on the same test was 74. What is the average on this test if the professor combines the scores for both classes?

This would be a weighted average.

\[
\text{avg.} = \frac{25(82) + 15(74)}{25 + 15} = \frac{2050 + 1110}{40} = \frac{3160}{40} = 79.
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Exercise 5.3, p. 311.

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Percentiles and Quartiles

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

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 (Quartiles)

Find the median and quartiles of the following sample.

5, 8, 10, 15, 17, 19, 20, 24, 25, 30, 32
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Median
Example (Quartiles)

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Median
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Q_1  Median  Q_3
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Definition (Five-Number Summary)

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

- Minimum
- 1\(^{\text{st}}\) quartile
- Median
- 3\(^{\text{rd}}\) quartile
- Maximum

These five numbers divide the set of numbers into four groups of equal size, each containing one-fourth of the set.
Example (Five-Number Summary)

The five-number summary of the previous sample is

- Min = 5.
- Q₁ = 10.
- Med = 19.
- Q₃ = 25.
- Max = 32.
Find the five-number summary of the Plant B data from Exercise 4.36, page 262.

27  29  31  32  32  33  33  34  37  44
46  51  56  56  57  58  58  59  62  63
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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**

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

<table>
<thead>
<tr>
<th>5.94</th>
<th>1.11</th>
<th>9.52</th>
<th>0.08</th>
<th>6.14</th>
<th>8.68</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.93</td>
<td>2.03</td>
<td>3.60</td>
<td>14.71</td>
<td>4.01</td>
<td>0.85</td>
</tr>
<tr>
<td>6.89</td>
<td>11.07</td>
<td>4.42</td>
<td>3.41</td>
<td>2.85</td>
<td>2.56</td>
</tr>
<tr>
<td>1.92</td>
<td>5.15</td>
<td>1.58</td>
<td>4.44</td>
<td>0.77</td>
<td>4.76</td>
</tr>
<tr>
<td>1.15</td>
<td>3.02</td>
<td>1.73</td>
<td>2.60</td>
<td>2.56</td>
<td>10.01</td>
</tr>
</tbody>
</table>
If the distribution were uniform from 0 to 10, what would be the five-number summary?
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![Five-number summary diagram]

- Min
- Q1
- Med
- Q3
- Max
Where would the median and quartiles be in this symmetric non-uniform distribution?
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Where would the median and quartiles be in this symmetric non-uniform distribution?
Where would the median and quartiles be in this non-symmetric non-uniform distribution?
Where would the median and quartiles be in this non-symmetric non-uniform distribution?
Describe the distribution.
Describe the distribution.
Describe the distribution.

- Min
- Q₁
- Med
- Q₃
- Max
Describe the distribution.
The Interquartile Range

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

**Example (IQR)**

The IQR of 5, 8, 10, 15, 17, 19, 20, 24, 25, 30, 32 is

\[
\text{IQR} = Q_3 - Q_1 = 25 - 10 = 15
\]
The IQR

Practice

Find the IQR of the Plant B data

27  29  31  32  32  33  33  34  37  44
46  51  56  56  57  58  58  59  62  63

and use it to describe the sample.
Use the stem-and-leaf display to find a five-number summary of the Plant B data.

<table>
<thead>
<tr>
<th>Stem</th>
<th>Leaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>7 9</td>
</tr>
<tr>
<td>3</td>
<td>1 2 2 3 3 4 7</td>
</tr>
<tr>
<td>4</td>
<td>4 6</td>
</tr>
<tr>
<td>5</td>
<td>1 6 6 7 8 8 9</td>
</tr>
<tr>
<td>6</td>
<td>2 3</td>
</tr>
</tbody>
</table>

Note: 1|2 means 12.
Find the five-number summary of the following salaries of school board chairmen.

<table>
<thead>
<tr>
<th>County/City</th>
<th>Salary</th>
<th>County/City</th>
<th>Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Henrico</td>
<td>20,000</td>
<td>Caroline</td>
<td>5,000</td>
</tr>
<tr>
<td>Chesterfield</td>
<td>18,711</td>
<td>Louisa</td>
<td>4,921</td>
</tr>
<tr>
<td>Richmond</td>
<td>11,000</td>
<td>Powhatan</td>
<td>4,800</td>
</tr>
<tr>
<td>Hanover</td>
<td>11,000</td>
<td>Hopewell</td>
<td>4,500</td>
</tr>
<tr>
<td>Petersburg</td>
<td>8,500</td>
<td>Charles City</td>
<td>4,500</td>
</tr>
<tr>
<td>Sussex</td>
<td>7,000</td>
<td>Prince George</td>
<td>3,750</td>
</tr>
<tr>
<td>New Kent</td>
<td>6,500</td>
<td>Cumberland</td>
<td>3,600</td>
</tr>
<tr>
<td>Goochland</td>
<td>5,500</td>
<td>King &amp; Queen</td>
<td>3,000</td>
</tr>
<tr>
<td>Dinwiddie</td>
<td>5,120</td>
<td>King William</td>
<td>2,400</td>
</tr>
<tr>
<td>Colonial Hgts</td>
<td>5,100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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Excel’s Definition of Percentile

**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.

- 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.
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Assignment

Homework

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