

There are some good videos online, about what not to do in PowerPoint. You can find them using your favorite search engine, here are a few that I like:

- How NOT to use PowerPoint
- Life After Death by PowerPoint
- What Not to Do in PowerPoint

Unit 9 only requires us to do Sections 1 & 2.

If we have time, there are some topics in Sections 3 & 4, that I will also cover. They tie in with earlier units.

The PDF and other materials are located at:

[http://www.ramshillfarm.com/Math/Math150/Unit\\_9.html](http://www.ramshillfarm.com/Math/Math150/Unit_9.html)

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## 9.1

### Measures of Central Tendency

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## Definitions

An **average** is a number that is representative of a group of data.

Most common averages:

- Mean
- Median
- Mode
- Midrange

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### Mean

The **mean**,  $\bar{x}$  is the sum of the data divided by the number of pieces of data. The formula for calculating the mean is

$$\bar{x} = \frac{\sum x}{n}$$

where  $\sum x$  represents the sum of all the data and  $n$  represents the number of pieces of data.

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### Example-find the mean

Find the mean amount of money parents spent on new school supplies and clothes if 5 parents randomly surveyed replied as follows:

\$327 \$465 \$672 \$150 \$230

$$\begin{aligned} \bar{x} &= \frac{\sum x}{n} = \frac{\$327 + \$465 + \$672 + \$150 + \$230}{5} \\ &= \frac{\$1844}{5} = \$368.80 \end{aligned}$$

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### Median

The **median** is the value in the middle of a set of *ranked data*.

Determine the median of

\$327 \$465 \$672 \$150 \$230.

Rank the data from smallest to largest.

\$150 \$230 **\$327** \$465 \$672

↑  
middle value (median)

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### Example

The weights of eight Labrador retrievers rounded to the nearest pound are:

85, 92, 88, 75, 94, 88, 84, 101

Determine the

- a) mean
- b) median
- c) mode
- d) midrange
- e) rank the measures of central tendency from lowest to highest.

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weights: 85, 92, 88, 75, 94, 88, 84, 101

a. Mean

$$\bar{x} = \frac{85 + 92 + 88 + 75 + 94 + 88 + 84 + 101}{8}$$

$$= \frac{707}{8} = 88.375$$

b. Median: rank the data

75, 84, 85, 88, 88, 92, 94, 101  
The median is 88.

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Ranked: 75, 84, 85, 88, 88, 92, 94, 101

c. Mode-the number that occurs most frequently. The mode is 88.

d. Midrange =  $(L + H)/2$   
=  $(75 + 101)/2 = 88$

e. Rank the measures, lowest to highest  
88, 88, 88, 88.375

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Page 363

## Measures of Position

- Measures of position are often used to make comparisons.
- Two measures of position are *percentiles (percent)* and *quartiles (fourths)*.

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## Example: Quartiles

The weekly grocery bills for 23 families are as follows. Determine  $Q_1$ ,  $Q_2$ , and  $Q_3$ .

170	210	270	270	280
330	80	170	240	270
225	225	215	310	50
75	160	130	74	81
95	172	190		

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## Example: Quartiles continued

Order(Rank) the data:

50	74	75	80	81	95
130	160	170	170	172	190
210	215	225	225	240	270
270	270	280	310	330	

- $Q_2$  is the median of the entire data set which is **190**.
- $Q_1$  is the median of the numbers from 50 to 172 which is **95**.
- $Q_3$  is the median of the numbers from 210 to 330 which is **270**.

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## 9.2

### Measures of Dispersion

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### Measures of Dispersion

- Measures of dispersion are used to indicate the *spread of the data*.
- The **range** is the difference between the highest and lowest values; it indicates the total spread of the data.  
**Range** = highest value – lowest value

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### Example: Range

Nine different employees were selected and the amount of their salary was recorded. Find the range of the salaries.

\$24,000	\$26,500	\$27,000
\$28,500	\$32,000	\$34,500
\$48,000	\$56,000	\$56,750

Range = \$56,750 - \$24,000 = \$32,750

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Page 374

## Standard Deviation

The **standard deviation** measures how much the data *differ from the mean*. It is symbolized with  $s$  when it is calculated for a sample, and with  $\sigma$  (Greek letter sigma) when it is calculated for a population.

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

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## Example

Find the standard deviation of the following prices of selected washing machines:  
\$280, \$217, \$665, \$684, \$939, \$299

Step 1) Find the mean.

$$\bar{x} = \frac{\sum x}{n} = \frac{665 + 217 + 684 + 280 + 939 + 299}{6}$$

$$= \frac{3084}{6} = 514$$

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## Example continued, mean = 514

Step 2) Set up the table

Data (x)	Data - Mean (x - $\bar{x}$ )	(Data - Mean) <sup>2</sup> (x - $\bar{x}$ ) <sup>2</sup>
217	217 - 514 = -297	(-297) <sup>2</sup> = 88,209
280	280 - 514 = -234	(-234) <sup>2</sup> = 54,756
299	299 - 514 = -215	(-215) <sup>2</sup> = 46,225
665	665 - 514 = 151	(151) <sup>2</sup> = 22,801
684	684 - 514 = 170	(170) <sup>2</sup> = 28,900
939	939 - 514 = 425	(425) <sup>2</sup> = 180,625
<b>Total</b>	<b>3084</b>	<b>0</b>
		<b>421,516</b>

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Example continued, mean = 514

Step 3) Put values found into the formula.

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}} \quad s = \sqrt{\frac{421,516}{5}}$$

$$s = \sqrt{\frac{421,516}{6 - 1}} \quad s = \sqrt{84,303.2}$$

$$s = 290.350133...$$

The standard deviation is \$290.35.

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Labrador weights

Data Value (x)	Value - Mean $(x - \bar{x})$	(Value - Mean) <sup>2</sup> $(x - \bar{x})^2$
75	75 - 88.375 = -13.375	(-13.375) <sup>2</sup> = 178.890625
84	-4.375	19.140625
85	-3.375	11.390625
88	-.375	0.140625
88	-.375	0.140625
92	3.625	13.140625
94	5.625	31.640625
101	12.625	159.390625
Total	707	0
		413.875

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$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}} \quad s = \sqrt{\frac{413.875}{7}}$$

$$s = \sqrt{\frac{413.875}{8 - 1}} \quad s = \sqrt{59.125}$$

s = 7.6892782496148492545351482698176

The standard deviation is 7.69 rounded.

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Page 379

**9.3**

The Normal Curve

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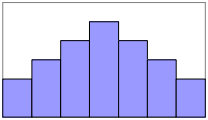
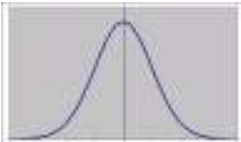
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**Normal Distribution**

• Line Graph                      • Histogram



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Page 383

**Properties of a Normal Distribution**

- The graph of a normal distribution is called the normal curve.
- The normal curve is bell shaped and symmetric about the mean.
- In a normal distribution, the mean, median, and mode all have the same value and all occur at the center of the distribution.

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### Empirical Rule

- Approximately 68% of all the data lie within one standard deviation of the mean (in both directions).
- Approximately 95% of all the data lie within two standard deviations of the mean (in both directions).
- Approximately 99.7% of all the data lie within three standard deviations of the mean (in both directions).

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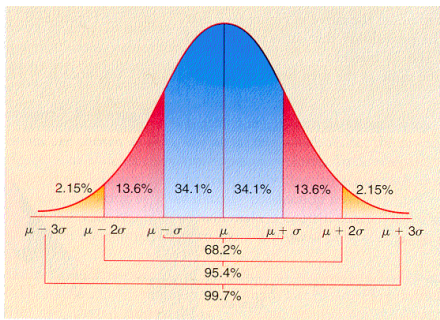
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Graph from: [http://www.comfsm.fm/~dleeing/statistics/fx\\_2001\\_02.html](http://www.comfsm.fm/~dleeing/statistics/fx_2001_02.html)

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### z-Scores

z-scores determine how far, in terms of standard deviations, a given score is from the mean of the distribution.

$$z = \frac{\text{value of piece of data} - \text{mean}}{\text{standard deviation}} = \frac{X - \mu}{\sigma}$$

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# 9.4

## Linear Correlation and Regression

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## Linear Correlation

*Linear correlation* is used to determine whether there is a relationship between two quantities and, if so, how strong the relationship is.

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## Linear Correlation

The *linear correlation coefficient*,  $r$ , is a unit-less measure that describes the strength of the linear relationship between two variables.

- If the value is **positive**, as one variable increases, the other increases.
- If the value is **negative**, as one variable increases, the other decreases.
- The variable,  $r$ , will always be a value **between -1 and 1 inclusive**.

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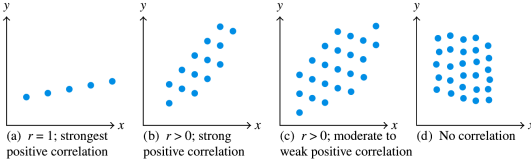
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$r > 0$



(a)  $r = 1$ ; strongest positive correlation  
 (b)  $r > 0$ ; strong positive correlation  
 (c)  $r > 0$ ; moderate to weak positive correlation  
 (d) No correlation

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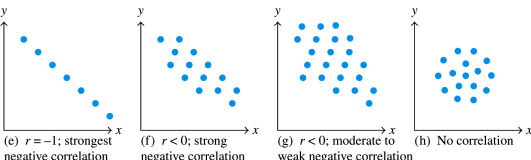
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$r < 0$



(e)  $r = -1$ ; strongest negative correlation  
 (f)  $r < 0$ ; strong negative correlation  
 (g)  $r < 0$ ; moderate to weak negative correlation  
 (h) No correlation

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Page 399

## Linear Correlation Coefficient

The formula to calculate the correlation coefficient ( $r$ ) is as follows:

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2} \sqrt{n(\sum y^2) - (\sum y)^2}}$$

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## Linear Regression

Page 403

- **Linear regression** is the process of determining the linear relationship between two variables.
- The **line of best fit** (*regression line* or the *least squares line*) is the line such that the sum of the squares of the vertical distances from the line to the data points (on a scatter diagram) is a minimum.

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## The Line of Best Fit

Equation:

$y = mx + b$ , where

$$m = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}, \text{ and } b = \frac{\sum y - m(\sum x)}{n}$$

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