Math 3

9.5 Margin of Error

Unit 9

SWBAT calculate the margin of error and the 95% confidence interval for entire and sample populations.

Margin of Error:
The interval in which the mean of the population is likely to be

FORMULA: $ME = 1.96\left(\frac{s}{\sqrt{n}}\right)$

ME= Margin of Error
n= # of terms (sample size)
S= Standard Deviation

Confidence Interval: We can say w/ 95% confidence that the mean lies between the 2 #s

$\bar{x} \pm ME$

FORMULA:

$\bar{x} - ME \leq \mu \leq \bar{x} + ME$

Where $\bar{x}$ is the *sample mean* and μ is the *population mean*; the range is the *confidence interval*

Example 1: A grocery store manager wanted to determine the wait times for customers in the express lines. He timed customers chosen at random.

Waiting Time (minutes)				
3.3	5.1	5.2	6.7	7.3
7.5	4.6	6.2	5.5	3.6
3.4	3.5	8.2	4.2	3.8
4.7	4.6	4.7	4.5	9.7
5.4	5.9	6.7	6.5	8.2
3.1	3.2	8.2	2.5	4.8

a) What is the mean and standard deviation of the sample? Round to the nearest tenth of a minute.

$\bar{x} = 5.36 \quad S_x = 1.83$

b) At a 95% confidence level, what is the approximate margin of error? Round to the nearest tenth of a minute.

$ME = 1.96\left(1.83/\sqrt{30}\right) = 0.65$

c) What is the confidence interval for a 95% confidence level?

$4.71 \leq \mu \leq 6.01$

d) What is the meaning of the interval in terms of wait times for customers?

95% confident that the mean is between 4.71 and 6.01 for a population

Sample Proportion: $\hat{p}$

"p hat"

$\frac{\text{desired \#}}{\text{total \#}}$

Example 2: What is the sample proportion for each situation? Write the ratios as percents rounded to the nearest tenth of a percent.

a) In a poll of 1085 voters selected randomly, 564 favor Candidate A.

$\hat{p} = 564/1085 = 0.52 = 52\%$

b) A coin is tossed 40 times, and it comes up heads 25 times.

$\hat{p} = 25/40 = 0.625 = 62.5\%$

Sample population

Margin of Error for a sample proportion:

$$ME = 1.96\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

Where $\hat{p}$ is the Sample proportion

and n is the # in the sample (sample size)

95% Confidence Interval for a Population Proportion:

$$\hat{p} \pm ME$$

Example 3: Find the sample proportion, the margin of error, and the 95% confidence interval for the population proportion.

a) In a survey of 530 randomly selected high school students, 280 preferred watching football to watching basketball.

$\hat{p} = \frac{280}{530} = 0.5283$ $\quad ME = 1.96\sqrt{\frac{0.5283(1-0.5283)}{530}} = 0.043$

95% confidence interval: $0.53 \pm 0.04 = 0.49$ to 0.57

b) In a simple random sample of 500 people, 342 reported using social networking.

$\hat{p} = \frac{342}{500} = 0.684$ $\quad ME = 1.96\sqrt{\frac{0.684(1-0.684)}{500}} = 0.04$

95% confidence interval: $0.684 \pm 0.04 = 0.644$ to 0.724

For Exercises 1-2, find the 95% confidence interval for the population mean or population proportion, and interpret the confidence interval in context.

1. A consumer research group tested the battery life of 36 randomly chosen batteries to establish the likely battery life for the population of the same type of battery.

Battery Life (In Hours)			
63.2	84.6	78.4	85.8
62.1	81.8	63.6	64.2
79.4	75.2	54.1	73.4
66.3	74.5	71.6	60.1
61.2	74.5	72.4	81.3
61.4	83.6	75.6	74.1
68.3	82.2	59.3	47.6
86.2	64.3	72.7	71.8
71.4	63.6	59.6	68.1

$\bar{x} = 70.5$

$s_x = 9.5$

$ME = 1.96\left(\frac{9.5}{\sqrt{36}}\right) = 3.10$

95% confidence interval:

$67.4 \leq \mu \leq 73.6$

2. In a poll of 720 likely voters, 358 indicate they plan to vote for Candidate A.

$\hat{p} = \frac{358}{720} = 0.5$ $\quad ME = 1.96\sqrt{\frac{0.5(1-0.5)}{720}}$

$ME = 0.04$

95% C.I.

0.5 ± 0.04

0.46 to 0.54