3.5 – Margin of Error (MOE)

– **margin of (sampling) error (MOE)** → represents a limit on the difference between how a sample responds and how the total population would respond

Margin of Error (MOE) "Formula" → If the percent of people in a sampling respond in a certain way is p and the size of the sample n, then 95% of the time, the percent of the population responding in that same way will be between $p - MOE$ and $p + MOE$, where MOE = $2\cdot\sqrt{\frac{p(1-p)}{n}}$

Example 1: Find the margin of error (MOE) where round it to the nearest percent. MOE = ?

a.) p = 72% and n = 100 (.72)

$MOE = 2\sqrt{\frac{.72(1-.72)}{100}}$

$MOE = .09 \rightarrow$ **MOE = 9%**

b.) p = 31% and n = 500 (.31)

$MOE = 2\sqrt{\frac{.31(1-.31)}{500}}$

$MOE = .04 \rightarrow$ **MOE = 4%**

c.) In a survey of 1000 randomly selected adults, 37% answered "yes" to a particular question. (n = 1000)

p = .37

$MOE = 2\sqrt{\frac{.37(1-.37)}{1000}}$

$MOE = .03 \rightarrow$ **MOE = 3%**

d.) In a survey of 520 randomly-selected high school students, 68% of those surveyed stated that they were involved in extracurricular activities. (n = 520, p = .68)

$MOE = 2\sqrt{\frac{.68(1-.68)}{520}}$

$MOE = .04 \rightarrow$ **MOE = 4%**

Example 2: Find the number of people surveyed in each situation. n = ?

a.) p = 67% and MOE = 2% (.67, .02)

$\frac{.02}{2} = \frac{2\sqrt{\frac{.67(1-.67)}{n}}}{2}$

$(.01)^2 = \left(\sqrt{\frac{.2211}{n}}\right)^2$

$\frac{1\times10^{-4}}{1} = \frac{.2211}{n}$

$\frac{1\times10^{-4}n}{1\times10^{-4}} = \frac{.2211}{(1\times10^{-4})}$

coincidence that it's same #...

n = 2211 people surveyed

b.) In a recent Gallup Poll, 25% of the people surveyed said they had smoked cigarettes in the past week. The margin of error was 3%. (p = .25, MOE = .03)

$\frac{.03}{2} = \frac{2\sqrt{\frac{.25(1-.25)}{n}}}{2}$

$(.015)^2 = \left(\sqrt{\frac{.1875}{n}}\right)^2$

$\frac{2.25\times10^{-4}}{1} = \frac{.1875}{n}$

$\frac{2.25\times10^{-4}n}{2.25\times10^{-4}} = \frac{.1875}{(2.25\times10^{-4})}$

n = about 833 people surveyed

Example 3: Find the percent of people surveyed who said "yes" in each situation. p = ?

a.) n = 1000 and MOE = 3% (MOE = .03)

$\frac{.03}{2} = \frac{2\sqrt{\frac{p(1-p)}{1000}}}{2}$

$(.015)^2 = \left(\sqrt{\frac{p-p^2}{1000}}\right)^2$

$\frac{2.25\times10^{-4}}{1} = \frac{p-p^2}{1000}$

$p - p^2 = .225$

$p - p^2 - .225 = 0 = Y_1$

$Y_2 = 0$ (for TI)

Find Intersection or Root...

left side = .34 = 34%

right side = .66 = 66%

34% or 66% of people surveyed said yes

b.) According to a survey in American Demographics, 283 Americans age 12 or older said they listen to the radio every day. The survey had a margin of error of 5%. (n = 283, MOE = .05)

$\frac{.05}{2} = \frac{2\sqrt{\frac{p(1-p)}{283}}}{2}$

$(.025)^2 = \left(\sqrt{\frac{p-p^2}{283}}\right)^2$

$\frac{6.25\times10^{-4}}{1} = \frac{p-p^2}{283}$

$p - p^2 = .176875$

$p - p^2 - .176875 = 0$

left side = .23 = 23%

right side = .77 = 77%

23% or 77% of people surveyed said yes