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Problem Set #4

1. (a) $p = .51$

$\sigma = .02$

$$z = \frac{.50 - .51}{.02} = -.5$$

$1 - \text{norm.cdf}(-.5) = .691 \rightarrow$ **69%** probab. candidate will win

$$\sqrt{\frac{p(1-p)}{N}} = .02$$

$$\left(\sqrt{\frac{(.51)(.49)}{N}}\right)^2 = (.02)^2$$

$$\frac{.2499}{N} = .0004$$

$$\frac{.2499}{.0004} = \frac{.0004N}{.0004}$$

625 $\leftarrow 624.75 = N$

people polled

(b) $p = .52 \qquad \sigma = .01$

$$z = \frac{.50 - .52}{.01} = -2$$

$1 - \text{norm.cdf}(-2) = .977 \rightarrow$ **98%** probab candidate will win now

changed by ~ 29%

$$\sqrt{\frac{p(1-p)}{N}} = .01$$

$$\left(\sqrt{\frac{(.52)(.48)}{N}}\right)^2 = (.01)^2$$

$$N\left(\frac{.2496}{N}\right) = (.0001)N$$

$$\frac{.2496}{.0001} = \frac{.0001N}{.0001}$$

$$\boxed{2496 = N}$$

(c) $\sigma = .05 \qquad p = .6$

$$z = \frac{.5 - .6}{.05} = -2$$

1 - norm.cdf(-.2) = .977 → **98%** probab candidate wins.

$$z = \frac{.50 - .61}{.05} = -2.2$$

1 - norm.cdf(-2.2) = .986 ~ **99%** probability candidate wins

changes by about 1%

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

$\left(\sqrt{\frac{(.6)(.4)}{N}}\right)^2 = (.05)^2$

$N\left(\frac{.24}{N}\right) = (.0025)N$

$\frac{.24}{.0025} = \frac{.0025N}{.0025}$

$96 = N$

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

$\left(\sqrt{\frac{(.61)(.39)}{N}}\right)^2 = (.05)^2$

$N\left(\frac{.2379}{N}\right) = (.0025)N$

$\frac{.2379}{.0025} = \frac{.0025N}{.0025}$

$95.16 = N$

# of people polled bw 95.16 and 96

(d) i) $p = .52 \quad \sigma = .02$

$z = \frac{.50 - .52}{.02} = -1$

1 − norm.cdf(−1) = .841 → **84%** probab of candidate winning

$\left(\sqrt{\frac{(.52)(.48)}{N}}\right)^2 = (.02)^2$

$N\left(\frac{.2496}{N}\right) = (.0004)N$

$\frac{.2496}{.0004} = \frac{.0004N}{.0004}$

624 = N

ii) $p = .53 \quad \sigma = .03$

$$z = \frac{.50 - .53}{.03} = -1$$

1 - norm.cdf(-1) = .841 → **84%** probability of winning

Probability of winning if candidate is at '+4' and std = .04 AND if candidate is at '+1' and std = .01 is also ~ 84% because z score is 1

iii)

$$\sqrt{\frac{p(1-p)}{N}} = .01$$

$$\left(\sqrt{\frac{(.5)(.5)}{N}}\right)^2 = (.01)^2$$

$$N\left(\frac{.25}{N}\right) = (.0001)N$$

$$2500 = N$$

(e) $p = .60 \quad \sigma = .02$

$$z = \frac{.50 - .60}{.02} = \frac{-.1}{.02} = -5$$

1 - norm.cdf(-5) = .99 → **99%**

2. (b)

i) $z = Np$
$= (30000)(.0001)$
$= 3$

ii) $p(0) = \frac{(3)^0 e^{-(3)}}{0!} = .049787 \rightarrow \boxed{.050}$

iii) $p(1) = \frac{(3)^1 e^{-(3)}}{1!} = \boxed{.149}$

$p(2) = \frac{(3)^2 e^{-(3)}}{2!} = \boxed{.224}$

$p(3) = \frac{(3)^3 e^{-(3)}}{3!} = \boxed{.224}$

iv) $1 - .6472 = \boxed{.352768}$ ← probability of 4 or more

(c) i) $z = Np = (14000)(\frac{1}{2000}) = \boxed{7}$

ii) $p(0) = \frac{(7)^0 e^{-7}}{0!} = .00091 * 14000 = \boxed{12.77}$
≈ 13 students

$p(4) = \frac{(7)^4 e^{-7}}{4!} = .0912 * 14000 = \boxed{1277.2}$
≈ 1277 students

$p(7) = \frac{(7)^7 e^{-7}}{7!} = .149 * 14000 = \boxed{2086.0389}$
≈ 2086 students

$$p(10) = \frac{(7)^{10}}{10!} e^{-7} = .070983 * 14000 = \boxed{993.77}$$

≈ 993 students

$$p(16) = \frac{(7)^{16}}{16!} e^{-7} = .0014 * 14000 = \boxed{20.278}$$

≈ 20 students