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§8.7 ESTIMATING THE DIFFERENCE BETWEEN POPULATION PROPORTIONS

54. (a) $(p_1 - p_2) \approx (\hat{p}_1 - \hat{p}_2) = \left(\frac{x_1}{n_1} - \frac{x_2}{n_2}\right)$

$$= \left(\frac{120}{500} - \frac{147}{500}\right) = -\frac{27}{500} = \boxed{-.054}$$

(b) $\hat{p}_1 = \frac{120}{500} = .24$, $\hat{p}_2 = \frac{147}{500} = .294$

$$S.E. = \sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}} \approx \sqrt{\frac{\hat{p}_1 \hat{q}_1}{n_1} + \frac{\hat{p}_2 \hat{q}_2}{n_2}}$$

$$= \sqrt{\frac{(.24)(.76)}{500} + \frac{(.294)(.706)}{500}} \approx \boxed{.0279}$$

(c) $1.96(S.E.) = 1.96(.0279) \approx \boxed{.0547}$

55. (a) $\hat{p}_1 = \frac{337}{800} = .4213$ $\hat{p}_2 = \frac{374}{640} = .5844$

$$(p_1 - p_2) \approx \hat{p}_1 - \hat{p}_2 \pm 1.645\,(S.E.)$$

$$= (.4213 - .5844) \pm 1.645\sqrt{\frac{(.4213)(.5787)}{800} + \frac{(.5844)(.4156)}{640}}$$

$$= -.1631 \pm .0430 = [-.2061\ ,\ -.1201]$$

90% OF INTERVAL CONSTRUCTED FROM RANDOM SAMPLES IN THIS WAY WILL CONTAIN THE TRUE VALUE OF $p_1 - p_2$.

(b) RANDOM AND INDEPENDENT SAMPLES FROM BINOMIAL DISTRIBUTIONS.
YES.

56. (a) $\hat{p}_1 = \frac{849}{1265} \approx .6711$ $\hat{p}_2 = \frac{910}{1688} \approx .5391$

$$(p_1 - p_2) \approx (\hat{p}_1 - \hat{p}_2) \pm 2.58 \sqrt{\frac{\hat{p}_1 \hat{q}_1}{n_1} + \frac{\hat{p}_2 \hat{q}_2}{n_2}}$$

$$= (.6711 - .5391) \pm 2.58 \sqrt{\frac{(.6711)(.3289)}{1265} + \frac{(.5391)(.4609)}{1688}}$$

$$= .1320 \pm .0463 = \boxed{[.0857 , .1783]}$$

99% OF INTERVALS CONSTRUCTED IN THIS WAY CONTAIN $p_1 - p_2$.

(b) YES. DOES NOT CONTAIN 0.

57. (a) $\hat{p}_1 = \frac{12}{56} \approx .2143$ $\hat{p}_2 = \frac{8}{32} = .25$

$$p_1 - p_2 \approx (.2143 - .25) \pm 1.96 \sqrt{\frac{(.2143)(.7857)}{56} + \frac{(.25)(.75)}{32}}$$

$$= -.0357 \pm .1846 = \boxed{[-.1489 , .2203]}$$

(b) NO, THE INTERVAL CONTAINS 0.

58. ECONOMY AND JOBS: $\hat{p}_R = .37$ $\hat{p}_D = .55$

$$p_R - p_D \approx (.37 - .55) \pm \underset{\uparrow}{1.96} \sqrt{\frac{(.37)(.63)}{350} + \frac{(.55)(.45)}{400}}$$

MY CHOICE

$$= -.18 \pm .0703 = \boxed{[-.2503 , -.1097]}$$

DEFICIT SPENDING: $\hat{p}_R = .22$ $\hat{p}_I = .16$

$$p_R - p_I \approx (.22 - .16) \pm 1.96\sqrt{\frac{(.22)(.78)}{350} + \frac{(.16)(.84)}{150}}$$

$$= .06 \pm .0730 = \boxed{[-.013, .133]}$$

IT IS LIKELY THAT DEMOCRATS ARE MORE CONCERNED ABOUT ECONOMY & JOBS THAN REPUBLICANS. IT IS INCONCLUSIVE WHETHER REPUBLICANS OR INDEPENDENTS CARE MORE ABOUT DEFICIT SPENDING.

<u>59.</u> (a) $$(.45 - .51) \pm 2.58\sqrt{\frac{(.45)(.55)}{1001} + \frac{(.51)(.49)}{1001}}$$

$$= -.06 \pm .0575 = \boxed{[-.1175, -.0025]}$$

(b) YES, THE INTERVAL DOES NOT CONTAIN ZERO. (AND IS ENTIRELY <u>BELOW</u> ZERO.)

<u>60.</u> (a) $$.30 - .25 \pm 1.96\sqrt{\frac{(.3)(.7)}{200} + \frac{(.25)(.75)}{200}}$$

$$= .05 \pm .0874 = \boxed{[-.0374, .1374]}$$

(b) NO, THE INTERVAL CONTAINS 0.

61. (a) $.62 - .35 \pm 2.58\sqrt{\dfrac{(.62)(.38)}{96} + \dfrac{(.35)(.65)}{105}}$

$= .27 \pm .1754 = \boxed{[.0946\ ,\ .4454]}$

(b) YES.

(c) EXPOSURE TO MORE GERMS LEADS TO HIGHER IMMUNITY OVER TIME, MAYBE.

62. $\hat{p}_W = \dfrac{120}{200} = .60 \qquad \hat{p}_E = \dfrac{142}{200} = .71$

$p_W - p_E \approx .6 - .71 \pm 1.96\sqrt{\dfrac{(.6)(.4)}{200} + \dfrac{(.71)(.29)}{200}}$

$= -.09 \pm .0925 = \boxed{[-.1825\ ,\ .0025]}$

WE CANNOT CONCLUDE THERE IS A TRUE DIFFERENCE BETWEEN p_W & p_E SINCE THE INTERVAL CONTAINS 0.

63. $\hat{p}_G = \dfrac{126}{180} = .7 \qquad \hat{p}_{NG} = \dfrac{54}{100} = .54$

$p_G - p_{NG} \approx .7 - .54 \pm 1.645\sqrt{\dfrac{(.7)(.3)}{180} + \dfrac{(.54)(.46)}{100}}$

$= .16 \pm .0994 = \boxed{[.0606\ ,\ .2594]}$

WE CAN BE REASONABLY SURE THAT COLLEGE GRADUATES ARE MORE LIKELY TO BE FIRST-BORN OR ONLY CHILDREN THAN NON-COLLEGE-GRADUATES.

64. (a) $\hat{p}_F = \frac{345}{500} = .69$ $\hat{p}_M = \frac{365}{500} = .73$

$$.69 - .73 \pm 2.33\sqrt{\frac{(.69)(.31)}{500} + \frac{(.73)(.27)}{500}}$$

$$= -.04 \pm .0668 = \boxed{[-.1068, .0268]}$$

(b) IF INDEPENDENT RANDOM SAMPLES FROM THESE 2 POPULATIONS WERE TAKEN AND INTERVALS WERE CONSTRUCTED IN THIS WAY, 98% OF THESE INTERVALS WOULD CONTAIN THE TRUE DIFFERENCE IN POPULATION PROPORTIONS.

(c) NO, THE INTERVAL CONTAINS 0.

65. (a) $$.93 - .96 \pm 2.58\sqrt{\frac{(.93)(.07)}{200} + \frac{(.96)(.04)}{450}}$$

$$= -.03 \pm .0523 = \boxed{[-.0823, .0223]}$$

(b) NO, THE INTERVAL CONTAINS 0.

66. (a) $p \approx \hat{p} = \frac{23}{41} \approx \boxed{.5610}$

MARGIN OF ERROR : $1.96\sqrt{\frac{(.5610)(.4390)}{41}} \approx \boxed{.1519}$

(b) $\hat{p}_1 = \frac{10}{32} = .3125$ $\hat{p}_2 = .5610$

$$p_1 - p_2 \approx .3125 - .5610 \pm 1.96\sqrt{\frac{(.3125)(.6875)}{32} + \frac{(.5610)(.4390)}{41}}$$

$$= -.2485 \pm .2211 = \boxed{[-.4696, -.0274]}$$