Quiz 12 - Solutions

-15 for incorrect test

Question 1:

1/ null: use of hypertension drugs and developing cancer are independent, i.e. boxes are the same (2)

alternative: use of hypertension drugs and developing cancer are dependent, i.e., at least one box differs (2)

2/ χ^2-test for independence:

obs | esp	Beta		ACE		Calcium		Total
yes	28	34.5	6	10	27	16.5	61
No	396	389.5	118	114	175	185.5	689
Total	424		124		202		750

expected: $\frac{424 \cdot 61}{750} = 34.5$ $\frac{124 \cdot 61}{750} = 10$ $\frac{202 \cdot 61}{750} = 16.5$ (4)

389.5 114 185.5

$$\chi^2 = \frac{(28-34.5)^2}{34.5} + \frac{(6-10)^2}{10} + \frac{(27-16.5)^2}{16.5} + \frac{(396-389.5)^2}{389.5} + \frac{(118-114)^2}{114} + \frac{(175-185.5)^2}{185.5}$$

$= 10.35$ (4)

3/ $df = (2-1)\cdot(3-1) = 2$ (2)

χ^2-statistic is 10.35: above 9.21 ↓ 1%

P-value < 1% (2)

4/ Conclusion:

- reject the null (P-value < 1%) (2)
- result is highly statistically significant (1)
- there is high evidence that use of hypertension drugs and developing cancer are dependent (1)

Question 2:

-8 for incorrect test

box A: urban

$\text{sample}\%_A = \frac{63}{100} = 63\%$

box B: suburban

$\text{sample}\%_B = \frac{59}{110} = 53.6\%$

1/ null: no difference in percentage of residents who favor nuclear plant, i.e., (1)

$\text{box A}\% - \text{box B}\% = 0$

alternative: difference in percentage of residents who favor nuclear plant, i.e., (1)

$\text{box A}\% - \text{box B}\% \neq 0$ [two-tailed test!]

2/ 2-sample z-test:

$SD_{\text{box}_A} = \sqrt{\frac{63}{100} \cdot \frac{37}{100}} = 0.48$ (1/2) $SD_{\text{box}_B} = \sqrt{\frac{59}{110} \cdot \frac{51}{110}} = 0.50$ (1/2)

$SE_{\text{sum}_A} = \sqrt{100} \cdot 0.48 = 4.8$ (1/2) $SE_{\text{sum}_B} = \sqrt{110} \cdot 0.50 = 5.2$ (1/2)

$SE_{\%\,A} = \frac{4.8}{100} \cdot 100\% = 4.8\%$ (1/2) $SE_{\%\,B} = \frac{5.2}{110} \cdot 100\% = 4.7\%$ (1/2)

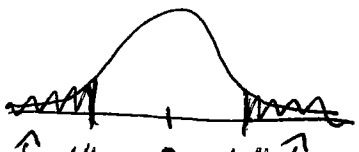
$SE_{\text{diff}\%} = \sqrt{4.8\%^2 + 4.7\%^2} = 6.7\%$ (1)

observed % (difference): $63\% - 53.6\% = 9.4\%$

expected % (difference): 0%

$z = \frac{9.4\% - 0\%}{6.7\%} = 1.4$ (1)

3/ P-value:



P-value: both "tails" together: $100\% - 83.85\% = 16.15\%$ (1)

(do not divide by 2!)

4/ Conclusion:

- do not reject the null (P-value > 5%) (1)
- there is no difference in percentage of residents who favor nuclear plant (1)

Question 3:

-8 for incorrect test

box A: public
avg_A: 12.2
SD_A: 10.5
sample size$_A$: 1000

box B: private
avg_B: 9.2
SD_B: 9.9
sample size$_B$: 1000

1/ null: avg hours of work for pay are the same, i.e., $avg_A - avg_B = 0$ (1)

alternative: avg hours of work for pay are different, i.e., $avg_A - avg_B \neq 0$ (1)

[two-tailed test!]

2/ 2-sample z-test:

observed (difference): $12.2 - 9.2 = 3.0$

expected (difference): 0

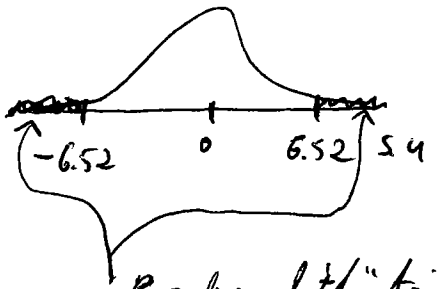
$SE_{sam_A} = \sqrt{1000} \cdot 10.5 = 332.0$ (1/2) $\quad SE_{sam_B} = \sqrt{1000} \cdot 9.9 = 313.1$ (1/2)

$SE_{avg_A} = \frac{332.0}{1000} = 0.332$ (1/2) $\quad SE_{avg_B} = \frac{313.1}{1000} = 0.313$ (1/2)

$$SE_{diff} = \sqrt{0.332^2 + 0.313^2} = 0.46 \quad (1)$$

$$z = \frac{3.0 - 0}{0.46} = 6.52 \quad (1)$$

3/ P-value:



P-value: both "tails" together: 100% - almost 100% = almost 0% (1)

(do not divide by 2!)

4/ Conclusion:

- reject the null (P-value < 1%) (1)
- result is highly statistically significant (1)
- there is high evidence that the avg hours of work for pay are different, (1/2) typically, "students in private universities come from wealthier families, and have more support from home" (see FPP, p. A-96, Q7.) (1 1/2)