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Applied Stats Assignment 2

1. Answers
    a. P(Type B or Type O) = P(Type B) + P(Type O) = 0.13 + 0.44 = 0.57
       P(Husband not acceptable donor) = P(Husband Type B) + P(Husband Type AB) = 0.13 + 0.06 = 0.19
    b. P(Husband Type A and Wife Type B) = P(Husband Type A) x P(Wife Type AB) = 0.37 x 0.06 = 0.022

2. Answers
    a. Student answers "no"
       P(No) = P(Didn't go) x P(Tails) = 0.80 x 0.50 = 0.40
       20% have gone to an event $\Rightarrow$ 80% have not gone
    b. Student answers "yes"
       P(Yes) = 1 – P(No) = 1 – 0.40 = 0.60
       Student answers "yes" because head toss
       P(Didn't go and answered Yes) = P(Didn't go) x P(Yes) = 0.80 x 0.60 = 0.48
    c. Student answers "yes" because head toss (independent)
       P(Didn't go / Yes) = P(Didn't go) = 0.80

3. Textbook questions
    a. #11
        i. X is the number of students out of 20 who watch television for minimum three hours per day
           X is binomial distribution where n = 20 and p = prob of success = 0.207

$$E(X) = np = (20)(0.207) = 4.14 \approx 4$$

           Probability mass function of X:

$$P(X = x) = \binom{n}{x} p^x q^{n-x} = \binom{20}{x} 0.207^x (1 - 0.207)^{20-x} \text{ where x = 0,1, 2,….,20}$$

        ii. $$P(X = 18) = \binom{20}{18} 0.207^{18} (1 - 0.207)^2 = 5.82 \times 10^{-11}$$

        iii. $$P(X = 8) = \binom{20}{8} 0.207^8 (1 - 0.207)^{12} = 0.026$$

           In part B it is seen that 18 such students is much less likely to happen. In part C we see that getting eight such students is still less likely but more likely than part B.
    b. #12
        i. Given, X is Poisson where mean = 4.5

$$P(X = x) = \frac{4.5^x e^{-4.5}}{x!}$$

$$\Rightarrow P(X = 1) = \frac{4.5^1 e^{-4.5}}{1!} = 0.4999048$$

ii. $P(x \leq 2) = P(X = 0) + P(X = 1) + P(X = 2)$

$$\Longrightarrow \frac{4.5^0 e^{-4.5}}{0!} + \frac{4.5^1 e^{-4.5}}{1!} + \frac{4.5^2 e^{-4.5}}{2!} = 0.1735781$$

iii. $P(X \geq 4) = 1 - P(X = 0) - P(X = 1) - P(X = 2) - P(X = 3)$

$$\Longrightarrow \frac{4.5^0 e^{-4.5}}{0!} + \frac{4.5^1 e^{-4.5}}{1!} + \frac{4.5^2 e^{-4.5}}{2!} + \frac{4.5^3 e^{-4.5}}{3!} = 0.657704$$

iv. Mean = 4.5
Standard Dev = sqrt(4.5) = 2.12132

c. #17

i. $\mu = 172.2$ and $\sigma = 29.8$

$$Z = \frac{X - \mu}{\sigma} = \frac{130 - 172.2}{29.8} = -1.4161$$

$$|Z| = 1.4161$$

ii. To find P(X < 130): From table Area Under Standard Normal Curve
Corresponding to Z = 1.4161 is area = 0.4222

$$P(X < 130) = 0.5 - 4.222 = 0.0778$$

iii. $Z = \frac{210-172.2}{29.8} = 1.2685$
To find P(X > 210): From table Area Under Standard Normal Curve
Corresponding to Z = 1.2685 is area = 0.3980

$$P(X > 210) = 0.5 - 0.3980 = 0.1020$$

$$P(exactly\ 2) = \binom{5}{2}\ 0.0778^3\ 0.9222^2 + \binom{5}{2}\ 0.1020^3\ 0.898^2$$

iv.

$$= 8.5092 + 8.0747 = 16.5839$$

v. Probability of one male between 130 and 210 lbs = 0.0778 + 0.1020 = 0.1798
Probability all five are within range = (0.1789) x 5 = 0.899
Probability at least one is outside of range = 1 – 0.899 = 0.101

4. Answers

a. P(980 < z < 1032.6) = P(z<1032.6) - P(z>980)
R Code:
= [pchisq(q = 1032.6, df = 1000, lower.tail = TRUE)] - [pchisq(q = 980, df = 1000, lower.tail = TRUE)]
= 0.7691504 - 0.3316733 = 0.4374772

b. Normal Approx
R Code:
= [pnorm(q = 1032.6, mean = 1000, sd = sqrt(2*1000), lower.tail = TRUE)] - [pnorm(q = 980, mean =1000, sd = sqrt(2*1000), lower.tail = TRUE)]
= 0.7669864 - 0.3273604 = 0.4396259

5. x – binomial distribution
y – poisson distribution

a. mean(w) = mean(x) + mean(y) = np + 1 = (20)(0.06) + 1 = 2.2
var(w) = var(x) + var(y) = np(1 – p) + 2 = (20)(0.06)(0.94) + 1 = 2.128

b. prob(w = 1) = P(x = 0, y = 1) + P(x=1, y = 0)
R Code:
prob_w1 = [dbinom(x = 0, sine = 20, prob = 0.06) * dpois(x = 1, lambda = 1)] + [dbinom(x = 1, sine = 20, prob = 0.06) * dpois(x = 0, lambda = 1)]
= 0.1067241 + 0.1362436 = 0.2429677

c. Normal Approximation
R Code:
std_x = sqrt(3.128)
Prob_Normal_w1 = [pnorm(q = 1.5, mean = 3.2, sd = std_x)] - [pnorm(q = 0.5, mean = 3.2, sd = std_x)]
= 0.3156644 - 0.121935 = 0.1937294