



Final Assignment

Probability and Statistics

Section 4

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North South University

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Final Assignment

1 The pentagon consists of five triangles.

If we spun the spinner the every number (1, 2, 3, 4, 5) or side have the probability of $\frac{1}{5}$ to get the side or number. So, the probability of getting any side of number is $p = \frac{1}{5}$

The spinner spun, 5 times ($n=5$)

We have to calculate the probability of getting at most two 5's.

In here we are following the binomial distribution.

So, the probability of getting at most two 5's

$$\begin{aligned} P(X \leq 2) &= P(X=0) + P(X=1) + P(X=2) \\ &= \binom{5}{0} \left(\frac{1}{5}\right)^0 \left(1-\frac{1}{5}\right)^{5-0} + \binom{5}{1} \left(\frac{1}{5}\right)^1 \left(1-\frac{1}{5}\right)^{5-1} + \binom{5}{2} \left(\frac{1}{5}\right)^2 \left(1-\frac{1}{5}\right)^{5-2} \\ &= 0.3277 + 0.4096 + 0.2048 \\ &= 0.9421 \text{ Answer} \end{aligned}$$

2] Given, an average of 5 failures a every year.

As it is measured in a time interval, it ~~is~~ follows Poisson distribution. probability, $p(x=n) = \frac{e^{-\lambda} \lambda^n}{n!}$

here, $E(n) = \lambda_y = 5$

Probability that there will be more than one failure during a particular week, $p(x>1)$

For particular week,

$$\lambda_w = \frac{5}{52.143}$$

$$= 0.0959$$

$$\begin{aligned} 1 \text{ year} &= 365 \text{ days} \\ 1 \text{ week} &= 7 \text{ days} \\ \therefore 1 \text{ year} &= \frac{365}{7} \text{ weeks} \\ &= 52.143 \text{ weeks} \end{aligned}$$

$$p(x>1) = p(x=2) + p(x=3) + \dots$$

$$= 1 - p(x=0) - p(x=1)$$

$$= 1 - \frac{e^{-0.0959} (0.0959)^0}{0!} - \frac{e^{-0.0959} (0.0959)^1}{1!}$$

$$= 1 - 0.90855 - 0.0871$$

$$= 4.3196 \times 10^{-3}$$

$$= 0.00432 \text{ Answer}$$

3] Given, Normally distributed,

$$\text{mean, } E(x) = \mu = 185 \text{ cm}$$

$$\text{Variance, } V(x) = \sigma^2 = 2 \text{ cm}^2$$

$$\therefore \sigma = \sqrt{2}$$

To calculate the probability that a adult people height is greater than 184 cm,

$$P(x > 184)$$

$$= P(184 < x < \infty)$$

$$= P\left(\frac{184 - \mu}{\sigma} < \frac{x - \mu}{\sigma} < \frac{\infty - \mu}{\sigma}\right)$$

$$= P\left(\frac{184 - 185}{\sqrt{2}} < z < \infty\right)$$

$$= P(-0.707 < z < \infty)$$

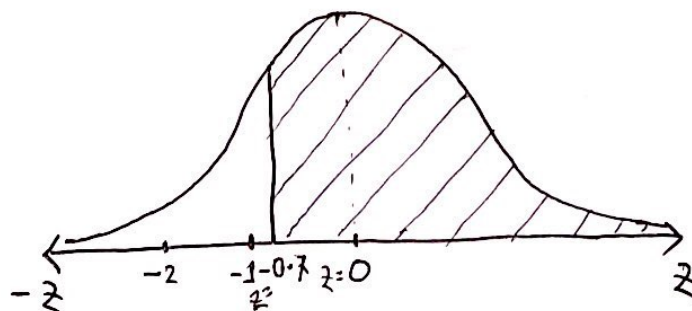
$$= F(\infty) - F(-0.707)$$

$$= 1 - F(-0.71)$$

$$= 1 - 0.2389$$

$$= 0.7611 \text{ Answer}$$

sketch



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$$H_0: \mu = 70$$

$$H_1: \mu < 70$$

Test statistic is $\frac{\bar{X} - \mu_0}{\sqrt{\frac{s^2}{n}}} \sim t_{(n-1)}$

$$\bar{X} = \frac{60+75+72+65+68}{5}$$

$$\therefore \bar{X} = 68$$

$$\mu_0 = 70$$

$$n = 5$$

$$s^2 = \frac{\sum (x_i - \bar{X})^2}{n-1}$$

$$= \frac{(60-68)^2 + (75-68)^2 + (72-68)^2 + (65-68)^2 + (68-68)^2}{5-1}$$

$$= \frac{69}{2}$$

$$= 34.5$$

$$\therefore s = \sqrt{34.5} = 5.8737$$

$$\begin{aligned} \therefore \text{Test statistic is } & \frac{68-70}{\sqrt{\frac{34.5}{5}}} \\ & = \frac{-2}{\frac{5.8737}{\sqrt{5}}} \\ & = -0.76 \end{aligned}$$

The rejection region is $[-\infty, -t_\alpha]$
 $= [-\infty, -t_{0.05}]$

$$\alpha = 5\% \\ = 0.05$$

$$\text{degree of freedom} \\ v = 5 - 1 = 4$$

$$= [-\infty, 2.132]$$

Comment: Since test statistics value (-0.76) doesn't fall in rejection region, so we cannot reject null hypothesis (H_0).

The researcher's assumption about testing the mean weight of adult men in Bangladesh is incorrect.

5] Here, blood sample of 5 people (same) were sent to each of two laboratories (lab1 and lab2) for cholesterol determinations. Though same blood sample of 5 people sent to each of two lab, it is matched paired t test. From the data we get significant mean difference between two sets of data. paired data.

$$H_0: \mu_d = 0 \quad \text{and} \quad H_1: \mu_d < 0$$

$$\left. \begin{array}{l} \therefore \mu_y > \mu_x \\ \therefore \mu_y - \mu_x < 0 \end{array} \right\}$$

$$\text{where } \mu_d = \mu_y - \mu_x$$

μ_x indicates mean cholesterol levels reported by lab1.

μ_y indicates mean cholesterol levels reported by lab2.

$$\text{Test static} = \frac{\bar{d}}{\sqrt{\frac{s_d^2}{n}}} \sim t_{n-1}$$

From the data we get,

Person (i)	$d_i = y_i - x_i$
1	$318 - 276 = 42$
2	$287 - 270 = 17$
3	$285 - 265 = 20$
4	$-300 + 262 = -38$
5	$-280 + 296 = 16$

$$\begin{aligned} \therefore \text{sample mean difference, } \bar{d} &= \frac{42 + 17 + 20 - 38 + 16}{5} \\ &= \frac{57}{5} = 11.4. \end{aligned}$$

$$\begin{aligned}
 S_d^2 &= \frac{\sum_{i=1}^5 (x_i - \bar{x})^2}{n-1} \\
 &= \frac{(42-11.4)^2 + (17-11.4)^2 + (20-11.4)^2 + (-38-11.4)^2 + (16-11.4)^2}{5-1} \\
 &= \frac{3503.2}{4} \\
 &= 875.8
 \end{aligned}$$

$$\begin{aligned}
 \therefore \text{Test statistics} &= \frac{11.4}{\sqrt{\frac{875.8}{5}}} \\
 &= \frac{11.4}{13.235} \\
 &= 0.8614
 \end{aligned}$$

$\alpha = 10\% = 0.1$ and degree of freedom, $v = 5-1 = 4$

$$\begin{aligned}
 \text{Rejection region} &:]-\infty, -t_{\alpha, n-1}] \\
 &=]-\infty, -t_{0.1, 4}] \\
 &=]-\infty, -1.533]
 \end{aligned}$$

Comment: Since the calculated value (0.86) does not fall in the rejection region. We cannot reject null hypothesis (H_0)

So, the assumption about the (population) mean cholesterol levels reported by lab 1 ~~and~~ and the (population) mean cholesterol levels reported by lab 2 is incorrect. The mean cholesterol levels reported by lab 1 is not greater than the mean cholesterol levels reported by lab 2.