Board Infinity - Maths Assignment

Problem - 1

Question

The maximum weight that an Elevator can accomodate $y = 800kgs$

Average Adult weight = 70kgs

Variance = 200

To find:-

the probability that lift safely reaches the ground when there are 10 adults in the lift.

Solution

Mean = 70kgs

Variance = 200

Therefore, mean for 10 adults will be $(70 \times 10) = 700$

Variance for 10 adults will be $(200 \times 10) = 2000$

Standard deviation $= \sqrt{2000} = 44.72$

where, mean $= \mu$

variance $= \sigma^2$

Standard deviation $= \sigma$

thereby we can conclude by taking the mean for 10 adults (i.e) 700 which is obviously less than the maximum weight that an elevator can accomodate

Hence, it can reach the ground safely when there are 10 adults

To make it more accurate in understand we can find upper tail of Normal distribution

P (weight of 10 adults $> 800kg$)

It can be done through Z-score

$$Z\text{-score} = \frac{X - \mu}{\sigma}$$

$$= \frac{(800 - 700)}{14.72}$$

Z-score = 2.24

By using Z table we get 0.9875 (i.e) 98.75%.

So, we can conclude that the lift can reach safely to the ground with 98.75% of accuracy.

Problem - 2

Question

A life of a 60-watt bulb is normally distributed with

Standard deviation $\sigma = 25$

Create 5 random samples of 100 bulbs with

Mean $\mu \cong 1000$ hours

perform one-way Anova

To find

To obtain a perfect solution for this problem we have to find the following :-

df_b, df_w, SS_w, SS_b, MSS_w, MSS_b, F, F_{crit}, P value

where,

df_b — degree of freedom (between)
df_w — degree of freedom (within)
SS_w — sum of squares (within)
SS_b — sum of squares (between)
MSS_w — Mean sum of squares (within)
MSS_b — Mean sum of squares (between)

Solution

5 random samples for 100 bulbs are taken from which

$n = 500$ (no. of samples)

$k = 5$ (random variable)

→ For any sample it is mandatory to find the degree of freedom [the no. of independent values assigned to a statistical distribution]

degree of freedom $df_b = k - 1 = 5 - 1$

$df_b = 4$

$df_w = n - k = 500 - 5$

$= 495$

$df_{total} = 495 + 4 = 499$

→ Mean for each sample is

$\bar{X}_1 = 1000$, $\bar{X}_2 = 1001$, $\bar{X}_3 = 999$, $\bar{X}_4 = 1003$

$\bar{X}_5 = 1000$

→ Variance for each sample is

$\sigma_1^2 = 685$, $\sigma_2^2 = 600$, $\sigma_3^2 = 483$, $\sigma_4^2 = 499$

$\sigma_5^2 = 611$

→ The next step will be the calculation of SS_W & SS_B

As the sample is too large it is very difficult and time consuming in calculating those

So we take one-way Anova (Analysis of variance) in performing operations.

Calculated Results from Anova

$$MSS_W = \frac{(X_g - \bar{X}_g)^2}{n-k}$$

where, $(X_g - \bar{X}_g)^2 = SS_W$

$= 286878$

$n - k = dfw$

$= 495$

$$= \frac{286878}{495}$$

$MSS_W = 580$

$$MSS_B = \frac{n_g (\bar{X}_g - \bar{X}_G)^2}{k-1}$$

where, $n_g(\bar{X}_g - \bar{X}_G)^2 = SS_B$

$= 801$

$k - 1 = dfb$

$= 4$

$$= \frac{801}{4}$$

$MSS_B = 200$

Hypothesis testing

H_0 (Null hypothesis) : $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$

H_1 (Alternative hypothesis) : $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5$

where

$\alpha = 0.05$

→ calculation of test statistic

$$F = \frac{MSS_B}{MSS_W} = \frac{200}{580}$$

$F = 0.34$

$$F_{crit} = \frac{df_B}{df_W} = \frac{4}{495} = 2.3719 \text{ (from table)}$$

when $F_{crit} > F$, Alternative hypothesis is rejected

From Anova,

p-value is generated = 0.84795

$\therefore$ $p > 0.05$ which is not is favor of Alternative Hypothesis

Hence it is rejected.

Problem :3

Question

15 trainees in a technical program are Randomly assigned to three different types of instructional approaches

Use Anova to find null hypothesis test where significance level is 5%

Solution

Mean for 3 samples

$\bar{x}_1 = 80$, $\bar{x}_2 = 85$, $\bar{x}_3 = 75$

Variance for 3 samples

$\sigma_1^2 = 38.5$ $\sigma_2^2 = 35$ $\sigma_3^2 = 38.5$

→ confidence interval

$$= \bar{x} \pm z \times \frac{SD}{\sqrt{n}}$$

It is given as 95% of confidence interval & significance level is 5%

Hypothesis testing

Values obtained from Anova

$F = 3.34$

$F_{crit} = 3.88$

P-value = 0.06

Here,

$F_{crit} > F$ and $p > 0.05$ through which null hypothesis cannot be claimed

we can conclude here by saying that Null hypothesis is not rejected