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Statistics and Probability Assignment Solution

Solution – 1 -:

Given mean= 70
variance = 200
hence mean for 10 adults = 10(70) = 700
variance for 10 adults = 10(200) = 2000
therefore, standard deviation sd = √2000 = 44.72
If the weight > 800 kg causes the elevator to "unsafely" reach the ground, then we can find the upper tail of our normal distribution:
P (Weight of 10 adults > 800 kg).

Z – score = (X – mu)/SD = (800 – 700)/44.72 = 2.24

Hence P (Z <2.24), using z table we get 0.9875 or 98.75%
Hence it is safe to reach the ground when there are 10 adults in the lift.

Solution – 2 -:

The total sample size is N = 500. Therefore, the total degrees of freedom are:

$df_{total} = 500 - 1 = 499$

The between-groups degrees of freedom are $df_{between} = 5 – 1 = 4$, and the within-groups degrees of freedom are:

$df_{within} = df_{total} – df_{between} = 499 − 4 = 495$

$_{i,j}\sum X_{ij} = 499712$

$_{i,j}\sum X_{ij}^2 = 499691630$

$SS_{total} = {}_{i,j}\sum X_{ij}^2 – 1/N \ ({}_{i,j}\sum X_{ij})^2 = 267464.112$

$SS_{within} = 266084.42$

$SS_{between} = 1379.692$

$MS_{between} = SS_{between} / df_{between} = 1379.692 / 4 = 344.923$

$MS_{within} = SS_{within} / df_{within} = 266084.42 / 495 = 537.544$

$F = MS_{between} / MS_{within} = 344.923 / 537.544 = 0.642$

The following null and alternative hypotheses need to be tested:

$H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$

H_1 : Not all means are equal.

The above hypotheses will be tested using an F-ratio for a One-Way ANOVA.

Based on the information provided, the significance level is $\alpha = 0.05$, and the degrees of freedom are $df_1 = 4$ and $df_2 = 4$, therefore, the rejection region for this F-test is $R = \{F : F > F_c = 2.39\}$.

Test Statistics

$F = MS_{between} / MS_{within} = 344.923 / 537.544 = 0.642$

Since it is observed that $F = 0.642 < 2.39 = F_c$, it is then concluded that the null hypothesis is not rejected. Therefore, there is not enough evidence to claim that not all 5 population means are equal, at the $\alpha = 0.05$ significance level.

Using the P-value approach: The p-value is $p = 0.633$, and since $p = 0.633 \geq 0.05$, it is concluded that the null hypothesis is not rejected. Therefore, there is not enough evidence to claim that not all 5 population means are equal, at the $\alpha = 0.05$ significance level.

Solution – 3 -:

	A1	A2	A3
	86	90	82
	79	76	68
	81	88	73
	70	82	71
	84	89	81
Sum	400	425	375
Mean	80	85	75

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
Column 1	5	400	80	38.5
Column 2	5	425	85	35
Column 3	5	375	75	38.5

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	250	2	125	3.34821429	0.06991	3.88529
Within Groups	448	12	37.3333333			
Total	698	14				

We have the sample of the scores of 15 trainees (A1, A2, A3). Each group consists of 5 trainees. We calculate the mean of each group. We should find out whether these means are different significantly (whether they were chosen from the different populations), $\alpha = 0.05$.

$H_0 : \mu_1 = \mu_2 = \mu_3$

H_1 : at least one of the means is different.

Using Single-Factor ANOVA in Excel we get p-value $\approx 0.069 > \alpha$.

So, we accept H_0.

Three different types of the instructional approaches have the same effect on the trainees.