IS4305: PROBABILITY & STATISTICS

TAKE HOME ASSIGNMENT 2

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Q1) An experiment was conducted to examine the effect of varying the water/cement ratio on the strength of concrete that had been aged 30 days and the obtained data presented in Table. Calculate the value of the correlation coefficient and interpret the result.

$n = 10$

Water/ Cement ratio (x)	Strength (y)	x^2	y^2	xy
1.1	1.2	1.21	1.44	1.32
1.3	1.3	1.69	1.69	1.69
1.2	1.2	1.44	1.44	1.44
1.4	1.3	1.96	1.69	1.82
1.8	1.6	3.24	2.56	2.88
1.9	1.7	3.61	2.89	3.23
1.6	1.4	2.56	1.96	2.24
1.5	1.4	2.25	1.96	2.10
1.7	1.4	2.89	1.96	2.38
1.5	1.3	2.25	1.69	1.95
$\sum x = 15.0$	$\sum y = 13.8$	$\sum x^2 = 23.10$	$\sum y^2 = 19.28$	$\sum xy = 21.05$

$$Correlation\ Coefficient\ (r) = \frac{n\sum xy - \sum x \sum y}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

$$r = \frac{10 \times 21.05 - 15.0 \times 13.8}{\sqrt{(10 \times 23.10 - 15.0^2)(10 \times 19.28 - 13.8^2)}}$$

$$r = 0.93$$

The ratio of water to cement and concrete strength are strongly positively correlated.

Q2) A study was designed to investigate the iron content of some of the foods cooked in Aluminum, Clay and Iron pots. The iron content (mg/100g food) of the food cooked in each of the three types of pots is summarized by the Table. Use this data and a significance level of 0.01 to test the null hypothesis of no difference in mean iron content of foods for three types of pots.

Assumptions:

- The samples are independent and randomly selected.
- Population variances are equal in all the samples.
- All the samples are normally distributed.

Hypotheses:

H0 : No difference in mean iron content of food samples of three types of pots. ($\mu_{Al} = \mu_{Clay} = \mu_{Iron}$)

H1 : Mean iron content of food samples of three types of pots are different. ($\mu_{Al} \neq \mu_{Clay} \neq \mu_{Iron}$)

$$\bar{y}_{..} = \frac{2.06 + 2.18 + 4.68}{3}$$

$$\bar{y}_{..} = 2.973$$

$$SST_r = 4 \times (2.06 - 2.973)^2 + 4 \times (2.18 - 2.973)^2 + 4 \times (4.68 - 2.973)^2$$

$$SST_r = 17.505$$

$$SS_E = (4 - 1) \times 0.25^2 + (4 - 1) \times 0.62^2 + (4 - 1) \times 0.63^2$$

$$SS_E = 2.5314$$

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F- value
SS_{Tr}	17.505	3 – 1 = 2	$\frac{17.505}{2} = 8.7525$	$\frac{8.7525}{0.2813} = 31.114$
SS_E	2.5314	12 – 3 = 9	$\frac{2.5314}{9} = 0.2813$	
SS_T	20.0364	12 – 1 = 11		

$$F_{T.S} = 31.114$$

$$F_{table} = F_{0.01,2,9} = 8.0215$$

- H_0 (the null hypothesis) can be rejected since $F_{TS} > F_{CRITICAL}$. H_1 (the alternative hypothesis) is also a viable option.
- The average iron level of meal samples from the three different types of pots varies.
- Conclusion: Food's iron content is impacted by the cooking vessel.