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MC 3020 : Probability and Statistics

Tutorial-06 **July 2024**

1. Suppose you are working as a civil engineer and you are tasked with predicting the compressive strength of concrete based on the age of the concrete sample. You collected data from various concrete samples and measured their age (in days) and compressive strength (in megapascals). The dataset is as follows:

Age(days)	7	14	21	28	35	42	49	56
Compressive Strength (MPa)	15	20	23	27	30	33	37	40

   (a) Plot the data points on a scatter plot.

   (b) Calculate the equation of the least squares regression line for predicting compressive strength based on the age of the concrete.

   (c) Interpret the slope and intercept coefficients of the regression line in the context of the problem.

   (d) Use the regression line to predict the compressive strength of a concrete sample that is 30 days old.

   (e) Calculate a 95% prediction interval for an individual compressive strength measurement at 30 days of age.

   (f) Calculate the coefficient of determination (R-squared) for the regression line and interpret its meaning.

   (g) Perform a hypothesis test to determine whether the regression line is statistically significant at a 90% confidence level. State your hypotheses, the test statistic, and the conclusion clearly.

   (h) Discuss any assumptions or limitations of the linear regression model in this context.

2. Discuss any assumptions or limitations of the linear regression model in this context.

Operating Voltage (V)	110	125	130	141	145	160
Power Consumption (W)	75	68	70	80	90	100

   (a) Plot the data points on a scatter plot. what type of relation, if any, appears to exist between Operating Voltage and Power Consumption.

   (b) Estimate the correlation coefficient and interpret it.

   (c) Calculate the coefficient of determination (R-squared) for the regression line and interpret its meaning.

   (d) Test the significance of the correlation coefficient (use α =0.05).

   (e) Find the equation of the least squares regression line for predicting power consumption based on operating voltage.

   (f) Interpret the slope coefficient of the regression line in the context of the problem.

   (g) Use the regression line to predict the power consumption for an appliance with an operating voltage of 135V.

   (h) Compute a 90% confidence interval for the slope of the regression line.

3. The table shows data on the number of visitors to the UK in a month, ν(1000s), and the amount of money they spent, m(£ millions), for each of 8 months

Number of visitors ν(1000s)	2450	2480	2540	2420	2350	2290	2400	2460
Amount of money spent m(£ millions)	1370	1350	1400	1330	1270	1210	1330	1350

(a) Find the correlation coefficient between m and ν.

(b) Fit a regression model of the form $m = a+b\nu$ to these data.

(c) Interpret the value of b.

(d) Compute a 95% confidence interval for the intercept of the regression line.

(e) Test the hypothesis that the regression line passes through the origin, using a 0.05 significance level.

(f) Estimate the amount of money spent when the no.of visitors to the UK in a month is 2500000.

(g) Compute a 90% confidence interval estimate for the amount of money spent in part(e).

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