biostat1_exam2_tk

PROBLEM 1A

$$\underbrace{P-1}\ 5-1=4$$

Dummy Variables need to create to analyze the effect of variable region.

P represents the number of predictors

PROBLEM 1b

0 Dummy Variables needed to create to analyze the effect of variable region.

PROBLEM 1c

$$\begin{aligned} E(Y) = &\ \beta_0 + \beta_1(\text{Age}) \\ &\beta_2 I(\text{Region} = \text{East Europe}) + \\ &\beta_3 I(\text{Region} = \text{Asia}) + \\ &\beta_4 I(\text{Region} = \text{Sub Saharan Africa}) + \\ &\beta_5 I(\text{Region} = \text{South America}) + \\ &\beta_6 I(\text{Sex} = \text{Female}) + \\ &\beta_7 I(\text{Sex} = \text{Declined to Answer}) + \\ &\varepsilon_i \end{aligned}$$

I Removed Region=North America and Sex=Male, one less for each categorical variable

PROBLEM 1d

Regression Degrees of Freedom: $p = 7$

Error Degrees of Freedom: $n-(p+1)$

$1000-(7+1)$

$= 100 - 8$

992

$$F\left(1-\alpha,\ \underbrace{p},\ \underbrace{n-p-1}\right)$$

$$F\left(1-\alpha,\ \underline{7},\ \underline{992}\right)$$

PROBLEM 1e

Model 1:

$$Y_i = \beta_0 + \beta_1(\text{Age})$$
$$\beta_2 I(\text{Region} = \text{East Europe}) +$$
$$\beta_3 I(\text{Region} = \text{Asia}) +$$
$$\beta_4 I(\text{Region} = \text{Sub Saharan Africa}) +$$
$$\beta_5 I(\text{Region} = \text{South America}) +$$
$$\beta_6 I(\text{Sex} = \text{Female}) +$$
$$\beta_7 I(\text{Sex} = \text{Declined to Answer}) +$$
$$\varepsilon_i$$

I Removed Region = North America and Sex = Male, one less for each categorical variable

Model 2:

$$Y_i = \beta_0 + \beta_1(\text{Age}) +$$
$$\beta_2 I(\text{Sex} = \text{Female}) +$$
$$\beta_3 I(\text{Sex} = \text{Declined to Answer})$$

$$df_S = n - P_S - 1 = 1000 - 3 - 1 = 996$$

$$df_L = n - P_L - 1 = 1000 - 7 - 1 = 992$$

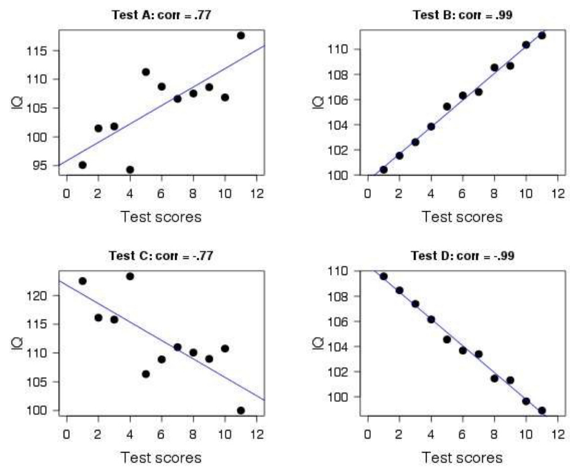
$$F_{df_L - df_S,\ df_L}$$

$$F_{4,\ 992}$$

PROBLEM 2a

Problem 2

Researchers investigated the relationships between the results of four different visual tests (Test A, B, C, and D) and IQ. They randomly selected 44 subjects and split them into 4 groups of equal size. Each subject had his/her IQ evaluated and was then given one of the four tests. For each test, the researchers made a scatter plot of the subjects' test scores and their IQs and computed the corresponding sample correlation.



a) [Select one correct answer.] Which of the following statements correctly describes the above figure? (2 points)

I. Higher scores on Tests C and D correspond to higher IQ.
II. Higher scores on Tests A and C correspond to higher IQ.
III. The relationship between scores on Test A and IQ is stronger than the relationship between scores on Test D and IQ.
IV. Subjects with similar scores on Test A have a larger spread of IQs than subjects with similar scores on Test B.

Problem 2b

Researchers fit a simple linear regression relating IQ to test score using data from one of the four groups of subjects. Here is part of the regression output:

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	121.7847	2.9582	41.169	$1.47e^{-11}$
Test score	-1.6031	0.4362	____________	____________

Model Information:

Residual standard error: 4.574 with 9 degrees of freedom
R-squared: 0.5929
Adjusted R-squared: 0.5538
F-statistic: 13.51 with 1 and 9 DF and a p-value of 0.00511

b) [Select one correct answer.] Which test's scores did researchers use as the predictor in the regression? (4 points)

I. Test A
II. Test B
III. Test C
IV. Test D

Problem 2c

2c:

We know researchers fit a simple linear regression.

Compute & Interpret 95% CI

For the slope from the regression output above:

• A $(1-\alpha)100\%$ Confidence Interval for the true slope is given by:

$$\hat{\beta}_1 \pm t_{n-2,1-\alpha/2} \cdot se(\hat{\beta}_1),$$

where $se(\hat{\beta}_1) = \sqrt{MSE / \sum_{i=1}^{n}(x_i - \bar{x})^2}$

$$\underbrace{\hat{\beta}_1}_{-1.6031} \pm \underbrace{t_{n-2,1-\alpha/2}}_{t_{11-2,1-0.05/2}} \cdot \underbrace{se(\hat{\beta}_1)}_{0.4362}$$

$$\underbrace{t_{11-2,1-0.05/2}}_{\underbrace{t_{9,0.975}}_{\underbrace{qt(.975,9)}}}$$

$$\left.-1.6031 - 2.26 \cdot 0.4362\right\} -2.5889$$

$$\left.-1.6031 + 2.26 \cdot 0.4362\right\} -0.62$$

Interpretation: With 95% Confidence Interval; we estimate that the IQ score decreases somewhere between 0.62 and 2.5889 for each additional 1 point increase in test score.

Problem 2d

$\boxed{2d}$: Two-Sided Hypothesis test

$H_0: B_{TestScore} = 0$

$H_1: B_{TestScore} \neq 0$

Test statistics has following distribution:

$$t = \frac{\hat{B}_1 - B_{10}}{se(\hat{B}_1)} \sim t_{n-2}, \text{ under } H_0$$

$$t = \frac{-1.6031 - 0}{0.4362} = -3.675$$

$$t = -3.675$$

$$|-3.675| > 2.262$$

$$\underbrace{\underbrace{\underbrace{\underbrace{t_{\underbrace{11-2}, 1-\alpha/2}}_{t_{9,\, 1-0.05/2}}}_{t_{9,\, 0.975},\ \text{under } H_0}}_{qt(.975,\, 9)}}_{2.262}$$

Interpretation: At 5% Significance level, $|-3.675| > t_{9,.975} = 2.262$, we reject the null and conclude that there is a significant linear association between test score and IQ score.