1. **MLR: Introduction, Sampling, & Adequacy checking (3h)**

1. Least square estimation means-
   (a) minimization of absolute deviation of the observed data points from the regression line.
   (b) minimization of deviation of the observed data points from the fitted line.
   (c) minimization of squared deviation of the observed data points from the fitted line.
   (d) All of these
   (e) None of these

2. In multiple linear regression, the estimated value of $\beta$ is:
   (a) $\hat{\beta} = (X^TX)^{-1}X^TY$
   (b) $\hat{\beta} = (X^TY)^{-1}XY$
   (c) $\hat{\beta} = (X^TY)^{-1}X^TY$
   (d) $\hat{\beta} = (X^TY)^{-1}YX^{-1}$

3. The coefficient of determination ($R^2$) is:
   (a) $R^2 = (\text{Explained variance of dependent variable}) / (\text{Unexplained variance of dependent variable})$
   (b) $R^2 = (\text{Unexplained variance of dependent variable}) / (\text{Total variance of dependent variable})$
   (c) $R^2 = (\text{Explained variance of dependent variable}) / (\text{Total variance of dependent variable})$
   (d) None of these.

4. In multiple linear regression, the errors are:
   (a) normally distributed with mean zero, and standard deviation $\sigma^2$
   (b) normally distributed with mean one, and standard deviation $\sigma^2$
   (c) normally distributed with mean zero, and standard deviation one
   (d) none of these

5. In a multiple linear regression study with $p$ number of independent variables and $n$ number of observations, the value of $R^2$ for $n=p+1$ is:
   (a) 1
   (b) 0
   (c) -0.50
   (d) 0.50
6. Answer the following questions 6 to 9.
For a dependence relationship using regression model, the following statistics are obtained from a secondary data source that used 90 direct observations:

\[
X^T X = \begin{bmatrix} 90 & 180 & 780 \\ 180 & 420 & 1450 \\ 780 & 1450 & 9600 \end{bmatrix} ; X^T y = \begin{bmatrix} 4800 \\ 9600 \\ 3970 \end{bmatrix} ; \text{SST} = 7928; \text{SSE} = 6405.
\]

Compute the regression coefficients \( \hat{\beta} \).

(a) \[
\begin{bmatrix} 229.24 \\ -26.14 \\ -14.26 \end{bmatrix}
\]

(b) \[
\begin{bmatrix} 229.24 \\ -36.14 \\ -14.26 \end{bmatrix}
\]

(c) \[
\begin{bmatrix} 229.24 \\ -26.14 \\ -25.26 \end{bmatrix}
\]

(d) None of these.

7. Based on the data given in Q6, obtain the covariance matrix of \( \hat{\beta} \).

(a) \[
\begin{bmatrix} 9.97 & 3.08 & -0.344 \\ -3.08 & 1.32 & 0.0511 \\ -0.344 & 0.0511 & 0.0279 \end{bmatrix}
\]

(b) \[
\begin{bmatrix} 1.00 & 3.08 & -0.344 \\ -3.08 & 1.00 & 0.0511 \\ -0.344 & 0.0511 & 1.00 \end{bmatrix}
\]

(c) \[
\begin{bmatrix} 1.00 & 3.08 & 0.344 \\ -3.08 & 1.00 & -0.0511 \\ 0.344 & -0.0511 & 1.00 \end{bmatrix}
\]

(d) None of these

8. Choose the calculated F-value based on the data given in Q6.

(a) 15.21

(b) 25.38

(c) 10.34

(d) None of these
9. Choose the calculated adjusted $R^2$ value based on the data given in Q6.
   (a) 0.29
   (b) 0.42
   (c) 0.17
   (d) None of these

Marks: 2