[This question paper contains 4 printed pages.]

Your Roll No.:.....

Sr. No. of Question Paper : 1777 **L**

Unique Paper Code : 2372013603

Name of the Paper : Econometrics (NEP-UGCF)

Name of the Course : **B.Sc. (H) Statistics**

Semester : VI

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question no. **1** is compulsory.
3. Attempt **five** more questions choosing at least **two** from each section.
4. Use of non-programmable scientific calculator is allowed.

1 (a) Fill in the blanks

(i) If the correlation coefficient between X_2 and X_3 is 0.7, then the variance inflating factor (VIF) is _____.

(ii) In Run's test, we assume that the number of positive symbols and negative symbols should be atleast _____ each respectively.

(iii) The coefficients estimated in the presence of heteroscedasticity are not _____ estimators.

(iv) If the residual from a regression estimated using a small sample of data are not normally distributed, then test statistics concerning the parameters _____follow their assumed distribution.

(v) Consider variance-covariance matrix of the OLS estimator of a multiple linear regression model with k regressors as well as a constant. Maximum number of different elements in this matrix is _____.

(b) State whether True/False. If false, then give the correct statement.

(i) Smoothed statistic S_T is not a weighted average of all the past observations.

(ii) The interpretation of the slope coefficient in the model $Y = \beta_0 + \beta_1 \text{Ln}(X) + \varepsilon$: is a change in X by one unit is associated with β_1% change in Y.

(iii) If $\bar{R}^2$ turns out to be negative, its value should be taken as zero.

P.T.O.

(iv) When supply of a commodity, for example agricultural commodities, react to price with a lag of one time period due to gestation period in production, such a phenomenon is referred to as Cobb-Web Phenomenon.

(vi) Glejser's test requires re-ordering of the observations with respect to X variable.

(c) You are given the following regression results:

$$\hat{Y}_t = 16.899 - 2978.5\, X_{2t}$$

t = (8.5152) (-5.108) $R^2 = 0.6149$

Find out the sample size underlying the above result?

(d) What is the relationship between Von-Neumann ratio and Durbin Watson statistics. Suppose the value of Durbin Watson test statistic is 0.9374 based on 20 observations, then compute the corresponding value of Von-Neumann ratio. (5, 5, 2½, 2½)

Section A

2 (a) For the general linear model $\mathbf{Y} = X\boldsymbol{\beta} + U$, explain the process to test the hypothesis $H_0 : \boldsymbol{c'\beta} = \boldsymbol{r}$, where **c** is an appropriately specified vector of constants and **r** is a known constant.

(b) The estimated equation below depicts the empirical relationship between demand for coke (D), its own price (PC), advertisement expenditure (ADV) and the price of substitute goods (PPC) i.e. Pepsi Cola.

$$\begin{array}{l} D = 38.5 - 0.41PC + 0.35ADV + 0.01PPC \\ \quad\quad (6.32)\quad (3.082)\quad\quad (5.273)\quad\quad (1.134) \end{array}$$

$s_e = 24.33$ $R^2 = 0.61$ F-stat = 13.662 [0.000]

(the numbers in parentheses are t statistics), [p-value is given in square brackets]

a) Briefly comment on the coefficient of determination.

b) Do the parameter estimates bear the expected signs? Justify your answer.

c) Can you tell whether the explanatory variables jointly affect demand for Coke at the 5% level of significance?

d) Taken individually, do the variables have a significant influence on Coke demand at the 5% level of significance? (7, 8)

3 (a) Estimate the coefficients of the relation $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + U_i$ on considering the restrictions, $2\beta_1 + \beta_2 - \beta_3 = 3$ and $\beta_1 + \beta_3 = 2$. It is given that $X'X = \begin{bmatrix} 20 & 0 \\ 0 & 40 \end{bmatrix}$, $X'Y = \begin{bmatrix} 15 \\ 25 \end{bmatrix}$ and the number of observations is 25.

(b) Explain four remedial measures for addressing the problem of multicollinearity.

(7, 8)

4 (a) A data set produces the following regression:

$$\hat{I}_t = 1.508 + 1.966C_t$$
$$S.E. \quad (0.815) \quad (0.156) \qquad R^2 = 0.929$$
$$t \quad [1.850] \quad [12.564]$$

But after adding variable G_t to the above regression we get:

$$\hat{I}_t = -2.311 + 3.230G_t - 1.968C_t$$
$$S.E. \quad (1.029) \quad (0.751) \quad (0.920) \qquad R^2 = 0.974$$
$$t \quad [-2.245] \quad [4.299] \quad [-2.138]$$

Do you suspect that the data is suffering from some problem? If yes, what could be the possible cause of concern? Give reasons to support your conclusions.

Also regressing G_t on C_t, we get:

$$\hat{G}_t = 1.182 + 1.218C_t$$
$$S.E. \quad (0.200) \quad (0.038) \qquad R^2 = 0.988$$
$$t \quad [5.915] \quad [31.756]$$

Does above equation help you reach at a conclusion? Give reasons to support your conclusion.

(b) For the regression model $Y_t = \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + U_t; t = 1, 2, \ldots, n$, with usual assumptions, examine the effect of multicollinearity on $\hat{\sigma}_u^2$, $V(\hat{\beta}_2)$, $V(\hat{\beta}_3)$, $\hat{\beta}_2 - \beta_2$, $\hat{\beta}_3 - \beta_3$. (6, 9)

Section B

5 (a) For the generalized least square model $Y = X\beta + u$, with $E(uu') = \sigma^2\Omega$. σ^2 being unknown and Ω being known, symmetric positive definite matrix. Compute Aitken's estimator for β, its variance and σ^2.

(b) For a two variable model, assume the first order autoregressive scheme $u_t = \rho\, u_{t-1} + \varepsilon_t$ where ε_t satisfies the assumptions of the classical linear regression model.

(i) Show that $Var(u_t) = \sigma^2/(1 - \rho^2)$, where σ^2 is the variance of ε_t.

(ii) What is the covariance between (i) u_t and u_{t-1} and (ii) u_t and u_{t-2}? Generalize your results and construct the variance-covariance matrix of u's.

(iii) "In the presence of autocorrelation the ordinary least square estimators are biased and but efficient". Explain whether the given statement is true or false and justify your answer with the help of the above mentioned model. Also show that residual variance $\hat{\sigma}_u^2 = \dfrac{e'e}{n-2}$ will on an average underestimate the true variance.

(6, 9)

6 (a) What do you understand by exponential smoothing? Show that

(i) Smoothed statistic S_T is a weighted average of all the past observations.
(ii) For sufficiently large T, the exponential smoothing process yields an unbiased estimator of the true process average.

(b) Briefly outline Durbin's two stage procedure for estimating the parameters of the model $Y = \alpha + \beta X + U$. For a given regression estimated residuals have the following signs:

(++++)(-)(+++++++)(-)(++++)(--)(+)(--)(+)(--)(++)(-)(+)(---------)(+)

On the basis of a suitable test, do we have enough evidence to reject the null hypothesis that there is no autocorrelation in the residuals? (7, 8)

7 (a) Describe Glejser's test for the detection of heteroscedasticity. Also discuss the powers and limitations of the test.

(b) Explain the concept of hetroscedasticity with the help of suitable examples. For the model $Y_t = \alpha + \beta X_t + U_t$ with $E(U_t) = 0$, $E(U_t^2) = \sigma_t^2 = \sigma^2/\lambda_t$, $t=1,2,\ldots n$, σ^2 being unknown λ's being known positive numbers. Further, suppose that the variance of the disturbance term is inversely proportional to X i.e. $E(U_t^2) = \sigma^2/X_t$, then obtain the variance of Aitken's estimator and OLS estimator for β, assuming the heteroscedastic structure. Comment on the result.

(5, 10)

(1000)