Assignment 4

Note : Questions 1-8 are based on the output of a software in Figures 1 and 2 in fitting a multiple

linear regression model $y = X\beta + \epsilon$, $\epsilon \sim N(\mathbf{0}, \sigma^2 \mathbf{I})$. The 5% level of significance is used in the results.

```
Analysis of Variance

Source       DF    Adj SS    Adj MS   F-Value   P-Value
Regression    5   13195.5   2639.11     40.84     0.000
  x1          1     350.6    350.56      5.42     0.029
  x2          1     270.1    270.13      4.18     0.053
  x3          1     437.2    437.15      6.76     0.016
  x4          1    4656.6   4656.56     72.05     0.000
  x5          1     115.5    115.50      1.79     0.194
Error        23    1486.4     64.63
Total        28   14681.9

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Model Summary
       S    R-sq   R-sq(adj)   R-sq(pred)
 8.03902  89.88%     87.68%       78.82%


Coefficients
Term          Coef   SE Coef   T-Value   P-Value    VIF
Constant     325.4      96.1      3.39     0.003
x1         0.0675    0.0290      2.33     0.029   2.32
x2           2.55      1.25      2.04     0.053   1.36
x3           3.80      1.46      2.60     0.016   3.18
x4         -22.95      2.70     -8.49     0.000   2.61
x5           2.42      1.81      1.34     0.194   5.37

Durbin-Watson Statistic

Durbin-Watson Statistic =  1.59707
```

Figure 1: Software output for Questions 1 - 6 (Continued in Figure 2)

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Fits and Diagnostics for All Observations

Obs     y     Fit   SE Fit      95% CI        Resid  Std Resid  Del Resid     HI      Cook's D    DFITS
 1   10.00   7.02   0.71  ( 5.53,   8.51)    2.98     1.77       1.89    0.150367    0.06     0.79381
 2   11.00   9.88   1.14  ( 7.47,  12.29)    1.12     0.78       0.78    0.391312    0.04     0.62198
 3   11.00   8.72   1.04  ( 6.54,  10.90)    2.28     1.51       1.57    0.320439    0.11     1.07933
 4   13.00  10.79   1.41  ( 7.82,  13.76)    2.21     1.90       2.06    0.596505    0.53     2.50927
 5   10.00  10.19   1.15  ( 7.78,  12.60)   -0.19    -0.13      -0.13    0.393017    0.00    -0.10503
 6   11.00  11.70   1.02  ( 9.55,  13.86)   -0.70    -0.46      -0.45    0.313247    0.01    -0.30656
 7   10.00  11.57   0.84  ( 9.80,  13.33)   -1.57    -0.96      -0.96    0.209840    0.02    -0.49505
 8   11.00  11.06   0.89  ( 9.19,  12.93)   -0.06    -0.04      -0.04    0.236131    0.00    -0.01990
 9    4.00   2.19   1.14  (-0.20,   4.57)    1.81     1.26       1.29    0.385180    0.10     1.01727
10    2.00   5.04   1.11  ( 2.71,   7.37)   -3.04    -2.09      -2.33    0.368077    0.25    -1.78131
11    7.00   6.38   1.34  ( 3.57,   9.18)    0.62     0.50       0.49    0.533149    0.03     0.52258
12   10.00   8.18   0.92  ( 6.26,  10.11)    1.82     1.15       1.16    0.250967    0.04     0.66946
13    9.00   9.17   1.06  ( 6.95,  11.40)   -0.17    -0.11      -0.11    0.334971    0.00    -0.07923
14    9.00   9.18   1.02  ( 7.04,  11.32)   -0.18    -0.12      -0.11    0.309844    0.00    -0.07525
15    6.00   8.89   0.68  ( 7.46,  10.32)   -2.89    -1.70      -1.81    0.138604    0.05    -0.72462
16    5.00   3.99   0.97  ( 1.97,   6.02)    1.01     0.65       0.64    0.278350    0.02     0.39525
17    5.00   5.04   1.06  ( 2.82,   7.27)   -0.04    -0.03      -0.03    0.334554    0.00    -0.02025
18    5.00   5.67   1.30  ( 2.95,   8.40)   -0.67    -0.52      -0.51    0.501901    0.03    -0.51158
19    6.00   5.36   1.08  ( 3.10,   7.63)    0.64     0.43       0.42    0.346326    0.01     0.30554
20    4.00   5.20   1.34  ( 2.39,   8.01)   -1.20    -0.96      -0.96    0.533253    0.11    -1.02564
21    3.00   5.41   1.10  ( 3.09,   7.73)   -2.41    -1.65      -1.74    0.363506    0.16    -1.31414
22    3.00   2.02   1.17  (-0.44,   4.49)    0.98     0.69       0.68    0.411061    0.03     0.57188
23    4.00   3.85   1.12  ( 1.50,   6.21)    0.15     0.10       0.10    0.374867    0.00     0.07648
24   10.00  10.36   1.13  ( 8.00,  12.72)   -0.36    -0.25      -0.24    0.377897    0.00    -0.18990
25    6.00   6.17   1.32  ( 3.40,   8.93)   -0.17    -0.13      -0.13    0.518013    0.00    -0.13266
26    8.00   8.63   1.03  ( 6.47,  10.79)   -0.63    -0.42      -0.41    0.316379    0.01    -0.27643
27    2.00   1.97   1.24  (-0.63,   4.57)    0.03     0.02       0.02    0.457915    0.00     0.02159
28    0.00   1.35   0.92  (-0.59,   3.29)   -1.35    -0.85      -0.85    0.254330    0.02    -0.49538
```

Figure 2: Software output for Questions 1 - 6 (Continued from Figure 1)

[1] Which of the following statements are correct?

Statement 1 : The model is approximately 87% good.

Statement 2 : The model is approximately 13% good.

Statement 3 : The model is approximately 79% good for prediction.

Statement 4 : The model is approximately 21% good for prediction.

A. Statements 1 and 3 are correct.

B. Statements 2 and 4 are correct.

C. Statements 1 and 4 are correct.

D. Statements 2 and 3 are correct.

[2] Which of the following statements are correct?

Statement 1 : The average value of study variable increases as the values of x_1 and x_2 increase.

Statement 2 : The average value of study variable increases as the values of x_3 and x_5 increase.

Statement 3 : The average value of study variable decreases as the values of x_4 increase.

Statement 4 : When $x_1 = x_2 = x_3 = x_4 = x_5 = 0$, then the average value of study variable is 325.4.

A. Statements 1, 2 and 4 are correct.

B. Statements 2, 3 and 4 are correct.

C. Statements 1, 2 and 3 are correct.

D. Statements 1, 2, 3 and 4 are correct.

[3] Which of the following explanatory variables are significant so that they are entering into the model?

A. X_2, X_4 and X_5.

B. X_1, X_2, X_3 and X_4.

C. X_1, X_3 and X_4.

D. Only X_4.

[4] The null hypothesis $H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ is

A. accepted.

B. rejected.

C. Nothing is clear to decide about the acceptance or rejection of H_0.

D. Data is inadequate to decide about the acceptance or rejection of H_0.

[5] Which of the following is the correct statement?

    A. The first order positive autocorrelation is present in the data.

    B. The first order negative autocorrelation is present in the data.

    C. Nothing is clear to infer about the presence of first order autocorrelation in the data.

    D. Data is inadequate to infer about the presence of first order autocorrelation in the data.

[6] Which of the observations are possibly the influential points?

    A. Observation numbers : 2, 5, 6, 11, 13, 14, 15, 17, 25, 28

    B. Observation numbers : 4, 9 and 21

    C. Observation numbers : 1, 3, 7, 8, 10, 12, 16, 18, 19, 20, 22-29

    D. None of the observations is influential.

[7] The `HI` values in Figure 2 are used to check the

    A. presence of influential points in the data.

    B. presence of leverage points in the data.

    C. adequacy of number of explanatory variables.

    D. constancy of variance of dependent variable.

[8] The within sample forecast for the average value of study variable for given $x_1 = 250$, $x_2 = 700$, $x_3 = 40$, $x_4 = 15$ and $x_5 = 10$ is

    A. 2646

    B. 2320

    C. 1958

    D. 1631

[9] What does the following Figure 3 indicates?
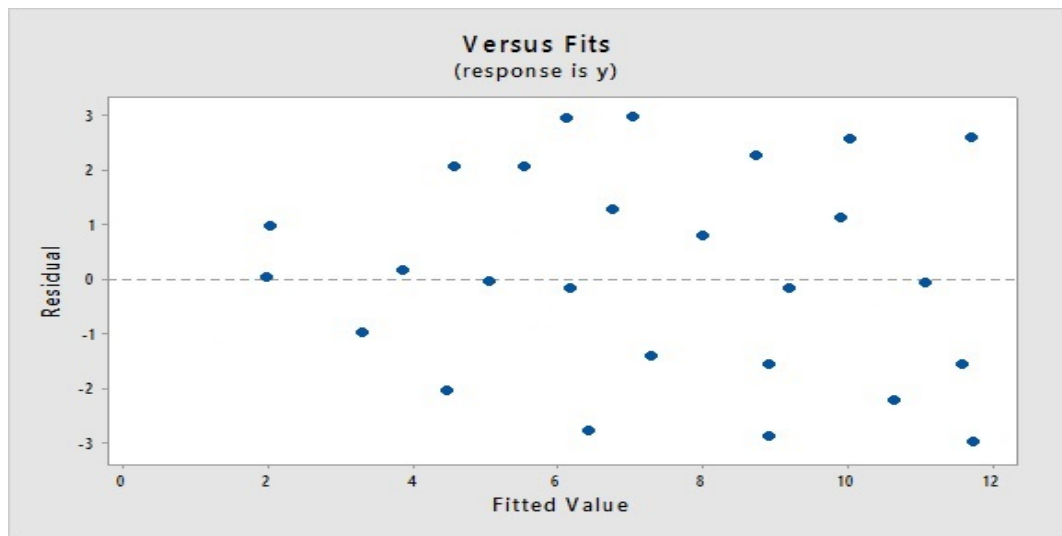

Versus Fits
(response is y)

Figure 3: x and y axis represent fitted values $\hat{y}_i$'s and residuals respectively based on OLSE for Q. 9

A. Variance of ϵ is not constant.

B. Observations are autocorrelated.

C. Severe degree of multicollinearity.

D. Nonlinear relationship between study and explanatory variables.

[10] The following normal probability plot in Figure 4 is indicating that the underlying distribution from where the observations are generated is
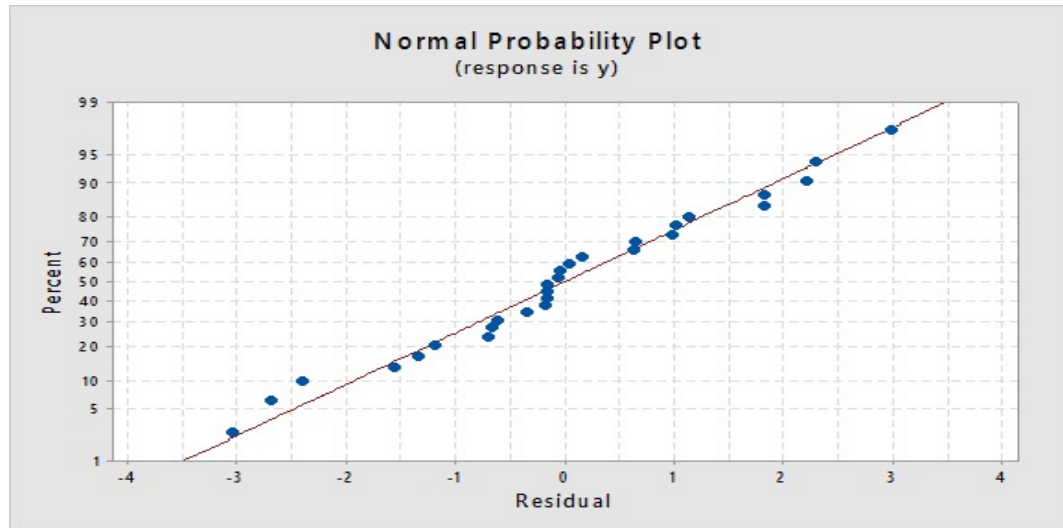

Figure 4: Normal probability plot based on OLS estimation for Q. 10

    A. positively skewed distribution.

    B. heavy tailed distribution.

    C. Normal distribution.

    D. Binomial distribution.

Solution to Assignment 4

Answer of Question 1 – A

Answer of Question 2 – D

Answer of Question 3 – C

Answer of Question 4 – B

Answer of Question 5 – A

Answer of Question 6 – B

Answer of Question 7 – B

Answer of Question 8 – C

Answer of Question 9 – A

Answer of Question 10 – C