

Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
300 level 1st Semester Examination – Sept. / Oct. 2015
MRT 305-3 Mathematical and Statistical Methods in Mineral Sciences



Part B

Instructions to candidates

Duration: 01 hour

Number of questions: 02 essay questions

Mark allocation: 40 mark

Use standard symbols without definition.

Scientific Calculators are allowed.

Answer Part B in a separate answer book.



1. The following model output is developed from a random sample of 182 countries from the world bank databank and seeks to explain % Annual Population Growth (PopGrowth) by examining Infant Mortality Rate (IMR), Gross Domestic Product (GDP), Life Expectancy (LifeExpect), and % Rural Population (RuralPop). Examine the output and answer the following questions.
 - a. Does the model predict well and is it significant? Indicate how you reached your decision. (Construct the full ANOVA table to answer this part) (8 mark)
 - b. How much variation do these independent variables collectively explain? (2 mark)
 - c. Which variables, if any proved to be significant? (5 mark)
 - d. What would your next step be in attempting to refine and further develop your model to explain % Manufacturing Exports. (3 mark)

Output:

Table 01: Parameter Estimated

	Estimate	Std. Error	t value	Pr (> t)
(Intercept)	2.560e+00	1.934e+00	1.324	0.187251
GDP	2.973e-05	8.079e-06	3.680	0.000308
IMR	1.947e-02	7.932e-03	2.455	0.015019
LifeExpect	-3.063e-02	2.437e-02	-1.257	0.210451
RuralPop	4.395e-07	5.202e-03	0.000	0.999933

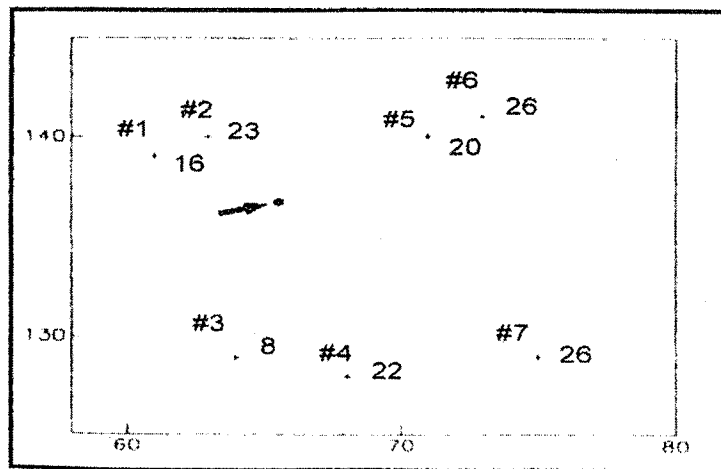
Multiple R-squared: 0.6374, Adjusted R-squared: 0.6206, MSE: 25.6
 F-distribution: 14.16 on 4 and 177 DF, p value: 4.395e-10

2.

- a. The table below shows the effect of changing distance on the semi-variance value in the N45E direction.

Distance (meters)	Semi-Variance value
50	128
100	188
150	226
200	253
250	267
300	283
350	288
400	289
450	293
500	296
550	296
600	297

- i. Graph the variogram of reservoir thickness and use the basic features of the variogram to describe the spatial variation of porosity. (5 mark)
 - ii. Which variogram model(s) best describe(s) the directional sample variogram model for reservoir interval? Why? (3 mark)
- b. In many circumstances the reservoir scientist is asked to predict the value of a variable at a particular unknown location.
- i. What factors influence the estimated value of a variable at a given location? (4 mark)
 - ii. The figure below shows the locations of the porosity samples.



The table below shows porosity values at seven sample locations and the distance from an unsampled location.

Sample No.	X-coordinate	Y-Coordinate	Distance from Un-sampled Point (metres)	Porosity (%)
1	61	139	4.5	16
2	63	140	3.6	23
3	64	129	8.1	8
4	68	128	9.5	22
5	71	140	6.7	20
6	73	141	8.9	26
7	75	128	13.5	26

Consider Kriging weighted vector $\lambda = \begin{pmatrix} 0.45 \\ 0.36 \\ 0.81 \\ 0.95 \\ -0.67 \\ 0.89 \\ -1.35 \\ -0.12 \end{pmatrix}$ and slope of the fitted model is 6.5.

Using Kriging prediction methods, estimate the porosity at location X and construct 95% confidence Interval for X. (10 mark)

