PROGRAM	:	**B.TECH. MINERAL RESOURCE MANAGEMENT**
SUBJECT	:	**GEOSTATISTICS**
CODE	:	**GEOS41-1**
DATE	:	FINAL EXAMINATION 2019 **25 MAY 2019**
DURATION	:	3 HOURS (08:30 – 11:30 AM)
TOTAL MARKS	:	100 Marks
FULL MARKS	:	100 Marks

LECTURER	:	Mrs M MPANZA
MODERATOR	:	Prof H GROBLER
NUMBER OF PAGES	:	5

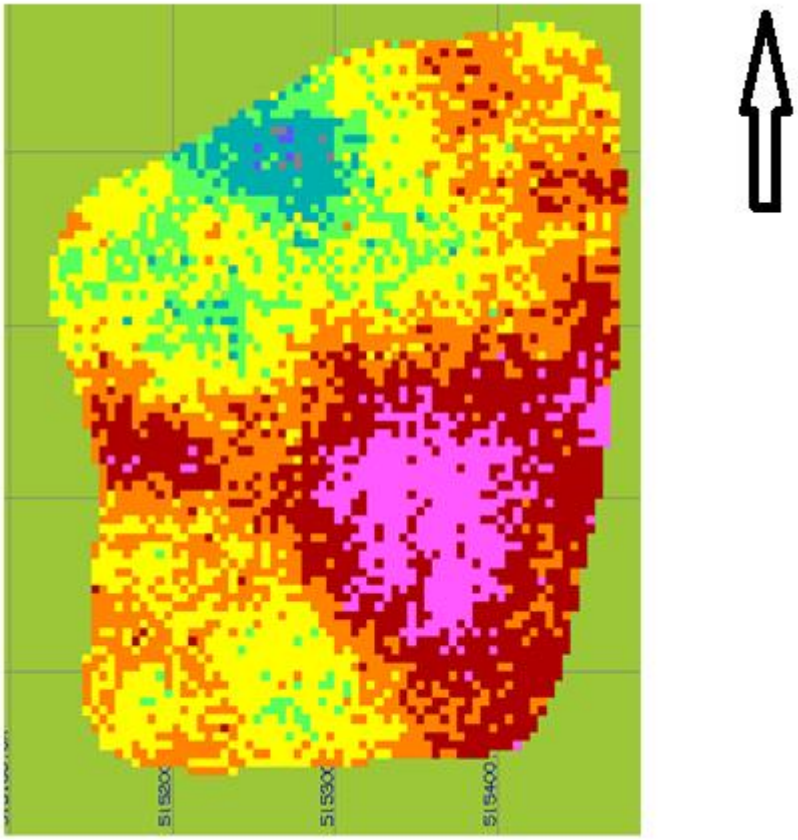
INSTRUCTIONS	:	- ANY CALCULATOR PERMITTED. - CANDIDATES ALLOWED TO MAKE USE OF THE COMPUTER FACILITIES IN THE EXAMINATION VENUE. - FORMULA SHEET WILL BE SUPPLIED **- NO EXTERNAL STORAGE DEVICES ALLOWED** - **ALL WORK DONE ON COMPUTER MUST BE TRANSFERRED INTO THE EXAMINATION SCRIPT**
REQUIREMENTS	:	NONE.

INSTRUCTIONS TO STUDENTS:

1. ANSWER ALL THE QUESTIONS.
2. WORK NEATLY AND SYSTEMATICALLY. MARKS WILL BE GIVEN FOR WELL LAYED OUT ANSWERS.
3. STUDENTS TO ENSURE THAT THEIR NAME AND OR STUDENT NUMBER APPEARS ON EACH SHEET HANDED IN.
4. STUDENTS MAY MAKE USE OF THE COMPUTERS AND FUNCTIONS ON EXCEL AVAILABLE IN THE VENUE
5. NO COMMUNICATIONS OF ANY KIND WILL BE ALLOWED BETWEEN CANDIDATES. .

QUESTION 1

1.1 Given the regionalized variable in the diagram below discuss giving reasons in which direction would you construct and calculate the semi-variogram.



[8]

1.2 Differentiate between Inverse Distance Weighting and Kriging techniques. Give examples of mineral deposits best estimated by each technique **[7]**

QUESTION 2.

2.1

The following table gives the relationship between the initial block values allotted to block as determined from development sampling, and the stope values as obtained from numerous samples taken during mining of these blocks. (Values in cmg/t)

Block Estimate x (cmg/t)	Follow-up y (cmg/t)
165	420
238	640
290	480
380	980
390	720
510	510
550	930
580	720
720	1170
750	565
850	590
1000	1100
1220	1370
1290	840
1370	1050
1640	1310
1860	990
1980	1760
2670	1290
2990	1670

Additive Constant	**100.0**	cmg/t
Pay Limit	**4.5**	g/t
Stope Width	**110.0**	cm

Calculate:

i. The Mean and Standard deviation estimates for both populations — 5 marks

ii. The Correlation Co-efficient — 2 marks

iii. The regression line of stope values on block values — 4 marks

2.2 Draw an annotated diagram showing regression lines for LnGM and LnMV **[9]**

[20 marks]

QUESTION 3.

The following values were obtained from dense borehole drilling on an outcrop of a platinum reef
The Semi-variogram has been determined to be of a Spherical form with

$$\gamma(h) = C_0 + C_1\left\{\frac{3h}{2a} - \frac{h^3}{2a^3}\right\} \; for \; \mathbf{h} < \mathbf{a}$$

Nugget Effect (C_0)	**0.5**	$(ppm)^2$
Sill of the Spherical Component (C_1)	**3.5**	$(ppm)^2$
Range of Influence (a)	**205**	m

Point	X	Y	ppm PGM
1	1,100.0	445.0	3.18
2	1,125.0	490.0	2.05
3	1,300.0	390.0	2.9
4	1,370.0	385.0	1.57

It is required that you:

i Calculate T* and the error variance using a point estimation technique using the semivariogram

ii set up and solve the Ordinary kriging equations and estimate the Best Linear unbiased Estimator at the location:

Point	X	Y
P	1,300.0	415.0

with a **90** % confidence limit

using the following equations:

The Variance of Estimation Errors:

$$\sigma_\varepsilon^2 = 2w_1\gamma(d_1) + 2w_2\gamma(d_2) + 2w_3\gamma(d_3) + 2w_4\gamma(d_4) - \begin{Bmatrix} w_1w_1\gamma(h_{11}) + w_1w_2\gamma(h_{12}) + w_1w_3\gamma(h_{13}) + w_1w_4\gamma(h_{14}) \\ + w_2w_1\gamma(h_{21}) + w_2w_2\gamma(h_{22}) + w_2w_3\gamma(h_{23}) + w_2w_4\gamma(h_{24}) \\ + w_3w_1\gamma(h_{31}) + w_3w_2\gamma(h_{32}) + w_3w_3\gamma(h_{33}) + w_3w_4\gamma(h_{34}) \\ + w_4w_1\gamma(h_{41}) + w_4w_2\gamma(h_{42}) + w_4w_3\gamma(h_{43}) + w_4w_4\gamma(h_{44}) \end{Bmatrix} - 0$$

To calculate the weighting:

$w_1\gamma(0)$	+	$w_2\gamma(g_1,g_2)$	+	$w_3\gamma(g_1,g_3)$	+	$w_4\gamma(g_1,g_4)$	+	λ	=	$\gamma(T,g_1)$
$w_1\gamma(g_2,g_1)$	+	$w_2\gamma(0)$	+	$w_3\gamma(g_2,g_3)$	+	$w_4\gamma(g_2,g_4)$	+	λ	=	$\gamma(T,g_2)$
$w_1\gamma(g_3,g_1)$	+	$w_2\gamma(g_3,g_2)$	+	$w_3\gamma(0)$	+	$w_4\gamma(g_3,g_4)$	+	λ	=	$\gamma(T,g_3)$
$w_1\gamma(g_4,g_1)$	+	$w_2\gamma(g_4,g_2)$	+	$w_3\gamma(g_4,g_3)$	+	$w_4\gamma(0)$	+	λ	=	$\gamma(T,g4)$
w_1	+	w_2	+	w_3	+	w_4	+	0	=	1

$T^* = w_1g_1 + w_2g_2 + w_3g_3 + w_4g_4$

$\sigma^2_{OK} = w_1\gamma(T,g_1)+w_2\gamma(T,g_2)+w_3\gamma(T,g_3)+w_4\gamma(T,g_4)+\lambda$

[35 Marks]

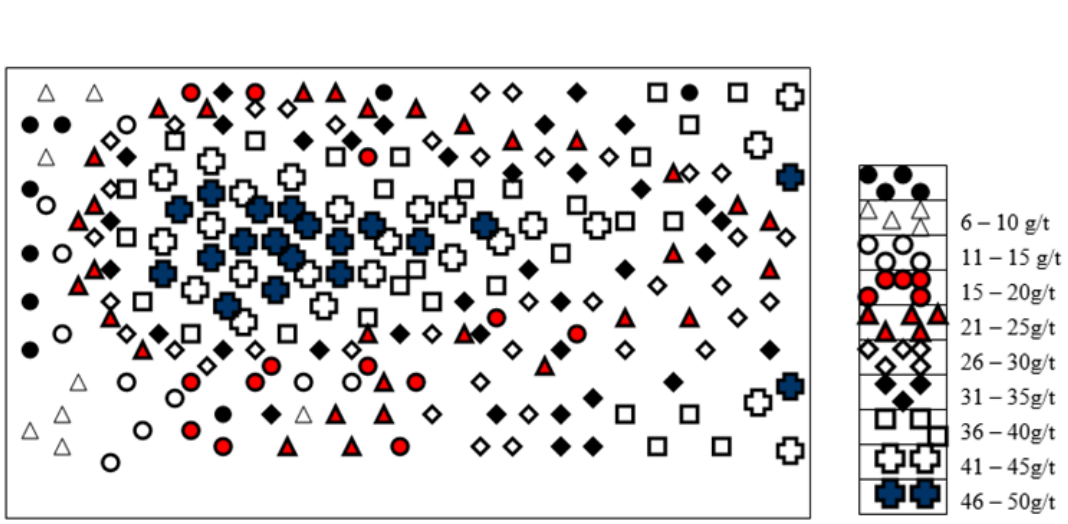
QUESTION 4.

4.1 Discuss and explain, in your own words, the following Geostatistical terminology.

(IMPORTANT NOTE: Refer in your explanation to the meaning as well as the possible causes for and ways to overcome or deal with the phenomena where applicable)

a) Hole effect
b) Support
c) Simple kriging
d) Intrinsic Hypothesis
e) Ordinary kriging
f) Stationarity **[12 Marks]**

4.2 The following sketch shows a post plot of a regionalised variable.



Analyse the posted regionalised variable with special reference to the different variability that may be present. **[10 Marks]**

4.3 Make an annotated sketch of a spherical semi-variogram and discuss the various aspects thereof

[8 Marks]

TOTAL [100 MARKS]