

PROGRAM : B.TECH. MINERAL RESOURCE

MANAGEMENT

SUBJECT : GEOSTATISTICS

CODE : GEOS41-1

DATE : 26 JULY 2019

: SUPPLEMENTARY EXAMINATION

<u>DURATION</u> : 3 HOURS (08:30 – 11:30)

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

- <u>ALL WORK DONE ON COMPUTER MUST BE</u> 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 A reef has two minerals being mined at the same time

i.e. Gold and Sulphur.

The semi-variogram for the gold values is;

ISOTROPICAL

RANDOM variability = 10.2 m.g/t2

Structural model: Linear

Sill = 9.8 m.g/t2 and

Range of 128m

Nugget effect 6.0 m.g/t2

The semi-variogram for the Sulphur values is;

ANISPTROPICAL

RANDOM variability = 18 %Sulphur²

Structural model: Gaussian

Sill = 24 %Sulphur²

Range = 94m N40°E

Nugget effect of = $0 \%^2$

The semi-variogram between the gold and Sulphur values is;

ISOTROPICAL

RANDOM variability = 16 m.g/t. %Sulphur

Structural model:

1st Structure is Spherical with a sill of 14 m.g/t.%Sulphur and a range of 24 m 2nd Structure is Linear with a sill of 10 m.g/t. % Sulphur and a range of 88 m Nugget effect = 4 m.g/t. %

Using the information provided in 1.1:

a) draw a sketch of the gold semi-variogram

7.5 marks

b) draw a sketch of the sulphur semi-variogram

7.5 marks

c) draw a sketch of a semi-variogram between gold and sulphur NB: Semi- variogram must be fully labelled

10marks

[25 marks]

QUESTION 2.

2.1

	-				on an outcrop of a p	latinum reef				
The Semi-v	ariogram	has been dete	ermined to be	of a Spherical	form with					
				(1)	$\begin{bmatrix} 3h & h^3 \end{bmatrix}$					
				$\gamma(h) = C_0 + C_0$	$\left\{\frac{3h}{2a} - \frac{h^3}{2a^3}\right\}$ for 1	1 <a< th=""><th></th><th></th><th></th><th></th></a<>				
				et Effect (C ₀)		(ppm) ²				
		Sill of the	Spherical Cor	nponent (C ₁)	3.5	(ppm) ²				
			Range of Influence (a)		205	m				
	Point	X	Υ	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	d that you	r								
	_		ror variance us	sing a point es	timation technique us	sing the semiva	riogram			
					estimate the Best Li			at the location		
	Daint	V	V							
	Point	1.300.0	Y 415.0							
	_ P	1,300.0	415.0							
	with a	90	% confidenc	e limit						
using the fo	llowing e	quations:								
The Variance	ce of Esti	mation Errors:			6 (b.)	(h.)	. /h. \ .	(b.))	
				$w_1w_1\gamma(h_{11}) + w_1w_2\gamma(h_{12}) + w_1w_3\gamma(h_{13}) + w_1w_4\gamma(h_{14})$						
2	•	$y(d_1) + 2w_2y(d_2) + 2w_3y(d_3) + 2w_4y(d_4)$			$+w_2w_1\gamma(h_{21})+w_2w_2\gamma(h_{22})+w_2w_3\gamma(h_{23})+w_2w_4\gamma(h_{24})$					
σ _ε =	=2w ₁ γ(α	$+2W_2\gamma(\mathbf{d}_2)$	$+2W_3\gamma(d_3)$	$+2W_4\gamma(d_4)$	$+w_3w_1\gamma(h_{31})+w_1$	$_{3}^{2}W_{2}^{2}\gamma(h_{32})+W_{3}^{2}$	w ₃ γ(h ₃₃)	+W ₃ W ₄ γ(h ₃₄		
					$+w_4w_1y(h_{41})+w_1y(h_{41})$	$_{4}^{4}$ $W_{2}^{\gamma}(h_{42}) + W_{2}^{\gamma}$	₄ w ₃ γ(h ₄₃	+w4w47(h4	.)]	
To calculate	e the weig	ghting:								
$w_1\gamma(0)$	+	$w_2\gamma(g_1,g_2)$	+	$w_3\gamma(g_1,g_3)$	+	$w_4\gamma(g_1,g_4)$	+	λ	=	γ(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 γ(0)	+	$w_4\gamma(g_3,g_4)$	+	λ	=	γ(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 γ(0)	+	λ	=	γ(T,g4
\mathbf{w}_1	+	w ₂	+	W ₃	+	W_4	+	0	=	1
T*	=	w ₁ g ₁ + w ₂ g ₂	+ w ₃ g ₃ + w ₄ g ₄							
σ ² οκ	_	$w_1\gamma(T,g_1)+v$	ww(T a.)	w(T o)+m	v(T a.)+)					
0-0K		W17(1,81)T	w27(1,82)⊤W	31(1,83)	/(±,84) · /					

[45 marks]

QUESTION 3.

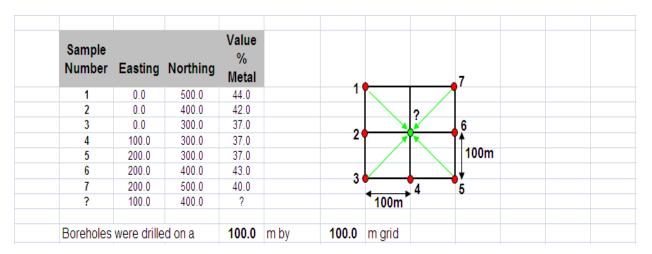
3.1 Discuss and explain, in your own words, the following Geostatistical terminology.

(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) Simple Kriging
- b) Second order stationarity
- c) Variability associated with regionalised variables
- d) Ordinary kriging
- e) Support

[10 marks]

3.2 Give an estimate for the central point using Inverse Distance Weighting Squared method and the information available.



NB: Use IDW² and assume a regular grid

[20 marks]

TOTAL [100 MARKS]