

**REPUBLIC OF SOUTH AFRICA
DEPARTMENT OF MINERALS AND ENERGY
EXAMINATION FOR THE MINE SURVEYOR'S CERTIFICATE OF COMPETENCY**

DATE: 17 April 2008 (Thursday)
TIME: 12:30 – 15:30 (3 Hours)

TOTAL MARKS: 100
TO PASS: 50

MINING ECONOMICS II

NOTE:

1. Any pocket calculator may be used and intermediate results need not be shown. The make and model number of the calculator used must be noted on the front cover of the answer book.
2. Tables that may be used are attached hereto.
3. Graph, Probability and Log paper will be supplied if required
4. Your examination number must be written on all graph paper and loose sheets that are handed in with your examination script.

QUESTION 1

a) Explain what is meant by the following terms:

- i) Normal distribution
- ii) Skewness
- iii) Log normal distribution
- iv) Covariance
- v) Correlation Coefficient
- vi) Coefficient of Variation
- vii) Kurtosis
- viii) Variance
- ix) Variogram
- x) Support effect

[20]

b) Name three types of estimation techniques.

[3]

[23 marks]

QUESTION 2

It was planned that a producing shaft will be worked out within 15 years. A new shaft will be sunk 10 years from date, the cost of which will be R 50 million. With an average inflation rate of 17%, what must be the semi annual investment to enable the mining company to sink the shaft?

[8 marks]

QUESTION 3

The following table shows the breakdown for the monthly tons mined and monthly costs encountered for a mining operation for the first 6 months of a year.

Parameter	Months					
	Jan	Feb	Mar	Apr	May	Jun
Tons Mined	95 000	69 000	101 000	82 000	116 000	99 000
Mining Costs	R34 000	R22 100	R41 450	R28 520	R52 000	R37 500
Engineering Costs	R11 450	R9 200	R13 320	R10 500	R16 230	R12 650
Plant Costs	R14 440	R10 320	R15 600	R11 430	R17 350	R12 050
Other Costs	R15 500	R11 240	R12 500	R11 910	R12 040	R13 200

Note: Costs are in R 000's

All of the "Other Costs" can be taken as a constant cost for the respective month.

Calculate the expected cost breakdown per parameter if the mine intends to increase the tons mined to 250 000 tons per month.

[17 marks]

QUESTION 4

- a) The information below is from the planned yearly production on a gold mine. Calculate the Stopping pay limit.

Total Square Metres mined	261 709 m ²
Shortfall	29,55 %
Reef development to mill	1,5 % @ 14,49 g/t
Waste development to mill	37 916 Tons
Mine Call Factor	96,0 %
Recovery Factor	97,2 %
Milling width	214,46 cm
Working costs	R 2 173,44 per m ²
Gold Price	R 53 000 per Kg
Backlog vamping	29 334 Tons @ 8,17 g/t
Falls of ground (not packed u/g)	3,13 % of tons hoisted
Gully waste	3,02 % of tons hoisted
Relative density	2,78 Tons per cubic metre

[17]

- b) Below is a gradation of the measured resource base of the above mine. Plot on the graph paper provided, the cut off grade of the resource, based on the above pay limit.

g/t Value	Progressives		g/t Value	Progressives	
Category	Stope tons	Grams	Category	Stope tons	Grams
20.0 +	261 448	6 405 180	9,0 - 9,9	1 290 667	19 694 177
19,0 - 19,9	261 482	6 405 853	8,0 - 8,9	1 418 064	20 777 535
18,0 - 18,9	299 579	7 115 373	7,0 - 7,9	1 597 155	22 093 185
17,0 - 17,9	350 632	8 004 216	6,0 - 6,9	1 663 212	22 517 281
16,0 - 16,9	455 272	9 743 916	5,0 - 5,9	2 098 288	24 920 725
15,0 - 15,9	590 429	11 851 071	4,0 - 4,9	2 287 134	25 753 199
14,0 - 14,9	598 307	11 964 853	3,0 - 3,9	2 533 833	26 580 785
13,0 - 13,9	669 306	12 910 742	2,0 - 2,9	2 820 892	27 318 025
12,0 - 12,9	749 291	13 913 231	1,0 - 1,9	2 970 366	27 592 181
11,0 - 11,9	977 205	16 534 657	0,0 - 0,9	2 986 703	27 599 667
10,0 - 10,9	1 190 401	18 764 000	Totals	2 986 703	27 599 667

[8]

[25 marks]

QUESTION 5

In a developing mine a complex ore is being opened up. Tests of typical specimens have shown the ore body to be composed of the following constituents.

	m ³ per ton	Percent
Antimony Sulphide	0,20	8
Arsenical Pyrites	0,15	5
Iron Pyrites	0,18	35
Bornite	0,17	8
Quartz	0,34	44
Total ore		100

It is estimated that, in stoping operations, the width of the country rock, consisting of dolomite (0,32 m³ per ton) which will be unavoidably included in the stoping width, will average 10 % of the width of the ore body.

Allowing 10 % for porosity, derive a formula to connect “tons stoped” with “m² excavated” and “stopping width” for use in compiling future tonnage returns.

[15 marks]

QUESTION 6

A borehole dipping at 80° on a bearing of 30° (zero south) has been sunk through a copper lode which strikes in a east-west direction and dips at 30° to the south.

Record of core and sludge

	Pull 1	Pull 2	Pull 3
Measured widths along core	1,31 m	1,71 m	1,19 m
Mass of core	34,0 Kg	44,4 Kg	30,8 Kg
Mass of sludge	54,4 Kg	70,8 Kg	49,4 Kg
Assay value of core	4,1 % copper	3,3 % copper	4,6 % copper
Assay value of sludge	5,0 % copper	2,2 % copper	6,0 % copper
Core and sludge recovery	100 %	100 %	100 %

Calculate:

- i) The true width of the lode
- ii) The value of the core and the sludge

[12 marks]

Total Marks [100]

SOME USEFUL FORMULAE

$$\sigma^2 = \frac{1}{N} \sum_{i=1}^N (x_i - \mu)^2$$

$$\sigma^2 = \frac{1}{N} \sum_{i=1}^N x_i^2 - \mu^2$$

$$s^2 = \frac{1}{n-1} \sum (x - \bar{x})^2$$

$$y(h) = C \left(\frac{3h}{2a} - \frac{h^3}{2a^3} \right)$$

$$s^2 = \frac{1}{n-1} [\sum x^2 - n\bar{x}^2]$$

$$y(h) = C(1 - \exp(-\frac{h}{a}))$$

$$T = \frac{\bar{x} - \mu}{s\sqrt{n}}$$

$$T = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

$$P = PV \frac{i}{1 - (1+i)^n}$$

$$PV = A/(1+r)^n$$

$$PV = P(1 - (1+i)^{-n})/i$$

$$PV = \frac{P[(1+r)^n - 1]}{r(1+r)^n}$$

$$b = \frac{Mx^2 - x_p x_{1-p}}{x_p + x_{1-p} - 2Mx}$$

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}$$

$$2y(h) = \frac{1}{n} \sum [g(x) - g(x+h)]$$

$$r = \frac{\sum xy - \sum x \sum y / n}{[\sum x^2 - (\sum x)^2 / n][\sum y^2 - (\sum y)^2 / n]}$$

$$\sigma^r = \hat{s}_y \sqrt{1-r^2}$$



