GWANDA STATE UNIVERSITY

FACULTY OF ENGINEERING AND ENVIRONMENT

DEPARTMENT OF GEOMATICS AND SURVEYING

ADJUSTMENT COMPUTATIONS II

EGS 3209

Examination Paper

May 2023

This examination paper consists of 4 pages

Time Allowed: **3 hours**

Total Marks: **100**

Examiner's Name: **Mr A Sibanda**

INSTRUCTIONS

1. Answer ALL 4 questions
2. Each question carries 25 marks
3. Use of calculators is permissible, but programmable calculators are not allowed in the exam
4. Statistical tables

QUESTION 1

a) Given the values below, find the best point estimate for the population mean μ.

7.62, 7.17, 9.06, 6.305, 7.805, 7.11, 9.705, 6.11, 8.56, 7.11, 6.455, 9.06 [5]

Normal Probability Table

Critical Values Z_α	Level of significance (α)			
	1%	2%	5%	10%
Two-tailed test	$\|Z_\alpha\|$=2.58	$\|Z_\alpha\|$=2.33	$\|Z_\alpha\|$=1.96	$\|Z_\alpha\|$=1.645
Right tailed test	Z_α =2.33	Z_α =2.055	Z_α =1.645	Z_α =1.28
Left tailed test	Z_α = -2.33	Z_α = −2.055	Z_α = −1.645	Z_α = −1.28

b) The mean life time of a sample of 169 level bulbs manufactured by a company is found to be 1350 hours with a standard deviation of 100 hours. Establish 90% confidence limits within which the mean life time of light bulbs is expected to lie. [5]

c) A machine produces a component of a product with a standard deviation of 1.6 cm in length. A random sample of 64 components was selected from the output and this sample has a mean length of 90 cm. The customer will reject the part if it is either less than 88 cm or more than 92 cm. Does the 95% confidence interval for the true mean length of all the components produced ensure acceptance by the customer? [6]

d) Define or explain the following terms:

i. Null hypothesis and alternative hypothesis [3]
ii. Correlation coefficient [3]
iii. Type I and type II errors in statistical testing [3]

QUESTION 2

a) What fundamental condition is enforced by the method of the weighted least squares? [2]

b) What are the advantages of the method of least squares over other methods of adjustment? [3]

c) Three horizontal angles were observed around the horizon of station A. Their values are 165.07.54, 160.25.36 and 34.26.36.

(i) Assuming equal weighting, what are the most probable values for the three angles? [6]

(ii) What are the standard deviations of the adjusted values? [3]

(iii) The standard deviations of the three angles are ±1.5 seconds, ±3.0 seconds and ±4.9 seconds, respectively. What are the most probable values for the three angles? [6]

d) An angle was measured six times by different observers and the following values were obtained:
42°25′10″ (2), 42°25′08″ (1), 42°25′09″ (3), 42°25′07″ (2), 42°25′11″ (3), 42°25′09″ (2).
The values given in the parentheses are the weights of the observations. Determine the most probable value of the angle using least squares. [5]

QUESTION 3

a) Define the three terms Scaling, Rotation and Translations in terms of two-dimensional conformal coordinate transformation. [5]

b) Show the development of the transformation equation shown below; [5]

$$X = (S\ cos\ \theta)x - (S\ sin\ \theta)y + T_X$$
$$Y = (S\ sin\ \theta)x + (S\ cos\theta)y + T_Y$$

c) Points A and B have their coordinates known in both an EN system and a XY system. Points C and D have their coordinates known only in the XY system. These coordinates are shown in the table below. Using a two-dimensional conformal coordinate transformation Determine:

Point	E	N	X	Y
A	194 683.50	99 760.22	2848.28	2319.94
B	196 412.80	102 367.61	5720.05	3561.68
C			3541.72	897.03
D			6160.31	1941.26

i. The transformation parameters [5]
ii. The most probable coordinates in the XY coordinate system. [5]
iii. The rotation angle and scale factor. [5]

QUESTION 4

a) A baseline is observed repeatedly using an EDM instrument over a period of time. Each day, 10 observations are taken and averaged. The variances for the observations are listed below. At a significance level of 0.05, are the results of day 2 statistically different from those of day 5? [5]

Day	1	2	3	4	5
Variance, S^2 (mm^2)	50.0	61.0	51.0	53.0	54.0

b) The sample mean of the 20 independent measurements of a distance was found to be 537.615m

i. If the standard deviation of each measurement is known to be 0.033m, construct a 95% confidence interval for the population mean μ. [5]
ii. If the sample standard deviation is calculated to be 0.035m, construct a 95% confidence interval for the population mean. [5]
iii. Construct a 95% confidence interval of δ^2 and the corresponding confidence interval for δ if the sample standard deviation is calculated to be 0.035m. [5]

c) The owner of a surveying firm wants all surveying technicians to be able to read a particular instrument to within ±1.5". To test this value the owner asks the senior field crew chief to perform a reading test with the instrument. The crew chief reads the circle 30 times and obtains $\sigma_r = \pm 0.9$". Does this support the 1.5" limit at a 5% level of significance? [5]