



GWANDA STATE UNIVERSITY

FACULTY OF ENGINEERING AND ENVIRONMENT

DEPARTMENT OF GEOMATICS AND SURVEYING

ADJUSTMENT COMPUTATIONS II

EGS 3209

Examination Paper

April 2024

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

<i>Statistical Distribution and Hypothesis tests</i>			<i>Marks</i>
1	a)	Define or explain the following terms:	
		I. Null hypothesis and alternative hypothesis	3
		II. Type I and type II errors in statistical testing	2
	b	A baseline of calibrated length (μ) 1153.00m is measured 5 times. Each measurement is independent and made with the same precision. The sample mean ($\bar{x}$) and sample standard deviation (s) are calculated from measurement $\bar{X}=1153.39m$ $s=0.06m$	
		I. Describe the major steps to test the mean.	10
		II. Test at the 10% level of confidence of the measured distance is significantly different from the calibrated Distance.	10

<i>Least Squares</i>			
2	a	What do you understand by the following? Giving geomatics related example.	
		i. Functional Model	3
		ii. Stochastic Model	3
	b	i. What fundamental condition is enforced by the method of the weighted least squares?	2
		ii. 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 $165^{\circ}07'54''$, $160^{\circ}25'36''$ and $34^{\circ}26'36''$	
		i. Assuming equal weighting, what are the most probable values for the three angles?	5
		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

<i>Point and interval Estimation</i>			
3	a	What is the difference between RSME and MSE?	3
	b	Solve the following nonlinear equations using the least squares method. Use initial approximations of $x_0 = 2.1$ and $y_0 = 0.45$. $x^2 + 3xy - y^2 = 7.0 + v_1$ $7x^3 - 3y^2 = 55.2 + v_2$ $2x - 6xy + 3y^2 = -1.2 + v_3$	9
		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	3

	c	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																																																								
	d	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?	5																																																								
Similarity Transformation																																																											
4	a	Define the three terms Scaling, Rotation and Translations in terms of two-dimensional conformal coordinate transformation.	5																																																								
		Show the development of the transformation equation shown below; $X = (S \cos \theta)x - (S \sin \theta)y + T_x$ $Y = (S \sin \theta)x + (S \cos \theta)y + T_y$	5																																																								
	b	Points <i>A, B, C, D</i> , and <i>E</i> have their coordinates known in both an <i>XY</i> system and a <i>xy</i> system. Points <i>F</i> and <i>G</i> have their coordinates known only in the <i>xy</i> system. These coordinates are shown in the table below. Using a two-dimensional conformal coordinate transformation, determine: <table><tr><td>Point</td><td><i>X</i></td><td><i>Y</i></td><td><i>x</i></td><td><i>y</i></td><td><i>S_x</i></td><td><i>S_y</i></td></tr><tr><td><i>A</i></td><td>535,802.071</td><td>245,462.419</td><td>1221.35</td><td>1031.87</td><td>0.104</td><td>0.088</td></tr><tr><td><i>B</i></td><td>544,118.703</td><td>252,826.247</td><td>4607.03</td><td>1046.02</td><td>0.095</td><td>0.081</td></tr><tr><td><i>C</i></td><td>539,001.505</td><td>256,629.861</td><td>4200.13</td><td>2946.31</td><td>0.092</td><td>0.097</td></tr><tr><td><i>D</i></td><td>541,979.517</td><td>252,118.983</td><td>3974.84</td><td>1314.28</td><td>0.107</td><td>0.111</td></tr><tr><td><i>E</i></td><td>539,287.964</td><td>253,248.381</td><td>3585.50</td><td>2114.28</td><td>0.105</td><td>0.111</td></tr><tr><td><i>F</i></td><td></td><td></td><td>2767.73</td><td>1621.58</td><td>0.091</td><td>0.098</td></tr><tr><td><i>G</i></td><td></td><td></td><td>2596.55</td><td>2693.00</td><td>0.108</td><td>0.099</td></tr></table>	Point	<i>X</i>	<i>Y</i>	<i>x</i>	<i>y</i>	<i>S_x</i>	<i>S_y</i>	<i>A</i>	535,802.071	245,462.419	1221.35	1031.87	0.104	0.088	<i>B</i>	544,118.703	252,826.247	4607.03	1046.02	0.095	0.081	<i>C</i>	539,001.505	256,629.861	4200.13	2946.31	0.092	0.097	<i>D</i>	541,979.517	252,118.983	3974.84	1314.28	0.107	0.111	<i>E</i>	539,287.964	253,248.381	3585.50	2114.28	0.105	0.111	<i>F</i>			2767.73	1621.58	0.091	0.098	<i>G</i>			2596.55	2693.00	0.108	0.099	
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		i. The transformation parameters and their standard deviations	5																																																								
		ii. The most probable coordinates and their standard deviations for <i>F</i> and <i>G</i> in the <i>XY</i> coordinate system.	5																																																								
		iii. The rotation angle and scale factor.	5																																																								

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	$Z_{\alpha} = 2.33$	$Z_{\alpha} = 2.055$	$Z_{\alpha} = 1.645$	$Z_{\alpha} = 1.28$
Left tailed test	$Z_{\alpha} = -2.33$	$Z_{\alpha} = -2.055$	$Z_{\alpha} = -1.645$	$Z_{\alpha} = -1.28$