



**FACULTY OF ENGINEERING AND THE BUILT  
ENVIRONMENT**

**DEPARTMENT OF ARCHITECTURE, PLANNING AND  
GEOMATICS**

**GEOMATICS DIVISION**

**Numerical Methods Tutorial 2 (APG3013F)**

**Tutorial Objectives**

**Question 1.**

**Design a program to compute the standard deviation in the Area of the triangle ABC**

In a triangle side  $c$  and angle  $\alpha$  and  $\beta$  are observed. Their standard deviations are  $\delta_c$ ,  $\delta_\alpha$  and  $\delta_\beta$  are known. Determine the standard deviation  $\delta_b$  of Side  $b$

$$b = c \frac{\sin \beta}{\sin(180 - (\alpha + \beta))}$$

The numerical values the observed data are given as follows: -

$$\alpha = 60^\circ \pm 30''$$

$$\beta = 60^\circ \pm 2'$$

$$c = 100.00\text{m} \pm 3\text{cm}$$

In order to reach the desired solution you may have to compute the Jacobian Matrix for  $b$  and apply the law of propagation of variances.

Compute the following using matrices to solve your problem

- i) Calculate an actual value for  $b$
- ii) Recall the law of error propagation and now Formulate and compute the Jacobian Matric for the Function in  $b$  the side to be determined
- iii) Now apply the law of propagation of error and solve for the standard deviation in side  $b$   
Note You may need to convert the standard deviations of the two angles into radians for computational compatablity
- iv) Now that you have completed your task, inspect how much each measurement which is a product of its differential multiplied by its corresponding standard deviation in the computation contributed to error. The one which gave the highest value affected the propagation the most. Which one is it between  $\alpha$ ,  $\beta$  and  $c$ ?
- v) What decision would you make in practise in terms of reducing the propagated variance. Your answer to v) must guide your response.