Mathematical Skills of Data Scientists CSCM70 Assessed Sheet 2 Hand in ONLINE by 6 Dec 2022	Name	
	Number	

Feedback	Mark	/100
Date Marked / /2022	Presentation	Poor Good Excellent

Please attach a scanned copy of your working and relevant m files of the MATLAB work

Please answer all questions, giving all the details. These questions are for hand calculations only but you can always check your answers using Matlab

1. Did you attach scanned copy of **self marked** Unassessed Assignments; UA4, UA5, UA6 and UA7? [10 Marks]

2. Compute the gradients of the following function of x and y and find extrema.

$$f(x, y) = x^2 + xy + y^2 + 5x - 5y + 3$$

[10 Marks]

3. The equation $2x^3 - 7x^2 - x + 12 = 0$ has a root near $x = 1.5$. Do the first three steps of Newton?s Method by hand, to find this root. [20 Marks]

4. Find an eigenvector of $\begin{pmatrix} 1 & 0 & 4 \\ 0 & 2 & 0 \\ 3 & 1 & -3 \end{pmatrix}$ to the eigenvalue 2, and one for the eigenvalue 3.

[20 Marks]

5. Compute the sample covariance matrix of the following data (by hand with details):

	Prop 1	Prop 2	Prop 3	Prop 4
Trial 1	2	2	5	96
Trial 2	4	3	1	105
Trial 3	1	3	2	98

[20 Marks]

Turn over.

6. There are 5 balls in an urn, of which 4 balls are red and 1 ball is blue. You do the following:

- draw a ball from the urn at random, note its colour, do not return the ball to the urn;
- draw a second ball, note its colour, do not return the ball to the urn;
- finally draw a third ball and note its colour.

(i) Give the sample space Ω for this experiment. Calculate the probability for each outcome. [10 Marks]

(ii) Consider the following event,

A: **One of the first two balls is blue.**

Write down A as a subset of the sample space Ω and find its probability, P (A).

[10 Marks]

7. **Additional Question- not compulsory and no marks**

A ball is drawn from one of three urns depending on the outcome of a roll of a dice. If the dice shows a 1, a ball is drawn from Urn I, which contains 2 black balls and 3 white balls. If the dice shows a 2 or 3, a ball is drawn from Urn II, which contains 1 black ball and 3 white balls. If the dice shows a 4, 5, or 6, a ball is drawn from Urn III, which contains 1 black ball and 2 white balls.

(i) What is the probability to draw a black ball?

(ii) Assume that a black ball is drawn. What is the probability that it came from Urn I? [0 Marks]