Monday 16 May 2022
09:30-11:30 BST
Duration: 2 hours
Additional time: 30 minutes
Timed exam – fixed start time

DEGREES OF MSc in Information Technology, MSc in Software Development

COMPUTATIONAL SOCIAL INTELLIGENCE M COMPSC5095

(Answer all 3 questions.)

This examination paper is worth a total of 75 marks

1. Consider a set of N pairs (x_k, y_k), where x_k and y_k are two random variables and $k = 1, \dots, N$.

(a) Provide the mathematical expression of the covariance σ_{xy} between x and y and explain what is its meaning from a statistical point of view. Furthermore, show that the covariance σ_{xy} of x and y corresponds to the variance of x when $x_k = y_k$ for every value of k.

[6 marks]

(b) Explain what the correlation ρ_{xy} between x and y is and provide its mathematical expression. Furthermore, calculate the value of such a correlation when $x_k = y_k$ for every value of k (when $x_k = y_k$ for all values of k, there is no need to know the values of x_k and y_k to calculate the value of the correlation ρ_{xy}).

[6 marks]

(c) Provide the mathematical expression of covariance σ_{xy} and calculate correlation ρ_{xy} when $y_k = -x_k$ for every value of k (please notice that, when $y_k = -x_k$ for all values of k, there is no need to know the values of x_k and y_k to calculate ρ_{xy}).

[6 marks]

(d) Consider the more general case in which $x_k \neq y_k$. Is it possible for the covariance to be negative? If yes, please explain when it happens. If not, please explain why it cannot happen. Furthermore, explain what are the differences between covariance and correlation.

[6 marks]

(e) Consider the 5 pairs $(1,3), (7,7), (5,2), (2,4), (1,4)$. Calculate covariance σ_{xy} and correlation ρ_{xy}.

[6 marks]

2. Consider the following two tables:

Table 1

	V_1	V_2	V_3	V_4	V_5
V_1	13	1	3	1	3
V_2	2	9	9	1	2
V_3	8	7	21	7	8
V_4	4	5	7	7	1
V_5	1	1	2	1	11

Table 2

	T_1	T_2	T_3	T_4	T_5
S_1	5	4	5	3	4
S_2	2	1	1	2	2
S_3	3	3	4	3	3
S_4	1	1	2	2	2
S_5	4	4	5	5	4

(a) Table 1 shows the outcome of a judgment's study involving two judges. Element a_{ij} is the number of times judge 1 decided for category V_i, while judge 2 decided for category V_j. Provide the mathematical expression of the probability p_i of two judges agreeing on category i when the judgments are random. Furthermore, estimate the value of such a probability for all categories.

[9 marks]

(b) Provide the mathematical expression of Cohen's kappa and calculate its value for the data in Table 1. Furthermore, explain the reason why it is necessary to calculate the Cohen's kappa (or any equivalent coefficient) in a judgment's study.

[6 marks]

(c) Table 2 shows the outcome of a judgment's study involving 5 judges. Element b_{ij} of the table shows the score that judge T_j assigns to sample S_i. Provide the mathematical expression of the total variance in the judgments and calculate its value. Furthermore, provide the mathematical expression of the variance in the judgments of each individual judge and calculate the variance value for each individual judge.

[9 marks]

(d) Provide the mathematical expressions of the Cronbach's Alpha for Table 2 and calculate its value. Explain what are the differences between Cronbach's Alpha and Cohen's kappa.

[6 marks]

3. Explain the most important aspects of <u>one</u> of the four experimental studies that have been presented during the course:

1.   Synthetic impressions;
2.   Speech and Personality;
3.   Facial Expressions;
4.   Nonverbal Behaviour in Phone Calls.

The answer must include no more than 1,000 words. The text beyond the first 1,000 words will not be considered.

[15 marks]