Mathematical Foundations of Data Science
Assignment 2

Trimester 2, 2024

1. Labourers on a construction site are being assigned to groups to complete tasks. In each of the following, you should keep track of individual labourers (that is, the labourers are distinct). For full marks, you must explain your reasoning in each case.

   (a) Suppose the labourers are arranged into 5 groups of 3, where each group is to complete a different task. In how many ways can the labourers be arranged into groups?
   Hint: Each group performs a different task, so workers A,B,C in Group 1 is ***NOT*** *the same as workers A,B,C in Group 2.*

   (b) Suppose instead that the labourers need to be arranged into 3 groups of 5, and that each group will be performing the same task. In how many ways can the labourers be arranged into groups?
   Hint: Each group now performs the same task, so workers A,B,C, D,E in Group 1 ***IS*** *the same as workers A,B,C,D,E in Group 2*

2. 175 students completed a survey about social media platforms they use. The three platforms considered were Instagram, Reddit, and TikTok. The results of the survey are summarised below:

14 students	None of the platforms
17 students	Instagram only
12 students	Reddit only
28 students	TikTok only
19 students	Instagram and Reddit, but not TikTok
23 students	Instagram and TikTok, but not Reddit
27 students	Reddit and TikTok, but not Instagram
35 students	All three platforms

   (a) Draw this information in a Venn diagram.

   (b) Find the probability that a randomly selected student:

      i. uses Reddit.

      ii. uses at least one platform.

      iii. does not use Instagram, given that they use TikTok.

   Please round your answers to the nearest three decimal places.

3. Consider a standard deck of 52 playing cards, comprising 13 values (the numbers 2-10 plus J, Q, K, and A) in each of four suits (clubs, diamonds, hearts, spades). Suppose that the deck is randomly shuffled and you are dealt 5 cards.

(a) What is the probability that all five of the cards you are dealt are diamonds?

(b) What is the probability that you are dealt five cards of the same suit?

(c) What is the probability that you are dealt a "Royal flush" (A, K, Q, J, 10, all of the same suit)?

For full marks, you must justify your answers and show all working out. Please give your answers to 3 significant figures.

4. This question is contained in the Jupyter notebook `MFDS_A2_Q4.ipynb`. The notebook shows you how to use a `for` loop in Python to calculate a sum, then asks you do some calculations. You should follow the instructions in the notebook, filling in code and answers where required.

   Please submit your answers to this question by converting your completed Jupyter Notebook to a PDF.

   Please note: You must include the code you used to find each answer. Each answer submitted without code will receive a mark of 0.

   Hint for submitting: You can "Download As PDF" in Jupyter, but this may not work on your computer. If it doesn't, you can download as HTML, then convert the HTML file to a PDF. It is best to submit all of your answers as a single file, so make sure you join your PDF to the rest of your answers before submitting. If you are unsure, the Python Practicals Module on MyUni contains a video demonstrating how to save a Jupyter Notebook as a PDF.