Mathematical Foundations of Data Science
Assignment 2

Trimester 1, 2023

1. A pizza restaurant makes 11 standard pizzas, 3 of which contain pepperoni. On 6 different days each week, they discount the price of one pizza. The chef is deciding which pizzas to discount in a given week. Suppose that they only care about which pizzas are discounted, not the specific day that each is discounted.

   For each of the following questions, show working to justify your answer. Evaluate all answers (i.e., do not leave them in terms of combination notation or factorials).

   How many choices are there if:

   (a) there are no restrictions on which pizzas are discounted?

   (b) they want to discount 6 different pizzas?

   (c) they want to discount 6 different pizzas, but the restaurant wants to sell discounted pizzas containing pepperoni on 2 or 3 nights?

   (d) the same pizza can be discounted on multiple nights, but the restaurant wants to sell discounted pizzas containing pepperoni on 2 or 3 nights?

2. Consider the following infinite sums. In each case, state whether the sum is convergent or divergent, giving justification.

   (a) $\displaystyle\sum_{n=1}^{\infty} \left(\frac{-1}{2}\right)^n$.

   (b) $\displaystyle\sum_{n=1}^{\infty} \sqrt[3]{n}$.

   (c) $\displaystyle\sum_{n=1}^{\infty} b_n$, where $\displaystyle\sum_{n=1}^{N} b_n = 1 + \frac{1}{N}$ for all $N \geq 1$.

3. 180 students completed a survey about the sports they enjoy. The three sports considered were Australian football, netball, and surfing. The results of the survey are summarised below:

   - 30 enjoy none of the sports;
   - 25 enjoy Australian football only;
   - 33 enjoy netball only;
   - 7 enjoy surfing only;

- 40 enjoy Australian football and netball, but not surfing;
- 15 enjoy Australian football and surfing, but not netball;
- 10 enjoy netball and surfing, but not Australian football;
- 20 enjoy Australian football, netball, and surfing.

(a) Draw this information in a Venn diagram.

(b) Find the probability that a randomly selected survey respondent:

i. enjoys at least one sport.

ii. enjoys Australian football.

iii. enjoys netball but does not enjoy surfing.

iv. enjoys Australian football or netball.

Please round your answers to 3 decimal places.

4. This question is contained in the Jupyter notebook `MFDS_A2_Q4.ipynb`. The notebook leads you through some exercises about defining and plotting mathematical functions in Python. You should follow the instructions in the notebook, filling in code and answers where required.