MATHS 7027 Mathematical Foundations of Data Science
Assignment 5
Due: 4:59pm Tuesday 22 October 2019 via Canvas (PDF only)

CHECKLIST

- ☐ Have you shown all of your working for every mathematical question?
- ☐ Are your questions submitted in order?
- ☐ Is the writing in your submission legible and clearly structured?
- ☐ Is your submission a single, correctly oriented, pdf file?
- ☐ If after the deadline, but within 24 hours, have you contacted us via email (if applying for an extension) and submitted your assignment online via Canvas?
- ☐ Have you checked that the assignment submitted is the correct one, as we cannot accept other submissions after the due date?

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1. The following table shows some results from an analysis by the ABC (Australian Broadcasting Corporation) in April 2017 on property ownership of Australian politicians. It lists the number of politicians in each of the major party groups/coalitions and whether or not they have a property specifically listed as investment property (IP for short).

	owns IP	doesn't own IP	
Labor/Greens	42	63	105
Liberal/National/LNP	58	47	105
other	0	14	14
	100	124	224

A politician is chosen at random from this group. Let P denote the event they have an investment property, LN denote the event they are are a Lib/Nat/LNP member, LG denote the event they are a Labor/Greens member and O denote the event they are a other party member (minor parties and independents). Determine each of the following and describe the event in words.

(a) $\Pr(P^c)$

(b) $\Pr(LG)$

(c) $\Pr(P^c|LN)$

(d) $\Pr(P|LG)$

(e) $\Pr(O|P^c)$

2. A pharmaceutical company conducts a drug trial for a new antibiotic. Of the $1,000$ participants, each having an infection initially, 400 are given a placebo whilst the remaining portion are given the antibiotic.

   (a) Suppose that 75% of participants taking the antibiotic have recovered within 3 days and 30% of participants taking the placebo have recovered in 3 days.

      i. What is the probability that a randomly selected participant in the trial did not recover in 3 days.

      ii. Draw a Venn diagram for this scenario filling in the probabilities for each distinct piece.

   (b) Suppose that 8% of participants taking the placebo report experience at least one side effect and 21% of participants taking the antibiotic experience at least one side effect. Determine the probability that a randomly chosen participant was taking the antibiotic given they experienced at least one side effect.

   (c) Suppose it is discovered that 100 of the participants had been taking another antibiotic simultaneously during the trial. It is known that 78 of these participants had recovered within 3 days. If possible, determine each of the following. If it is not possible, describe what extra information is needed.

      i. The probability a participant was taking the second antibiotic given they recovered in three days.

      ii. The probability a participant was given the placebo given they were taking the second antibiotic.

3. A box contains four blue balls and six green balls. A fair die is rolled and that number of balls are taken out of the box (randomly). Suppose all of the balls taken out are blue, what is the probability that a 3 was rolled?

4. A fair coin is tossed four times and a fair die is rolled. Let X denote the number rolled on the die plus the number times heads was flipped.

   (a) What are the possible values of X and how likely is each?

   (b) What is the expected result, i.e. $\mathbb{E}[X]$?

   (c) What is the variance $\mathrm{Var}(X)$?