Mathematics for Data Science Tutorial 5 (week 10)

Semester 2, 2019

1. Semaphore is a telegraphy system widely used in the maritime world during the 19th century in which a signal person holds two flags in different arrangements (one in each hand) to form different characters. Each flag can be held in one of eight different positions (say N,NE,E,SE,S,SW,W,NW). A character is is defined by the position of the two flags (noting it does not matter which hand is holding which).

   (a) How many different characters could you potentially make? (Note: two flags can be held in the same position.)

   (b) What if we were to disallow two flags being in the same position?

2. An investor has $\$16,000$ to invest in five possible companies where each investment must be a multiple of $\$1,000$.

   (a) If all of the money is invested, how many possible investment strategies are there?

   (b) What if at least $\$1,000$ must be invested in each company, and all of the money must be invested?

   (c) If, in addition to investing at least $\$1,000$ in each company, at least $\$10,000$ must be invested in total, how many investment strategies are there?

3. Suppose someone has forgotten their 4 digit PIN to unlock their phone.

   (a) They make a random guess, what is the probability of it is correct?

   (b) What is the probability of a random guess containing repeat digits?

   (c) Suppose they know that their pin has no repeat digits, what is the probability of guessing correctly with this knowledge?

   (d) If their PIN has no repeat digits, and they remember one digit but not necessarily which of the 4 it is, what is the probability of guessing correctly?

4. A fast food chain is doing a study on the most popular items on their menu. Let B be the event a customer buys a burger, S be the event they buy a soft drink and C be the event they buy chips. From a large survey they determine that

   - $\Pr(B) = 0.65$
   - $\Pr(S) = 0.55$
   - $\Pr(C) = 0.5$
   - $\Pr(B \cap C) = 0.25$

- $\Pr(B \cap S) = 0.35$
- $\Pr(C \cap S) = 0.3$
- $\Pr(B \cap S \cap C) = 0.15$

Based on this, determine each of the following

(a) the probability a customer buys chips but not soft drink;

(b) the probability a customer buys a burger and/or chips;

(c) the probability a customer buys at least one of burger, soft drink or chips;

(d) the probability a customer does not buy a burger, soft drink nor chips;

(e) the probability a customer bought a burger, but no chips and no soft drink;