Week 3/4
Term 3
2022

HAWKER COLLEGE
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**Learning Brief**
**SMM4**

## Goals

This fortnight we are going to:

- Understand probability distributions for discrete random variables
- Distinguish between discrete and continuous random variables
- Construct probability histograms
- Compute the central tendency and variability of discrete distributions (i.e. find the mean and variance of a discrete probability distribution)
- Compute the 95% confidence interval for a random variable, given the mean and the variance

## Theoretical Components

Make notes on the following chapters:

**Maths Quest 12 Mathematical Methods**

- 10A - Probability revision
- 10B - Discrete random variables
- 10C - Measures of centre of discrete random distributions
- 10D - Measures of variability of discrete random distributions

**Expected Values:**

- https://www.youtube.com/watch?v=j__Kredt7vY&list=PL4C863861E3B2E380
- https://www.youtube.com/watch?v=OvTEhNL96v0

**Probability Distribution:**

- https://www.intmath.com/counting-probability/11-probability-distributions-concepts.php

## Practical Components

**Do the following questions:**
Organise your solutions neatly in your exercise book.

Chapter 10 of Maths Quest 12 Mathematical Methods (pdf – Google Classroom)

- 10A: As many as you need
- 10B: 1, 3, 5, 7, 8, 11, 13, 17, 24
- 10C: 1, 3, 10, 12, 18
- 10D: 3, 5, 7, 14, 15, 20

Mathspace

## Investigation

See next page

## Other

In-class in Week 6.

**Fun fact:** Infinite sets can be classed as either ‘countable’ or ‘uncountable’. A countably infinite set is one that can be thought of as being discrete, such as the set of natural numbers, while an uncountably infinite set is one that can be thought of as being continuous, such as the set of real numbers. Two infinite sets are defined as being the same size, or ‘cardinality’, if there exists a bijection between them. Cantor’s diagonalisation argument demonstrates that the cardinality of the set of natural numbers is strictly ‘smaller’ than the cardinality of the set of real numbers. It is unknown whether there exists an infinite set whose cardinality lies between that of the natural numbers and the real numbers; the continuum hypothesis states that no such set exists, but this is yet to be proved!

## Week 3 and 4 Investigation

A door-to-door telecommunications representative has recorded their day-by-day sales figures over a period of time. They know that their probability of selling $X$ packages on any one day follows the probability distribution shown in the table.

| $x$ | 0 | 1 | 2 | 3 | 4 | 5 | >5 |
|---|---|---|---|---|---|---|---|
| $\Pr(X = x)$ | $2t^2$ | $3t$ | $2t^2$ | $2t$ | $4t^2 + t$ | $t$ | 0 |

a. Find the value of $t$.
b. Find the probability that they sell at least two packages on any one day.
c. Find the probability that they sell at most four packages on any one day.
d. Find the number of packages they can expect to sell each day.
e. Calculate the $Var(X)$ and standard deviation of $x$, correct to 4 decimal places.
f. Find $\Pr(\mu - 2\sigma \leq X \leq \mu + 2\sigma)$.
g. If the representative receives a commission of $25 per package sold and a bonus of $200 if they sell 4 or more packages in one day, find their expected earnings from commissions and bonuses.
h. Given that the representative will sell at least two packages tomorrow, find the probability that they will get their $200 bonus.