Week 7/8
Term 3 •
2020

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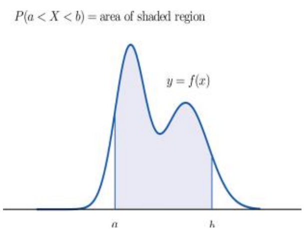
Learning Brief: MM4 Continuous Random Variables

Goals



By the end of this week, you should be able to:

• distinguish between discrete and continuous random variables (CRV)

• understand probability density functions and cumulative distributions for continuous random variables

• compute the central tendency and variability (spread) of continuous distributions

Theoretical Components

Resources:

- Maths Quest 12 Mathematical Methods, Chapter 12 (see pdf on Google Drive)

1. $f(x) \geq 0, \quad for\ all\ x$
2. $\int_{-\infty}^{\infty} f(x)dx = 1$
3. $P(a \leq X \leq b) = \int_a^b f(x)dx$

By now, you should be able to:

- Solving indicial and logarithmic equations using any base
- Investigate Euler's number
- Use natural logarithms to the base e. Learn notation used.
- Sketch logarithmic functions showing necessary features
- Solving indicial and logarithmic equations using base e
- Use natural logarithms to the base e.
- Using exponential and logarithmic modelling
- Use the chain rule for differentiation of exponential functions of the forms: $y = e^x$, and $y = e^{f(x)}$
- Find the derivatives logarithmic functions of the forms;
  $y = ln(x)$ and $y = ln[f(x)]$.
- Use derivatives to solve practical problems
- Integrate to give log functions
- Find an exact area under a given curve using definite integrals
- distinguish between discrete and continuous random variables (CRV)
- understand probability density functions and cumulative distributions for continuous random variables
- compute the central tendency and variability (spread) of continuous distributions

Practical Components

Exercises 12A Q1 a,b Q2 a,b Q4
Exercises 12B Q2,5,9,17
Exercises 12C Q1 a, Q4 a, Q5,9,11
Exercises 12D as many as you could

Revision:
Complete the chapter review for:
Chapter 3
Chapter 7
Chapter 12 (up to probability density function and application. No need to do the questions about normal distribution.)

Investigation

X is a random variable denoting the number of minutes in excess of two hours which a person takes to travel from one town to another. The probability density function is defined by:

$$f(x) = \begin{cases} k(10+x), & -10 \leq x \leq 0 \\ k(10-x), & 0 \leq x \leq 10 \\ 0, & elsewherer \end{cases}$$

(a) Find the value of k
(b) Sketch the graph of f
(c) Find the probability that:
(i) X is less than 5
(ii) X is less than 0, given that X is less than 5
(iii) -2 ≤ x < 3

QFO

Quiz/Forum/Other

NO quiz for this week

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Summary

Probability revision

- *Outcomes* are results of experiments.
- The set of all possible outcomes of an experiment is called the *sample space* and is denoted by ε, and each possible outcome is called a *sample point*.
- A subset of the sample space is known as an *event*.
- The *union* (symbol ∪) of two events A and B implies a combined event, that is, either event A or event B or both occurring. Common elements are written only once.
- The *intersection* (symbol ∩) of two events A and B is represented by the common sample points of the two events.
- Venn diagrams involve drawing a rectangle that represents the sample space and a series of circles that represent subsets of the sample space. They provide a visual representation of the information at hand and clearly display the relationships between sets.
- The probability of an event occurring is defined by the rule:

$$\Pr(A) = \frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}.$$

- The probability of an event occurring lies within the restricted interval $0 \le \Pr(A) \le 1$.
- The individual probabilities of a particular experiment will sum to 1; that is, $\Sigma\, p(x) = 1$.
- The addition rule of probability is defined by the rule $\Pr(A \cup B) = \Pr(A) + \Pr(B) - \Pr(A \cap B)$.
- If two events A and B are mutually exclusive, then $\Pr(A \cap B) = 0$ and therefore the addition rule becomes $\Pr(A \cup B) = \Pr(A) + \Pr(B)$.
- If two events A and B are independent, then $\Pr(A \cap B) = \Pr(A) \times \Pr(B)$.
- Karnaugh maps and probability tables summarise all combinations of two events (for example A and B) and their complements (for example A' and B').
- Conditional probability is defined by the rule $\Pr(A \mid B) = \dfrac{\Pr(A \cap B)}{\Pr(B)}$, where $\Pr(B) \neq 0$. This can be transposed to $\Pr(A \cap B) = \Pr(A \mid B) \times \Pr(B)$.
- Tree diagrams are useful tools in solving probability tasks as they display each of the possible outcomes along with their respective probabilities.
- A combination is defined by ${}^{n}C_{r}$, that is, the number of selections of n different objects taken r at a time.

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