

Cambridge Advanced Subsidiary Level Notes
Mathematics Cheatsheet

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1 Probability and Statistics

Discrete random variables

Discrete random variables are those where events are separate and separate, *discrete*.

- Sum of all probabilities

$$\sum(P(X = x)) = 1$$

- Expectation (mean)

$$E(X) = \mu = \sum(x \cdot P(X = x))$$

- Variance

$$\text{Var}(X) = \sigma^2 = E(X^2) - E(X)^2$$

where $E(X^2) = \sum(x^2 \cdot P(X = x))$

Binomial distribution

When there are a fixed number of trials n , each with only two possible outcomes where success has probability p , the discrete random variable X follows a binomial distribution $X \sim B(n, p)$.

- The probability of r successes

$$P(X = r) = \binom{n}{r} (p^r)(1 - p)^{n-r}$$

- Expectation

$$E(X) = np$$

- Variance

$$\text{Var}(X) = np(1 - p)$$

Geometrical distribution

Used when the number of trials X until the first success is counted. Trials must be independent and probability of success is p . $X \sim \text{Geo}(p)$.

- Probability that success occurs on the r th trial

$$P(X = r) = p(1 - p)^{r-1}$$

- Failure for k trials

$$P(X > k) = (1 - p)^k$$

- Mean

$$E(X) = p^{-1}$$

Normal distribution

A continuous distribution used for data that clusters around the mean in a “bell curve”, denoted $X \sim N(\mu, \sigma^2)$.

- To standardise the variable X to the standard variable Z such that $Z \sim N(0, 1)$.

$$Z = \frac{X - \mu}{\sigma}$$

- The curve is symmetrical, and so the following properties are derived

$$P(Z < -a) = P(Z > a) = 1 - \Phi(a)$$

$$P(Z > -a) = \Phi(a)$$

Normal approximation to the binomial

- The approximation is valid when

$$np > 5 \text{ and } n(1 - p) > 5$$

- Continuity must be corrected as half a unit above or below the given argument must be taken as a discrete variable is being converted to continuous.