# Edexcel Further Maths AS-level

## Further Statistics 1

Formula Sheet

| Provided in formula book | Not provided in formula book |
| --- | --- |

# Discrete Probability Distributions

## Discrete Random Variables

| For a discrete random variable $X$ taking values $x_i$ with probabilities $\mathrm{P}(X = x_i)$: | |
|---|---|
| Expectation (mean) | $\mathrm{E}(X) = \mu = \Sigma\, x_\mathrm{i}\, \mathrm{P}(X = x_i)$ |
| Variance | $\mathrm{Var}(X) = \sigma^2 = \Sigma\,(x_\mathrm{i} - \mu)^2 \mathrm{P}(X = x_i) = \mathrm{E}(\mathrm{X}^2) - \left(\mathrm{E}(X)\right)^2$ |
| For a function $\mathrm{g}(\mathrm{X})$: | $\mathrm{E}(\mathrm{g}(X)) = \Sigma\, \mathrm{g}(x_\mathrm{i})\, \mathrm{P}(X = x_i)$ |

| |
|---|
| $\mathrm{E}(aX + b) = a\mathrm{E}(X) + b$ |
| $\mathrm{Var}(aX + b) = a^2\mathrm{Var}(X)$ |

## Poisson and Binomial Distributions

| **Distribution** | **Binomial $\boldsymbol{B(n,p)}$** | **Poisson $\boldsymbol{Po(\lambda)}$** |
|---|---|---|
| $\mathrm{P}(X = x)$ | $\binom{n}{x} p^x (1-p)^x$ | $e^{-\lambda}\dfrac{\lambda^x}{x!}$ |
| $Mean$ | $np$ | $\lambda$ |
| $Variance$ | $np(1-p)$ | $\lambda$ |
| $P.G.F$ | $(1 - p + pt)^n$ | $e^{\lambda(t-1)}$ |

## Poisson Distribution

| | |
|---|---|
| If two Poisson distributions $X$, $Y$ are independent: | $X + Y \sim Po(\lambda_x + \lambda_y)$ |
| If each observation of $X$ is independent and $X \sim Po(\lambda)$: | $aX \sim Po(a\lambda)$ |

| | |
|---|---|
| Binomial approximation | *If* $X \sim B(n,p)$ *and* $n$ *is large and* $p$ *close to* $0$ *then* $X \approx \sim Po(np)$ *where* $\lambda = np$. |

## Hypothesis Testing

| ***Null hypothesis*** | $\boldsymbol{H_0 : \theta = m}$ |
|---|---|
| One tailed test | $H_1 : \theta > m$ *or* $\theta < m$ |
| Two-tailed test | $H_1 : \theta \neq m$ |

# Chi Squared Tests

## Measure of Goodness of Fit

$O_i = observed\ frequency$
$E_i = expected\ frequenct$
$N = number\ of\ trials$

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i} \sim {\chi_v}^2$$

The greater the value of $X^2$, the less good the fit.

## Degrees of Freedom

$$No. of\ degrees\ of\ freedom = No. of\ cells\ (after\ necessary\ combining) - No. of\ parameters$$

## Contingency Tables

$$Expected\ frequency = \frac{Row\ total\ \times Column\ total}{Grand\ total}$$

Number of degrees of freedom $v = (h-1)(k-1)$ for an $h \times k$ table