Further Statistics 1

Topics	What students need to learn:		
	Content		Guidance
1 **Discrete probability distributions**	1.1	Calculation of the mean and variance of discrete probability distributions. Extension of expected value function to include $\mathrm{E}(\mathrm{g}(X))$.	Use of $\mathrm{E}(X) = \mu = \sum x\mathrm{P}(X = x)$ and $\mathrm{Var}(X) = \sigma^2 = \sum x^2\mathrm{P}(X = \mathrm{x}) - \mu^2$ The formulae used to define $\mathrm{g}(x)$ will be consistent with the level required in AS Mathematics and AS Further Mathematics. Questions may require candidates to use these calculations to assess the suitability of models.
2 **Poisson & binomial distributions**	2.1	The Poisson distribution. The additive property of Poisson distributions.	Students will be expected to use this distribution to model a real-world situation and to comment critically on the appropriateness. Students will be expected to use their calculators to calculate probabilities including cumulative probabilities. Students will be expected to use the additive property of the Poisson distribution. E.g. if X = the number of events per minute and $X \sim \mathrm{Po}(\lambda)$, then the number of events per 5 minutes $\sim \mathrm{Po}(5\lambda)$. If X and Y are independent random variables with $X \sim \mathrm{Po}(\lambda)$ and $Y \sim \mathrm{Po}(\mu)$, then $X + Y \sim \mathrm{Po}(\lambda + \mu)$ No proofs are required.
	2.2	The mean and variance of the binomial distribution and the Poisson distribution.	Knowledge and use of : If $X \sim \mathrm{B}(n, p)$, then $\mathrm{E}(X) = np$ and $\mathrm{Var}(X) = np(1-p)$ If $Y \sim \mathrm{Po}(\lambda)$, then $\mathrm{E}(Y) = \lambda$ and $\mathrm{Var}(Y) = \lambda$ Derivations are not required.
	2.3	The use of the Poisson distribution as an approximation to the binomial distribution.	When n is large and p is small the distribution $\mathrm{B}(n, p)$ can be approximated by $\mathrm{Po}(np)$. Derivations are not required.
	2.4	Extend ideas of hypothesis tests to test for the mean of a Poisson distribution	Hypotheses should be stated in terms of a population parameter μ or λ

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3 **Chi Squared Tests**	3.1	Goodness of fit tests and Contingency Tables.	Applications to include the discrete uniform, binomial and Poisson distributions.
		The null and alternative hypotheses.	Lengthy calculations will not be required.
		The use of $\sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$ as an approximate χ^2 statistic.	Students will be expected to determine the degrees of freedom when one or more parameters are estimated from the data. Cells should be combined when $E_i < 5$.
		Degrees of freedom.	Students will be expected to obtain p-values from their calculator or use tables to find critical values.