If $X \sim Po(\lambda)$ and $Y \sim Po(\phi)$ are independent random variables, then $X+Y \sim Po(\lambda+\phi)$

If $X \sim B(n, p)$ and n is large and p is small, then $Y \sim Po(np)$.

Read pages 134 & 135 Three different scenarios for Poisson hypothesis tests!

1. Has rate changed/increased/decreased?

   $H_0: \lambda = ?$

   $H_1: \lambda \neq ?$ or $\lambda < ?$ or $\lambda > ?$

   Significance level $= 10\% = 0.1$ (or different significance)

   half this if test is two-tailed

   Find p value $P(X \geq \text{new value}) = p$ or $P(X \leq \ ) = p$ which we are testing for

   If $p <$ significance level $\Rightarrow$ result significant $\Rightarrow$ reject H_0

   If $p >$ " " $\Rightarrow$ " not sig $\Rightarrow$ do not reject H_0

2. Find critical region.

   This involves finding upper/lower tails as close to the significance level as possible (probably won't be exact)

   eg $P(X \leq 1) = 0.0072$ and $P(X \geq 15) = 0.0057$

   Question may ask for actual significance level.

   This is $P(X \leq 1) + P(X \geq 15) = 0.0072 + 0.0057 = 0.013$ ← not exactly 10% (or and)

   Question may then ask about a particular value, say 6;

   Student can say this is outside critical region and then conclude: 'There is insufficient evidence...'

3. A binomial scenario with large n and small p. Convert this to Poisson and then use either of the two above techniques

Geometric Hypothesis Tests similar to points 1 and 2 above for Poisson Hypothesis Tests

In order to find $\boxed{P(X \leq ?)}$ or $\boxed{P(X \geq ?)}$, you could use formulae:

$$\boxed{S_n = \frac{a(1-r^n)}{1-r}} \quad \text{or} \quad \boxed{S_\infty = \frac{a}{1-r}}$$

Chi-squared tests checks whether a model is suitable or not (it could be a Binomial model or Poisson etc)

Use expected and observed values.

Usually, degrees of freedom $= n-1$

If λ is estimated, then deg of freedom $= n-2$

If Test Statistic $<$ Critical Value $\Rightarrow$ not significant $\Rightarrow$ do not reject H_0

If " " $>$ " " $\Rightarrow$ result significant $\Rightarrow$ reject H_0

Finally state concluding sentences

For two variables, Chi-squared work as follows:

$$\text{Expected Values } E_i = \frac{(\text{row total}) \times (\text{column total})}{\text{overall total } N}$$

No. of degrees of freedom $= (r-1) \times (c-1)$

no. of rows

no. of columns

Quality of Tests: read pages 142 & 143 for a good example.

Type I Error - rejecting H_0 when it is actually true

Type II Error - not rejecting H_0 " " " false.

Size of a test is probability of Type I error (or probability of being in critical region given H_0 is correct)

Power of a test is probability of correctly rejection H_0.

Power of Test $= 1 - P(\text{Type II Error})$