\[ x - u(d - 1)x^d \binom{x}{u} = (x = X)d \]
Example: What is the probability that 2 people out of 100 will have syphilis if the rate in East Baltimore is the same as the rate in the U.S. (1.25 per 10,000)?

\[
\begin{align*}
\text{What is the probability that 2 people out of 100 will have syphilis if the rate in East Baltimore is the same as the rate in the U.S. (1.25 per 10,000)?} \\
\end{align*}
\]
is 0.01. $p$-value: under $H_0$, probability of observing $X = 2$ or more extreme

$1 - \Phi(0.9876) - 0.0123 = 1 - 0.001 = 0.999$
Approximation of Binomial distribution by Poisson when \( n \to \infty, p_n \to 0 \), \( \lambda_n = np_n \to \lambda \).

\[
P(X = x) \to e^{-\lambda} \frac{\lambda^x}{x!}
\]

Proof: exercise.

Reminder: \( \chi \to \int_0^{\infty} e^{-\chi} \frac{\chi^x}{x!} \, d\chi \) when \( n \to \infty \), \( u \to \frac{1}{\chi} \), \( x \to X \).

Approximation of Binomial distribution by Poisson