Homework Problem: Poisson Parameter

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10/10 points (graded)

We say that random variable X follows a *Poisson* distribution with parameter λ if its PMF is given by

$$p_X(x) = \frac{\lambda^x e^{-\lambda}}{x!},$$

with support over alphabet $\{0, 1, 2, \ldots\}$.

- **(a)** Suppose we observe $X^{(1)}, \ldots, X^{(n)}$, which are all independent Poisson random variables with the same parameter λ. If we observe the sequence $X^{(1)} = x^{(1)}, \ldots, X^{(n)} = x^{(n)}$, what is the maximum likelihood estimate for λ when the observed values are 5, 10, 14, 42? (You should make sure you can come up with the general expression rather than only specifically for the given sequence of 4 observed values.)

  Please provide an exact answer.

  17.75

- **(b)** Now, instead suppose $X^{(1)}, \dots, X^{(n)}$ are all independent random variables from the same distribution, but we don't know whether that distribution is Poisson with parameter $\lambda_1 = 12$ or parameter $\lambda_2 = 19$. Both parameters have known, fixed values. If we observe the sequence 5, 10, 14, 42, what is the maximum likelihood estimate for which distribution the variables are drawn from (i.e., is it the one corresponding to λ_1 or λ_2?)

  - ○ The distribution corresponding to λ_1
  - ◉ The distribution corresponding to λ_2 ✔

  If we still observe the same sequence 5, 10, 14, 42, but instead $\lambda_1 = 15$ and $\lambda_2 = 16$, what is the maximum likelihood estimate for which distribution the variables are drawn from?

  - ○ The distribution corresponding to λ_1
  - ◉ The distribution corresponding to λ_2 ✔

  (Note that you should be able to come up with a decision rule for the general case, although we don't have an autograder for this: If we observe the sequence $X^{(1)} = x^{(1)}, \dots, X^{(n)} = x^{(n)}$, what is the maximum likelihood estimate for which distribution the variables are drawn from? Your answer should be expressed as a decision rule in terms of the values x_n and λ_1 and λ_2.)

Submit You have used 1 of 5 attempts

✔ Correct (10/10 points)

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