PES University, Bangalore

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UE19CS203 – STATISTICS FOR DATA SCIENCE

Unit - 3 - Probability Distributions

QUESTION BANK

Principles of Point Estimation (Maximum Likelihood Estimation)

Exercises for Section 4.9

[Text Book Exercise – Section 4.9 – Q. No. [5 – 10] – Pg. No. [285]]

1. Let $X \sim Geom(p)$. Find MLE of p. **(Exclude)**

2. Let $X_1 \ldots . X_n$ be a random sample from the population with Poisson (λ) distribution. Find the MLE of λ.

3. Maximum Likelihood estimates possess the property of functional invariance, which means that if $\hat{\theta}$ is the MLE of θ, and $h(\theta)$ is any function of θ, then $h(\hat{\theta})$ is the MLE of $h(\theta)$.

   a) Let $X \sim Bin(n, p)$ where n is known and p is unknown. Find the MLE of the odds ratio $p/(1-p)$.
   b) Use the result of Exercise 5 to find the MLE of the odds ratio $p/(1-p)$ if $X \sim Geom(p)$. **(Exclude)**
   c) If $X \sim Poisson(\lambda)$, then $P(X = 0) = e^{-\lambda}$. Use the result of Exercise 6 to find the MLE of $P(X = 0)$ if $X_1 \ldots . X_n$ is a random sample from a population with the $Poisson\ (\lambda)$ distribution.

4. Let $X_1 \ldots . X_n$ be a random sample from a $N(\mu, 1)$ population. Find the MLE of μ.

5. Let $X_1 \ldots . X_n$ be a random sample from a $N(0, \sigma^2)$ population. Find the MLE of σ.

6. Let $X_1 \ldots . X_n$ be a random sample from a $N(\mu, \sigma^2)$ population. Find the MLEs of μ and σ. [Hint: The likelihood function is a function of two parameters μ and σ. Compute partial derivatives with respect to μ and σ and set them equal to 0 to find the values $\hat{\mu}$ and $\hat{\sigma}$ that maximize the likelihood function.