PABNA UNIVERSITY OF SCIENCE AND TECHNOLOGY



Department Of Information And Communication Engineering

Faculty Of Engineering And Technology

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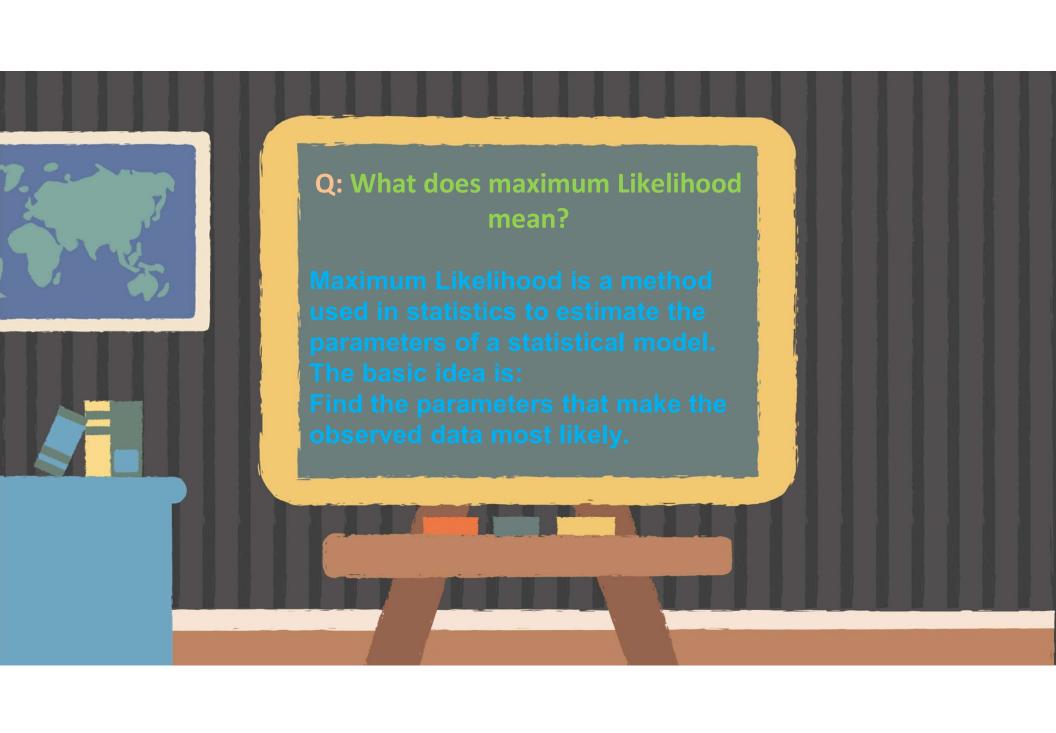
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The Principles of Maximum Likelihood

- 1. Likelihood Principle
- 2. Maximization Principle
- 3. Invariance Principle
- 4. Consistency
- 5. Efficiency (Asymptotic)



The **likelihood function** contains all the information about the parameters.

Focuses only on observed data, not on data that could have occurred

2. Maximization Principle

- •Choose the parameter values that maximize the likelihood
- Often maximize the log-likelihood (simplifies computation)
- •Goal:

θ^=argmaxθL(θ|data)\hat{\theta} = \arg\max_{\theta} L(\theta | \text{data})θ^=argθmaxL(θ|data)



- •If θ^{θ} is the MLE of θ , then $g(\theta^{\theta})g(\theta^{\theta})$ is the MLE of $g(\theta)g(\theta)$
- •Example:
- •If p^\hat{p}p^ is the MLE of a probability, then p^2\hat{p}^2p^2 is the MLE of p2p^2p2

4. Consistency

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- MLE becomes more accurate with more data
- As sample size $n \rightarrow \infty n \to \infty$,
- $\theta^n \rightarrow \theta(\text{true value}) \cdot \{\text{theta}_n \to \text{theta} \}$ \quad \text{\(\text{\true value}\}\theta^n \rightarrow \theta\)

5. Efficiency

- Among all consistent estimators, MLE has the lowest variance (in large samples)
- It is **asymptotically efficient**, meaning:
- Var(θ^)≈1nI(θ)\text{Var}(\hat{\theta})
 \approx \frac{1}{nI(\theta)}Var(θ^)≈nI(θ)1
 where I(θ)I(\theta)I(θ) is the Fisher
 information

