# Maximum Likelihood Estimation A Comprehensive Guide for Research Students

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May 23, 2025

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#### Motivation for MLE

- Understanding parameter estimation
- ▶ Importance in regression and classification tasks

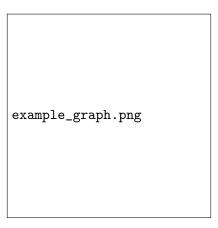
#### Statistical Inference

- Point Estimation
- ► Interval Estimation

#### Definition of Likelihood Function

$$\mathcal{L}(\theta; x) = P(X = x | \theta) \tag{1}$$

## Visual Explanation of MLE



# Deriving the Maximum Likelihood Estimator

$$\hat{\theta}_{MLE} = \arg\max_{\theta} \mathcal{L}(\theta; x) \tag{2}$$

#### MLE for Various Distributions

- Normal Distribution
- Poisson Distribution

## Consistency

Definition: An estimator is consistent if it converges in probability to the true value as sample size increases.

# Numerical Approaches

- Gradient Descent
- ► Newton-Raphson

## Real-world Examples

- ► Case Study 1
- ► Case Study 2

# Summary of Key Points

- ► Importance of MLE in ML
- ► Future Directions in MLE Research

#### References

► List of Recommended Readings and Resources