

# Maximum Likelihood Estimation

## A Comprehensive Guide for Research Students

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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

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

# Visual Explanation of MLE

example\_graph.png

# Deriving the Maximum Likelihood Estimator

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

# 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