# Estimation, Inference & Hypothesis Testing

## Estimation and Inference

Inferential Statistics:  
- Learn population characteristics from a sample.  
- Population characteristics = parameters.  
- Sample characteristics = statistics.  
- Parametric models use parameters like mean and standard deviation.  
  
Estimation:  
- Common method: Maximum Likelihood Estimation (MLE).  
- Estimation = determining population parameter from fitted model.  
  
Distributions:  
- Uniform, Normal, Log-normal, Exponential, Poisson.  
  
Approaches:  
- Frequentist: many experiment repetitions.  
- Bayesian: parameters described by probability distributions.

## Hypothesis Testing

Definitions:  
- Hypothesis: statement about a population parameter.  
- Null hypothesis (H0) vs. Alternative hypothesis (H1).  
- Hypothesis test = decision rule for accepting or rejecting H0.  
  
Errors:  
- Type I error: reject H0 when it is true (false positive).  
- Type II error: fail to reject H0 when it is false (false negative).

## Significance Level & p-values

- Significance level: threshold (e.g., 0.01, 0.05) chosen before test.  
- p-value: smallest significance level at which H0 would be rejected.  
- Confidence interval: values of statistic where we accept H0.

## Correlations

- Correlation can help predict outcomes but does not imply causation.  
- Consider confounding variables before making recommendations.  
- Spurious correlations may appear due to coincidences in data.