

Chapter 1

Probability

1.1 Basic concepts and results

- Random experiment
- Sample space
- Event
- Probability measure and its properties
- Conditional probability
- Total probability theorem
- Bayes' theorem
- Random variable
- Distribution function of a random variable
- Discrete random variable
- Continuous random variable
- Functions of a random variable
 1. Expected value
 2. Raw moment of order k
 3. Central moment of order k
 4. Moment generating function
- Bivariate random variables
 1. Marginal distributions
 2. Expectation of $Z = h(X, Y)$
 3. Conditional distributions
 4. Conditional expectations
 5. Raw moment of order (r, s)
 6. Central moment of order (r, s)
 7. Covariance
- Law of iterated expectation
- Stochastic independence

- Other forms of independence
 1. Mean independence
 2. Uncorrelatedness

1.2 Convergence of sequences of random variables

- Notions of Convergence
 1. Pointwise convergence
 2. Uniform convergence
 3. Convergence in L^p
 4. Convergence in measure
- Convergence for random variables
 1. Almost surely
 2. In the r th mean
 3. In probability
 4. In distribution
- Skorokhod representation theorem
- Continuous mapping theorem
- Slutsky theorem

1.3 Important asymptotic results

- Weak law of large numbers
- Strong law of large numbers
- Central limit theorem
- Lévy's continuity theorem
- Applications
 1. Bernoulli
 2. Simple Monte Carlo
- Delta method and its applications
 1. Log odds
 2. Variance stabilizing

Chapter 2

Classical Statistical Model

2.1 Probability versus statistical inference

- Probability theory
- Statistical inference

2.2 Model specification

- Random sample
- Sampling
- IID random sampling

2.3 Statistics

- Statistic definition

2.4 Sampling distribution

- Definition
- Methods to obtain the sampling distribution of a statistic
 - Monte Carlo simulation
- Sample distribution of the sample moments
 - Sample moments
 - Properties of the sample mean
 - Properties of the sample variance
 - Properties of the bias-corrected sample variance
 - Properties of central sample moments
 - Asymptotic distribution of \bar{X}
- Order statistics