Topics for Final Exam

1. **Probability Spaces**

   1.1 Sample spaces

   1.2 σ–Fields

   1.3 Probability functions

   1.4 Independent events

   1.5 Conditional probability

2. **Random Variables**

   2.1 Continuous and discrete random variables

   2.2 Cumulative distribution function (cdf)

   2.3 Probability density function (pdf) and probability mass function (pmf)

3. **Expectations of Random Variables**

   3.1 Expected Value a random variable

   3.2 Expected value of functions of random variables

   3.3 Moments and moment generating function

   3.4 Variance of a random variable

4. **Joint Distributions**

   4.1 Joint distribution of two random variables

   4.2 Marginal distributions

   4.3 Independent random variables

   4.4 Covariance and correlation

5. **Special Distributions**

   5.1 Discrete distributions: Bernoulli, Binomial, Geometric, Hypergeometric, (Discrete) Uniform and Poisson.

   5.2 Continuous distributions: Uniform, Exponential, Normal and Chi–Square.

6. **Limiting Distributions**
   - 6.1 The Poisson distribution as a limit of binomial distributions.
   - 6.2 Convergence in distribution
   - 6.3 mgf Convergence Theorem
7. **Limit Theorems**
   - 7.1 Markov and Chebyshev inequalities
   - 7.2 Convergence in probability
   - 7.3 The Law of Large Numbers
   - 7.4 Random samples: Sample Mean and Sample Variance
   - 7.5 The Central Limit Theorem
   - 7.6 Applications of the Central Limit Theorem: Point Estimates and Confidence Intervals.

Relevant sections in the text: 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.5, 3.7, 3.8, 3.9, 4.1, 4.2, 4.3, 4.4, 4.6, 5.2, 5.3, 5.4, 5.6, 6.2, 6.3, 6.4, 8.1, 8.2, and 8.5.

Relevant chapters and sections in the lecture notes: Chapters 1, 2, 3, 4, 5, 6, 7; Sections 8.1, 8.2 and 8.3

Important Concepts

Sample space, σ–Field, probability function, probability space, random variable, continuous and discrete random variables, cumulative distribution function (cdf), probability mass function (pmf), probability density function (pdf), expectation, moments, moment generating function (mgf), variance, joint distributions, marginal distributions, independent random variable, covariance, correlation, convergence in distribution, convergence in probability, limiting distribution, the Central Limit Theorem, the weak Law of Large Numbers, random samples, sampling distribution, point estimates, and interval estimates.

Important Skills

1. Know how to compute probabilities of events
2. Know how to compute conditional probabilities
3. Know how to compute the cdf and the pdf (or pmf) of a random variable

4. Know how to compute expectations, moments, variance and moment generating functions.
5. Know how to compute the joint cdf and the joint pdf (or pmf) of two or more random variables
6. Know how to compute marginal distributions
7. Know how to compute probabilities based on joint distributions
8. Know how to compute expectations of functions of random variables
9. Know how to compute covariance and correlation
10. Know how to use independence
11. Know how to apply the mgf convergence theorem
12. Know how to apply the Central Limit Theorem.
13. Know how to apply the Markov and Chebyshev inequalities.
14. Know how to obtain point and interval estimates for the mean of a distribution.