

## MA222 Probability and Statistics

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MA222 is a standard undergraduate course in probability and statistics for undergraduate students in sciences and engineering. This course covers basic concepts and methods in probability and statistics such as sample space, discrete and continuous random variables, probability distributions, introduction to the statistical inference, estimation, and testing statistical hypotheses. Students will have weekly homework assignments and closed book quizzes on recitations. There will be midterm and final exams.

### Course program

1. **Introduction to statistics and data analysis**
  - 1 Sampling procedures
  - 2 Measures of location: the sample mean
  - 3 Measures of variability
  - 4 Discrete and continuous data
  - 5 Graphical methods and data descriptions
2. **Probability**
  - 1 Sample space
  - 2 Events
  - 3 Counting sample points
  - 4 Probability of an event
  - 5 Additive rules
  - 6 Conditional probability
  - 7 Multiplicative rules
  - 8 Bayes' rule
3. **Random variables and probability distributions**
  - 1 Random variable
  - 2 Discrete probability distribution
  - 3 Continuous probability distribution
  - 4 Joint probability distribution
4. **Mathematical expectation**
  - 1 Mean of random variable
  - 2 Variance and covariance
  - 3 Means and variances of linear combinations of random variables
  - 4 Chebyshev's theorem
5. **Discrete probability distributions**
  - 1 Discrete uniform distribution
  - 2 Binomial and multinomial distributions
  - 3 Hypergeometric distribution
  - 4 Negative binomial and geometric distributions
  - 5 Poisson distribution and the Poisson process
6. **Continuous probability distributions**
  - 1 Continuous uniform distribution
  - 2 Normal distribution
  - 3 Areas under normal curve
  - 4 Applications of the normal distribution
  - 5 Normal approximation to the binomial
  - 6 Gamma and exponential distributions
  - 7 Applications of the gamma and exponential distributions

- 8 Chi-squared distribution
- 9 Lognormal distribution
- 10 Weibull distribution
- 7. **Functions of random variables**
  - 7.1. Transformations of variables
  - 7.2. Moments and moment-generation functions
- 8. **Fundamental sampling distributions and data distributions**
  - 8.1. Random sampling
  - 8.2. Some important statistics
  - 8.3. Data displays and graphical methods
  - 8.4. Sampling distributions
  - 8.5. Sampling distributions of means
  - 8.6. Sampling distributions of  $S^2$
  - 8.7. t-Distribution
  - 8.8. F-Distribution
- 9. **One- and two-sample estimation problems**
  - 9.1. Statistical inference
  - 9.2. Classical methods of estimation
  - 9.3. Single sample: estimating the mean
  - 9.4. Standard error of point estimate
  - 9.5. Prediction interval
  - 9.6. Tolerance limits
  - 9.7. Two samples: estimating the difference between two means
  - 9.8. Paired observations
  - 9.9. Estimating a proportion
  - 9.10. Estimating the variance
- 10. **Statistical hypotheses**
  - 10.1. Testing a statistical hypothesis
  - 10.2. One- and two-tailed tests
  - 10.3. The use of P-values for decision making
  - 10.4. Tests on a single mean
  - 10.5. Tests on two means
  - 10.6. Choice of sample size for testing means
  - 10.7. Graphical methods for comparing means
  - 10.8. Tests on proportions
  - 10.9. Goodness-of-fit test
  - 10.10. Two-sample case study