Course Outline

1. **Introduction to Probability**
   - *Sample spaces, events, outcomes, axioms of probability*
   - *Counting, permutations, combinations, binomial coefficients*
   - *Probability, conditional probability, Bayes rule, independence*
   - *Random variables, discrete and continuous distributions*
   - *Expectation, moments of a distribution*
   - *Chebyshev's inequality, characteristic functions, transformations of random variables*
   - *Binomial, Poisson, uniform, and normal distributions*
   - *Normal approximation to the binomial distribution, examples*
   - *Exponential distribution, reliability, redundancy*
   - *Distributions of several random variables, moments of joint distributions, independence, covariance, correlation coefficient*

2. **Mathematical Statistics**
   - *Random sampling, parameter estimation, distribution of the sample mean, central limit theorem*
   - *Confidence intervals for the mean with known variance, sample variance, biased and unbiased estimators*
   - *Chi-squared distribution, confidence intervals for the variance, t-distribution, confidence intervals for the mean for small samples*
   - *Maximum-likelihood estimation, hypothesis testing*
   - *Detection, significance levels, test for the mean of a normal distribution with known variance, operating curves*
   - *Test for the mean of a normal distribution with unknown variance, testing a proportion*
   - *Test for the variance of a normal distribution, test for the difference of two means, non-parametric tests: sign test, test for arbitrary trends*
   - *Chi-squared test for the goodness of fit*
   - *Regression analysis*
   - *Correlation analysis*