Outline

Reference:

- Wackerly, Mendenhall, Scheaffer; Mathematical Statistics with Applications

Topics:

1. Probability Axioms; set functions (unions, intersections, complements); law of total probability; Bayes theorem; conditional probability and independence.

2. Counting rules; combinations, permutations, multinomial coefficients.

3. Discrete random variables; probability functions and distribution functions; expected values, variance and standard deviation. Applications and properties of Binomial, Poisson, hypergeometric, geometric models. Finding the distribution of a function of a random variable.

4. Continuous random variables; density functions and distribution functions; expected values, moments; variance and standard deviation. Properties of normal, uniform, exponential distributions. Finding the distribution of a function of a random variable.

5. Joint distributions, discrete and continuous; joint pmf and pdf, joint cdf; marginal distributions, conditional distributions; independent random variables; marginal and joint moments; covariance and correlation. Independent random variables and their properties; finding the distribution of functions of random variables, particularly sums of random variables; finding the distribution of order statistics. Specific distributions include the multinomial and bivariate normal distributions.

6. Finding sampling distributions related to the normal distribution; central limit theorem and normal approximation to binomial distribution.

7. Bias and mean square error of point estimators; finding and evaluating a point estimator; finding small-sample confidence intervals and large-sample confidence intervals for μ, p, σ^2, $\mu_1 - \mu_2$, and $p_1 - p_2$.

8. Properties of point estimators: efficiency, consistency, and sufficiency; Rao-Blackwell theorem and minimum-variance unbiased estimation (MVUE); finding point estimators using method of moments and method of maximum likelihood.

9. Small-sample hypothesis testing; large-sample hypothesis testing; calculating type-I error probability, type-II error probability, power and p-value of a statistical test; power of tests and the Neyman-Pearson Lemma; understanding the relationships between hypothesis-testing procedures and confidence intervals; Finding likelihood ratio tests for hypotheses.