Applied Mathematics/Statistics
Comprehensive Examination Guidelines

Part 1. Probability and Statistics (MAT 451-452-453)

This is a three-hour, **closed-book** exam. It covers analytical and theoretical concepts of probability and statistical inference. Formula sheet and tables will be provided.

Textbook: Mathematical Statistics with Applications, 7th edition, by D. Wackerly, W. Mendenhall and R. Scheaffer, Brooks-Cole, 2008.

1. **Sections 2.2--2.10**: Elements of probability. Review conditional probabilities and independent event properties and be able to sketch proof of Bayes' theorem and apply it to specific problems. Review probability problems assigned for homework.

   Sample problems: 2.6-2.8, 2.15-2.17, 2.29, 2.26, 2.31, 2.37, 2.49, 2.57, 2.72, 2.73, 2.94, 2.102, 2.111, 2.124, 2.135, 2.134

2. **Sections 3.3--3.9, 3.11**: Discrete probability models: Bernoulli, Binomial, Poisson, Geometric, negative binomial, hyper-geometric, and multinomial distributions. Techebysheff's Theorem. Review development of means, and variances for commonly used functions.

   Sample problems: 3.1, 3.2, 3.6, 3.12-3.13, 3.21, 3.23, 3.33 (remember these results), 3.38, 3.43, 3.70,3.71,3.72, 3.96, 3.105, 3.127, 3.153, 3.155, 3.170

3. **Sections 4.2--4.7, 4.9, 4.10**: Continuous probability Models: Uniform, Normal**,** the Gamma family of distributions (including the exponential & χ^2); the Beta-family, Student-t, and Fisher's F distributions. Be familiar with simple proofs from these sections, m.g.f and be able to identify them for the different distributions along with their mean and variance.

   Sample problems: 4.1, 4.7, 4.11, 4.16, 4.21, 4.22, 4.25, 4.26 (remember the results), 4.27, 4.30, 4.44, 4.45, 4.51, 4.58, 4.59, 4.64, 4.654.88, 4.89, 4.96, 4.104, 4.107(a), 4.133 (abc), 4.140, 4.147

4. **Sections 5.2--5.9**: Multivariate probability distributions.

   Sample problems: 5.4, 5.5, 5.7, 5.8, 5.9, 5.16, 5.17,5.18, 5.22, 5.26, 5.27, 5.37, 5.38, 5.48, 5.49, 5.52, 5.72, 5.80, 5.81, 5.89, 5.91, 5.92, 5.102, 5.103, 5.106, 5.119, 5.123, 5.124

5. **Sections 6.2--6.5**: Finding the probability distribution of a function of random variable, Functions of random variables, and transformation of variables.

   Sample problems: 6.1, 6.23, 6.24, 6.39, 6.46, 6.52

6. **Sections 7.2, 7.3, 7.5**: Sampling distributions of means, variances, proportions. Laws of large numbers, and know the Central Limit Theorem as applied to means and proportions

   Sample problems: 7.11, 7.43, 7.55, 7.73, 7.75, 7.77

7. **Sections 8.2--8.9, 9.2--9.7**: Estimation: Properties of estimators, methods of estimation, point and interval estimation. Be familiar with simple proofs from these sections. Be able to find M.L.E.'s for certain functions.

   Sample problems: 8.6, 8.8, 8.10, 8.12, 8.13, 8.21, 8.25, 8.41, 8.46, 8.47, 8.59, 8.61, 8.71, 8.83, 8.95, 8.103, 9.1, 9.2, 9.19, 9.30, 9.32, 9.37, 9.42, 9.45, 9.46, 9.59, 9.70, 9.71, 9.77, 9.80, 9.81, 9.82, 9.84.

8. **Sections 10.2--10.11**: Hypothesis testing. Neyman-Pearson lemma, most powerful tests, simple and composite hypothesis tests of means, variances and proportions. Review Type II error and power of a test and be able to find them for specific problems. Go over simple proofs and examples from this section. Be familiar with simple proofs from homework problems assigned in these sections.

   Sample problems: 10.2, 10.4, 10.19, 10.21, 10.25, 10.34, 10.37, 10.41, 10.42, 10.43, 10. 53, 10.55, 10.63, 10.69, 10.82, 10.88, 10.91, 10.93, 10.101, 10.107, 10.115