ECON 6331— Quantitative Economic Analysis: Probability and Statistics

Detailed Syllabus

General Advice: You first priority should probably be to make sure that you *really* understand all homeworks, exams, and examples. Do not read stuff that goes beyond what you need to know for the exam.

We covered parts of the textbook by Ramu Ramanathan [R]: Statistical Methods in Econometrics,Academic Press 1993, although you should only read the book as a supplement to your class notes. Sometimes Ramanathan is hard to understand and you shouldn't worry about that if you understand the material from class. In principle you are expected to know everything that was taught in class. This note briefly outlines the details of what was covered, although it is **not** exhaustive—it is intended to help you set priorities when you prepare.

Chapter 1: Introduction—I will not directly ask questions in this.

Chapter 2: Basic Probability. This is all important, except we didn't go into details about Sigma-fields and Borel-fields (I will not ask questions about Sigma- or Borel-fields) and you do not need to worry about what "probability really is." Be sure that you know the axiomatic definition of probability, proofs of probability relations will have to start from that.

Chapter 3: Most of Chapter 3 is very important. I only proved the transformation for increasing functions but you should be able to modify that to monotonely declining functions. We did not cover Characteristic functions [i.e., make sure to skip pp. 53–56], but made more use of Moment Generating Functions (MGF)—see handout. I will not ask about the Stieltjes Integral. We skipped "Approximate Mean and Variance of g(x)."

Chapter 4: From this chapter, I expect you to know the Binomial, Poisson, Uniform, Exponential, Normal, Log-normal, and Cauchy distributions. The most important of these is the Normal but there will be questions in other distributions as well.
You should be able to derive the Moment Generation Function for each of them, but I expect you to know the MGF for the normal by heart.

Chapter 5: We covered the joint distribution function and the joint (or bivariate) density and how we get the marginal density from the joint density. Covariance, correlation coefficient, Schwartz inequality (the proof in the book is more clumsy than the one we did in class). The notion of independence is used a lot—make sure you know what is meant by independence of distributions as opposed to independence of events. We didn't talk about the approximate mean or variance of multivariate distributions. The bivariate normal distribution is important, but the n-dimensional normal, of course, specialize to the bivariate (univariate) for n=2 (n=1). You need to know the formulas for bivariate and multivariate transformations, but we didn't prove the formulas related to those. Mixture distributions are not important for the exam, and we didn't cover multivariate characteristic functions (nor multivariate moment generating functions) except you should know that in the case of n independent variables it is the product of MGF of the univariate distributions. Marginal and conditional normal distributions are important. You should be able to derive them for the bivariate case, while you just need to know the formulas for the n-dimensional case. You should know the chi-square distribution although you don't have to know the density, but you should know how it is derived from iid standard normal distributions. You should also know idempotent matrices, orthogonal matrices, and the distribution of quadratic forms including Theorem 5.24 (the "if" part). (We will do 5.28 after Midterm 2.) We will not cover 5.13: Multinomial distributions. As always: You need only to know what I did in class.

Chapter 6: The derivations of the distributions of the empirical mean and variance of normally distributed variables are important. The Student's t-distribution is important but you don't need to know the density. Make sure you can follow the derivation of Theorem 6.3. Know the definition of the F-distribution, but I will not ask about the density. We didn't cover the material in this chapter from page 134 on.

Chapter 7: You are expected to know convergence in distribution and convergence in probability, but we didn't cover convergence in mean(r) and almost sure convergence. Theorem 7.1 and 7.2 are important—I didn't cover the proofs but you should be able to do simple proof such as Theorem 7.2 (a). You should also know Theorem 7.4 nut I will not ask about the proof. You should know the (Weak) Law of Large Numbers (you don't need to remember to say "weak"). You should know both Khinchin's version (not the proof) and Markov's (you should be able to prove that on using Chebychev's inequality). The Central Limit Theorem (CLT) is also important (remember just the Lindberg-Levy version for independent random variables). You should also know the multivariate version in Theorem 7.19. We did not prove the CLT's.

Chapter 8: We covered Chapter 8 up to page 166. Note that Ramanathan defines "efficiency" in terms of low MSE while I defined it in terms of low variance, either way is fine (make sure that you can show how the MSE of an estimator is a function of the variance and the bias).