Topics for Test 1, ISyE 6644 Online Masters in Analytics, Summer 2018

1. I've tried my best to make this list as complete as possible, but I may have missed a topic or two. That being said, you are responsible for everything that we did in class or homework.
2. As Georgia Tech students, you are expected to formulate problems and solution strategies which are more than mere rote regurgitation of material you learned in class. Thus, you shouldn't be surprised if some questions cover natural extensions of material from class.
3. I will supply all necessary tables, but you can feel free to use your own. You may need the standard normal tables, and there is a small, nonzero chance that you'll need t or chi^2 tables.

OK, so off we go! Here's the list of all of the stiff we've done so far…

1. Intro Material
   a. Definition of simulation
   b. Advantages and disadvantages of simulation
   c. History of simulation
   d. Typical questions and applications

2. Calculus, Probability, and Statistics Review
   a. **Calculus ←- I will *not* ask any test questions on the Calculus material (which was optional material for the course)**
      i. Basic definitions
      ii. Derivatives
      iii. Solving for zeros
      iv. Integration
      v. Numerical integration
   b. Probability Preliminaries
      i. Conditional probability
      ii. Independent events
      iii. Definition of random variable
      iv. Discrete RV's and probability mass function
      v. Continuous RV's and probability density function
      vi. Cumulative distribution function
   c. Simulating RV's (first pass)
      i. Discrete uniform distribution
      ii. General discrete distribution
      iii. Inverse Transform Theorem for continuous RV's

iv. Exponential (and other) continuous distributions via IVT.
v. Generating U(0,1)'s via desert island algorithm, including walk-through of pseudo-code.

d. Expected Values
   i. Definition
   ii. Discrete and continuous examples of expected value
   iii. Law of the Unconscious Statistician
   iv. Moments, central moments, variance, standard deviation
   v. Discrete and continuous examples of LOTUS
   vi. Moment generating function
   vii. Examples and properties of mgf's
e. Functions of a RV
   i. Discrete examples
   ii. Continuous examples
   iii. IVT methods (again) with examples
   iv. Relationship with LOTUS
f. Jointly distributed RV's
   i. Definition of joint cdf
   ii. Marginal cdf's
   iii. Joint and marginal pmf's
   iv. Joint and marginal pdf's
   v. Examples for discrete and continuous cases
   vi. Independent RV's
   vii. Conditional pmf's and pdf's
   viii. Conditional expectation ← no test questions on this (optional) material!
   ix. Double expectation E(E(Y|X)) = EY, including examples ← no test questions on this (optional) material!
g. Covariance and correlation
   i. Definitions
   ii. Relationship between independence and correlation
   iii. Examples
   iv. Miscellaneous properties (e.g., Var(X+Y), bounds on correlation, etc.)
h. Probability distributions
   i. Discrete distributions
      1. Bernoulli
      2. Binomial
      3. Geometric
      4. Poisson (including discussion on Poisson processes)
   ii. Continuous distributions
      1. Uniform
      2. Exponential (including memoryless property)

3. Erlang, Gamma distributions
4. Triangular
5. Normal (including Standard Normal)
6. Other sampling distributions (including chi-square, t, F, and various relationships with each other)

i. Limit theorems
   i. Linear combinations of independent normal (including distribution of sample mean)
   ii. Convergence in distribution
   iii. Law of Large Numbers
   iv. Central Limit Theorem for independent and identically distributed data.
   v. Examples

j. Statistics Tidbits
   i. Properties of sample mean and sample variance
   ii. Confidence intervals for the mean and variance

3. Hand Simulations

a. Monte Carlo integration
b. Determining π via simulation (dart tossing on a circle and sphere)
c. Single-server queue (including FIFO and LIFO service disciplines)
d. (s,S) inventory system
e. Simulating RV's (repeats some material from the Prob/Stats review)
f. Spreadsheet simulation (e.g., stock portfolio in Excel)

4. General Simulation Principles

a. Steps in a simulation study
b. List of various simulation definitions (e.g., event, system state, simulation clock, etc.)
c. Event-Scheduling vs. Process Interaction modeling approaches
d. How are events processed?
e. Future events list + extended example

5. Baby Arena Stuff

You'll only be responsible for the first few lessons, since you may not have even started the first Arena HW yet! In fact, the purpose of including any of this on the list is just my way of making you look at a little of the Arena material.

a. Layout of Arena screen (panels, modules, etc.)
b. Basic Process modules (CREATE, PROCESS, DISPOSE, DECIDE, ASSIGN, etc.)
c. SEIZE-DELAY-RELEASE inside of the PROCESS module.
d. Really simple examples, e.g. (partial list),

i. Single-server queue
ii. Parallel servers
iii. Easy DECIDE module manipulations (by chance, and by condition)