

## **Computer Simulation (CSE 40239/60239) - Study Guide for Test 1 - Spring 2006**

### **I. Exam format**

- A. Two parts -- closed book followed by open book (bring your copy of Banks to the exam)**
- B. The exam will consist of:**
  - 1. open ended essay questions asking you to discuss topics and ideas of the course**
  - 2. probability analysis problems**
- C. The exam will last the entire class period**

### **II. Preparation hints**

- A. Review all assigned readings:**
  - 1. Banks: Chapters 1-5, 7-8**
  - 2. Grimm: Chapters 1-3**
  - 3. Web pages assigned as homework or discussed in class**
    - a. Cellular automata**
    - b. Probability distribution applets**
    - c. Life is lognormal**
    - d. Repast materials**
    - e. Self similarity**
    - f. Quicunx and lognormal Dalton board**
    - g. Long tail distributions**
    - h. Long period generators**
  - 4. Three papers on random number generators**
    - a. Random Number Generation, L'Ecuyer**
    - b. Evaluating Pseudo-Random Number Generators, Bowman**
    - c. Good random number generators are (not so) easy to find, Hellekalek**
  - 5. Review notes on the biological problem described in class and the agent based modeling approach used in project one**
- B. Review probability calculations**
- C. Review your class notes - emphasis will be on material discussed in class**
- D. Review attached exam from a previous semester**

## Computer Simulation - CSE 439/598S

Exam 1 - 100pts (allocated approximately in proportion to space on the page)

Name \_\_\_\_\_

**I. Draw a "conceptual" picture of the following pmf's or pdf's. Add a few words about the characteristic shape and any other features of the pmf or pdf. Include major variations of the distribution's shape if any exist.**

**A. Binomial**

**B. Erlang**

**C. Weibull**

**D. Poisson**

**II. Provide 1) a comparison of the Normal and Lognormal distributions, and 2) a description of the process that could generate each (this was discussed in detail in class, including online applet demos).**

**III. The service time for a processor is exponentially distributed with mean 50 nanosec.**

**A. What is the probability that two batch jobs in the queue ahead of a current arriving job will each take less than 60 nanosec?**

**B. What is the probability that the two batch jobs ahead of the arriving job will finish their processing so that the arriving job can start in less than 120 nanosec? Assume that the lead job currently in the queue starts processing at the same time that as the arriving job enters the queue.**

**IV. A web site uses load balancing hardware to distribute requests to twenty identical parallel web servers running Apache/CGI/Perl. Each request requires one of several CGI/Perl programs to dynamically generate the response page. Web page requests arrive randomly at the web site at the rate of fifty every second. On average, each of the parallel servers can handle five requests/sec.**

**A. Compute the steady-state utilization of the servers.**

**B. Compute the steady-state number of busy servers.**

**V. A multiplicative congruential random number generator has a multiplier of 7 and a modulus of 101. Starting with a seed of 13, compute the first 3 random numbers in (0, 1).**

**VI. Transactions arrive at a large Oracle database server independently with interarrival times that are exponentially distributed. Two thousand transactions on average arrive per second and the server is capable of three thousand transactions on average per second, also with an exponential distribution. The database server has a front-end "transaction processing monitor" that functions like an infinite capacity queue.**

**A. Compute the steady-state time-average number of transactions in the system (both the database server and the transaction processing monitor times combined).**

**B. Compute the average time that a transaction spends in the system (both the database server and the transaction processing monitor times combined).**

**C. Compute the average time that a transaction spends in the transaction processing monitor (i.e, the queue).**

**D. Compute the time-average steady-state number of transactions in the transaction processing monitor (i.e, the queue).**

**VII. What is unique about the TT800 random number generator.**

**VIII. What can go wrong with random number generation (5 pts)**

**IX. We learned that a system consisting of a sequence of servers with exponential service times, collectively will have an Erang distribution (p. 176). We also learned that several Poisson processes can be pooled (merged) resulting in a new Poisson process with arrival rate equal to the sum of the individual Poisson processes (p. 193). Explain why this isn't a contradiction. (5 pts)**