IE551 SIMULATION AND STOCHASTIC MODELS (Spring 2010)

Assignment 6: Metamodels and Dynamic Systems

(20 bonus points)

Due date: Fri. 5/7 – submit to TA in paper form

The Project is due on the same day – submit Project Final Report and HW6 together

1. Metamodels

(a) Use Arena to simulate and develop a regression metamodel for an M/M/s system as described in Friedman and Pressman's 1989 paper. Follow the format of the paper by also using the same log-linear model. Use the same experimental conditions described in the paper, i.e., the 10 experiments. You are required to use statistics software to perform the regression, e.g., SAS, SPSS, or MINITAB. Hand in the Arena model and the data you used for the regression (i.e., values of simulation output variables), and results of the regression from the statistics software, and if applicable the program, e.g., SAS code, including the necessary logarithmic transformation of the original data set from simulation. Also provide your own conclusion on the results.

(b) Now add 5 more experiments with s = 3, and the corresponding conditions (to keep the same utilization levels). Use the data from all 15 experiments (including 10 from (a) and the additional 5 here with s=3) to develop the same set of metamodels and compare with your results in (a).

(c) After you have fit the log-linear model, fit the same simulation results to different regression models, e.g., higher-order polynomial model (quadratic or even higher order) or use some transformation of the data (e.g., square root, refer to textbooks on regression analysis). Find the best regression you can fit and compare the results with the log-linear model.

2. Dynamic Systems

A bank opens from 10am to 4pm. Customers arrive at the bank following a Poisson process with the following time-between-arrival distributions (in minute):

10am – 11am: EXP(3); 11am – 12pm: EXP(2); 12 pm – 1pm: EXP(1.2)
1pm – 2pm: EXP(2); 2pm – 3pm: EXP(3); 3pm – 4pm: EXP(2)

All customers join a single waiting line before they are served by one of the bank tellers. The service time with one teller follows a distribution of EXP(3). There are three tellers (including a supervisor) during the day. The supervisor can work at the counter but also has administrative tasks to do. You will need to decide on staffing schedule for how many tellers should be working for each hour (i.e., you can only change the number of tellers by the hour). The goal of staffing is to maintain an equilibrium system at all times (i.e., traffic density is always < 1) and make the supervisor work the least at the counter. Simulate the system and provide hourly customer TIS, TIQ, and teller utilization, by plotting them in graphs.