Exam Optimization of Business Processes
26 May 2008

This exam consists of **4** problems, each consisting of several questions.
All answers should be motivated, including calculations, formulas used, etc.
It is allowed to use 1 sheet of paper (or 2 sheets written on one side) with **hand-written** notes.
The minimal note is 1. Question 1 can give 3 points, the other questions 2.
The use of a calculator and a dictionary are allowed.

1. Consider a single-server queue. The arrivals occur according to a Poisson process with rate 0.8. The customers have an expected service time of 1.
a. Compute the expected waiting times for exponential and deterministic service time distribution.
Now the customer consists of two types: exactly half of the customers are of type 1. Type 1 customers have exponential service times, type 2 customers have deterministic service times.
b. Compute the expected waiting times for type 1 and type 2 customers under both priority rules and under FCFS.

2a. Formulate the aggregate production planning model.
b. Allow the possibility of backorders. Formulate again the aggregate production planning model.

3. Consider a 2-out-of-3 system.
a. Calculate ϕ and Φ for this system.
b. Calculate the expected time to failure for this system for exponentially distributed life times with average 5.
c. Calculate the expected time to failure for this system for gamma distributed life times with 2 phases and average 5.

4. A maternity ward in a small hospital has 2 beds. Arrivals are approximately Poisson, and patients who find both beds occupied go to another hospital.
a. Give a formula for the probability that the ward is full.
b. Explain why this probability is equal to the probability that new patients are blocked.
c. Let the average length of stay be 0.5 day. The occupancy is 70%. What are the arrival rate (including blocked patients) and the blocking probability?