NAME (please print): **SOLUTION**

Student ID Number: _____

Excerpts from MAN-335 Exam #2
Fall 1998

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Instructions:

- Count your pages. There should be 10 of them (including 1 chart).
- Closed-book, Closed-note exam, except for your one 8 ½" x 11" "crib sheet"
- Place your answers in the spaces provided
- Show all your work, using the white space on the exam. Use the back of the test pages if you need more space.
- Make sure to print your name and student I. D. number at the top of this page
- **DO NOT START UNTIL TOLD TO DO SO!**

You have one hour and 15 minutes to complete the exam. This is a long exam so use your time wisely.

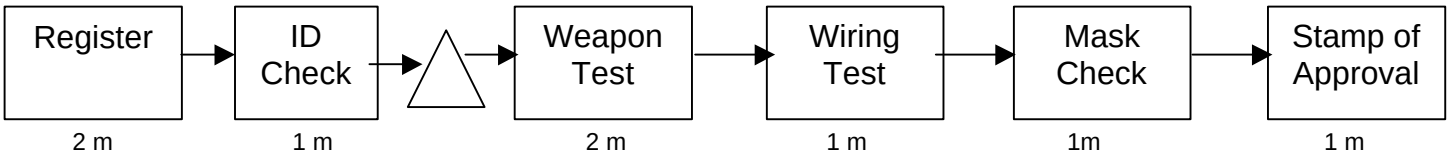
There are four questions worth a total of 100 points:

1) Short Multiple-choice questions (15 at 2 points each)
3) Service Design questions (6 at 4 points each)
4) Queuing questions (6 at 4 points each)
5) Linear Programming (4 at 5 points each)
6) You get 2 points for putting your name on the test

Good luck...

2) Service Process Redesign

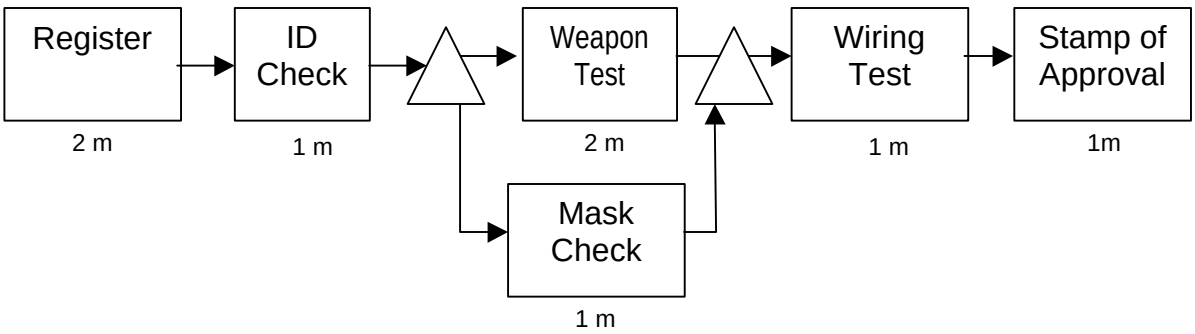
Use deterministic analysis for this section. In order to compete in a fencing tournament you have to go through the registration-approval process. You must be registered and sign waivers, have your ID checked to prove you have a fencing membership. Your weapons (foil, epee) need to be checked, your weapon wiring and cords get tested then you provide your mask to a tester who uses a tool to test durability. After everything is done you get a rubber stamp mark on the side of your mask. The process looks like this (Assume 1 clerk per operation):



1 Over the long run, the people waiting for Weapon test will:
   a. Increase
   b. Decrease down to zero
   c. Remain the same

2 This process has a cycle time of
   a. 1 minute
   b. 2 minutes
   c. 5 minutes
   d. 7 minutes
   e. 8 minutes

Some tournaments use this layout:



3 This process has a rush order flow time of
   a. 1 minute
   b. 2 minutes
   c. 5 minutes
   d. 7 minutes
   e. 8 minutes

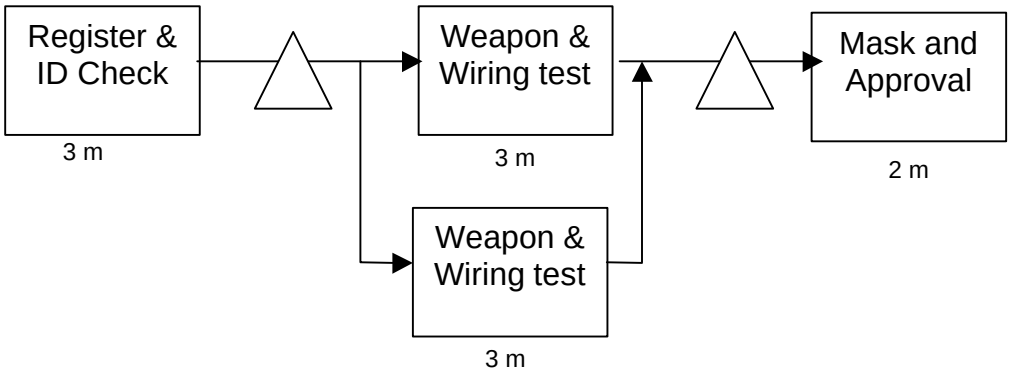
2.) Service Process Redesign (cont.)

4 Labor utilization at capacity for this process is approximately

a. 25%
b. 33%
c. 50%
d. 66%
e. 75%
f. 100%

$$\text{Utilization} = \frac{\text{Work Content}}{\text{Labor Available}} = \frac{8 \text{ min}}{6 \text{ clerks} * 2 \text{ mins/clrk}}$$

Other tournaments use this layout:



5 Labor utilization at capacity for this process is approximately

a. 25%
b. 33%
c. 50%
d. 66%
e. 75%
f. 100%

$$\text{Utilization} = \frac{\text{Work Content}}{\text{Labor Available}} = \frac{8 \text{ min}}{4 \text{ clerks} * 3 \text{ mins/clrk}}$$

6 Capacity of this system per hour is:

a. 5 people
b. 8 people
c. 11 people
d. 15 peopl
e. 20 people
f. 50 people

$$\text{Capacity} = \frac{1}{\text{CT=Mu}} = \frac{1}{3 \text{ mins/cust}} * \frac{60 \text{ mins}}{1 \text{ hr}}$$

3) Waiting Line Management

On his way to class Vicster gets a big coffee at the self-service "Urn-It-Yourself" coffee cart on 21st Street. It has one coffee urn. Vicster notices that people arrive in a random "poisson" distribution at an average rate of 4 people per minute. Being very observant, Vicster also notices that people take an average of 12 seconds to get a cup of coffee (serve themselves), and the service times seem exponentially distributed.

1 How many customers would the Vicster see on average waiting at the cart?
Lambda = 4 custs/min; Mu = 1 cust/12 secs * 60 secs/1 min = 5 custs/min;
Thus, rho=0.8 and M=1. This implies from the Q chart that Lq = 3.2 custs

2 What is the utilization of the urn?
Utilization = lambda/(mu*M) = 4 custs/min / [(1 cust/12 s/urn) *(60s/1 min)*1 urn] = 80%

3 How long does it take to get a full cup of coffee? (hint: service and wait time)
Wq = Lq/lambda = 3.2 custs / (4 cust/min * 1 min/60 s) = 48 s
FT = Sum(Wq's) + Sum (CT's) = 48s + 12s = 60 s

Today the Vicster is surprised to see two coffee urns at the "Urn-It-Yourself" coffee cart! (Note that this means that there is only ONE line serving two coffee urns)

4 How many customers would the Vicster see on average waiting at the cart?
Lambda = 4 custs/min; Mu = 1 cust/12 secs * 60 secs/1 min = 5 custs/min;
Thus, rho=0.8 and M=2. This implies from the Q chart that Lq = 0.15 custs

5 What is the utilization of the urns now?
Utilization = lambda/(mu*M) = 4 custs/min / [(1 cust/12 s/urn)*(60s/1 min)*2 urns] = 40%

6 How long does it take to get a full cup of coffee? (hint: service and wait time)
Wq = Lq/lambda = 0.15 custs / (4 cust/min * 1 min/60 s) = 2.25 s
FT = Sum(Wq's) + Sum (CT's) = 2.25s + 12s = 14.25 s