The Wharton School
The University of Pennsylvania

OPIM 631
Operations Management: Quality and Productivity
FINAL EXAM

Name: ______________________________ Cohort: _____

INSTRUCTIONS

The exam is open book / open notes and you may use a calculator. We will give points for correct answers, but will not subtract points for incorrect answers, so you should answer all questions.

In order to make your calculations as straightforward as possible, assume that, **unless stated otherwise**,

- there are sufficient parts or raw materials so that the initial operation(s) are never starved;
- processing times have negligible variability, and over time, workers neither speed up nor slow down, but work always at the processing rates given;
- there are no machine breakdowns;
- when there are buffers shown, they are large enough to accommodate any amount of inventory that would reside in those buffers under normal operations;
- travel time and time to transport parts from one operation to the next is negligible;
- all operations run with 100% yield, i.e., the operations produce no defective units; and
- all processes are in steady state (e.g., in the middle of the day); thus, you may ignore any start-up effects.

Exam Score

Course Grade

PART A

Mr. K's Hair Salon

Mr. K's is a very popular hair salon. It offers high-quality hair-styling and physical relaxation services at a reasonable price, so it always has unlimited demand. The service process includes five activities that are conducted in the sequence described below. (The time required for each activity is shown in parenthesis):

Activity 1: Welcome a guest and offer homemade herb tea. (10 minutes)
Activity 2: Wash and condition hair. (10 minutes)
Activity 3: Neck, shoulder, and back stress release massage. (10 minutes)
Activity 4: Design the hair style and do the hair. (25 minutes)
Activity 5: Check out the guest. (5 minutes)

Three servers (S1, S2, and S3) offer the services in a worker-paced line. The assignment of tasks to servers is the following:
S1 does Activity 1.
S2 does Activities 2 and Activity 3.
S3 does Activities 4 and Activity 5.

MRK1. Which server is the bottleneck of the process?

S1 can process 1/10 customers per minute.
S2 can process 1/20 customers per minute.
S3 can process 1/30 customers per minute.

S3 has the lowest capacity and is hence the bottleneck.

MRK2. What is the utilization of server 2?

Since we assume that there is unlimited demand, the flow rate is equal to the capacity of the process, i.e., 2 customers per hour.
The capacity of S2 is 3 customers per hour.
The utilization at S2 is 2/3= 66.7%.

MRK3. What is the average labor utilization of the servers? Assume the process operates at its capacity.

labor content = 10+20+30 = 60 min.
total idle time = 20+10 = 30 min.

Average labor utilization = 60/(60+30) = 2/3 = ***66.7%***

MRK4. Assume a wage rate of $18 per hour. What are the direct labor costs for one guest?

Direct labor costs = (Total wages) / (flow rate)
There are three employees with a wage of $18/hr implying that the total wages per hour are given by 18x3 = $54/hr.

We deduce that
Direct labor costs = 54/2 = $27

To increase the service rate, Mr. K's is considering two alternatives:

Alternative I: To hire a new employee to help any one (and only one) of the servers without changing the tasks performed by each server.
Alternative II: To redesign the assignment of tasks to servers. For this, Mr. K's is evaluating to reassign Activity 5 from S3 to S1.

MRK5. What would be the costs of direct labor of serving one guest under each of the two alternatives? Assume that the system operates at its capacity.

Under Alternative I, the additional worker would help S3 and under this case the bottleneck would become S2 with a capacity of 3 customers/hr.

Direct labor costs = (18*4)/3 = $24

Under Alternative II, S3 would still be the bottleneck but the new capacity of S3 will be of 60/25=2.4 customers/hr.

Direct labor costs = (18*3)/2.4 = $22.5