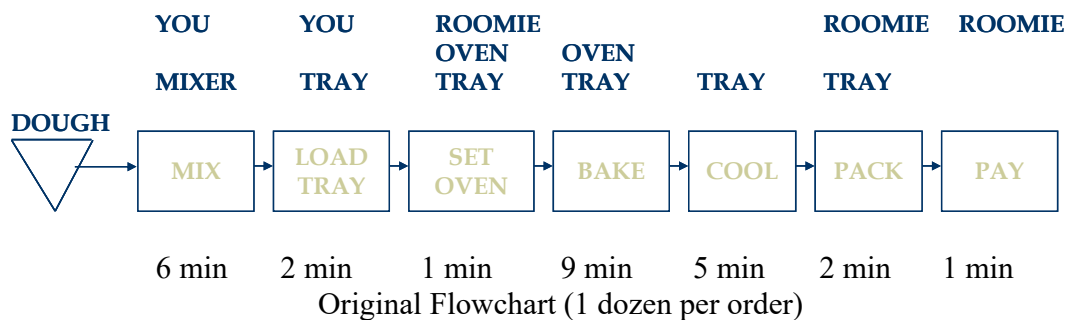# Individual Assignment 1 (2020 Spring, 85 points)

1. Suppose the data in the Kristen's Cookies case remains the same. There are many trays. (15 points)

Original Flowchart (1 dozen per order)

There are two ovens and each order is three dozen same type cookies. For each order, Kristen could mix the dough of three dozen cookies together, which still takes 6 mins. Assume loading and packing is for each dozen so each order will take 6 mins of loading time and 6 mins of packing time. Each oven can only bake 1 dozen each time, and it takes 1 min to set the oven for each dozen. Also assume that your roommate accepts payment for the order at the end of the process, as originally discussed in class.

In this case:

    a. Calculate the capacity of all three resources (Oven, Kristen, Roomie). (6 points)

    b. Which resource is now the bottleneck? What is the hourly capacity? (3 points)

c. Suppose Kristen and roomie are flexible in mixing, loading the tray, packing and paying, setting the oven, and they purchase a third oven, what is the hourly capacity now? (6 points)

2. An Amazon warehouse has space to store 1000 units of an average product. An average order consists of 4 units. Before robots, it takes a worker in average 10 minutes to collect all the products in an order and to pack it ready for delivery. Now, each robot only takes in average 2 minutes to collect and package for an order. Suppose there are 10 workers before and 20 robots now. (20 points)

   a. What is the capacity of a warehouse to fulfill orders before and now in orders/hour? (8 points)

   b. Suppose in average the warehouse space is 60% used before robots, and each worker is busy for 80% time. What is the flow rate? What is the average inventory time for a product? (6 points)

   c. Suppose in average the warehouse space is 90% used after robots (robots can survive in a fully occupied warehouse), and the robots are 90% utilized. What is the flow rate? What is the average inventory time for a product? (6 points)

3. UCL Haircuts employs 3 people to wash hair and 10 people to cut hair. Each customer has his/her hair first washed and then cut. It takes on average 8 minutes to wash a person's hair, 25 minutes to cut a man's hair, 45 minutes to cut a woman's hair. Suppose the arriving customers gender ratio between men and women is 3:1. (30 points)

    a. What is the capacity of the hair-washing stage? (2 points)

    b. What is the capacity of the hair-cutting stage? (2 points)

    c. What is the capacity of UCL Haircuts? (2 points)

    d. Suppose UCL Haircuts hires another hair washer, what is the new capacity of UCL Haircuts? (2 points)

    e. Suppose the newly hired hair washer can also do hair cutting, what is the capacity of UCL Haircuts now? (4 points)

Each year, UCL Haircuts have to hire 2 hair-cutters and 1 hair-washer to replace workers who have left (either been fired or resigned).

f. What is the average time a hair-washer and hair-cutter works for UCL Haircuts respectively? (2 points)

g. What is the average time a worker stay in UCL Haircuts? (2 points)

Each year, UCL Haircuts receives 18 hair-cutter applications but only hires 2 hair-cutters. On average, 50% of the applications are immediately rejected; and the other 50% are evaluated thoroughly before a hiring decision is made. There are on average 2 applications waiting to be evaluated thoroughly.

h. How long does a hair-cutter applicant who is eventually hired expect to wait before learning that she or he is hired? (2 points)

i. How long does a hair-cutter applicant who is eventually rejected expect to wait before learning that she or he is rejected? (2 points)

j. How long does a hair-cutter applicant expect to wait before learning the decision whether he or she has been hired? (2 points)
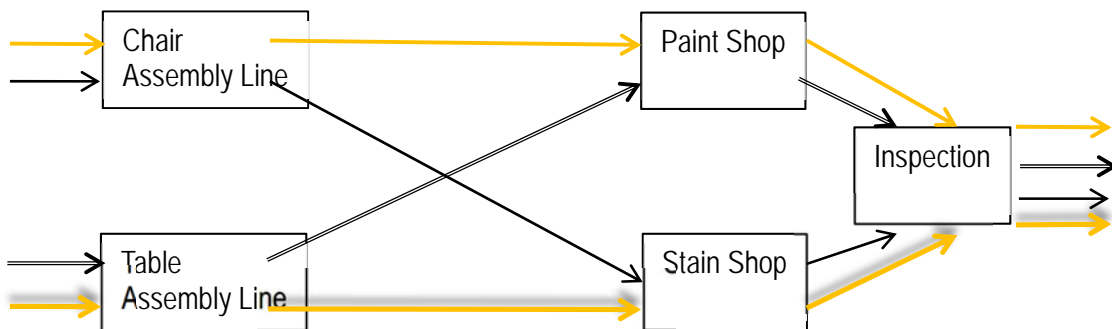
In a typical day, customer arrival rate is 16 persons/hr and they are all served. The average waiting time is 20 mins.

     k. How many customers are waiting in the queue in average (2 points)?

     l. How many customers are at the service in average (2 points)?

     m. How many male and female customers are in the shop in average (4 points)?

4. The Example 5 from the slides of Week 2. (20 points)

The hourly demand for the 4 products are: **6** Painted Chairs (PC), **9** Stained Chairs (SC), **8** Painted Tables (PB), **6** Stained Tables (ST). The processing times and other specifications are:

   – Chair Assembly Line produces one chair in **3** mins, after every **3** working hours, the line need be maintained for **30 mins**;

   – Table Assembly Line produces one table in **4** mins, it does not need be maintained;

   – It takes Paint Shop **3** mins to paint a chair, **5** mins to paint a table;

   – It takes Stain Shop **2** mins to stain a chair, **4** mins to stain a table;

   – Inspection takes **1** minute per unit, **90**% of the products (tables and chairs) are good.

a. Find the capacity of each resource (good units/hour)? Show the steps. (10 points)

b. Which resource is the bottleneck? (5 points)

c. What is the capacity of the factory in good units/hr? (5 points)