members per hour depending on how bad the case is. If there is some inventory available for every position (do not worry about the start-up), what is the expected output per hour? (Assume that each stage is independent and that it is equally likely that one, two, three, four, five, or six faculty members get processed each hour at each stage.)[5]

CASE: ANALYZING CASINO MONEY-HANDLING PROCESSES

Retrieving money from a mechanical slot machine is referred to as the *drop process*. The drop process begins with a security officer and the slot drop team leader obtaining the slot cabinet keys from the casino cashier's cage. Getting the keys takes about 15 minutes. The slot drop team consists of employees from the hard count coin room, security, and accounting. The slot drop leader, under the observation of a security officer and a person from accounting, actually removes the drop bucket from the slot machine cabinet. When the drop bucket is pulled from the slot cabinet, a tag with the proper slot machine number is placed on top of the coins to identify where that bucket came from when the weigh process begins. Retrieving the drop bucket takes about 10 minutes per slot machine. Once a cart is filled with buckets from 20 different slot machines, the drop team leader and security and accounting people deliver the buckets to the hard count room. The buckets are securely locked in the hard count room to await the start of the hard count process. Delivering and securing the buckets takes about 30 minutes per cart.

The hard count process is performed at a designated time known to gaming regulatory authorities. The hard count team first tests the weigh scale, which takes 10 minutes. The scale determines the dollar value, by denomination, for set weights of 10 and 25 pounds. These results are compared to calibration results, calculated when the scale was last serviced, to determine if a significant variance exists. If one does exist, the hard count supervisor must contact the contractor responsible for maintaining the scale and the controller's office. If no significant variance is found, the weigh process can continue.

Following the scale check, each drop bucket is emptied into the weigh scale holding hopper. Using information from the identification tag, the specific slot machine number from which the bucket originated is entered into the weigh scale computer. The weigh scale computer is programmed to convert the weight of coins, by denomination, into specific dollar values, which are recorded in the weigh journal along with the slot machine number. This weighing and recording process takes seven minutes per bucket. Once the scale has weighed the contents of the drop bucket, the coins automatically drop onto a conveyor belt, which transports them to wrapping machines. As the coins are wrapped, the rolls of coins drop onto another conveyor belt, which takes them to a canning station. Twenty-five silver dollars are wrapped in each roll at a rate of 10 rolls per minute.

At the canning station, the coin rolls are placed in metal or plastic cans that hold specific dollar amounts based on coin denomination. The cans are stacked to facilitate counting the wrapped coins. Silver dollar cans hold $1,000, or 40 rolls, and take five minutes to fill and stack. When the weigh process is completed, the weigh scale computer runs a summary report totaling the weight by denomination. These totals are recorded on the weigh/wrap verification report, which takes five minutes to produce.

When the wrap portion of the count is completed and all of the rolled coins have been canned and stacked, they are manually counted by denomination. These totals are also recorded on the weigh/wrap verification report. The variance in both dollar amounts and percentages, for each denomination, is calculated. Variances that exceed plus or minus 2 percent or are $1,000 or greater (whichever is less) must be investigated by the hard count supervisor, who writes an explanatory report. If no significant variances exist, all members of the hard count team sign the weigh/wrap verification report. To complete the hard count process, the casino cashier's cage is then notified that the slot drop is ready to be transferred into cage accountability. Manually counting and verifying the counts take on average two minutes per can.

In a process separate from the hard count, a cage cashier performs an independent count and verification, by denomination, of the wrap. If everything balances, the main bank cashier signs the weigh/wrap verification report, accepting the slot drop into cage accountability. It is at this point that the actual slot gross gaming revenue is recognized.

QUESTIONS

1. Draw a diagram of the drop process. How long should it take to empty 300 silver dollar slot machines?
2. Draw a diagram of the hard count process. How long should this process take to complete for 300 silver dollar slot machines? Assume that each slot machine has an average of 750 silver dollars when it is emptied.
3. The casino is considering the purchase of a second coin-wrapping machine. What impact would this have on the hard count process? Is this the most desirable machine to purchase?
4. What would be the impact of purchasing "electronic" slot machines that do not use coins?

CASE: KRISTEN'S COOKIE COMPANY (A)

You and your roommate are preparing to start Kristen's Cookie Company in your on-campus apartment. The company will provide fresh cookies to starving students late at night. You need to evaluate the preliminary design for the company's production process to figure out many variables, including what prices to charge, whether you will be able to make a profit, and how many orders to accept.

BUSINESS CONCEPT

Your idea is to bake fresh cookies to order, using any combination of ingredients that the buyer wants. The cookies will be ready for pickup at your apartment within an hour.

Several factors will set you apart from competing products such as store-bought cookies. First, your cookies will be completely fresh. You

will not bake any cookies before receiving the order; therefore, the buyer will be getting cookies that are literally hot out of the oven.

Second, like Steve's Ice Cream,[6] you will have a variety of ingredients available to add to the basic dough, including chocolate chips, M&M's, chopped Heath bars, coconut, walnuts, and raisins. Buyers will telephone in their orders and specify which of these ingredients they want in their cookies. You guarantee completely fresh cookies. In short, you will have the freshest, most exotic cookies anywhere, available right on campus.

THE PRODUCTION PROCESS

Baking cookies is simple: mix all the ingredients in a food processor; spoon out the cookie dough onto a tray; put the cookies into the oven; bake them; take the tray of cookies out of the oven; let the cookies cool; and, finally, take the cookies off the tray and carefully pack them in a box. You and your roommate already own all the necessary capital equipment: one food processor, cookie trays, and spoons. Your apartment has a small oven that will hold one tray at a time. Your landlord pays for all the electricity. The variable costs, therefore, are merely the cost of the ingredients (estimated to be $0.60/dozen), the cost of the box in which the cookies are packed ($0.10 per box; each box holds a dozen cookies), and your time (what value do you place on your time?).

A detailed examination of the production process, which specifies how long each of the steps will take, follows. The first step is to take an order, which your roommate has figured out how to do quickly and with 100 percent accuracy. (Actually, you and your roommate devised a method using the campus electronic mail system to accept orders and to inform customers when their orders will be ready for pickup. Because this runs automatically on your personal computer, it does not take any of your time.) Therefore, this step will be ignored in further analysis.

You and your roommate have timed the necessary physical operations. The first physical production step is to wash out the mixing bowl from the previous batch, add all of the ingredients, and mix them in your food processor. The mixing bowls hold ingredients for up to 3 dozen cookies. You then dish up the cookies, one dozen at a time, onto a cookie tray. These activities take six minutes for the washing and mixing steps, regardless of how many cookies are being made in the batch. That is, to mix enough dough and ingredients for two dozen cookies takes the same six minutes as one dozen cookies. However, dishing up the cookies onto the tray takes two minutes per tray.

The next step, performed by your roommate, is to put the cookies in the oven and set the thermostat and timer, which takes about one minute. The cookies bake for the next nine minutes. So total baking time is 10 minutes, during the first minute of which your roommate is busy setting the oven. Because the oven holds only one tray, a second dozen takes an additional 10 minutes to bake.

Your roommate also performs the last steps of the process by first removing the cookies from the oven and putting them aside to cool for 5 minutes, then carefully packing them in a box and accepting payment. Removing the cookies from the oven takes only a negligible amount of time, but it must be done promptly. It takes two minutes to pack each dozen and about one minute to accept payment for the order.

That is the process for producing cookies by the dozen in Kristen's Cookie Company. As experienced bakers know, a few simplifications were made in the actual cookie production process. For example, the first batch of cookies for the night requires preheating the oven. However, such complexities will be put aside for now. Begin your analysis by developing a process flow diagram of the cookie-making process.

KEY QUESTIONS TO ANSWER BEFORE YOU LAUNCH THE BUSINESS

To launch the business, you need to set prices and rules for accepting orders. Some issues will be resolved only after you get started and try out different ways of producing the cookies. Before you start, however, you at least want a preliminary plan, with as much as possible specified, so that you can do a careful calculation of how much time you will have to devote to this business each night, and how much money you can expect to make. For example, when you conduct a market survey to determine the likely demand, you will want to specify exactly what your order policies will be. Therefore, answering the following operational questions should help you:

1. How long will it take you to fill a rush order?
2. How many orders can you fill in a night, assuming you are open four hours each night?
3. How much of your own and your roommate's valuable time will it take to fill each order?
4. Because your baking trays can hold exactly one dozen cookies, you will produce and sell cookies by the dozen. Should you give any discount for people who order two dozen cookies, three dozen cookies, or more? If so, how much? Will it take you any longer to fill a two-dozen cookie order than a one-dozen cookie order?
5. How many food processors and baking trays will you need?
6. Are there any changes you can make in your production plans that will allow you to make better cookies or more cookies in less time or at lower cost? For example, is there a bottleneck operation in your production process that you can expand cheaply? What is the effect of adding another oven? How much would you be willing to pay to rent an additional oven?

PROBLEMS FOR FURTHER THOUGHT

1. What happens if you are trying to do this by yourself without a roommate?
2. Should you offer special rates for rush orders? Suppose you have just put a tray of cookies into the oven and someone calls up with a "crash priority" order for a dozen cookies of a different flavor. Can you fill the priority order while still fulfilling the order for the cookies that are already in the oven? If not, how much of a premium should you charge for filling the rush order?
3. When should you promise delivery? How can you look quickly at your order board (list of pending orders) and tell a caller when his or her order will be ready? How much of a safety margin for timing should you allow?
4. What other factors should you consider at this stage of planning your business?
5. Your product must be made to order because each order is potentially unique. If you decide to sell standard cookies instead, how should you change the production system? The order-taking process?