HW 3: Capacity Planning

ISE 453: Design of PLS Systems **Fall 2018**

Names: _____ Unity ID: _____ 30 Oct, due 8 Nov

1. A firm is currently considering designing a new production system to support an annual demand of 24,000. The costs for the new system are expected to be similar to a system that produced 15,000 units of the same product, operating for 50 weeks per year, 40 hours per week, at an annual operating cost of $300,000 and using capacity that had an initial investment of $100,000 with 25% salvage value after five years, a real cost of capital of 4%, and a utilization of 95%.

   (a) Assuming each unit will have a sales price of $30, that each unit will be worth 20% of its original value after eight hours, and that the price received from the sale of each unit will be reduced by 20% after 30 minutes of delay in filling an order, determine the best design for the new system, which corresponds to determining the best production rate and the best maximum finished goods inventory level for the system.

   (b) How would your design change if each unit lost 80% of its value after one hour?

2. Currently, the yield fraction of the six machines in the first workstation of a two-station serial production line (LO) is too low (0.75). The plant manager would like to know if it is a good idea to purchase new control software for each machine that will increase the yield fraction (HI) to approximately 0.94. The yield fraction of the second workstation is 0.90 and would be unaffected by the change. The following information is available: A single product is produced using a routing of stations 1 and 2. Each machine in stations 1 and 2 has a natural process time of exactly 12 and 6 minutes, respectively, and the machines never break down. The product's annual demand is expected to remain at 50,000 units per year for the next several years, and the line operates for one ten-hour shift per day, 250 days per year. Direct labor costs are $21.00 per hour, fully burdened, and one operator is assigned to each machine and is always paid for an entire shift. Raw material costs $4.25 per unit delivered and any scrapped material is not recovered. The investment cost of the software is $27,500 per machine, with no salvage value. You can assume that each machine that can be eliminated from the first station as a result of the

new software will have a salvage value of $50,000 and that each operator of an eliminated machine can be reassigned to a new production line that is just being constructed.

(a) What is the payback period (in years) associated with installing the software (i.e., replacing LO with HI) and minimizing the number of machines required at the workstation?

(b) What would be the payback period (in years) if, because of the plant's union contract, it will not be possible to reassign the operators of any of the machines that are eliminated?

3. The desired output rate from a workstation is 200 nondefective units per ten-hr shift. The units arrive to the workstation from an upstream workstation and the standard deviation of the time between arrivals is five minutes. On average, one in four units input to the workstation is scrapped. It takes exactly 11 minutes to process each unit, with a mean time to failure of 24 hours and the repair times are totally random with a mean of 3 hours.

(a) How many minutes per shift, on average, will be spent repairing the machines?

(b) What is the standard deviation of the effective processing time?

(c) Assuming each machine in the workstation requires 64 square feet of space and each unit waiting for processing requires 16 square feet of space, what is the minimum space needed for the workstation assuming that space will be provided for storage of twice the average number of waiting units? (The space between the machines, space for the operators, etc., can be ignored.)