

# ICA 12: Production System Design

ISE 453: Design of PLS Systems

Fall 2018

This ICA does not have to be submitted (see back for answers).

1. Assuming a facility operates for two eight-hour shifts per day, five days per week, fifty weeks per year, what is the hourly inventory carrying rate for a product if its interest and warehousing costs are expected to be average and it loses 20% of its value after six months?
2. Duplicate the spreadsheet below. You will need to create a VBA function for your spreadsheet that calculates  $q_{FG}$ .

Unit Sales Price ( $p$ , \$/q)	70	70	70
Unit Operating Cost ( $c$ , \$/q)	50	50	50
Unit Capital Cost ( $k$ , \$/q)	1	1	1
Discount Factor ( $g$ )	0.2	0.2	0.2
Inventory Carrying Rate ( $h$ )	0.01	0.01	0.01
Demand Rate ( $r_d$ , q/hr)	10	10	10
Effective Production Rate ( $r_e$ , q/hr)	15	15	12
Maximum FGI ( $q_{FG}^{max}$ )	20	10	20
Probability Out of FGI ( $\pi_0$ )	0.0001	0.005848	0.004444
Cycle Time ( $t_{CT}$ )	0.2	0.2	0.5
Average FGI Level ( $q_{FG}$ )	18.00421	8.128659	15.46661
Total Profit ( $TP$ , \$)	175.8171	180.8076	180.0231
Upper Bound on TP ( $TP_{UB}$ , \$)	190	190	190
Utilization ( $u$ )	0.666667	0.666667	0.833333

3. Use the spreadsheet developed above to solve this problem:

A new production system is designed with an effective capacity of 9 units per hour to support an annual demand of 15,000 units, operating 2000 hours per year, and will hold a maximum of two units in finished goods inventory. The annual capital and operating costs are estimated to be \$100,000 and \$500,000, respectively. Each unit will have a sales price of \$50, will be worth 20% of its original value after four hours, and a 20-minute delay in filling an order results in a 20% price discount. Estimate both (a) the expected total hourly profit and (b) the maximum possible profit possible if the design of the system were to be changed.