ICA 11: Service and MTO System Design

ISE 453: Design of PLS Systems — Fall 2018

The answers for questions 1 and 2 of this ICA should be submitted.

	A	B	C	D	E
1	Cost of Capital	(i)	4%		0.04
2	Economic Life	(N, yr)	5		5
3	Annual Demand	(q/yr)	10,000		10000
4	Sale Price	(p, $/q)	70		70
5	Investment Cost	(IV, $)	59,000		59000
6	Salvage Percentage		25%		0.25
7	Salvage Value	(SV, $)	14,750		=C5*C6
8	Eff. Investment Cost	(IV^{eff}, $)	46,877		=C5-C7*(1+C1)^(-C2)
9	Cost Cap Recovery	(K, $/yr)	10,530		=C8*(C1/(1-(1+C1)^(-C2)))
10	Annual Operating Hours	(H, hr/yr)	2,000		2000
11	Known Departure Rate	(r_d, q/hr)	5.00		=C3/C10
12	Estimated Utilization	(u)	0.95		0.95
13	Estimated Capacity	(r_e, q/hr)	5.26		=C11/C12
14	Capital Cost per Unit	(k, $/q)	1.00		=(C9/C10)/C13
15	Operating Cost	(OC, $/yr)	500,000		500000
16	Oper Cost per Unit	(c, $/q)	50		=C15/C3

$$IV^{\text{eff}} = IV - SV(1+i)^{-N}$$

$$K = IV^{\text{eff}}\left[\frac{i}{1-(1+i)^{-N}}\right]$$

$$TP = (p-c)\overbrace{(1-gt_{CT})}^{\text{time}}r_d - \overbrace{kr_e}^{\text{capacity}}$$

$$r_e^* = r_d + \sqrt{\frac{(p-c)gr_d}{k}}$$

$$g = \frac{px_g}{(p-c)t_g}$$

1. Assuming the unit price and operating costs are \$100 and \$40, respectively, determine the delay discount factor if a two-year delay results in a 20% price discount.
2. Determine the design (r_e) for a new service system that will be similar to an existing system of except for its expected demand and delay discount. The existing system had an annual demand of 1,500 customers last year, operating 2000 hours per year, and annual operating costs of \$50,000. Its investment costs were \$250,000, with 30% salvage after ten years at a 5% real cost of capital, and an average utilization of 0.8. The average revenue per customer was \$70. The new system is expected to face a demand of 2,500 units per year, with no yield loss, and each two-hour delay in servicing a customer will result in a 50% reduction in revenue.
3. Patients in the UK are willing to wait up to two years for hip replacement surgery, which that can receive for free from the NHS, but if the wait is longer, they are willing to pay \$10,000 to have the surgery performed at a private clinic. Assuming that the cost of the surgery is \$8,000 and is the same for the NHS and private clinics, discuss (in words) how a delay discount factor might be determined that the NHS could use in designing a new hip replacement program. What are the differences between your proposed factor and the factor used in class?