Case Study 6: Due 3/10/14

Economic Order Quantity with Defects

In *An economic order quantity model with defective items and shortages* by Eroglu and Azdemir, (*International Journal of Production Economics, Vol 106 (2007)*), the authors investigate the EOQ model in which 100% of the items received are not perfect. In it, they define the following:

D	demand rate in units per time	h	holding cost/unit/unit time
y	order size for each cycle	Π	backorder cost/unit/unit time
w	maximum backorder level allowed	θ	percentage of scrap items in the defective items
k	fixed order cost	x	screening rate in units per time
c	unit variable cost	d	unit screening cost
p	percentage of defective items in y	t_1	time to build up a backorder level of w units
s	unit selling price of good items	t_2	time to eliminate the backorder level of t_2 units
v	unit selling price of imperfect quality items $v < c$	t_3	time to screen y units per cycle
c_s	unit disposal cost for scrap items	t	cycle length

In their model, the expected total profit per unit time is given as

$$E(TPU) = sD + \frac{vD(1-\theta)E(p)}{E_1} - \frac{D(c+d+c_s\theta E(p))}{E_1} - \frac{kD}{yE_1} - \frac{hE_4 y}{2E_1} + hw - \frac{(h+\Pi)E_2 w^2}{2yE_1}$$

where,

$$E_1 = 1 - E(p)$$

$$E_2 = E\left(\frac{1-p}{1-p-D/x}\right)$$

$$E_3 = E((1-p-D/x)^2)$$

$$E_4 = \frac{D(2-D/x)}{x} + E_3$$

Given a company orders a product and expects the defective fraction, E(p), to be 5%. Demand is 15,000 units annually and they screen at a rate of 60,000 units annually (think of this as the QC check which is done much quicker than demand arrives). Order cost is \$400 per order, holding cost per year is \$4 per unit and shortage cost per year is \$6 per unit. Unit purchase, screening and disposal costs are \$35, \$1 and \$2, respectively. Selling price of good items is \$60 and sell price of imperfect items is \$25. The portion of scrap items in the defective items is 20% (so that the portion of scrap items in lot size y

is (0.05)(0.20)(y).

Optimum order quantity is given as

$$y^* = \sqrt{\frac{2kD(h+\pi)}{h\pi}}$$

and optimum maximum backorder allowed is

$$w^* = \frac{hy^*}{h+\pi}$$

ASSIGNMENT:

a)Calculate the expected total profit per unit.
b)What is the effect of different defective rates on optimal order quantity, backorder quantity and expected total profit per unit? Please display your results graphically as well as a brief description.