1. It is now January 1. A hardware distributor is reviewing his inventory policy for hammers, which have a relatively constant demand of 2000 units per month. The distributor buys the hammers from his supplier for $5 each and sells them for $10. Every time he places an order for replenishment a shipping and paper preparation cost of $500 is charged. The distributor's holding cost is 15% (annual) of his average investment in inventory. (The holding cost is $h$ = (0.15)(5) = $0.75 per hammer per year.)

   Answer each of the following independently ( one part does not depend on another).

a. The current inventory policy is to replenish the inventory every month. What is the total annual cost of this policy?
b. What is the optimum lot size when no shortages are allowed?
c. The distributor wants to order only at the beginning of the month, so the cycle time must be in whole months. What is the optimum lot size in this case?
d. Compute the annual profit on hammers for parts (a), (b), and (c).

| | | | |
|---|---|---|---|
| D | 2000 | per month | 24000 per year |
| c | 5 | dollars | |
| A | 500 | dollars | |
| i | 15% | per year | |
| h | 0.75 | per year | |

a. Q= 2000
TC = [AD /Q] + [hQ/2] + hs
TC= $ 6,750.00 per year
TC = $ 562.50 per month

b. Q* = $\sqrt{2AD/h}$

Q*= 5657 Units
T= 2.82842712 months
TC= $ 4,242.64 per year

c When T= 2
Q = 4000
TC= $ 4,500.00 per year
When T= 3
Q = 6000
TC= $ 4,250.00 per year

Better to order every three months

d Annual Profit: Profit per hammer*Demand Rate - Inventory Cost
Profit = (10 - 5)D - TC
Profit a $113,250
Profit b $115,757
Profit c $115,750

2. Consider again the hammer situation of problem 1, but rather than an instantaneous replenishment of inventory, the inventory is replaced by a production process that adds units to the inventory at a constant rate of 5000 units per month. Of course the process cannot be operated continually but must be started and stopped. Each time the process is begun a setup cost of $500 is expended. Using the information from problem 1, find the optimum lot size in this case.

| | | | |
|---|---|---|---|
| D | 2000 | per month | 24000 per year |
| c | 5 | dollars | |
| A | 500 | dollars | |
| i | 15% | per year | |
| h | 0.75 | per year | |
| P | 5000 | per month | 60000 per year |

$$Q^* = \sqrt{2AD/(1 - D/P)h}$$

Q*= 7303 Units

3. Light bulbs come in cases of 144 bulbs. A case of bulbs costs $200. An office building uses bulbs at an average rate of 1000 bulbs per month. The company that sells the bulbs charges $50 per delivery, regardless of the number of cases delivered. The management of the building uses a 15% annual carrying cost rate for inventory. No shortages are allowed.

a. Assuming the usage rate for bulbs is constant, how many cases of bulbs should be ordered in each delivery? Only whole cases can be ordered.

b. With this order quantity, how often will bulbs be delivered?

c. A long-standing policy has been to receive 10 cases per delivery. What is the annual cost penalty of this nonoptimum policy over the cost of the optimum policy?

| | | | | | |
|---|---|---|---|---|---|
| | D | 1000 | per month | 12000 per year | (bulbs) |
| | D | 6.94444444 | per month | 83.3333333 per year | (cases) |
| | c | 200 | dollars/case | | |
| | A | 50 | dollars | | |
| | i | 15% | per year | | |
| | h | 30 | per year | | |

$Q^* = \sqrt{2AD/h}$

| | | | |
|---|---|---|---|
| | Q* = | 16.67 | Cases |
| a. | Q | 17 | Cases rounded up |
| b. | T= | 2.448 | months |
| | T= | 0.204 | Years |
| c. | Q= | 10 | |

TC = [AD /Q] + [hQ/2] + hs

TC= $ 566.67 per year

Comparing to Q = 17

Q= 17

TC= $ 500.10

Penalty $ 66.57

Q= 16.67

TC= $ 500.00

Penalty $ 66.67

Homework from EOQ for several parts

Part a of problem

| Part | P1 | P2 | P3 | P4 | P5 |
|---|---|---|---|---|---|
| D (/wk) | 100 | 300 | 200 | 300 | 100 |
| A ($) | $1,000 | $1,000 | $1,000 | $1,000 | $1,000 |
| i/year | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| i/week | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |
| c | 100 | 200 | 300 | 400 | 500 |
| h | 0.5 | 1 | 1.5 | 2 | 2.5 |
| Q* | 632.46 | 774.60 | 516.40 | 547.72 | 282.84 |
| Frequency/wk | 0.16 | 0.39 | 0.39 | 0.55 | 0.35 |
| Freq./year | 7.91 | 19.36 | 19.36 | 27.39 | 17.68 |
| Inventory Inv. | 31623 | 77460 | 77460 | 109545 | 70711 |

Part b of problem

Optimum Inventory Policy with a Constraint on Order Frequency

| Product | P1 | P2 | P3 | P4 | P5 |
|---|---|---|---|---|---|
| D (per year) | 5000 | 15000 | 10000 | 15000 | 5000 |
| c ($/unt) | $ 100 | $ 200 | $ 300 | $ 400 | $ 500 |

| t | Lamba(t) | Q1(t) | Q2(t) | Q3(t) | Q4(t) | Q5(t) | F | Invest. |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 10 | 12 | 8 | 9 | 4 | 1160 | 5800 |
| 2 | 1000 | 316 | 387 | 258 | 274 | 141 | 36.68 | 183399 |
| 3 | 5000 | 707 | 866 | 577 | 612 | 316 | 16.40 | 410092 |
| 4 | 10000 | 1000 | 1225 | 816 | 866 | 447 | 11.60 | 579957 |
| 5 | 9500 | 975 | 1194 | 796 | 844 | 436 | 11.90 | 565273 |
| 6 | 9300 | 964 | 1181 | 787 | 835 | 431 | 12.03 | 559291 |
| 7 | 9320 | 965 | 1182 | 788 | 836 | 432 | 12.01 | 559892 |
| 8 | 9340 | 966 | 1184 | 789 | 837 | 432 | 12.00 | 560492 |

| | | | | | |
|---|---|---|---|---|---|
| Cucle time (wks) | 9.66 | 3.95 | 3.95 | 2.79 | 4.32 |
| Frequency(/yr) | 5.17 | 12.67 | 12.67 | 17.92 | 11.57 |

Part c of problem

| | P1 | P2 | P3 | P4 | P5 |
|---|---|---|---|---|---|
| T/sqrt(2) | 6.83 | 2.79 | 2.79 | 1.97 | 3.06 |
| T*sqrt(2) | 13.67 | 5.58 | 5.58 | 3.95 | 6.11 |
| T (power 2) | 8 | 4 | 4 | 2 | 4 |