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WHY I LIKE THE $(ax^2+b)/x$ FUNCTION?

INTRODUCTION

The $(ax^2+b)/x$ function is a very important function for production and operations managers and for reliability and maintenance experts, in other words: technical managers. They usually use this function to find the optimum solution to technical problems.

I would like to show some application of $(ax^2+b)/x$ function.

BASIC ECONOMIC ORDER QUANTITY (EOQ) MODEL

The EOQ model is used to identify the order size that will minimize the annual cost of ordering inventory and the sum of the annual cost of holding inventory. The unit purchase price is not generally included in the total cost. So the total cost (TC) is equal annual carrying cost (CC) plus the annual ordering cost (OC).

$$TC = CC + OC \tag{1}$$

The total cost curvel is illustrated in figure 1. The carrying cost is linearly related to order size, and the ordering cost is inversely and nonlinearly related to order size.

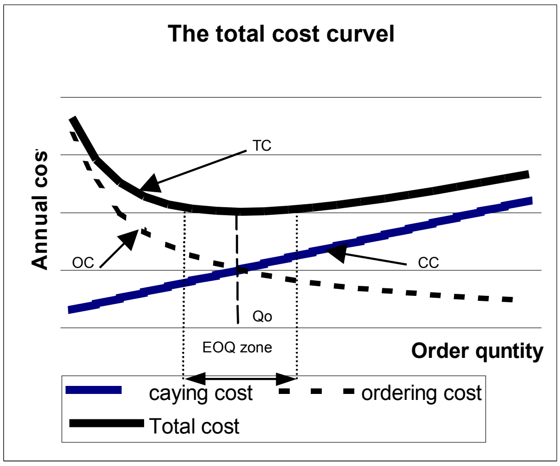

Fig. 1. The total cost curve

The total cost curve is U-shaped and that it reaches its minimum at the quantity where carrying and ordering cost are equal. An expression for the optimal order quantity (Q_0) can be obtained using a simple calculus:

$$Q_o = \sqrt{\frac{2DS}{H}} \tag{2}$$

where :

D — demand (units per year)
Q — order quantity (in units)
S — Ordering cost (Ft)
H — Carrying cost ($\frac{Ft \times year}{unit}$)

Quantity discounts

Are price reductions for large orders offered to customers to induce them to buy in large quantities. The buyer's goal in the case of quantity discounts is to select the order quantity that will minimize total cost. So the new total cost is the sum of carrying, purchasing and ordering cost. (The total costcurve is illustrated in figure 1.) Recall that in the EOQ model, determination of order size does not involve the purchasing cost.

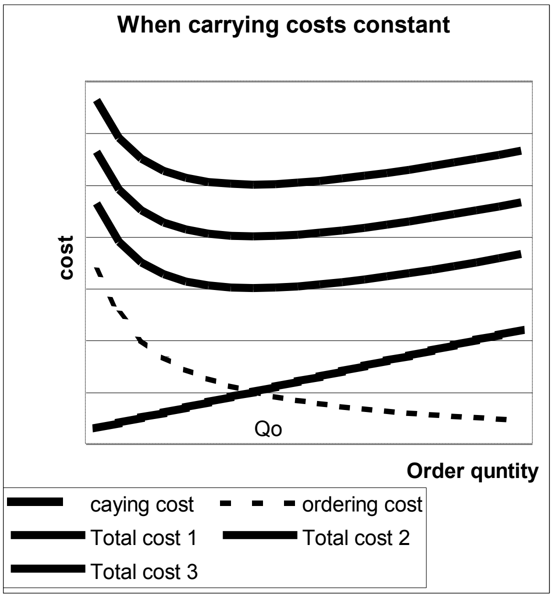

Fig. 2. When carrying costs are constants

A graph of the purchasing costs versus quantity would be a horizontal line. Hence , including purchasing costs would merely raise the total cost curve by the same amount at every point. That would not change the EOQ. So there are two general cases of the model:

- Carrying costs are constant and in the other carrying costs are stated as a percentage of purchase price. When carrying costs are constants, there will be a single EOQ that is the same for all of the cost curves. (figure 2.)
- When carrying costs are specified as a percentage of unit price, each curve will have a different EOQ. Since carrying costs are a percentage of price, lower prices will mean lower carrying costs and larger EOQs. (figure 3.)
- When carrying costs are specified as a percentage of unit price, each curve will have a different EOQ. Since carrying costs are a percentage.

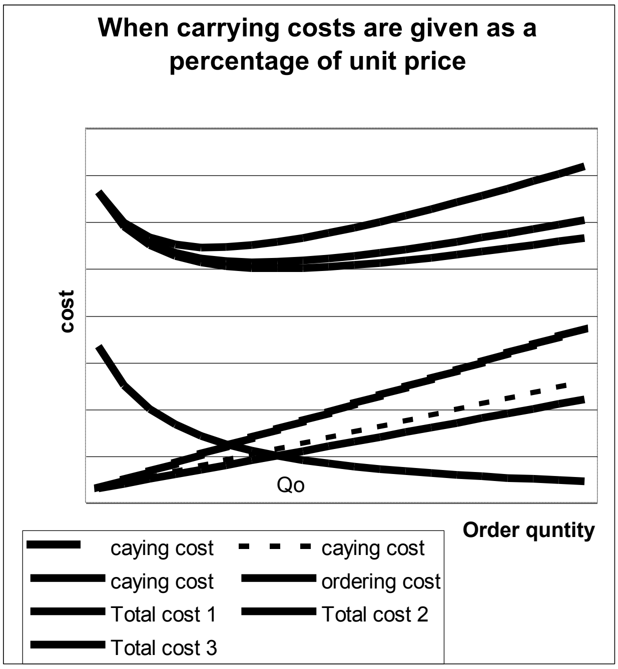

Fig. 3. When carrying costs are given as a percentage of unit price

MAINTENANCE

The goal of maintenance is to keep production systems in good working order at minimal cost. Decision makers have two basic options with respect to maintenance. One option is reactive and the other option is proactive.

Breakdown maintenance (reactive) is to deal with breakdowns or other problems when they occur. Preventive maintenance (reactive) is to reduce breakdowns through a program of lubrication, adjustment, cleaning, inspection, and replacement of worn parts. Decision makers try to make a trade-off between these two basic options that will result in minimizing their combined cost. Without preventive maintenance repair cost would be tremendous. Furthermore, hidden costs such as the cost of wages while equipment is not in service, and lost production, must be factored in. Also the cost of injuries or damage to other equipment or facilities, or to other units in production. However, beyond a certain point, preventive maintenance is wasteful. The best approach is to seek a balance between preventive and breakdown maintenance. The concept applies to maintaining production systems: Strike a balance between prevention cost and breakdowns cost. This concept is illustrated in figure 4.

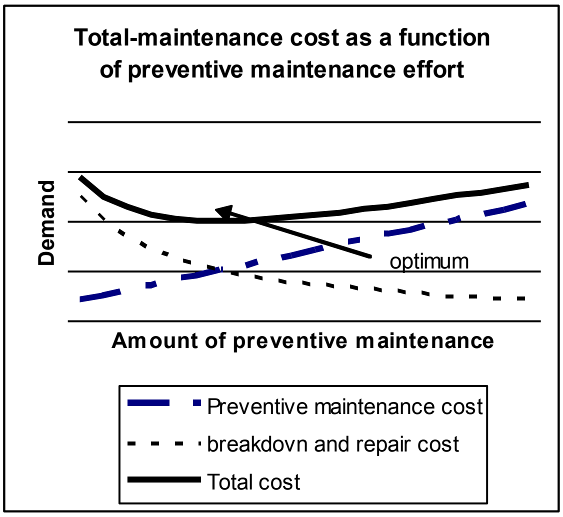

Fig. 4. Total-maintenance cost as a function of preventive maintenance effort

INSPECTION

To determine if a process is functioning as intended, or the final products does not contain more than a specified percentage of defectives. The main question is: How much to inspect and how often? The amount of inspection can range from no inspection whatsoever to inspecting each item numerous times. The majority of quality control application lies somewhere between the two extremes:

— Most require some inspection –this is not always can be expensive.

— The cost of letting undetected defectives slip through is high enough that inspection cannot be completely ignored.

The amount of inspection needed is governed by the costs of inspection and the expected costs of passing, defective items. (figure 5).

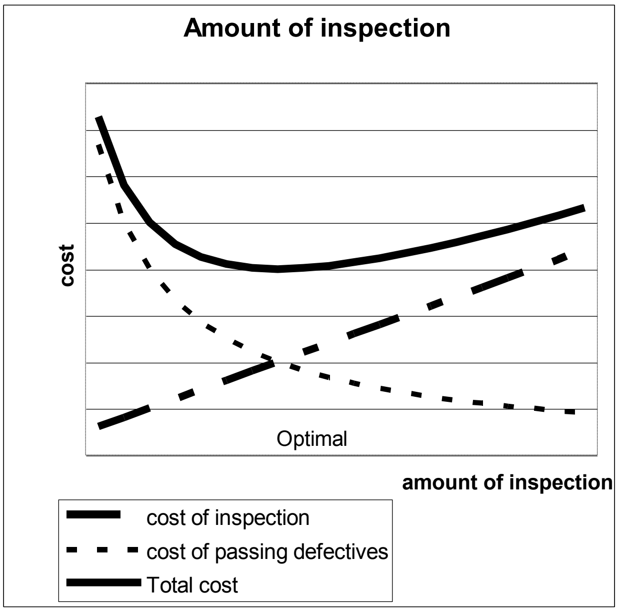

Fig. 5. Amount of inspection

These are only simple examples. The engineers every day use this function. This function is very simple and very usable. If we have a ruler we can optimize this function.

This is why , this is the reason engineers like using the $(ax^2 + b)/x$ function.

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