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Research paper



An Analytical Approach to Stock Issue Management

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Abstract

This paper is focused on developing an analytical formula for solving the stores issue management problem under First In First Out (FIFO) and Last In First Out (LIFO) methods of Queuing theory. Since the stores issue process follows the Queuing model for issuing materials to various departments, to arrive the conclusion price for closing stock it is necessary to update the balance stock with new arrivals and latest issues. In order to calculate the issue price which is issued from different lot, holding different price is actually a very big problem. To overcome this difficulty and to compute the closing stock price in the issue register the formulae get used. Moreover this study emphasis on issue orders with respective prices from various lots.

Keywords: *FIFO; LIFO; Stock Issue Management; Queue*

1. Introduction

1.1 Stock Issue Management

The investment in materials constitutes a major portion of current assets so there should be a separate stores department to exercise stores control. It is an amazing fact that in many industrial organizations while a most rigid control over cost exists, little or no attention is paid to materials. It is not desirable. Materials to become cash on sale of the finished products represent an equivalent amount of cash, so it is desirable to have an efficient and well equipped stores department to exercise an effective material control. It is very much essential to send requisition for materials for replenishment in time so that the production may not hamper for want of materials. The storekeeper is to see that neither production is adversely affected nor there is unnecessarily blocking of capital due to overstocking of materials. To avoid this, maintain re-order level, economic order quantity (EOQ) and the maximum and minimum quantity which is authorized to store in respect of each kind of material Materials are kept in stores so that the store keeper may issue them whenever these are required by the production departments by giving the proper material requisition from duly signed by the authorized signatory. The requisitions received are serially numbered and the details relating to quantity issued are entered in the issue column. After this, the cost is filled and entries are made in the store ledger and the job ledger. Sometimes materials may be issued in excess of the requirements if a particular job to facilitate convenient handling. In such a case, the full quantity issued is charged to the job and surplus materials of that job may either be returned to stores or transferred to other jobs. Transfer of surplus materials from one job to another job should be avoided as far as possible. The main objection is that the record for the transfer may not be made and actual material cost for job may be inaccurate.

1.2 Queuing Models:

The Queuing theory be indebted its development to A.K.Erlang. Queue are ever-present in all types of business problems. Queue forms because of

(a) There is too much demand on the facilities so that there is an excess of waiting time
(b) There is too less demand, in which case there is too much idle facility time or too many facilities.

In either case, the problem is to either schedule arrivals or provides proper number of facilities or both so as to obtain an optimum balance between the costs associated with waiting time and idle time.

1.2.1 Classification of Queuing Models:

- Probabilistic Queuing Model
- Deterministic Model
- Mixed Queuing Model

Among the abovementioned models, Deterministic Queuing model is employed to determine the price level of the materials under various circumstances like purchase, issue and return of materials with different lot size and respective price levels.

2. Valuing Material Issues:

Theoretically the value includes all expenses up to the point of placing materials at the processing plant. Therefore the value includes the invoice price less than the trade discount, insurance on incoming materials and expenses of purchase, receiving, storing and record keeping a carriage from and stores up to the process plant. Hence in order to calculate correct costs of jobs or work orders all these types of expenses should be included in value of materials issued.

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2.1 Methods of pricing material issues:

The purchase prices of materials fluctuate on account of changes in the product prices, buying from different suppliers and on account of quantity discounts. Because of pricing fluctuations, the stock may include several lots of the same material purchased at different prices. When these materials are issued to production, it is important to consider the correct price at which these materials are changed to production. Various methods in use are

- First In First Out
- Last In First Out
- Simple Average
- Weighted Average

If the same purchase price is paid for all lots of a given material, no difficulty would be encountered in the valuation of material when it is used to jobs. However, that is not the case and the price always changes in accordance with the market conditions. The stock of a given material will consists of purchases made at different times at different prices which possess problems to what should be the price when the material is issued. There are many methods of pricing material issues, among them, the most important are First In First Out and Last In First Out.

2.1.1 First In First Out:

- Under this method material is issued from the oldest consignment on hand and priced at the cost at which that consignment was placed in the stores. In other words materials received first are issued first. The units in the opening stock of materials are treated as earliest and they are issued first, the units from the first purchase issued next and so on until the units left in the closing stock materials are valued at the latest cost of purchases.
- Materials are issued in the chronological order as well as in the cost price in this method. As per the store keeping principle oldest items should be issued first to avoid deterioration. This method can be used for slow moving items of high unit costs. Closing stock represent the market price. In order to calculate that, shortages are considered as issues and surplus are treated as receipts.
- This method is most suitable in times of falling prices because the issue price of materials to jobs will be high while the cost of replacement of materials will be very low. But in the case of rising prices this method is not suitable because the issue price of materials to production will be low while the cost of replacement of materials will be high.

2.1.2 Last In First Out:

- Against the FIFO method the issues under are priced in the reverse order of purchase i.e. the price of the latest available consignment is taken. This method is also called as Replacement cost method because materials are issued at the current cost of jobs except when purchases are made long ago.
- This method is suitable in times of rising prices because material will be issued from the latest consignment at a price which is closely related to the current price levels. Valuing material issues at the price of the latest available consignment will help the management in fixing the competitive selling prices of the products.
- In the case of rising prices LIFO method of pricing issues is suitable because materials are issued at the current market prices which are high. This method thus helps in showing a lower profit because of increased charged to production during periods of rising prices and lower profit reduces burden of income tax. Here the issue price reflects the market price. In this method the closing stock will not reflects the market price. Hence the cost of one job may be different with another job started after sometime because of supply of stock from the next lot.
- Like FIFO, comparison between one job and the other job will become difficult because one job started a few minutes after another of the same type many bear a different charge for materials consumed, merely because the earlier job exhausted the supply of the lower priced or higher priced materials in stock.

3. Mathematical formula for material pricing:

Material handling procedures will be further classified under various cases on the basis of the receipt and issue cum material return.

3.1 Cases for handling material pricing:

1. No purchase no requirement
2. No purchase with requirement
3. No purchase further requirement
4. Purchase without requirement
5. Purchase with requirement
6. Purchase with further requirement
7. When goods returned

(a) Return from the first issue without purchase
(b) When return from further issue without purchase
(c) When return with purchase
(d) When return from further issue with purchase

8. When goods shortages occurred during delivery, it will be considered as loss and deducted from the balance and the treatment will be followed as issue of material.

3.2 Formula construction for each case under FIFO:

The following notations are used in constructing the formula:
Let Q_0 and P_0 be the opening quantity and its respective price and B_0 be the opening balance.
$Q_1, Q_2, Q_3 \ldots, Q_n$ are quantities purchased;
$P_1, P_2, P_3 \ldots, P_n$ be the corresponding prices
$B_1, B_2, B_3 \ldots, B_n$ be calculated balance stock with n effects;
$R_1, R_2, R_3 \ldots, R_n$ be requirements;
$I_1, I_2, I_3 \ldots, I_n$ be issues followed by requirements;
$\bar{\imath}_1, \bar{I}_2, \bar{I}_3 \ldots, \bar{I}_n$ be quantity returned;

Opening balance $B_0 = Q_0$.

Case 1: No purchase no requirement.

$$Q_1 = 0 \text{ and } R_1 = 0 \therefore B_1 = B_0 = Q_0$$

Case 2: No purchase with requirement R_1.

$$I_1 = \begin{cases} R_1 \times P_0 & if\ R_1 \le Q_0 \\ 0 & if\ R_1 > Q_0 \end{cases} \quad \text{and}$$

$$B_1 = \begin{cases} Q_0 - R_1\ if\ R_1 \le Q_0 \\ B_0\ if\ R_1 > Q_0 \end{cases}$$

Case 3: No purchase and further requirement R_2.

$$I_2 = \begin{cases} R_2 \times P_0\ if\ R_2 \le Q_0 - R_1 \\ 0 \qquad if\ R_2 > Q_0 - R_1 \end{cases} \quad \text{and}$$

$$B_2 = \begin{cases} Q_0 - R_1 - R_2\ if\ R_2 \le Q_0 - R_1 \\ 0 \qquad\qquad\qquad if\ R_2 > Q_0 - R_1 \end{cases}$$

Case 4: With purchase Q_1 and without requirement

$I_1 = 0$ and $B_1 = B_0 + Q_1$

Case 5: With purchase Q_1 and with requirement R_1.

$$I_1 = \begin{cases} R_1 \times P_0 & ; R_1 \le Q_0 \\ Q_0 \times P_0 + (R_1 - Q_0)P_1 & ; Q_0 < R_1 \le Q_0 + Q_1 \\ 0 & ; R_1 > Q_0 + Q_1 \end{cases}$$

and

$$B_1 = \begin{cases} Q_1 + (Q_0 - R_1) & ; R_1 \le Q_0 \\ (Q_1 - (R_1 - Q_0)) & ; Q_0 < R_1 \le Q_0 + Q_1 \\ B_0 + Q_1 & ; R_1 > Q_0 + Q_1 \end{cases}$$

Case 6: With purchase Q_1 and further requirement

$$I_2 = \begin{cases} R_2 \times P_0 & ; R_2 \le Q_0 - R_1 \\ (Q_0 - R_1)P_0 + (R_2 - (Q_0 - R_1))P_1 & ; Q_0 - R_1 < R_2 \le Q_0 - \\ 0 & ; R_2 > Q_1 + (Q_0 - R_1) \end{cases}$$

and

$$B_2 = \begin{cases} Q_1 + (Q_0 - R_1 - R_2) & ; R_2 \le Q_0 - R_1 \\ (Q_1 + (Q_0 - R_1) - R_2) & ; Q_0 - R_1 < R_2 \le (Q_0 - R_1) + Q_1 \\ Q_1 + Q_0 - R_1 & ; R_2 > Q_1 + (Q_0 - R_1) \end{cases}$$

Case7: When goods get returned, the following sub cases are there;

(1) If the return is from the first issue (I_1) without purchase then $B_1 = Q_0 + \bar{I}_1$

(2) If the return is from further issue (I_2) without Purchase then $B_1 = Q_0 + \bar{I}_1 + \bar{I}_2$

(3) If the return $\bar{I}_1$ is with purchase or after issue then $B_2 = B_1 + \bar{I}_1$

(4) If the return $\bar{I}_2$ is with purchase and further issue then $B_2 = B_1 + \bar{I}_1 + \bar{I}_2$

3.2 Formula construction for each case under LIFO:

Opening balance $B_0 = Q_0$.

Case 1: No purchase no requirement.

$Q_1 = 0$ and $R_1 = 0 \therefore B_1 = B_0 = Q_0$

Case 2: No purchase with requirement R_1.

$$I_1 = \begin{cases} R_1 \times P_0 & if\ R_1 \le Q_0 \\ 0 & if\ R_1 > Q_0 \end{cases}$$ and

$$B_1 = \begin{cases} Q_0 - R_1 & if\ R_1 \le Q_0 \\ B_0 & if\ R_1 > Q_0 \end{cases}$$

Case 3: No purchase and further requirement R_2.

$$I_2 = \begin{cases} R_2 \times P_0 & if\ R_2 \le Q_0 - R_1 \\ 0 & if\ R_2 > Q_0 - R_1 \end{cases}$$ and

$$B_2 = \begin{cases} Q_0 - R_1 - R_2 & if\ R_2 \le Q_0 - R_1 \\ B_0 - R_1 & if\ R_2 > Q_0 - R_1 \end{cases}$$

Case 4: With purchase Q_1 and without requirement

$I_1 = 0$ and $B_1 = B_0 + Q_1$

Case 5: With purchase Q_1 and with requirement R_1.

$$I_1 = \begin{cases} R_1 \times P_1 & ; R_1 \le Q_1 \\ Q_1 \times P_1 + (R_1 - Q_1)P_0 & ; Q_1 < R_1 \le Q_1 + Q_0 \\ 0 & ; R_1 > Q_0 + Q_1 \end{cases}$$

and

$$B_1 = \begin{cases} Q_0 + (Q_1 - R_1) & ; R_1 \le Q_1 \\ (Q_0 - (R_1 - Q_1)) & ; Q_1 < R_1 \le Q_1 + Q_0 \\ B_0 + Q_1 & ; R_1 > Q_0 + Q_1 \end{cases}$$

Case 6: With purchase Q_1 and further requirement R_2.

$$I_2 = \begin{cases} R_2 \times P_1 & ; R_2 \le Q_1 - R_1 \\ (Q_1 - R_1)P_1 + (R_2 - (Q_1 - R_1))P_0 & ; Q_1 - R_1 < R_2 \le Q_1 - R_1 + Q_0 \\ 0 & ; R_2 > Q_0 + (Q_1 - R_1) \end{cases}$$

and

$$B_2 = \begin{cases} Q_0 + (Q_1 - R_1 - R_2) & ; R_2 \le Q_1 - R_1 \\ (Q_0 + (Q_1 - R_1) - R_2) & ; Q_1 - R_1 < R_2 \le (Q_1 - R_1) + Q_0 \\ Q_0 + Q_1 - R_1 & ; R_2 > Q_0 + (Q_1 - R_1) \end{cases}$$

Case7: When goods get returned all sub cases are similar to FIFO

3.3. Example:

From the following particulars prepare stores ledger account under FIFO and LIFO method:

Jan 01'2018 Opening Stock - 200 units @ Rs.10 each
05 purchases - 500 units @ Rs.12each
20 Issued - 300 units
Feb 05 Issued - 200 units
07 Purchased - 150 units @ Rs.12.5each
10 Issued - 150 units
15 Goods returned - 50 units @ Rs.12 each
On Feb 8 th2018, stock verification revealed a shortage of 10 units.

Solution:

Table 1: Convention method- First in First Out

Date	Receipts			Issues			Balance		
	Unit	Price	Amount	Unit	Price	Amount	Unit	Price	Amount
1.1.18	-	-	-	-	-	-	200	10	2000
5.1.18	500	12	6000	-	-	-	200 500	10 12	2000 6000
20.1.18	-	-	-	300 units			400	12	4800

				200 100	10 12	2000 1200			
5.2.18	-	-	-	200	12	2400	200	12	2400
7.2.18	150	12.5	1875	-	-	-	200 150	12 12.5	2400 1875
8.2.18	-	-	-	Shortage 10 units	12	120	190 150	12 12.5	2280 1875
10.2.18	-	-	-	150	12	1800	40 150	12 12.5	480 1875
15.2.18	50	12	600	-	-	-	40 150 50	12 12.5 12	480 1875 600
Total	500+ 150+ 50	12 12.5 12	6000 1875 600	300(200+100)+ 200+ 10+ 150	10 12 12 12 12	2000 1200 2400 120 1800	40 150 50	12 12.5 12	480 1875 600

Solution:

Table 2: First in First out method

Date	Receipts			Issues			Balance		
	Unit	Price	Amount	Unit	Price	Amount	Unit	Price	Amount
1.1.18	-	-	-	-	-	-	$B_0 = Q_0 =$200	10	2000
5.1.18	Q_1= 500	12	6000	-	-	-	$B_1 = B_0 + Q_1 =$200+ 500	10 12	2000+ 6000
20.1.18	-	-	-	R_1=300 Q_0<R_1< Q_0+Q_1I_1=200+ 100	10 12	2000+ 1200	B2=Q_0+Q_1-R_1=200+500-300= 400	12	4800
5.2.18	-	-	-	R_2=200 R_2< B_2 I_2=200	12	2400	B_3=B_2-200 = 200	12	2400
7.2.18	Q_2= 150	12.5	1875	-	-	-	B_4=B_3+Q_2=200+150	12 12.5	2400 1875
8.2.18	-	-	-	Shortage 10 units R_3= 10 R_3<B_3+Q_2 I_3 =10	12	120	B_5=(B_3-R_3)+Q_2=(200-10)+150=190 150	12 12.5	2280 1875
10.2.18	-	-	-	R_4=150 R_4<(B_3-R_3)+Q_2 I_4= 150	12	1800	B6=(B_3-R_3-R_4)+Q_2(190- 150)+150=40+ 150	12 12.5	480 1875
15.2.18	Q_3= 50	12	600	-	-	-	B_7=B_6+ Q_3= 40+ 150+ 50	12 12.5 12	480 1875 600
Total	500+ 150+ 50	12 12.5 12	6000 1875 600	300(200+100)+ 200+ 10+ 150	10 12 12 12 12	2000 1200 2400 120 1800	40+ 150+ 50	12 12.5 12	480 1875 600
Closing Stock	700	--	8475	660	--	7520	240	--	2955

Table 3: Last in First Out method:

Date	Receipts			Issues			Balance		
	Unit	Price	Amount	Unit	Price	Amount	Unit	Price	Amount
1.1.2018	-	-	-	-	-	-	$B_0 = Q_0$ =200	10	2000
5.1.2018	Q1= 500	12	6000	-		-	$B_1=B_0+Q_1$= 200+ 500	10 12	2000 6000
20.1.'18	-	-	-	R_1=300 $R_1<Q_1$ I_1=300	12	3600	$B_2=B_0+$ (Q_1-R_1)=200 +200	10 12	2000 2400
05.02.18	-	-	-	R_2=200 $R_2=(Q_1-R_1)$ I_2=200	12	2400	$B_3=Q_0+$ $(Q_1-R_1-R_2)$ = 200	10	2000
07.02.18	Q_2= 150	12.5	1875	-	-	-	$B_4= B_3+Q_2$= 200+ 150	10 12.5	2000 1875
08.02.18	-	-	-	Shortage 10 units $R_3=I_3$=10	12.5	125	$B_5=B_3+$ (Q_2-R_3)= 200+ 140	10 12.5	2000 1750
10.02.18	-	-	-	R_4=150 $R_4>(Q_2-R_3)$ I_4=140+ 10	12.5 10	1750 100	$B_6=(B_3-10)= (Q_0-10)$=200-10=190	10	1900
15.02.18	Q_3= 50	12	600	-	-	-	$B_7=B_6+Q_3$= 190+ 50	10 12	1900 600
Total	500+ 150+ 50	12 12.5 12	6000 1875 600	300+ 200+ 10+ 140+ 10	12 12 12.5 12.5 10	3600 2400 125 1750 100	190+ 50	10 12	1900 600
Closing Stock	700	--	8475	660	--	7975	240	--	2500

4. Conclusion:

This analytical method includes all of the aforesaid conditions. So it is proved itself that it is an opt method for stores issue management under FIFO and LIFO. The cost price is calculated in par with the market price according to LIFO principle and depends upon the nature of material the issue was happened under FIFO principle, all can easily be incorporated with analytical approach. Calculations should be made each time when the new materials are received which involves heavy clerical work. This limitation of convention method can be overcome by using the formulae.

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