Chapter 11 Aggregate Planning

Workers needed = Regular time Production Required \( \div \) Production per worker (ROUND UP)

Available inventory = Beginning inventory + Total output

Ending inventory = Maximum\{0, Available inventory – (Forecast + Previous backlog)\}

Average inventory = (Beginning inventory + Ending inventory)/2

Backlog = Maximum\{0, (Forecast + Previous backlog) - Available inventory\}

Cost summary for aggregate planning:

<table>
<thead>
<tr>
<th>Cost Type</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular time cost</td>
<td>Regular time output ( \times ) cost per unit for regular time</td>
</tr>
<tr>
<td>Overtime cost</td>
<td>Overtime output ( \times ) Overtime cost/unit</td>
</tr>
<tr>
<td>Subcontracting cost</td>
<td>Subcontracting quantity ( \times ) SC cost/unit</td>
</tr>
<tr>
<td>Hiring cost</td>
<td>Workers hired ( \times ) hiring cost per worker</td>
</tr>
<tr>
<td>Firing cost</td>
<td>Workers fired ( \times ) firing cost per worker</td>
</tr>
<tr>
<td>Inventory carrying cost</td>
<td>Average inventory ( \times ) inventory carrying cost/unit/period</td>
</tr>
<tr>
<td>Backorder cost</td>
<td>Backorder units ( \times ) Backorder cost per unit</td>
</tr>
</tbody>
</table>

Chase:

Regular time output = Minimum(Forecast, Capacity)

Level:

Required production = Average forecasted demand per period

Number of workers = (Required Production/period) / (Production rate/ worker/period)

Chapter 12 Material Requirements Planning

<table>
<thead>
<tr>
<th>GR</th>
<th>Planned-order releases of “parents” ( \times ) No. required per unit OR Master Schedule for level zero</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR</td>
<td>Given</td>
</tr>
<tr>
<td>POH</td>
<td>From previous period POH + SR + PORT – GR , (POH cannot be negative)</td>
</tr>
<tr>
<td>NR</td>
<td>GR – (POH + SR + PORT) if positive, otherwise zero</td>
</tr>
<tr>
<td>PORT</td>
<td>NR in the case of Lot for Lot</td>
</tr>
<tr>
<td>PORTL</td>
<td>PORT offset by lead time</td>
</tr>
</tbody>
</table>

Chapter 13 Inventory Management

ABC Classification rule:

Class A: 10 to 20% of items, 60 to 70% annual $ usage
Class B: Intermediate
Class C: 50 to 60% of items, <= 15% annual $ usage

<table>
<thead>
<tr>
<th>Item</th>
<th>$ Usage</th>
<th>% of $ usage</th>
<th>Cumulative % of $</th>
<th>Cumulative % of no. of items</th>
<th>Class</th>
</tr>
</thead>
</table>
Basic EOQ Model
\[ Q_0 = \sqrt{\frac{2DS}{H}} \]

Length of order cycle = \( \frac{Q}{D} \) in years = \( \frac{Q}{u} \) in days where \( u \) = demand rate/day
Number of orders per year = Number of cycles = \( \frac{D}{Q} \)
Average inventory = \( \frac{Q}{2} \)
Annual ordering cost = \( \frac{D}{Q}S \)
Annual carrying cost = \( \frac{Q}{2}H \)
Total annual cost (TC) = \( \frac{D}{Q}S + \frac{Q}{2}H \)

EPQ Model
\[ Q_p = \sqrt{\frac{2DS}{H}} \sqrt{\frac{p}{p-u}} \]
Cycle time = \( \frac{Q_p}{u} \)
Run time = \( \frac{Q_p}{p} \)
Rate of increase of inventory during production = \( p - u \)
Maximum inventory = \( I_{max} = \frac{Q}{p}(p-u) \)
Average inventory = \( \frac{I_{max}}{2} \)
Number of batches per year = \( \frac{D}{Q} \)
Annual setup cost = \( \frac{D}{Q}S \)
Annual carrying cost = \( \frac{I_{max}}{2}H \)
Total annual cost (TC) = \( \frac{D}{Q}S + \frac{I_{max}}{2}H \)

Quantity discount model
\[ Q = \sqrt{\frac{2DS}{IP}} \]
Step 1: Determine Candidate Q
1. Compute Formula-Q for each price break price.
2. If Formula Q > Upper limit for price, then no candidate Q, ignore this price
   If Formula Q is within the limits for the price, then Candidate Q = Formula Q
   If Formula Q < Lower limit for price, then Candidate Q = Lower limit

<table>
<thead>
<tr>
<th>Q-Range</th>
<th>Price</th>
<th>Holding cost/unit = % \times P</th>
<th>Formula Q</th>
<th>Adjusted Q</th>
</tr>
</thead>
</table>

Step 2: Compute total annual cost (TC) for each valid candidate Q and select the candidate Q with least cost as EOQ.
Total annual cost (TC) = \( \frac{D}{Q}S + \frac{Q}{2}H + PD \)
Total annual cost = Annual holding cost + Annual ordering cost + Annual item cost
i.e. = \( \frac{Q}{2}H + \frac{D}{Q}S + PD \), where \( P = \) cost of the item per unit