Inventory Policy Decisions

Push Inventory Control

- *Solution:* We need to calculate total requirements for each warehouse.

Total Requirements = Forecast + (z x Forecast error)

where, z = number of standard deviations on the normal distribution curve beyond the forecast (the distribution mean) to the point where 90 percent of the area under the curve is represented.

for 90 % stock availability level, z= 1.28

hence, total requirements for warehouse 1 = 10,000 + (1.28 x 2000) = 12,560

- ✓ *Net requirements are found as the difference between total requirements and the quantity on hand in the warehouse.*
- ✓ *Summing the net requirements (110,635) shows that 125,000 – 110,635 = 14,365, which is the excess production that needs to be prorated to the warehouses.*
- ✓ *Prorating the excess production of 14,365 lb is made in proportion to the average demand rate for each warehouse.*

WAREHOUSE	(1) TOTAL REQUIREMENTS	(2) ON HAND	(3) = (1) – (2) NET REQUIREMENTS	(4) PRORATED EXCESS	(5) = (3) + (4) ALLOCATION
1	12,560 lb	5,000	7,560 lb	1,105 lb	8,665 lb
2	52, 475	15,000	37.475	5,525	43,000
3	95,600	30,000	65,600	7,735	73,335
	160,635		**110,635**	**14,365**	**125,000**

Single-Order Quantity

- *Example:* A grocery store estimates that it will sell 100 pounds of its specially prepared potato salad in the next week. The demand distribution is normally distributed with a standard deviation of 20 pounds. The supermarket can sell the salad for $5.99 per pound. It pays $2.50 per pound for the ingredients. Since no preservatives are used, any unsold salad is given to charity at no cost.

  Find the quantity to prepare that will maximize the profit.

  Solution:

$$CP_n = \frac{Profit}{Profit + Loss} = \frac{(5.99 - 2.50)}{(5.99 - 2.50) + 2.50} = 0.583$$

  From the normal distribution curve, the optimum Q* is at the point of 58.3 percent of the area under the curve.

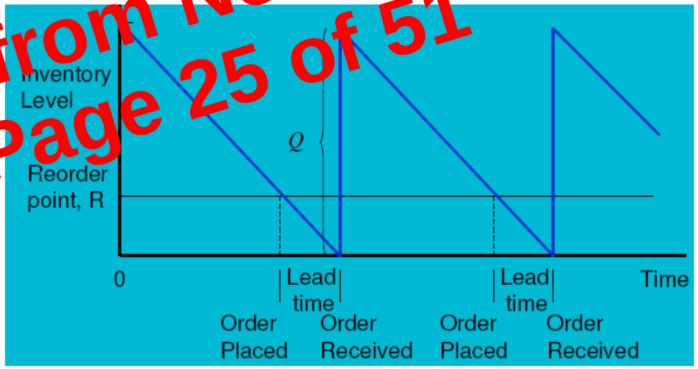
  This is a point where z = 0.21

  The salad preparation quantity should be,

  Q = 100 lb + 0.21(20 lb) = 104.2 lb.*

A Lead Time for Resupply

- Using the previous formula as a part of a basic inventory control procedure, a saw tooth pattern of inventory depletion and replenishment occurs.



- Reorder point is the quantity to which inventory is allowed to drop before a replenishment order is placed.
- Since there is generally a time lapse between when the order is placed and when the items are available in inventory, the demand that occurs over this lead time must be anticipated. The reorder point (ROP) is,

$$ROP = d \times LT$$

where,

ROP = reorder point quantity, units

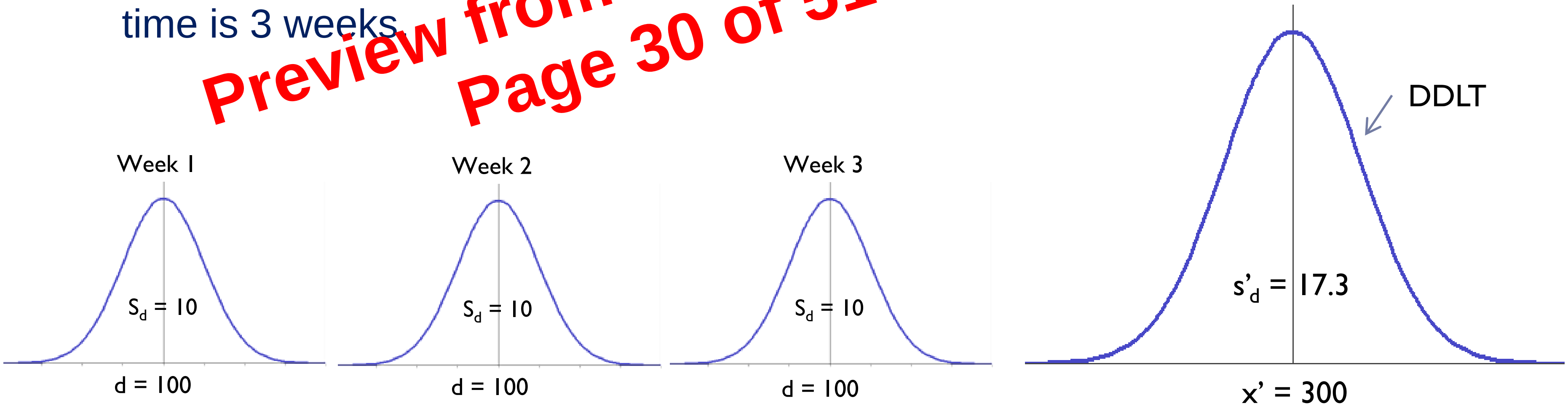
d = demand rate, in time units

LT = average lead time, in time units

The demand rate (d) and the average lead time (LT) must be expressed in the same time dimension.

A Reorder Point Model with Uncertain Demand

- For example, suppose weekly demand for an item is normally distributed with a mean d = 100 units and a standard deviation of s'_d = 10 units. Lead time is 3 weeks.



- The mean of the DDLT distribution is simply the demand rate d times LT, or

x' = d x LT

- The varience of DDLT distribution is found by adding the variances of the weekly demand distributions. That is,

$$s_d'^2 = LT(s_d^2)$$

and, ROP = (d x LT) + z (s'_d)

A Reorder Point Model with Uncertain Demand

- <u>*Solution:*</u>
  - <u>***Total Relevant Cost (TC)***</u>

Total cost = Order cost + Carrying cost, regular stock + Carrying cost, safety stock + Stockout cost

$$TC = \frac{D}{Q}S + IC\frac{Q}{2} + ICzs_d^{'} + \frac{D}{Q}ks_d^{'}E_{(z)}$$

$$= \frac{11{,}107(12)(10)}{11.008} + 0.20(0.11)(\frac{11{,}008}{2}) + 0.20(0.11)(0.67)(3{,}795) + \frac{11{,}107(12)}{11{,}008}(0.01)(3{,}795)(0.150)$$

= $367.03 per year

Note: $E_{(z)} = E_{(0.67)} = 0.150$ *(from unit normal loss integral table)*

  - <u>***Service Level (SL)***</u>

$$SL = 1 - \frac{(D/Q)(s_d^{'}\ x\ E_{(z)})}{D} = 1 - \frac{s_d^{'}(E_{(z)})}{Q}$$

$$= 1 - \frac{3{,}795(0.150)}{11{,}008} = 0.948$$

A Periodic Review Model with Uncertain Demand: Single Item Control

- *Example:* Buyers Products Company distributes an item known as a tie bar, which is a U-bolt used on truck equipment. The following data have been collected for this item held in inventory. Develop a periodic review policy for it.
  - Monthly demand forecast , d — 11,107 units
  - Std. error of forecast, sd — 3,099 units
  - Replenishment lead time, LT — 1.5 months
  - Item value, C — $0.11/unit
  - Cost for processing vendor order, S — $10/order
  - Carrying cost, I — 20% per year
  - In –stock probability during lead time, P — 75%

A Periodic Review Model with Uncertain Demand: Joint Ordering

- Ordering multiple items at the same time and on the same order can result in economic benefits such as
  - Qualifying for price-quantity discount
  - Meeting vendor, carrier, or production minimum quantities

So, inventory policy should reflect joint ordering.

- An inventory joint ordering policy involves determining a common inventory review time for all jointly ordered items, and then finding each item's maximum level (M*) as dictated from its particular costs and service level.