Inventory Management V

Inventory Policy – Single Item w/ Probabilistic Demand

Lecture 8
ESD.260 Fall 2003

Caplice

Key Questions

- What are the questions I should ask to determine the type of inventory control system to use?
  - How important is the item?
  - Should the item be reviewed periodically or continuously?
  - What form of inventory policy should I use?
  - What cost or service objectives should I set?

How important is the item?

- Segmentation of Inventory
  - Not all inventory is created equally
  - Different classes of inventory
    - Result in different levels of profitability / revenue
    - Have different demand patterns and magnitudes
    - And thus - require different control policies
- ABC Analysis
  - Commonly used in practice
  - Classify items by revenue or value
  - Combination of usage, sales price, etc.

ABC Analysis

Part ID	Price	Annual Demand	Annual $ Value
5497J	$ 2.25	260	$ 585.00
3K62	$ 2.85	43	$ 122.55
88450	$ 1.50	21	$ 31.50
P001	$ 0.77	388	$ 298.76
2M993	$ 4.45	612	$ 2,723.40
3HHT8	$ 6.10	220	$ 1,342.00
56M4	$ 3.10	110	$ 341.00
89KE	$ 1.32	786	$ 1,037.52
45O3	$ 12.80	14	$ 179.20
55K2	$ 24.99	334	$ 8,346.66
978SD3	$ 7.75	24	$ 186.00
78HJQ2	$ 0.68	77	$ 52.36
23LK	$ 0.25	56	$ 14.00
990RT	$ 3.89	89	$ 346.21
58JH4	$ 7.70	675	$ 5,197.50
2340P	$ 6.22	66	$ 410.52
3784	$ 0.85	148	$ 125.80
38JQ2	$ 0.77	690	$ 531.30
56TT7	$ 1.23	52	$ 63.96
7UJS2	$ 4.05	12	$ 48.60
		4,677	**$ 21,983.84**

- Identify the SKUs that management should spend time on
- Prioritize SKUs by their value to firm
- Create logical groupings
- Adjust as needed

- Example:
  - Sample of 20 SKUs
  - Total of 4,677 units
  - Total ~$22k

ABC Analysis

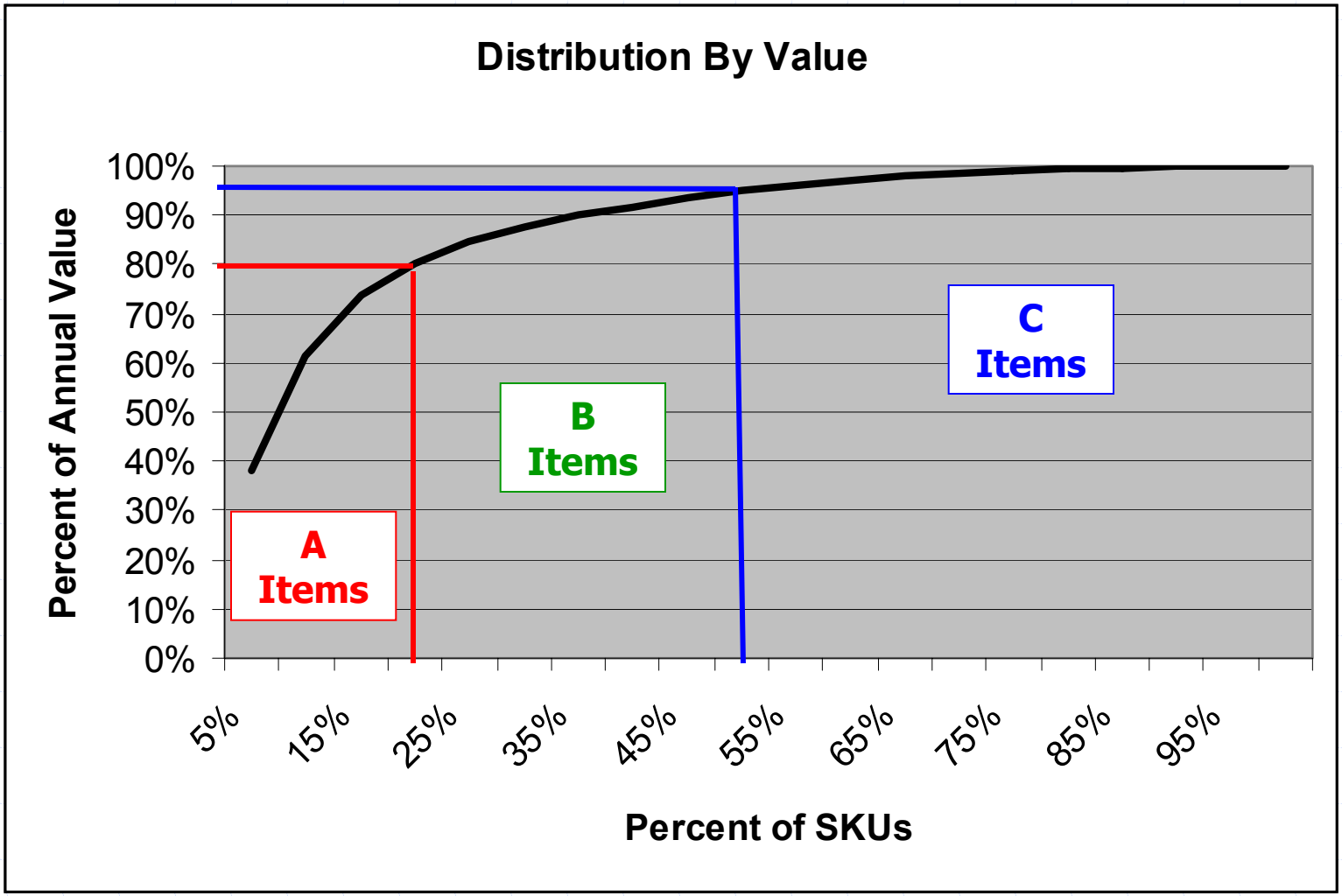
Part ID	Price	Annual Demand	Annual $ Value	Cum $ Value	Pct Ann $ Value
55K2	$ 24.99	334	$ 8,347	$ 8,347	38%
58JH4	$ 7.70	675	$ 5,198	$ 13,544	62%
2M993	$ 4.45	612	$ 2,723	$ 16,268	74%
3HHT8	$ 6.10	220	$ 1,342	$ 17,610	80%
89KE	$ 1.32	786	$ 1,038	$ 18,647	85%
5497J	$ 2.25	260	$ 585	$ 19,232	87%
38JQ2	$ 0.77	690	$ 531	$ 19,763	90%
2340P	$ 6.22	66	$ 411	$ 20,174	92%
990RT	$ 3.89	89	$ 346	$ 20,520	93%
56M4	$ 3.10	110	$ 341	$ 20,861	95%
P001	$ 0.77	388	$ 299	$ 21,160	96%
978SD3	$ 7.75	24	$ 186	$ 21,346	97%
45O3	$ 12.80	14	$ 179	$ 21,525	98%
3784	$ 0.85	148	$ 126	$ 21,651	98%
3K62	$ 2.85	43	$ 123	$ 21,773	99%
56TT7	$ 1.23	52	$ 64	$ 21,837	99%
78HJQ2	$ 0.68	77	$ 52	$ 21,890	100%
7UJS2	$ 4.05	12	$ 49	$ 21,938	100%
88450	$ 1.50	21	$ 32	$ 21,970	100%
23LK	$ 0.25	56	$ 14	$ 21,984	100%
		4,677	**$ 21,984**		

A Items:
80% of Value
20% of SKUs

B Items:
15% of Value
30% of SKUs

C Items:
5% of Value
50% of SKUs

ABC Analysis



ABC Analysis

- So, what is different between the classes?
  - A Items
    - Very few high impact items are included
    - Require the most managerial attention and review
    - Expect many exceptions to be made
  - B Items
    - Many moderate impact items (sometimes most)
    - Automated control w/ management by exception
    - Rules can be used for A (but usually too many exceptions)
  - C Items
    - Many if not most of the items that make up minor impact
    - Control systems should be as simple as possible
    - Reduce wasted management time and attention
    - Group into common regions, suppliers, end users
- But – these are arbitrary classifications

How else to classify inventory?

- Criticality to Operations
- Profitability
- Usage rate * Volume
- Dollar Value & # Customer Transactions
- Dollar Value & Criticality
- Multiple dimensions (cluster analysis)

Continuous or Periodic Review?

- Periodic Review
  - Know stock level only at certain times
  - Review interval (RI) = time between consecutive reviews
- Continuous Review
  - Is continuous really continuous?
  - Transactions reporting
  - Collecting information vs. Making decision
- Advantages of Periodic Review
  - Coordination of replenishments
  - Able to predict workload
  - Forces a periodic review
- Continuous Review
  - Replenishments made dynamically
  - Cost of equipment (scanners etc.)
  - Able to provide same level of service with less safety stock

What form of inventory policy?

- Order-Point, Order-Quantity (Q,R) System
  - Continuous Review (RI=0)
  - Policy: Order Q if Inventory Position (IP) ≤ R
  - Two-bin system
  - Simple to set up and operate – low errors
- Order-Point, Order-Up-To-Level (s, S) System
  - Continuous Review (RI=0)
  - Policy: Order (S-IP) if IP ≤ s
  - Min-Max system
  - Optimal (s,S) is typically better than optimal (Q,R)
  - Finding optimal (s,S) is difficult – try *reasonable* values
  - Impact on suppliers – fixed versus variable orders

What form of inventory policy?

- Periodic-Review, Order-Up-To-Level (RI, S) System
  - Periodic Review (RI>0)
  - Policy: Order (S-IP) every RI units of time
  - Replenishment cycle system
  - Higher carrying costs than Continuous System
  - Able to coordinate related replenishments
- Periodic Review, Hybrid (RI, s, S) System
  - Periodic Review (RI>0)
  - Policy: Every RI units of time, order (S-IP) if IP ≤ s, otherwise, do not order
  - General case for other policies
  - Optimal (RI,s,S) is better than any other system
  - Use of reasonable vs. optimal parameters

What form of inventory policy?

- No hard and fast rules, but some rules of thumb

Type of Item	Continuous Review	Periodic Review
A Items	(s, S)	(RI, s, S)
B Items	(Q, R)	(RI, S)
C Items	Manual ~ (Q,R)	Manual ~ (RI,S)

What cost and service objectives?

1. Common Safety Factors Approach
   - Simple, widely used method
   - Apply a common metric to aggregated items
   - Example: Time Supplies
     - SS = 2 month supply for all items
   - Example: Equal Safety Factors
     - SS = $k\sigma_e$ for all items

What cost and service objectives?

2. Cost Minimization Approach

- Requires costing of shortages
  - Fixed cost per stockout
  - Fractional cost per unit short
  - Fractional cost per short per unit time
  - Cost per customer line item short
- Find trade-off between relevant costs

What cost and service objectives?

3. Customer Service Approach

- Establish constraint on customer service
  - Probability of no stockouts per replenishment cycle (Service Level)
  - Fraction of demand satisfied from shelf (Fill Rate)
  - Fraction of time that net stock is positive (Ready Rate)
  - Average time between stock outs (TBS)
  - Fraction of orders completely satisfied from shelf (Order Fill Rate)
- Definitions in practice are fuzzy
- Minimize costs with respect to customer service constraints

What cost and service objectives?

4. Aggregate Considerations
   - Weight specific characteristic of each item
   - Examples
     - Minimize expected total stockout occasions per year
       - Equivalent to including a fixed cost per stockout
       - Same cost applied across all products
     - Minimize expected total value of shortages per year
       - Equivalent to including fractional cost per unit short for each item and minimizing costs
   - Select characteristic most "essential" to firm