**ABC Inventory Classification**

*Michael D. Harper, Ph.D.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ABC Inventory Classification**   |  |  |  | | --- | --- | --- | | Class | Annual Usage ($) | Total SKU Items | | A | 75% to 80% | 10% to 20% | | B | 10% to 15% | 20% to 40% | | C | 5% to 10% | 40% to 50% |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | SKU | Annual  Usage ($) | Percent  Usage (%) | Cumulative  Percentage | Class | %Usage | %Items | | 5 | 73728 | 64.7 | 64.7 | A |  |  | | 8 | 18432 | 16.2 | 80.9 | A | 80.9 | 20 | | 1 | 8063 | 7.1 | 88.0 | B |  |  | | 6 | 4478 | 3.9 | 91.9 | B |  |  | | 4 | 2819 | 2.5 | 94.4 | B | 13.5 | 30 | | 9 | 2057 | 1.8 | 96.2 | C |  |  | | 7 | 1515 | 1.3 | 97.5 | C |  |  | | 3 | 1161 | 1.0 | 98.5 | C |  |  | | 10 | 920 | 0.8 | 99.3 | C |  |  | | 2 | 747 | 0.7 | 100.0 | C | 5.6 | 50 | | Total | 113920 | 100.0 |  |  |  |  |     . . . |

|  |
| --- |
| **ABC Classification Cost Analysis** |
| \*Assume Unit Ordering Cost is $40/order and Unit Carrying Cost is $0.25/$/year.  \*Evaluate the arbitrary inventory policy (10,8,4) that represents the annual order frequency for classes A,B,C, respectively.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Class  i | Annual  Usage($) Mi | Number of  SKUs  Ni | Order  Frequency  Fi | Total  Orders  NiFi | Average  Inventory($)  Mi/(2Fi) | | A | 92160 | 2 | 10 | 20 | 4608 | | B | 15360 | 3 | 8 | 24 | 960 | | C | 6400 | 5 | 4 | 20 | 800 | | Total | 113920 | 10 |  | 64 | 6368 |  |  |  |  | | --- | --- | --- | | Unit Costs | $40 | $0.25 | | Total Ordering Cost | $2560 |  | | Total Carrying Cost |  | $1592 |  |  |  | | --- | --- | | Total Inventory Cost | $4152 |   **Objective: Determine order frequency that will minimize total inventory cost.**  . . . |

|  |
| --- |
| **Economic ABC Inventory Policy**  - |
| Order frequency per class to minimize cost is:  **Fi = sqrt[ Mi/(2\*Ni\*EPP) ], i=A,B,C. EPP=Co/Cc**  This relationship yields, FA = sqrt[ 92160/(2\*2\*(40/0.25))] = 12  FB = sqrt[ 15360/(2\*3\*(40/0.25))] = 4  FC = sqrt[ 6400/(2\*5\*(40/0.25))] = 2  where EPP = 40/0.25 = 160.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Class  i | Annual  Usage($) Mi | Number of  SKUs  Ni | Order  Frequency  Fi | Total  Orders  NiFi | Average  Inventory($)  Mi/(2Fi) | EPP | | A | 92160 | 2 | 12 | 24 | 3840 | 160 | | B | 15360 | 3 | 4 | 12 | 1920 | 160 | | C | 6400 | 5 | 2 | 10 | 1600 | 160 | | Total | 113920 | 10 |  | 46 | 7360 |  |  |  |  |  | | --- | --- | --- | | Unit Costs | $40 | $0.25 | | Total Ordering Cost | $1840 |  | | Total Carrying Cost |  | $1840 |  |  |  | | --- | --- | | Total Inventory Cost | $3680 |   . . . |

|  |
| --- |
| **Item Analysis E–ABC Inventory Policy** |
| \*From the E-ABC Policy: Fi = sqrt[ Mi/(2\*Ni\*EPP) ], i=A,B,C. EPP=Co/Cc  \*Let each SKU be its own class. Then an optimal order frequency can be determined for each SKU using: Fi = sqrt[ Mi/(2\*EPP) ], i=SKU. EPP=Co/Cc.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | SKU | Annual  Usage ($) | Number of  SKUs  Ni | Order  Frequency  Fi | Total  Orders  NiFi | Average  Inventory($)  Mi/(2Fi) | EPP | | 5 | 73728 | 1 | 15.179 | 15.179 | 2428.629 | 160 | | 8 | 18432 | 1 | 7.589 | 7.589 | 1214.315 | 160 | | 1 | 8063 | 1 | 5.020 | 5.020 | 803.144 | 160 | | 6 | 4478 | 1 | 3.741 | 3.741 | 598.532 | 160 | | 4 | 2819 | 1 | 2.968 | 2.968 | 474.889 | 160 | | 9 | 2057 | 1 | 2.535 | 2.535 | 405.660 | 160 | | 7 | 1515 | 1 | 2.176 | 2.176 | 348.138 | 160 | | 3 | 1161 | 1 | 1.905 | 1.905 | 304.762 | 160 | | 10 | 920 | 1 | 1.696 | 1.696 | 271.293 | 160 | | 2 | 747 | 1 | 1.528 | 1.528 | 244.459 | 160 | | Total | 113920 | 10 | 44.337 | 44.337 | 7093.821 |  |  |  |  |  | | --- | --- | --- | | Unit Costs | $40 | $0.25 | | Total Ordering Cost | $1773.5 |  | | Total Carrying Cost |  | $1773.5 |  |  |  | | --- | --- | | Total Inventory Cost | $3546.9 |   - |

|  |
| --- |
| **Economically Balanced E–ABC Inventory Policy** |
| \*From the E-ABC Policy: Fi = sqrt[ Mi/(2\*Ni\*EPP) ], i=A,B,C. EPP=Co/Cc.  \*Suppose the unit costs are unknown.  \*Perform analysis of Class A items and determine the order frequency, FA.  \*Then, the “Observed EPP” would be “[Ave.Inv.]/[TotalOrders]=“[MA/(2FA)]/[NAFA]” for Class A items.  \*Use this Observed EPP for the order frequencies for Class B and Class C items.  Suppose after an extensive Class A analysis, it was determined that FA=15.  Using FA=15, determine the Observed EPP=[92160/(2\*15)]/[2\*15]=102.4 in the table.  Then, FB = sqrt[ 15360/(2\*3\*102.4) ]=5  And, FC = sqrt[ 6400/(2\*5\*102.4) ]=2.5   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Class  i | Annual  Usage($) Mi | Number of  SKUs  Ni | Order  Frequency  Fi | Total  Orders  NiFi | Average  Inventory($)  Mi/(2Fi) | EPPO | | **A** | **92160** | **2** | **15** | **30** | **3072** | **102.4** | | B | 15360 | 3 | 5 | 15 | 1536 | 102.4 | | C | 6400 | 5 | 2.5 | 12.5 | 1280 | 102.4 | | Total | 113920 | 10 |  | 57.5 | 5888 |  |   - |
| \*Although not optimal, all classes will have the same Observed EPP. This is called an “Economically Balanced” inventory, EB-ABC Inventory Policy.  \*Although not optimal, an economically balanced inventory will be based on the accuracy of the Class A inventory analysis.  \*The EB-ABC inventory analysis can also be used to obtain an Item EB-ABC policy.  \*It can be shown that the structure of an EB-ABC inventory can be used for further analysis and strategy.  \*\*All ABC Inventory analyses can be used for an Echelon Inventory.  - |