Shipping, \((n^*)_i = \sqrt{\frac{D_i h_i c_i}{2 S_i}} = \frac{D_i}{(Q^*_i)}\)

or

transportation

cost for

product \(i\)

Case II: Multiple products, simple aggregation

- Each shipment contains all products

- Advantage: smaller lot sizes per product

\[ S^* = S + \sum_{i=1}^{N} s_i \rightarrow (1) \]

\[ n = A \text{ shipment } = \# \text{ of shipments } \rightarrow (2) \]

frequency

year
Annual shipment cost \( S^* n \rightarrow (3) \)

Annual holding cost for \( N \) products
\[
\sum_{i=1}^{N} \left( \frac{Q_i}{2} \right) h_i C_i
\]
\[
= \sum_{i=1}^{N} \left( \frac{D_i}{n} \right) h_i C_i
\]
\[
= \frac{1}{2} \sum_{i=1}^{N} \left( \frac{D_i}{2n} \right) h_i C_i \rightarrow (4)
\]

Total inventory associated costs (annual)
\[
C' = (\text{shipment cost}) + (\text{holding cost})
\]
\[
C' = S^* n + \sum_{i=1}^{N} \frac{D_i h_i C_i}{2n} \rightarrow (34)
\]
\[
= f(n) \rightarrow (5)
\]

To obtain the optimal shipping freq.
\[
\frac{dC'}{dn} = 0 \Rightarrow n^* \rightarrow (6)
\]
\[ n^* = \sqrt{\frac{\sum_{i=1}^{N} \frac{D_i h_i c_i}{2 s^*}}{N}} \]  

optimal shipment frequency

optimal lot size for product \( i \)
\[(Q_{L}^*)_i = \frac{D_i}{n^*} \]  
\((i = 1, 2, \ldots, N)\)

average or cycle inventory for product \( i \)
\[ \frac{(Q_{L}^*)_i}{2} \]  
\((i = 1, 2, \ldots, N)\)

TAILORED Aggregation \rightarrow \text{next lecture}
Homework # 4

Problem 2

Harley Davidson

Third Edition E1

# of working days/year = 365

E2 optimal lot size, \( Q_L^* = 100 \)

\( D \) given
\( h \) given
\( C \) given

Calculate \( S \)

\[
Q_L^* = \sqrt{\frac{2DS}{hC}}
\]

E3 independent shipping simple aggregation
Prob 3: WALMART

assumptions
- single store

HW # 2 \Rightarrow \text{Re-do, clean-up}

HW # 3 \Rightarrow \$ \text{re-submit}