

Numerical Examples

Example - 1

1-Transportation Model Selection Basing on Total Cost

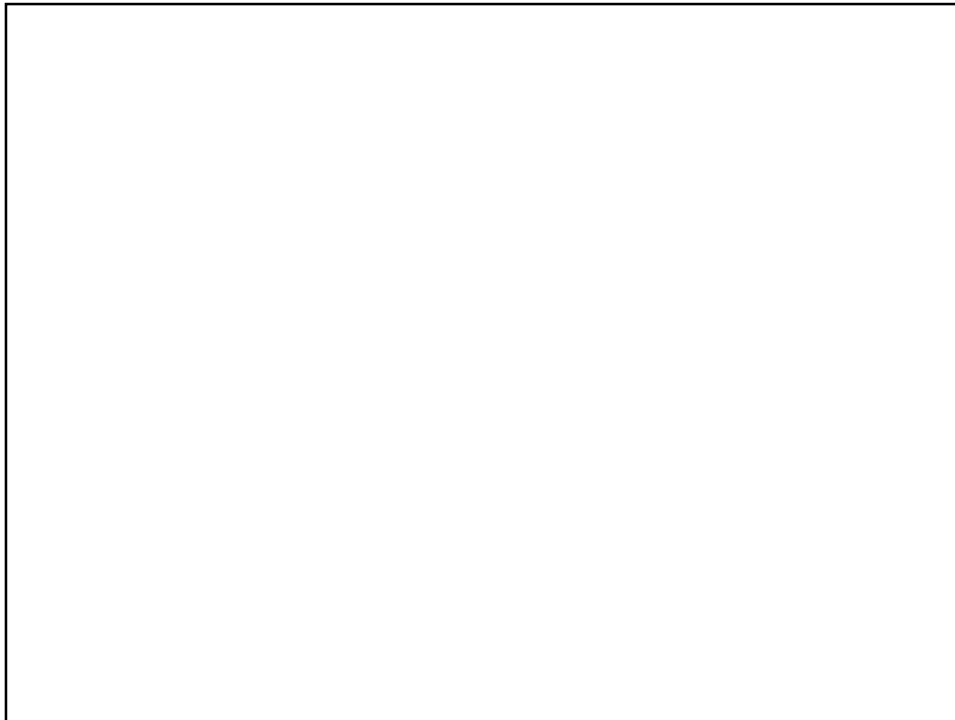
Transportation Mode	Transportation Cost (\$/unit)	Door to door transportation time (day)	Yearly Trip Number
Railway	0,10	21	7
Piggyback(TOFC)	0,15	14	14
Road	0,2	5	14
Air	1,4	2	28

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PROBLEM DATA

- A suitcase manufacturer desires to select the transportation mode with the lowest cost.
- The manufacturer has a production facility and a warehouse which are located in different cities.
- A suitcase value is (C) \$30, and the total yearly demand (D) is 700.000
- Current transportation time with railway is (T) 21 days.
- 1% decrease will be seen on an average stock level for each one day transportation time shortening
- The yearly interest rate (I) for holding cost is 30%
- Yearly in-transit stock cost : $ICDT/365$
- Transportation lot size is denoted as "Q"
- The average stock level in both facility and warehouse is equal to $Q/2$
- Value of the product is C at the production facility and C' at the warehouse ($C'=C+$ transportation cost)

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Cost Type	Formula	Railway	RO-LA	Road	Airway
Transportation	$R \cdot D$	$0.1 \cdot 700,000$ =\$70,000	$0.15 \cdot 700,000$ =\$105,000	$0.2 \cdot 700,000$ =\$140,000	$1.1 \cdot 700,000$ =\$780,000
In-Transit	$(I \cdot C \cdot D \cdot T) / 365$	$(0.3 \cdot 30 \cdot 700,000 \cdot 21) / 365$ =\$363,466	$(0.3 \cdot 30 \cdot 700,000 \cdot 14) / 365$ =\$241,644	$(0.3 \cdot 30 \cdot 700,000 \cdot 5) / 365$ =\$86,301	$(0.3 \cdot 30 \cdot 700,000 \cdot 2) / 365$ =\$34,521
Facility Stock	$(I \cdot C \cdot Q) / 2$	$(0.3 \cdot 30 \cdot 100,000) / 2$ =\$450,000	$(0.3 \cdot 30 \cdot 50,000 \cdot 0.93) / 2$ =\$209,250	$(0.3 \cdot 30 \cdot 50,000 \cdot 0.84) / 2$ =\$189,000	$(0.3 \cdot 30 \cdot 25,000 \cdot 0.81) / 2$ =\$91,125
Warehouse Stock	$(I \cdot C \cdot Q) / 2$	$(0.3 \cdot 30 \cdot 1 \cdot 100,000) / 2$ =\$451,500	$(0.3 \cdot 30 \cdot 15 \cdot 50,000 \cdot 0.93) / 2$ =\$210,296	$(0.3 \cdot 30 \cdot 2 \cdot 50,000 \cdot 0.84) / 2$ =\$190,260	$(0.3 \cdot 31.4 \cdot 25,000 \cdot 0.81) / 2$ =\$95,378
TOTAL		1,334,966 USD	766,190 USD	605,561 USD	1,201,024 USD

Example - 2

Transportation mode selection based on competitive edge

Data Table

Transportation Mode	Transportation Cost	Delivery Time (days)
Railway	\$2,5/pallet	7
Road	\$6/pallet	4
Airway	\$10,35/pallet	2

Transportation mode selection based on competitive edge

- Currently, a manufacturing firm supplies by 1500 pallets raw material from each of the two supplier
- Value of each one pallet material: \$100
- If the supplier can decrease the transportation time, the manufacturer promises to shift the %5 of the ordered quantity from the other supplier to this supplier, for each one-day shortening.
- Gross margin of the supplier is 20% of each pallet value.

Transportation Mode	Sold pallet number	Gross Margin	Transportation Cost	Net Profit
Railway	1500	\$30000	-\$3750	= \$26250
Road	1950	\$39000	-\$11700	= \$27300
Airway	2250	\$45000	-\$23287.5	= \$21712.5

Example – 3

- Transportation Mode Selection
- Transportation and Inventory Cost Trade-off

Skoda is a major car manufacturer in Czech Republic. Skoda's assembly plant in Mlada Boleslav plans to source the steering system set from TRW Autoelektronika. Skoda plans to purchase 120,000 steering system parts a year from TRW Autoelektronika at a price of \$120 per set. Demand is expected to be constant. Each set of steering system parts weighs about 10 pounds. Skoda traditionally purchased lots of 3,000 steering system sets. At its assembly plant, Skoda carries safety inventory equal to 50 percent of the average demand for steering systems during the delivery lead time.

TABLE 13-4 Transportation Proposals for Skoda

Carrier	Range of Quantity Shipped (cwt)	Shipping Cost (\$/cwt)
Local Rail	200+	6.50
Exel	100+	7.50
Unipart	50–150	8.00
Unipart	150–250	6.00
Unipart	250+	4.00

The plant manager at Skoda received several proposals for transportation and must decide on the one to accept. The details of various proposals are provided in Table 13-4, where one cwt is equal to one hundred pounds.

Unipart's pricing represents a marginal unit quantity discount (see Chapter 10). Unipart's representative has proposed lowering the marginal rate for the quantity over 250 cwt in a shipment from \$4/cwt to \$3/cwt and suggested that Skoda increase its batch size to 4,000 motors to take advantage of the lower transportation cost. What should the plant manager do?

Analysis

Unipart's new proposal will result in very low transportation costs for Skoda if the plant manager orders in lots of 4,000 steering systems. The plant manager, however, decides to include inventory costs in the transportation decision. Skoda's annual cost of holding inventory is 25 percent, which implies an annual holding cost of $H = \$120 \times 0.25 = \30 per steering system. Shipments by rail require a five-day transit time, whereas shipments by truck have a transit time of three days. The transportation decision affects the cycle inventory, safety inventory, and in-transit inventory for Skoda. Therefore, the plant manager decides to evaluate the total transportation and inventory cost for each transportation option.

The Local Rail proposal requires a minimum shipment of 20,000 pounds or 2,000 steering systems. The replenishment lead time in this case is $L = 5 + 1 = 6$ days. For a lot size of $Q = 2,000$ steering systems, the plant manager obtains the following:

Analysis

Cycle inventory = $Q/2 = 2,000/2 = 1,000$ steering systems

Safety inventory = $L/2$ days of demand = $(6/2)(120,000/365)$
= 986 steering systems

In-transit inventory = $120,000(5/365) = 1,644$ steering systems

Total average inventory = $1,000 + 986 + 1,644 = 3,630$ steering systems

Annual holding cost using Local Rail = $3,630 \times \$30 = \$108,900$

Local Rail charges \$6.50 per cwt, resulting in a transportation cost of \$0.65 per steering system because each steering system weighs 10 pounds. Thus,

Annual transportation cost using Local Rail = $120,000 \times 0.65 = \$78,000$

TABLE 13-5 Analysis of Transportation Options for Skoda

Alternative	Lot Size (Motors)	Transportation Cost	Cycle Inventory	Safety Inventory	In-Transit Inventory	Inventory Cost	Total Cost
Local Rail	2,000	\$78,000	1,000	986	1,644	\$108,900	\$186,900
	1,000	\$90,000	500	658	986	\$64,320	\$154,320
Unipart	500	\$96,000	250	658	986	\$56,820	\$152,820
Unipart	1,500	\$96,000	750	658	986	\$71,820	\$167,820
Unipart	2,500	\$86,400	1,250	658	986	\$86,820	\$173,220
Unipart	3,000	\$78,000	1,500	658	986	\$94,320	\$172,320
Unipart (old proposal)	4,000	\$72,000	2,000	658	986	\$109,320	\$181,320
Unipart (new proposal)	4,000	\$67,500	2,000	658	986	\$109,320	\$176,820