Operational Research: Client Report

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Task: To improve Supply Chain Management for goods transportation from distribution center to store for a supermarket chain.

Client Communication: To commence an optimum mathematical solution, it is very important that client details the requirement and the business specification. We received the following communications from the client:

1) Currently, there are 10 stores and 3 distribution centers operating in the supermarket.
2) The cost of transporting one truckload from each distribution center to a store is as follows:

	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
DC0	1938	1424	1407	918	2140	1421	1876	1194	1459	900
DC1	1801	1843	1898	1613	919	912	1063	1553	1453	2220
DC2	3074	2575	857	2171	2800	1942	2699	1223	2525	2038

3) Distribution Capacity:

Distribution Centre	DC0	DC1	DC2
Capacity	28	58	66

4) Distribution Constraints: $Dc_0 + Dc_1 <= 75$
5) Demand & Surges: 6 scenarios of demand and surges were brought to attention:

Scenarios	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
Initial	8	12	12	18	7	8	9	10	8	18
1	8	12	12	18	7	8	9	14	8	21
2	8	12	12	18	7	8	9	10	8	18
3	8	12	14	18	7	8	31	17	18	31
4	33	12	12	18	7	8	9	15	8	18
5	8	12	12	18	7	8	31	11	8	18

Problem Solving: This problem can be best solved using "Revised Simple Algorithm" as it provides a mathematical optimization, given the constraints of real world. To build the solution, we followed the following steps:

1) The objective for this problem is to minimize the cost of transportation for the supermarket
2) All constraints on distribution capacity was included for different distribution scenario
3) All the variable for distribution was converted into proportions this was done to constrain the sum total of distribution to 1.

Solution: Upon optimization, an optimum solution was obtained which satisfied all the constraints and scenarios.

1) The final proportions of distributions going into each shopping center are as the following:

	S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
DC0	0.0	1.0	0.0	0.11	0.0	0.0	0.0	0.0	0.38	0.0
DC1	0.88	0.0	0.0	0.89	1.0	1.0	1.0	0.0	0.62	0.0
DC2	0.12	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0

2) For different scenarios, expenses are the following:
   a. Initial demand: $139,381
   b. Scenario 0: $174,482
   c. Scenario 1: $ 163,476
   d. Scenario 2: . $ 197,137
   e. Scenario 3: $ 218,435
   f. Scenario 4 : $ 188,085

Solution Testing: To test the solution, we checked the following constrains are satisfied:

1) The complete demand for each supermarket is satisfied by the total from the distribution's centers.
2) Demand from each supermarket is less than or equal to capacity for each scenario.
3) For Dc_0 and Dc_1, total capacity is met.
4) From our last communication with the client, we checked that initial cost of the new solution and the old one matches ($139,381)