

Minimization Problem

Original Data:					
	LOS ANGELES	TULSA	DENVER	SEATTLE	
# of trips	190	125	235	125	
# of Consultants	8	5	10	5	
Fixed Cost of office	165,428	131,230	140,000	145,000	FC = \$581,658
Cost of Trips	15,250	7,375	19,625	9,875	VC = \$ 52,125
Total Office Cost	180,678	138,605	159,625	154,875	
Total System Cost				\$633,783	

- 1) Without changing the LP program, examine the effect of completely removing the Tulsa office from the network.
- Precisely how does this effect total costs?
Removing the Tulsa office positively affects total costs by decreasing it by over \$120,000.

	Total Cost
All Four Offices	\$683,783
After Removing Tulsa	\$508,803
DIFFERENCE	\$124,980

- Precisely what is the impact on the number of trips assigned to every other office?
All of Tulsa's trips become assigned to the Denver office, whose total trips is increased by 107 trips.

	Num. of Trips Before	Num. of Trips After	Difference
Los Angeles	190	190	--
Tulsa	125	0	Decrease of 125
Denver	253	360	Increase of 107
Seattle	125	125	--

- From the perspective of profitability, is this a good decision?
After removing the Tulsa office and its costs, the amount of total costs decreases by \$124,980. This is largely due to the removal of the fixed cost of the Tulsa office, which was \$131,230. If one would examine the variable costs, however, it can be seen that shipping costs for Nebraska and Kansas are fairly similar, but the Oklahoma shipping costs from Denver are 5 times more expensive than those from Tulsa. I think profitability wouldn't change much if there weren't many orders coming in from Oklahoma, but if there were, variable costs could increase dramatically and negatively affect the company's total profit.

	VARIABLE COSTS TO SHIP	
	Tulsa	Denver
Nebraska	\$3,000	\$3,750
Kansas	\$3,000	\$3,000
Oklahoma	\$1,375	\$6,875
TOTAL	\$7,375	\$13,625

- 2) Assume that SC Consulting can close only one office.

- a. Which office would you choose? **Los Angeles**

Office Closed	Total Cost after Office Removal	Variable Costs	Total Savings
Los Angeles	\$475,605	\$59,375	\$158,178
Tulsa	\$508,803	\$58,375	\$124,980
Denver	\$508,783	\$67,125	\$125,000
Seattle	\$496,408	\$59,750	\$137,375

- b. Why? Compared to the relative overall total costs after closing each of the four offices, the smallest total cost (\$475,605) resulted when the Los Angeles office was closed. Originally when all four offices were being utilized the total cost was \$633,783 and by closing the LA location, the company decreases that amount by \$158,178. That large decrease is partially due to the fact that the LA office produced the highest fixed costs (\$165,428).

- 3) Assume that SC Consulting must still serve the same states, but is free to close as many offices as necessary to arrive at the low cost solution.

- a. Which office(s) would you close? Why?

According to the results in the table below, closing the Los Angeles, Tulsa, and Seattle offices and operating only from Denver would result in the lowest total cost (\$219,500) compared to any other combination of office closings.

Closed Offices	Open Offices	Total Cost
(3) LA, Tulsa, Seattle	(1) Denver	\$ 219,500
(3) LA, Denver, Seattle	(1) Tulsa	\$ 240,605
(3) Tulsa, Denver, Seattle	(1) LA	\$ 273,053
(3) LA, Tulsa, Denver	(1) Seattle	\$ 273,625
(2) LA, Seattle	(2) Tulsa, Denver	\$ 344,480
(2) LA, Tulsa	(2) Denver, Seattle	\$ 350,625
(2) LA, Denver	(2) Tulsa, Seattle	\$ 356,605
(2) Tulsa, Seattle	(2) LA, Denver	\$ 371,428
(2) Denver, Seattle	(2) LA, Tulsa	\$ 373,283
(2) Tulsa, Denver	(2) LA, Seattle	\$ 403,553
(1) Los Angeles	(3) Tulsa, Denver, Seattle	\$ 475,605
(1) Seattle	(3) LA, Tulsa, Denver	\$ 496,408
(1) Denver	(3) LA, Tulsa, Seattle	\$ 508,783
(1) Tulsa	(3) LA, Denver, Seattle	\$ 508,803

- b. How much money would you save?

Operating with only the Denver office would save the company \$414,283. The variable costs naturally have increased since Denver isn't as close to some locations as the other offices were, but the massive decrease in total cost from fixed costs resulted in over \$441,658.

	All Four Offices Open	Only Denver Open	DIFFERENCE
Total Cost	\$ 633,783	\$ 219,500	\$414,283
Variable Costs	\$ 52,125	\$ 79,500	(\$27,375)
Fixed Costs	\$ 581,658	\$ 140,000	\$441,658

- c. How many trips would be provided by each of the remaining offices?
All 27 trips would be operated by the Denver office.

	All Four Offices Open	Only Denver Open
Los Angeles	8	0
Tulsa	5	0
Denver	10	27
Seattle	5	0

4) Assume that you need to add a constraint that no office can have more than 7 consultants.

- a. How would you modify the LP model? Either explain in detail, or provide a modified Excel model that incorporates this constraint.

	A	B	C	D	E	F	G	H	I	J	K
1		State	Total # of trips	Trips from LA	Cost from LA	Trips from Tulsa	Cost from Tulsa	Trips from Denver	Cost From Denver	Trips from Seattle	Cost from Seattle
18											
19		# of trips			190		125		260		100
20		# of Consultants			7		7		7		7
21		Fixed Cost of office			165,428		131,230		140,000		145,000
22		Cost of Trips			15,250		7,375		22,750		6,750

1) Add each office's "# of Consultants" cell to the list of decision variables: E20, G20, I20, K20

2) Add a constraint so that the number of consultants for each office is less than or equal to 7: E20 <=7, G20 <=7, I20 <=7, K20 <=7

3) Define each of those cells as integers: E20 = integer, G20 = integer, I20 = integer, K20 = integer

b. Precisely how many consultants would be located at each of the 4 offices?

There would be 7 consultants located at each office with the new constraints in place.

Number of Trips	LOS ANGELES	TULSA	DENVER	SEATTLE	Total
Before LP Change	8	5	10	5	28
After LP Change	7	7	7	7	28
Difference	-1	+2	-3	+2	

c. What would the total cost be (assuming all demand must be satisfied)?

Total cost actually stays the exact same at \$633,783, the only thing that the change in the LP affects is Idaho's change from the Seattle office to the Denver office. Even with the change, the variable costs remain the same as well as fixed costs.

Old LA	New LA	Old TULSA	New TULSA	Old DENVER	New DENVER	Old SEATTLE	New SEATTLE
-	-	-	-	-	-	40	40
-	-	-	-	-	-	35	35
100	100	-	-	-	-	-	-
-	-	-	-	-	25	25	-
40	40	-	-	-	-	-	25
-	-	-	-	-	-	-	-
-	-	-	-	50	50	-	-
-	-	-	-	30	30	-	-
50	50	-	-	-	-	-	-
-	-	-	-	65	65	-	-
-	-	-	-	40	40	-	-
-	-	-	-	30	30	-	-
-	-	-	-	20	20	-	-
-	-	30	30	-	-	-	-
-	-	40	40	-	-	-	-
-	-	55	55	-	-	-	-
# of trips				235	260	125	100
# of Consultants				10	7	5	7
Fixed Cost of office				140,000	140,000	145,000	145,000
Cost of Trips				19,625	22,750	9,875	6,750

	Before LP Change	After LP Change
Total Cost	\$ 633,783	\$ 633,783
Variable Costs	\$ 52,125	\$ 52,125
Fixed Costs	\$ 581,658	\$ 581,658