



## Round 2 Section 3 - Case Study Information Pack

### Section 3: System Allocation

Relates to Questions 26-35

35 Marks available in this Section - Estimated time is 30-45 minutes

#### BACKGROUND

You are working for ModelOff Vehicle Services (MVC) who specialize in servicing highly specialized vehicles. MVC have 9 depots (referred to as Depot A to Depot I) which they use to service the vehicles. You are planning for the expected vehicles due next quarter and need to allocate the vehicle intake to the 9 depots under the allocation methodology that MVC uses.

MVC earns revenue of \$2,000 per vehicle serviced.

Profit is calculated as revenue less any transportation costs incurred less any penalty costs incurred.

Where a vehicle is serviced at a depot other than the one where the customer drops it off, MVC must pay the transport costs associated with getting it to the depot it is serviced at, then back to the original depot for collection. Transport costs are \$1.40 per vehicle per mile (part miles are charged pro rata).

If MVC cannot service a vehicle, they must pay a \$500 penalty per vehicle. They will pay this penalty in two situations:

- 1) Where there is insufficient capacity within a hub to service a vehicle; and
- 2) Where the revenue for a vehicle less the transport costs for that vehicle would be more expensive for MVC than not servicing the vehicle and paying the penalty.

#### DEPOTS AND HUBS

There are 9 depots. The distance between each depot pairing (one way, in miles) is shown in the table below:

	Depot A	Depot B	Depot C	Depot D	Depot E	Depot F	Depot G	Depot H	Depot I
Depot A									
Depot B	482.00								
Depot C	417.00	381.49							
Depot D	297.00	681.69	340.00						
Depot E	576.00	1,096.43	790.23	362.22					
Depot F	285.00	853.92	683.40	330.00	290.00				
Depot G	613.00	1,150.65	1,095.05	759.71	577.00	341.00			
Depot H	521.00	791.91	976.13	882.81	993.16	620.00	557.82		
Depot I	529.43	477.25	819.70	908.42	1,133.92	804.87	913.33	319.66	

This table is also in the Excel workbook provided. All distances in this table are unique (there are no duplicates).

The total capacity of each depot is shown in the table below:

Depot	Depot A	Depot B	Depot C	Depot D	Depot E	Depot F	Depot G	Depot H	Depot I
# Vehicles	2,700	400	100	400	100	400	600	700	900

The depots are organized into between 1 and 3 hubs under the different the scenarios, as set out below.



## Round 2 Section 3 - Case Study Information Pack

### ALLOCATION METHODOLOGY

For legal reasons, allocation must be assessed and performed for each hub in isolation (no cars from one hub may be serviced in any other hub). The methodology for allocating vehicles to depots for servicing *within a hub* is:

- 1) Each vehicle is initially delivered to a certain depot and must be collected from that depot. If MVC chooses to transport that vehicle to another depot for servicing, MVC will bear a transportation cost for that vehicle as set out above.
- 2) All vehicles are serviced at the depot they arrive, where capacity exists to do so. Where any depot has excess vehicles that cannot be serviced at that depot, vehicles are allocated as per step 3.
- 3) Calculate the vehicle that has the shortest trip (and therefore cost) to any other depot with available capacity. Allocate that vehicle to that depot for servicing
- 4) Repeat step 3 until either no excess vehicles remain or MVC would choose to instead pay the penalty per vehicle (as described above).

Note that MVC's allocation methodology may not lead to the optimum allocation between depots. You need to model MVC's allocation methodology as it is set out above, you are not required to make any changes to this methodology.

All analysis is conducted on whole vehicles only (no part vehicle calculations are performed).

### SCENARIOS

There are 4 different scenarios you need to consider of your model. These scenarios are in the excel workbook provided and in the table below:

	Depot A	Depot B	Depot C	Depot D	Depot E	Depot F	Depot G	Depot H	Depot I
<b>Scenario 1 vehicles</b>	<b>2,438</b>	<b>544</b>	<b>121</b>	<b>553</b>	<b>103</b>	<b>300</b>	<b>501</b>	<b>579</b>	<b>1,138</b>
<i>Scenario 1a hubs</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 2</i>	<i>Hub 2</i>	<i>Hub 2</i>	<i>Hub 3</i>	<i>Hub 3</i>	<i>Hub 3</i>
<i>Scenario 1b hubs</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 2</i>	<i>Hub 2</i>	<i>Hub 2</i>	<i>Hub 2</i>	<i>Hub 2</i>
<b>Scenario 2 vehicles</b>	<b>2,099</b>	<b>519</b>	<b>107</b>	<b>333</b>	<b>88</b>	<b>280</b>	<b>567</b>	<b>898</b>	<b>1,087</b>
<i>Scenario 2a hubs</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 2</i>	<i>Hub 2</i>	<i>Hub 2</i>	<i>Hub 3</i>	<i>Hub 3</i>	<i>Hub 3</i>
<i>Scenario 2b hubs</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 1</i>	<i>Hub 1</i>

**For Questions 26-31, 33, select your answer from a multiple choice list.**

**For Questions 32, 34 you are required to type in your answer.**

**Prepare your model and then use it to answer the given questions.**

**When finished, please upload your workbook (Question 35).**



## Round 2 Section 3 - Case Study Information Pack

### QUESTIONS

#### Question 26

There are 36 individual distances listed between two depots (or 'depot pairings'). Of these, how many would never be used because they cost more to transport (and earn the revenue) than paying the penalty? [3 marks]

- A. 6
- B. 7
- C. 8
- D. 9
- E. 10
- F. 11
- G. 12
- H. 13
- I. 14

#### Question 27

What is the total transport cost (in \$) for Hub 1 in Scenario 1a? [3 marks]

- A. \$218,854
- B. \$218,855
- C. \$218,856
- D. \$218,857
- E. \$218,858
- F. \$218,859
- G. \$218,860
- H. \$218,861
- I. \$218,862



**Round 2 Section 3 - Case Study Information Pack**

**Question 28**

**What is the total penalty cost (in \$) for Hub 2 in Scenario 1a? [3 marks]**

- A. \$27,500
- B. \$28,000
- C. \$28,500
- D. \$29,000
- E. \$29,500
- F. \$30,000
- G. \$30,500
- H. \$31,000
- I. \$31,500

**Question 29**

**What is the total profit (in \$) for Hub 3 in Scenario 1a? [4 marks]**

- A. \$4,035,199
- B. \$4,035,200
- C. \$4,035,201
- D. \$4,035,202
- E. \$4,035,203
- F. \$4,035,204
- G. \$4,035,205
- H. \$4,035,206
- I. \$4,035,207



**Round 2 Section 3 - Case Study Information Pack**

**Question 30**

**What is the total transport cost (in \$) for Hub 1 in Scenario 1b? [4 marks]**

- A. \$270,511
- B. \$270,512
- C. \$270,513
- D. \$270,514
- E. \$270,515
- F. \$270,516
- G. \$270,517
- H. \$270,518
- I. \$270,519

**Question 31**

**What is the total revenue (in \$) for Hub 2 in Scenario 1b? [4 marks]**

- A. \$5,194,000
- B. \$5,196,000
- C. \$5,198,000
- D. \$5,200,000
- E. \$5,202,000
- F. \$5,204,000
- G. \$5,206,000
- H. \$5,208,000
- I. \$5,210,000



**Round 2 Section 3 - Case Study Information Pack**

**Question 32**

**What is the difference in the total profit (in \$) between Scenario 1b and Scenario 1a (both including all hubs)? State your answer as a positive number to the nearest dollar (e.g. \$10,000) [5 marks]**

**Question 33**

**What is the total profit (in \$) for Scenario 2a (including all hubs)? [4 marks]**

- A. \$10,855,677
- B. \$10,855,678
- C. \$10,855,679
- D. \$10,855,680
- E. \$10,855,681
- F. \$10,855,682
- G. \$10,855,683
- H. \$10,855,684
- I. \$10,855,685

**Question 34**

**What is the difference in the total transport cost (in \$) between Scenario 2a and Scenario 2b (both including all hubs)? State your answer as a positive number to the nearest dollar (e.g. \$10,000) [5 marks]**



## Round 2 Section 3 - Case Study Information Pack

### Answers

26	C	
27	I	
28	B	
29	A	
30	I	
31	E	
32	-	\$61,868
33	F	
34	-	\$513,000