

## MELOGIC PROJECT: ESHFP input data and solution for a large scale problem

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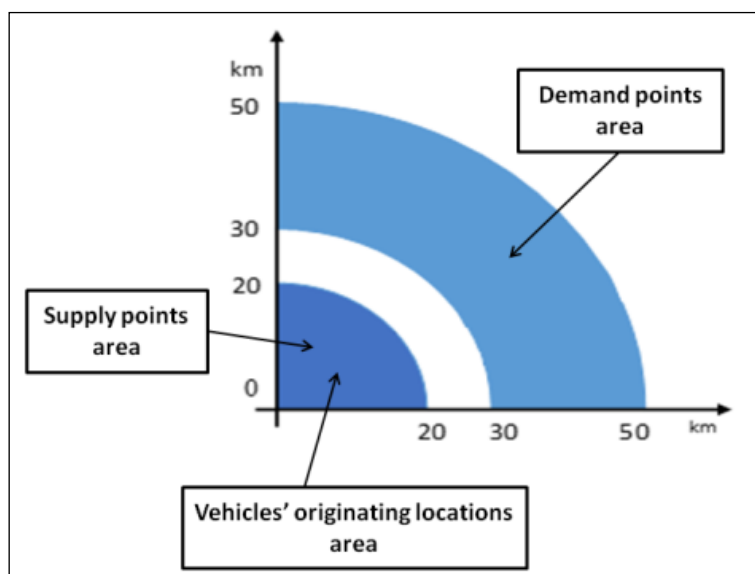
The following tables present the necessary data in terms of a) demand points, b) the available fleet of vehicles for supplying consumable and non-consumable provisions to civilians and intervention groups at their cities and c) the supply point providing the necessary commodities for the theoretical case study where the proposed heuristic is applied on a large-scale problem

a large scale instance of the ESHFP:

### A. Input Data

#### 1. Demand Points

Ten (10) demand points (D1, ..., D10) with a total demand of 150 pallets. The number of pallets per demand point is defined by selecting a random number between 1 and 150, always keeping in mind that the total demand cannot exceed 150 pallets. The coordinates of the demand are generated from the uniform distribution  $U(0,50)$  under the constraint that their Euclidian distance from the origin (0,0) is between 30 and 50 (see Figure A1). Three clusters (user defined) are considered. Finally note that for thresholds  $T_1$  and  $T_2$  it is assumed  $T_1 = 0 m^3$ ,  $T_2 = 10 min$ .



**Figure A1.** Supply points, vehicles' originating and demand point locations for the large-scale problem

Table A1, presents the demand points (shelters) to which supplies should be transported. Each supply point is assigned with an ID and its location is defined by coordinates. Additionally, Table A1 presents the demand (in units) at each shelter per commodity. Note that we assume 6 different commodities with IDs C1-C6.

**Table A1. Demand points input data**

Shelter ID	Coordinates		Demand					
	Latitude	Longitude	SKU (in units ) per Commodity					
			C1	C2	C3	C4	C5	C6
<b>D1</b>	28.62252	25.06812	685	274	411	411	137	137
<b>D2</b>	32.12284	29.88376	1650	660	990	990	330	330
<b>D3</b>	28.12088	25.27463	1520	608	912	912	304	304
<b>D4</b>	45.55720	8.45113	1555	622	933	933	311	311
<b>D5</b>	36.44648	23.60142	170	68	102	102	34	34
<b>D6</b>	17.87427	32.62052	2220	888	1332	1332	444	444
<b>D7</b>	38.22012	26.82770	295	118	177	177	59	59
<b>D8</b>	33.52497	25.64120	565	226	339	339	113	113
<b>D9</b>	40.09190	11.14081	1100	440	660	660	220	220
<b>D10</b>	41.28546	5.55578	155	62	93	93	31	31

## 2. Available fleet

Fifteen (15) vehicles (V1, ..., V15) are used with total capacity of 140 pallets. The capacity of each vehicle is defined by selecting a random number between 1 and 140, always taking into consideration that the total capacity cannot exceed 140 pallets. The coordinates of vehicles' originating locations are generated from the uniform distribution  $U(0,20)$  under the constraint that their Euclidian distance from the origin (0,0) is between 0 and 20 (see Figure A1). Note that the vehicle average speed is 50 km/h and the travel time between two nodes is calculated based on their Euclidian distance

Table A2, presents the available vehicles for the large scale instance of ESHFP. For each vehicle Table A2 presents its ID, its capacity in m<sup>3</sup>, the coordinates of its starting location as well as the ID of each starting location.

**Table A2. Vehicle-related input data**

ID	Capacity (in m <sup>3</sup> )	Starting Point's Coordinates		ID of Starting Point
		Latitude	Longitude	
V1	1.92	8.30188	0.49109	O1
V2	2.88	0.90862	3.15435	O2
V3	38.4	11.97254	0.95399	O3
V4	2.88	16.05791	11.72555	O4
V5	3.84	10.37627	15.48094	O5
V6	0.96	4.30651	4.81584	O6
V7	3.84	2.14079	3.82517	O7
V8	9.6	2.77112	11.07906	O8
V9	2.88	12.87692	6.75774	O9
V10	1.92	8.12413	17.71033	O10
V11	19.2	0.49832	3.76161	O11
V12	22.08	10.95012	11.80569	O12
V13	10.56	5.79782	2.70611	O13
V14	7.68	10.94655	10.78272	O14
V15	5.76	15.20290	5.15760	O15

### 3. Supply points

Sixteen (16) supply points (S1 ,..., S16) are considered with a total inventory of 250 pallets (66% higher than demand) and it is distributed almost equally ( $\sigma=low$ ) to the supply points. Note that 6 commodities (C1, ..., C6) in total are considered at each supply point. The coordinates of the supply points are generated from the uniform distribution  $U(0,20)$  under the constraint that their Euclidian distance from the origin (0,0) is between 0 and 20 (see Figure A1).

Table A3, presents the supply points to provide all the necessary commodities. It presents the ID, the coordinates and the inventory per commodity for each demand points.

**Table A3. Supply points-related input data**

ID	Coordinates		Inventory (Stock in Units) Per Commodity					
	Latitude	Longitude	C1	C2	C3	C4	C5	C6
<b>S1</b>	2.55768	1.6915182	1020	397	631	606	209	191
<b>S2</b>	2.09433	0.3041957	1029	398	606	608	216	213
<b>S3</b>	6.63329	3.9935998	1014	401	614	601	190	205
<b>S4</b>	10.6376	10.723178	1023	394	609	605	200	216
<b>S5</b>	8.24496	9.4037379	1015	416	599	614	205	201
<b>S6</b>	17.1423	6.2502943	1013	427	622	606	190	206
<b>S7</b>	11.8174	5.7167841	1024	406	608	600	216	215
<b>S8</b>	8.315	11.119006	1046	393	626	605	208	226
<b>S9</b>	10.7021	15.165915	1012	410	600	602	191	220
<b>S10</b>	1.84617	2.6087816	1046	421	605	632	188	226
<b>S11</b>	7.82167	12.544112	1025	399	620	606	190	225
<b>S12</b>	8.94398	9.1487563	1026	403	624	633	188	210
<b>S13</b>	1.17416	13.526003	1028	401	621	608	200	196
<b>S14</b>	13.5124	10.230851	1039	403	601	609	204	225
<b>S15</b>	5.96999	3.4724486	1017	418	602	633	199	225
<b>S16</b>	11.2983	1.8842816	1148	523	727	747	311	105

## **B. Output Data**

The results provided by the proposed algorithm for the large scale instance of the ESHFP are given in Table B1. Table B1 presents the routes operated, the corresponding vehicle to operate each route, the starting time and the ending time for each route, the sequence of visits at the supply points and the corresponding supplies collected from each of them per commodity, the sequence of visits at the demand points and the corresponding supplies delivered at each of them per commodity.

**Table A2. Large-scale problem Results**

Trips										
Vehicle	1			2			3			
Starting Time	V3			V12			V11			
Ending Time	0			0			0			
(min)	337			227			187			
	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	
Supply Points	S16	C1	1.7759	S15	C1	1.5732	S1	C1	0	
		C2	0.593		C2	0.474		C2	0	
		C3	0.727		C3	0.602		C3	0	
		C4	0.9412		C4	0.7975		C4	0	
		C5	0.5598		C5	0.3581		C5	0	
		C6	0		C6	12.15		C6	5.4111	
	S1	C1	0.9514	S2	C1	1.072	S11	C1	0.874	
		C2	0.2325		C2	0.3016		C2	0.2562	
		C3	0.355		C3	0.424		C3	0.339	
		C4	0.4145		C4	0.4951		C4	0.1697	
		C5	0.1152		C5	0.2575		C5	0	
		C6	0		C6	3.575		C6	12.15	
	S10	C1	1.6181	-	-	-	-	-	-	
		C2	0.4774		-	-	-	-	-	
		C3	0.605		-	-	-	-	-	
		C4	0.7963		-	-	-	-	-	
		C5	0.3384		-	-	-	-	-	
		C6	12.204		-	-	-	-	-	
	S8	C1	1.6181	-	-	-	-	-	-	
		C2	0.4456		-	-	-	-	-	
		C3	0.626		-	-	-	-	-	
		C4	0.7623		-	-	-	-	-	
		C5	0.3744		-	-	-	-	-	
		C6	11.8689		-	-	-	-	-	
	-Demand Points	D3	C1	2.3514	D10	C1	0.2397	D2	C1	0
			C2	0.6894		C2	0.0703		C2	0
			C3	0.912		C3	0.093		C3	0
			C4	1.1491		C4	0.1171		C4	0
			C5	0.5472		C5	0.0558		C5	0
			C6	16.416		C6	1.674		C6	17.5611
		D1	C1	1.0596	D4	C1	2.4055	D8	C1	0.874
			C2	0.3107		C2	0.7053		C2	0.2562
			C3	0.411		C3	0.933		C3	0.339
			C4	0.5178		C4	1.1755		C4	0.1697
			C5	0.2466		C5	0.5598		C5	0
			C6	7.398		C6	14.051		C6	0
D2		C1	2.5525	-	-	-	-	-	-	
		C2	0.7484		-	-	-	-	-	
		C3	0.99		-	-	-	-	-	
		C4	1.2474		-	-	-	-	-	
		C5	0.594		-	-	-	-	-	
		C6	0.2589		-	-	-	-	-	

Trips									
Vehicle	4				5				6
Starting Time	V13				V8				V14
Ending Time	0				0				0
(min)	141				119				126
	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )
		C1	0.2398		C1	0		C1	0.1176
		C2	0.0929		C2	0		C2	0.0385
	S1	C3	0.107	S3	C3	0	S1	C3	0.052
		C4	0.1135		C4	0		C4	0.0756
		C5	0.0937		C5	0		C5	0.0071
		C6	0		C6	9.6		C6	0
Supply Points		C1	1.5872		-	-		C1	1.5841
		C2	0.457		-	-		C2	0.4604
	S12	C3	0.624	-	-	-	S7	C3	0.608
		C4	0.7975		-	-		C4	0.756
		C5	0.3384		-	-		C5	0.3888
		C6	2.3093		-	-		C6	3.5919
		C1	1.6073		-	-		-	-
		C2	0.457		-	-		-	-
	S14	C3	0.601		-	-		-	-
		C4	0.7673		-	-		-	-
	C5	0.3671		-	-		-	-	
	C6	0		-	-		-	-	
Demand Points		C1	3.4343		C1	0		C1	1.7017
		C2	1.0069		C2	0		C2	0.4989
	D6	C3	1.332	D6	C3	0	D9	C3	0.66
		C4	1.6783		C4	0		C4	0.8316
		C5	0.7992		C5	0		C5	0.3959
		C6	2.3093		C6	9.6		C6	3.5919

Trips									
<b>Vehicle</b>	7				8				9
<b>Starting Time</b>	V15				V7				V5
<b>Ending Time</b>	0				0				0
<b>(min)</b>	78				81				105
	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )
<b>Supply Points</b>	S4	C1	0	S1	C1	0	S2	C1	0
		C2	0		C2	0		C2	0
		C3	0		C3	0		C3	0
		C4	0.2574		C4	0		C4	0
		C5	0.2034		C5	0		C5	0
		C6	5.2992		C6	3.84		C6	3.84
<b>Demand Points</b>	D8	C1	0	D6	C1	0	D9	C1	0
		C2	0		C2	0		C2	0
		C3	0		C3	0		C3	0
		C4	0.2574		C4	0		C4	0
		C5	0.2034		C5	0		C5	0
		C6	5.2992		C6	3.84		C6	3.84



Trips									
<b>Vehicle</b>	10				11				12
<b>Starting Time</b>	V9				V4				V2
<b>Ending Time (min)</b>	0				0				0
	78				73				69
	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )
<b>Supply Points</b>	S2	C1	0	S4	C1	0.4563	S4	C1	0
		C2	0		C2	0.1338		C2	0
		C3	0		C3	0.177		C3	0
		C4	0		C4	0.223		C4	0
		C5	0		C5	0.1062		C5	0
		C6	2.88		C6	1.7837		C6	2,88
<b>Demand Points</b>	D6	C1	0	D8	C1	0	D9	C1	0
		C2	0		C2	0		C2	0
		C3	0		C3	0		C3	0
		C4	0		C4	0		C4	0
		C5	0		C5	0		C5	0
		C6	2.88		C6	0.8028		C6	2.88
	-	-	-	D7	C1	0.4563	-	-	-
	-	-	-		C2	0.1338	-	-	-
	-	-	-		C3	0.177	-	-	-
	-	-	-		C4	0.223	-	-	-
	-	-	-		C5	0.1062	-	-	-
	-	-	-		C6	0.9809	-	-	-

Trips									
<b>Vehicle</b>	13			14			15		
<b>Starting Time</b>	V10			V1			V6		
<b>Ending Time (min)</b>	0			0			0		
	59			66			70		
	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )
Supply Points	S5	C1	0	S3	C1	0.2629	S1	C1	0
		C2	0		C2	0.0771		C2	0
		C3	0		C3	0.102		C3	0
		C4	0		C4	0.1285		C4	0
		C5	0		C5	0.0612		C5	0
		C6	1.92		C6	1.2883		C6	0.96
Demand Points	D6	C1	0	D5	C1	0.2629	D9	C1	0
		C2	0		C2	0.0771		C2	0
		C3	0		C3	0.102		C3	0
		C4	0		C4	0.1285		C4	0
		C5	0		C5	0.0612		C5	0
		C6	1.92		C6	1.2883		C6	0.96

Trips									
	16			17			18		
Vehicle	V10			V9			V1		
Starting Time	90			109			111		
Ending Time (min)	149			193			191		
	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )
Supply Points	S5	C1	0	S5	C1	0	S5	C1	0
		C2	0		C2	0		C2	0
		C3	0		C3	0		C3	0
		C4	0		C4	0		C4	0
		C5	0		C5	0		C5	0
		C6	1.92		C6	2.88		C6	1.92
Demand Points	D6	C1	0	D9	C1	0	D5	C1	0
		C2	0		C2	0		C2	0
		C3	0		C3	0		C3	0
		C4	0		C4	0		C4	0
		C5	0		C5	0		C5	0
		C6	1.92		C6	0.6081		C6	0.5477
	-	-	-	D4	C1	0	D7	C1	0
	-	-	-		C2	0		C2	0
	-	-	-		C3	0		C3	0
	-	-	-		C4	0		C4	0
	-	-	-		C5	0		C5	0
	-	-	-		C6	2.2719		C6	1.3723

Trips									
<b>Vehicle</b>	19				20				21
<b>Starting Time</b>	V7				V2				V6
<b>Ending Time</b>	112				116				117
<b>(min)</b>	170				204				190
	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )	ID of Supply Point / Demand Point	SKU	Quantity (in m <sup>3</sup> )
<b>Supply Points</b>	S4	C1	0	S2	C1	0	S5	C1	0
		C2	0		C2	0		C2	0
		C3	0		C3	0		C3	0
		C4	0		C4	0		C4	0
		C5	0		C5	0		C5	0
		C6	1.5067		C6	0.8328		C6	0.4711
<b>Demand Points</b>	D6	C1	0	D7	C1	0	D4	C1	0
		C2	0		C2	0		C2	0
		C3	0		C3	0		C3	0
		C4	0		C4	0		C4	0
		C5	0		C5	0		C5	0
		C6	1.5067		C6	0.8328		C6	0.4711
<b>Total Supply Time:</b>									<b>337 min</b>