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Introduction

Since 2011, Europe and the Middle East has faced a major inflow of refugees, which was caused by an outburst of Syrian Civil War (Doganay and Demiraslan, 2016**)**. Greece was one of the countries, which has agreed to accept Syrian refugees. This has resulted in a massive inflow of refugees from Turkey to Greece, with for example in 2018 alone, more than 30000 refugees arriving at the Greek islands by sea **(**UNCHR, 2018**).** Hotspots created for refugees on the Greek islands became over-occupied, with for example Lesvos hotspot fitting 8789 individuals, with its' capacity being only 3300 in 2018 (UNCHR, 2018). This has created adverse effects on the multiple groups of individuals and the Greek economy as a whole. Refugees themselves are living in abhorrent conditions. Local businesses suffer from the reduction of tourists' inflow, caused by the unpleasant views of overcrowded hotspots. Government is faced with an additional burden, associated with environmental damage caused (Skanavis and Kounani, 2016). To address the above-mentioned problems, we have proposed an integrated mathematical model to maximize the number of refugees transferred from island hotspots to both existing and potentially new camps. We additionally perform sensitivity analysis to evaluate the effect of both different budgets and capacities of potential camps on the outcome of the model. The report includes the following sections: related literature, problem description, mathematical formulation, computational results and conclusions and recommendations.

Related literature

The transhipment problem has been greatly broadened over the years since its first introduction in 1956 (Orden, 1956). The original problem has focused on the shipment of various goods or materials to a set of final destinations, by using intermediate nodes through which the shipments can be transported. This idea has been implemented in various ways, depending on the nature of the problem that needs to be solved. In some cases, resources are stocked at a node for certain reasons like emergencies, while in other, the model attempts to supply additional goods to the endpoints in order to fulfil future demand (Gupta and Mohan, 2006; Hmiden, Said and Ghedira, 2009). In our study, a restricted transhipment model was implemented. Instead of minimizing the total transportation cost or time required, this model focuses on a humanitarian aspect, by maximizing the number of people sent from each hotspot to each camp. Therefore, a restriction was added for the intermediate points, since all the refugees need to be transported to their final destination.

Various approaches were used to select new facility locations in operational research problems covering humanitarian needs. Haghani (1995) suggested a mixed integer linear programming model that can be used for any maximum covering problem. The model maximizes the covered demand at each node. Coverage and maximum capacity constraints ensure that no demand should be allocated to a facility unless the facility exists. Other constraints indicate that the total number of new facilities should not exceed the pre-determined amount and that the demand allocated to each facility cannot exceed the demand at that node. Additionally, this paper focuses on another model, which includes distances between the facilities in the objective function.

However, in our study we did not include distances in the objective function, instead we considered them in our budget constraint as a parameter to our cost function. Coverage and maximum capacity constraints used in this paper were adopted in our model.

Özdamar and Ertemb (2014) in their research focused on humanitarian logistics problem. In their relief management study, supplies were delivered to demand points by vehicles with a given capacity, where vehicles were dispatched from a set of warehouses and served multiple demand locations. We have adopted a similar model with the use of vehicles with a certain capacity to calculate the cost of supplies transportation per refugee. Knott (1987) conducted a research about disaster relief, where the objective function has focused on maximizing the number of trips executed to fulfil the victims' food demand. This model has been integrated as part of the main cost of our model, under the assumption that each supply package sent to camps, fulfils an individual's needs. Demand fulfilment under a budget restriction has been added as a constraint, while the cost has been calculated individually for every package.

Problem description

Due to the major refugee inflow since 2014, Greece has faced a challenge of allocating refugees efficiently. Lack of island hotspots originally built by the Greek government and constantly growing refugee inflow from Turkey has resulted in those hotspots being over-occupied. Poor conditions at the hotspots and negative side effects associated with the local community have motivated us to develop an effective solution to this problem. Since, some camps in the mainland of Greece are under-capacitated we propose to reallocate refugees from island hotspots to those camps. Additionally, since the availability of spaces in the mainland camps are far less than the number of refugees to reallocate, we propose to build new camps to accommodate those refugees. Potential camp locations are determined under a set of assumptions and come in two sizes. The proposed model aims to maximize the number of people transferred from hotspots to both existing and potential new mainland camps via various ports. That is done under a set of constraints. It is important to mention, that the model takes into account the supply cost per refugee and aims to meet the refugee's needs under a certain budget. Both sizes of the new camps and budgets needed for this operation are examined through sensitivity analysis.

The model is based on a set of assumptions, which are the following:

Hotspots:

- Priorities are assigned to hotspots according to the over occupancy of each. The more overcrowded the hotspot is, the greater the priority assigned to it. Priorities for each hotspot are calculated as the subtraction of the capacity of the hotspot from the number of refugees currently occupying it.
- Only one port is used for refugee transportation per island.

New camps:

- The location of the potential new camps is on accessible areas e.g. not mountains
- New camps shouldn't be located further than 70 km (approximately 1-hour drive) from a nearby warehouse, so that the transportation cost of supplying each camp is reasonable and realistic.
- In order to avoid potential conflicts between locals and refugees, new camps should be established at least 10km from the city centre.
- Building cost of a new camp is assumed to be 1000 euros per refugee (UNCHR 201X)

- Average size of existing camps could fit 842 refugees with the standard deviation of 244. Therefore, the initial two types for the new camps were assumed to be: mean -1sd for the small camps and mean + 1sd for the large camps

Supplies:

- We have selected big supermarkets in each province of Greece as our warehouses. Warehouses are assumed to have enough stock to provide supply packages to all camps.
- A supply package per refugee is assumed to last for a day, containing 2 large bottles of water and 3 meals. The cost for each package is assumed to be 10.5 euros.

Transportation:

- 1 type of ferry and 1 type of truck are used to transport refugees from island ports to mainland camps
- 1 type of truck is being used to transport supplies from warehouses to mainland camps
- Enough trucks and boats are available for both supply and refugee transportation in a single trip
- The busiest ports for passenger transportation were used as the mainland arrival point for refugees. Those ports hold a well-established infrastructure for the large volume of arrivals.
- There is a direct trip from each hotspot port to mainland port.

Limitations:

- Lack of data on the budget available to build new camps, since no camps were planned to be built in 2018
- Lack of data for real locations of the warehouses supplying the camps
- Locations are selected based on various criteria, but it is not certain that building new camps will be allowed there

Mathematical formulation

Sets:

$I: set\ of\ i\ hotspots$

$J: set\ of\ j\ ports$

$K: set\ of\ k\ existing\ mainland\ camps$

$G: set\ of\ g\ new\ mainland\ camps$

$W: set\ of\ w\ warehouses$

Decision Variables:

$X_{ij}\ -number\ of\ people\ travelling\ from\ hotspot\ i\ to\ port\ j$

$Y_{jk}\ -number\ of\ people\ travelling\ from\ port\ j\ to\ camp\ k$

$Z_{jg}\ -number\ of\ people\ travelling\ from\ port\ j\ to\ camp\ g$

$S_{wk}\ -number\ of\ supply\ packages\ to\ be\ sent\ from\ warehouse\ w\ to\ camp\ k$

$S'_{wg} -number\ of\ supply\ packages\ to\ be\ sent\ from\ warehouse\ w\ to\ camp\ g$

$$U_g = \begin{cases} 1, if\ the\ camp\ is\ established\ at\ node\ g\ with\ size\ 1(big) \\ 0, otherwise \end{cases}$$

$$V_g = \begin{cases} 1, if\ the\ camp\ is\ established\ at\ node\ g\ with\ size\ 2(small) \\ 0, otherwise \end{cases}$$

Parameters:

$F - total\ cost\ of\ transporting, supply\ and\ building\ new\ camps$

$c_{ij}^{[1]} - transportation\ cost\ from\ hotspot\ i\ to\ port\ j\ per\ person$

$c_{jk}^{[2]} - transportation\ cost\ from\ port\ j\ to\ camp\ k\ per\ person$

$c_{jg}^{[3]} - transportation\ cost\ from\ port\ j\ to\ camp\ g\ per\ person$

$c_{wk}^{[4]} - cost\ of\ one\ supply\ package\ from\ warehouse\ w\ to\ camp\ k$

$c_{wg}^{[5]} - cost\ of\ one\ supply\ package\ to\ from\ warehouse\ w\ to\ camp\ g$

$c_{g1}^{[6]} - cost\ of\ opening\ a\ small\ sized\ camp$

$c_{g2}^{[7]} - cost\ of\ opening\ a\ big\ sized\ camp$

$d_{ij}^{[1]} - distance\ traveled\ (in\ km)\ from\ hotspot\ i\ to\ port\ j$

$d_{jk}^{[2]} - distance\ traveled\ (in\ km)\ from\ port\ j\ to\ camp\ k$

$d_{jg}^{[3]} - distance\ traveled\ (in\ km)\ from\ port\ j\ to\ camp\ g$

$d_{wk}^{[4]} - distance\ traveled\ (in\ km)\ from\ warehouse\ w\ to\ camp\ k$

$d_{wg}^{[5]} - distance\ traveled\ (in\ km)\ from\ warehouse\ w\ to\ camp\ g$

$\theta - fixed\ cost\ of\ one\ supply\ package$

$\eta - fixed\ cost\ of\ opening\ camp\ with\ size\ 1$

$\eta' - fixed\ cost\ of\ opening\ camp\ with\ size\ 2$

$r_i - number\ of\ refugees\ at\ hotspot\ i$

$r_k' - number\ of\ refugees\ at\ camp\ k$

$\gamma_k - capacity\ of\ camp\ k$

$\gamma'_{g1} - capacity\ of\ camp\ g\ with\ size\ 1$

$\gamma''_{g2} - capacity\ of\ camp\ g\ with\ size\ 2$

$\varphi_s - consumption\ of\ ships$

$\varphi'_t - consumption\ of\ trucks$

$b_{ship} - capacity\ of\ a\ ship\ that\ carries\ refugees\ from\ hotspots\ to\ ports$

$b'_{truck} - capacity\ of\ truck\ that\ carries\ refugees\ from\ ports\ to\ camps$

$p_{ship} - price\ of\ ship\ fuel\ per\ km$

$p'_{land} - price\ of\ land\ fuel\ per\ km$

$\delta_i - coefficients\ of\ priorities\ of\ hotspots\ ranging\ between\ 0\ and\ 1$

Objective function:

$$\max(z) = \sum_{i=1}^{I} \sum_{j=1}^{J} \delta_i X_{ij} \quad (1)$$

$$F = \sum_{i=1}^{I} \sum_{j=1}^{J} c_{ij}^{[1]} X_{ij} + \sum_{j=1}^{J} \sum_{k=1}^{K} c_{jk}^{[2]} Y_{jk} + \sum_{j=1}^{J} \sum_{g=1}^{G} c_{jg}^{[3]} Z_{jg} + \sum_{w=1}^{W} \sum_{k=1}^{K} c_{wk}^{[4]} S_{wk} + \sum_{w=1}^{W} \sum_{g=1}^{G} c_{wg}^{[5]} S'_{wg} + \sum_{g=1}^{G} c_{g1}^{[6]} V_g + \sum_{g=1}^{G} c_{g2}^{[7]} U_g \quad (2)$$

$$c_{ij}^{[1]} = \frac{(p_{ship} * \varphi_s * d_{ij}^{[1]})}{b_{ship}} \quad (3)$$

$$c_{jk}^{[2]} = \frac{(p'_{land} * \varphi'_t * d_{jk}^{[2]})}{b'_{truck}} \quad (4)$$

$$c_{jg}^{[3]} = \frac{(p'_{land} * \varphi'_t * d_{jg}^{[3]})}{b'_{truck}} \quad (5)$$

$$c_{wk}^{[4]} = \theta + \left(\frac{\mathrm{p'_{land}} * \varphi'_t * d_{wk}^{[4]}}{b'_{truck}} \right) \quad (6)$$

$$c_{wg}^{[5]} = \theta + \left(\frac{\mathrm{p'_{land}} * \varphi'_t * d_{wg}^{[5]}}{b'_{truck}} \right) \quad (7)$$

$$c_{g1}^{[6]} = \eta \quad (8)$$

$$c_{g2}^{[7]} = \eta' \quad (9)$$

Subject to:

$$F \leq b \quad (1)$$

$$V_g + U_g \leq 1, \ \forall g \in G \quad (11)$$

$$\sum_{j=1}^{J} Y_{jk} \leq \gamma_k - r'_k, \quad \forall k \in K \quad (12)$$

$$\sum_{j=1}^{J} Z_{jg} \leq \gamma'_{g1} U_g + \gamma''_{g2} V_g, \ \forall g \in G \quad (13)$$

$$\sum_{i=1}^{I} X_{ij} = \sum_{k=1}^{K} Y_{jk} + \sum_{g=1}^{G} Z_{jg}, \ \forall j \in J \quad (14)$$

$$\sum_{j=1}^{J} X_{ij} \leq r_i, \ \forall i \in I \quad (15)$$

$$\sum_{w=1}^{W} S_{wk} \geq \sum_{j=1}^{J} Y_{jk} \quad , \forall k \in K \quad (16)$$

$$\sum_{w=1}^{W} S'_{wg} \geq \sum_{j=1}^{J} Z_{jg} \quad , \forall g \in G \quad (17)$$

$$X_{ij} \geq 0, Y_{jk} \geq 0, Z_{jg} \geq 0, S_{wk} \geq 0, S'_{wg} \geq 0 \quad , \forall i \in I, \forall j \in J, \forall k \in K, \forall g \in G, \forall w \in W \quad (18)$$

$$V_g, U_g \ \in \{0,1\} \quad , \forall g \in G \quad (19)$$

The objective function (1) maximizes the number of refugees transferred from hotspots to ports, considering the priority assigned to each hotspot. Equation (2) denotes the cost function of the model, which consists of seven different cost components. Cost equations (3), (4) and (5) calculate the cost of transportation per refugee. Cost equations (6) and (7) indicate how the unit cost of one supply package is calculated and cost equations (8) and (9) are the costs related with opening new camps. All these 7 costs in total form up our cost function and constraint (10) ensures that the cost function cannot exceed the available budget. Constraint (11) states that either none or only one camp of either size can be opened in each candidate location. Constraint (12) ensures that the number of people transferred to each old camp should be less than or equal to the available spaces in the camp. Similarly, (13) states that the number of people transferred from ports to each new camp should not exceed its capacity, considering the selected size, while simultaneously making

sure that refugees are not transferred to a camp that wasn't established. Constraint (14) makes sure that every refugee transferred from hotspots to ports should be placed to either a new or an existing camp. Constraint (15) ensures that the number of people transferred from a hotspot does not exceed the number of people currently living in that hotspot. Constraints (16) and (17) state that the number of supply packages sent from warehouses to existing camps or new camps is greater than or equal to the number of people transferred to those camps. This means that only recently settled refugees will receive one supply package per person. Constraint (18) is the non-negativity constraint and constraint (19) is the integrality constraint.

Computational results

Data collection was based on available official documents and research on the parameters of the cost functions. The data on the name, occupancy and the capacity of each island hotspot is from The Ministry of National Defense of Greece website. We then proceeded to collect the data on the distance between each of the 5 islands' ports and 4 mainland ports. The coordinates of each port for distance calculation were determined through *Google Maps*. Since we have assumed, that there is a direct trip from each hotspot port to mainland port, we have used the *Sea Distance Maps* (an app similar to Google Maps for sea travel) to construct a matrix of distances. The above-mentioned ship trip cost formula requires 3 components. The components are: the fuel consumption per km, ship capacity and the price of fuel. The Greek government has previously used *HSC Caldera Vista* to transport refugees from islands to mainland **(**Nianias, 2019**)**. We used the ship parameters to determine capacity and consumption. Additionally, the ships use diesel, therefore the price of diesel in December 2018 is used as our 3rd component.

The name, occupancy level and capacity of each mainland were again collected from The Ministry of National Defense of Greece. We then used UNCHR report on the camps of Greece to determine the exact locations of those camps **(**Site profiles – Greece, 2017**)**. To calculate distances between mainland ports and mainland camps and construct a distance matrix we have again used *Google Maps,* where the minimum driving distance between 2 nodes was used. Truck trip cost was calculated using the same formula. We have found out that the Greek Army has previously used *Steyr 12M18* truck to transport refugees. The fuel consumption and truck capacity were obtained for this vehicle model. The truck uses diesel; therefore, the above-mentioned price of fuel was used.

The locations of new camps were determined based on the assumptions discussed in the *"Problem Definition"* section of the report. The set-up cost of 1000 euros for opening new camp per refugee was taken from UNCHR official announcement (2016). That includes containers, water, sewer, electrical and site works.

The existing and new camps are in 4 provinces. We chose large supermarkets in the center of each region as our warehouses. The province of Attica has used 2 warehouses, since it has a lot more camps. The distances from warehouses to both new and existing camps were calculated, using the above-mentioned procedure.

The decision variables of the model are the number of refugees transferred from each hotspot to a port and from the port to either an existing camp or new one to be built. In addition to that, the model will also provide the location of new mainland camps and their respective size, taking into consideration the number of supply packages that would have to be provided to the refugees transferred to the camp. The computational result of this model will allow the Greek government to maximize the number of refugees it accommodates within a certain budget.

The machine used to run these experiments is a Lenovo ThinkPad T460p with an i5-6440HQ vPro CPU, 8GB DDR4 RAM running Ubuntu 16.04 LTS. We used GAMS to program and run the model. Runtime was considerably fast and within one second since the data sets were not of big volume. Branch-and-Cut method was used under the CPLEX configuration of GAMS.

Since the budget is yet to be determined, we conducted a sensitivity analysis on it alongside the size of the camps. We selected the range of our budget starting from the minimum in which no new camps would be built and up to a maximum that would allow Greece to meet the capacity of its mainland camps. Thus, taking full advantage of all resources available. Moreover, it was found that the sizes chosen for the camps affect the number of refugees accommodated. For that reason, the budget sensitivity analysis was conducted multiple times on different sized camps.

The main aim of this project is to reduce the number of refugees located at hotspots. Therefore, we have plotted the following graphs which show the change in occupancy levels across camps after the refugees have been allocated according to the solution of the model.

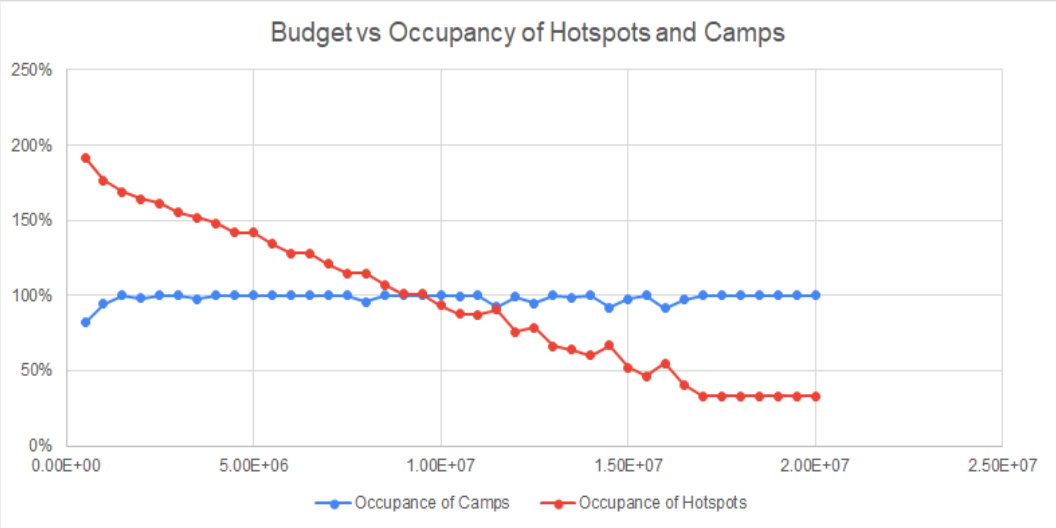

Figure 1 Small Camp Size:600 - Large Camp Size: 1100

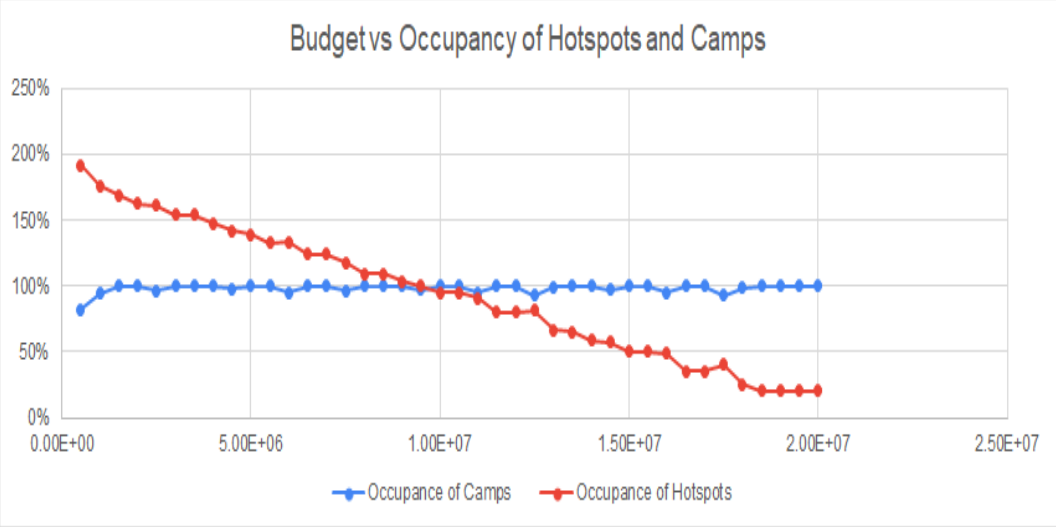

Figure 2 Small Camp Size:500 - Large Camp Size: 1200

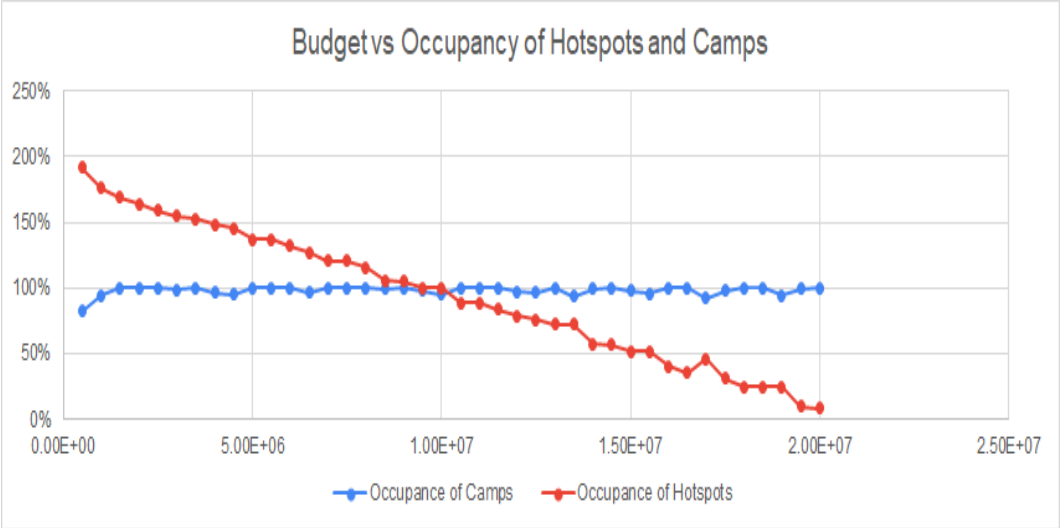

Figure 3 Small Camp Size: 400 - Large Camp Size: 1300

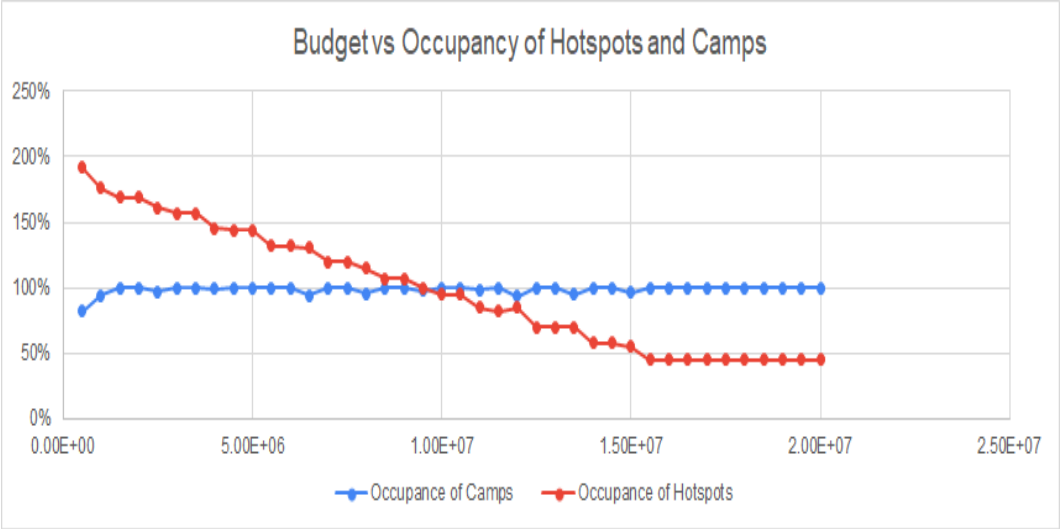

Figure 4 Small Camp Size: 1000 - Large Camp Size: 1000

The above graphs illustrate how the occupancy at the hotspots change with the available budget under different sized camps. We notice that the mainland camps are always at optimal capacity. This indicates that the model is performing well in allocating refugees and resources, utilizing the best of the budget available. In addition to that, we notice that under all three different camp size allocations, the optimal budget is around 9.5 million euros, at which both hotspots and camps are at or just below full capacity. Details about the sensitivity analysis can be found in Appendix.

To further study the effect of different camps sizes, we provide the tables below. The tables indicate the maximum number of refugees accommodated under each camp size scenario alongside the budget required.

Camp Size	Column1	Maximum Refugees Accommodated	Budget Required
Small	Large		
600	1,100	14,137	€ 17,000,000.00
500	1,200	15,137	€ 18,500,000.00
400	1,300	16,137	€ 20,000,000.00
1,000	1,000	13,137	€ 15,500,000.00

Table 1 Maximum Number of Refugees Accommodated and the Respective Budget

Camp Size		Refugees Accommodated
Small	Large	
600	1,100	8637
500	1,200	8732
400	1,300	8736
1,000	1,000	8724

Table 2 Refugees Accommodated at a Budget of 9,500,000 Euros

In regards of the best camp size, from the tables above, we notice that the greatest number of accommodated refugees occurs for a small camp size of 400 and large camp size of 1300 at the optimal budget of 9.5 million euros. Moreover, if we intend reduce hotspot capacity as much as possible, this is also the optimal camp sizes. Enabling Greece to accommodate a total of 16,137 refugees but at rather much higher cost of 20 million euros.

Conclusions and recommendations

The refugee crisis is a humanitarian issue and should be dealt with extreme care and consideration. Therefore, the purpose of our model is to maximize refugee allocation instead of minimizing cost. The budget is a very important factor that greatly affects the results. Old mainland camps in Greece were under capacitated yet they could not serve the influx of refugees that the Syrian war was generating. Alternative measures must be taken as hotspots in Greece quickly became over-capacitated and refugee conditions are deteriorated. To accommodate more refugees, Greece could build more mainland camps. However, to utilize the full potential of a budget, the location and size

of new camps are considered in the model alongside the supply of a refugee at a camp. The integrated model provides us with the optimal location of new camps as well as the number of refugees transferred and the optimal transportation route from each hotspot to the destination camp.

We have found the best new camp locations to be Keratea and Petra as they are the first chosen locations with a low available budget. Petra is a destination located farther from the ports; however, it has a lower cost of supplies which the model favoured.

The results of this research could act as a basis for setting the budget for refugee aid that could be used by the government of Greece. It also provides insights on the possible locations of camps. Moreover, by assigning priorities to hotspots, the model would initially benefit refugees currently located in more overcrowded hotspots. Therefore, the model focuses on relieving refugees living in abhorrent conditions due to the lack of hosting capabilities and infrastructure in the hotspots.

The model does have limitations such as the lack of enough data on costs and previous budget. However, this does not invalidate the results of this research. Future research could possibly tackle these limitations and consider more supply sources, various types of supplies and different camp sizes and locations.

In conclusion, the model is able to optimally reduce the number of refugees at hotspots. This is achieved by utilizing the full potential of a given budget, prioritizing refugees located in more overcrowded hotspots, while taking their supply under consideration.

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Appendix

Camp Size: 600 – 1100

Budget	Total refugees taken	# of new small camps built	# of new large camps built	cost % increase	refugees % increase	Occupancy of Camps	Occupancy of Hotspots
5.00E+05	1280	0	0	0	0	82%	192%
1.00E+06	2537	0	0	100.00%	98.20%	94%	176%
1.50E+06	3137	0	0	50.00%	23.65%	100%	169%
2.00E+06	3524	1	0	33.33%	12.34%	98%	164%
2.50E+06	3737	1	0	25.00%	6.04%	100%	162%
3.00E+06	4237	0	1	20.00%	13.38%	100%	155%
3.50E+06	4542	1	1	16.67%	7.20%	98%	152%
4.00E+06	4837	1	1	14.29%	6.49%	100%	148%
4.50E+06	5337	0	2	12.50%	10.34%	100%	142%
5.00E+06	5337	0	2	11.11%	0.00%	100%	142%
5.50E+06	5937	1	2	10.00%	11.24%	100%	134%
6.00E+06	6437	0	3	9.09%	8.42%	100%	128%
6.50E+06	6437	0	3	8.33%	0.00%	100%	128%
7.00E+06	7037	1	3	7.69%	9.32%	100%	121%
7.50E+06	7537	0	4	7.14%	7.11%	100%	115%
8.00E+06	7503	1	4	14.29%	6.62%	96%	115%
8.50E+06	8137	1	4	6.25%	8.45%	100%	107%
9.00E+06	8637	0	5	12.50%	15.11%	100%	101%
9.50E+06	8637	0	5	5.56%	0.00%	100%	101%
1.00E+07	9237	1	5	11.11%	6.95%	100%	94%
1.05E+07	9698	0	6	5.00%	4.99%	100%	88%
1.10E+07	9737	0	6	4.76%	0.40%	100%	87%
1.15E+07	9463	0	7	9.52%	-2.42%	92%	91%
1.20E+07	10674	0	7	4.35%	12.80%	99%	76%
1.25E+07	10434	1	7	4.17%	-2.25%	95%	79%
1.30E+07	11437	1	7	8.33%	7.15%	100%	66%
1.35E+07	11639	0	8	3.85%	1.77%	98%	64%
1.40E+07	11937	0	8	3.70%	2.56%	100%	60%
1.45E+07	11398	0	9	7.41%	-2.07%	92%	67%
1.50E+07	12599	0	9	3.45%	10.54%	98%	52%
1.55E+07	13037	0	9	3.33%	3.48%	100%	47%
1.60E+07	12359	0	10	3.23%	-5.20%	92%	55%
1.65E+07	13534	0	10	6.45%	3.81%	97%	40%
1.70E+07	14137	0	10	3.03%	4.46%	100%	33%
1.75E+07	14137	0	10	2.94%	0.00%	100%	33%
1.80E+07	14137	0	10	2.86%	0.00%	100%	33%
1.85E+07	14137	0	10	5.71%	0.00%	100%	33%
1.90E+07	14137	0	10	2.70%	0.00%	100%	33%
1.95E+07	14137	0	10	2.63%	0.00%	100%	33%
2.00E+07	14137	0	10	2.56%	0.00%	100%	33%

Camp Size: 500 – 1200

Budget	Total refugees taken	# of new small camps built	# of new large camps built	cost % increase	refugees % increase	Occupancy of Camps	Occupancy of Hotspots
5.00E+05	1280	0	0	0	0	82%	192%
1.00E+06	2537	0	0	100.00%	98.20%	94%	176%
1.50E+06	3137	0	0	50.00%	23.65%	100%	169%
2.00E+06	3637	1	0	33.33%	15.94%	100%	163%
2.50E+06	3781	2	0	25.00%	3.96%	97%	161%
3.00E+06	4337	0	1	20.00%	14.71%	100%	154%
3.50E+06	4337	0	1	16.67%	0.00%	100%	154%
4.00E+06	4837	1	1	14.29%	11.53%	100%	148%
4.50E+06	5286	0	2	12.50%	9.28%	98%	142%
5.00E+06	5537	0	2	11.11%	4.75%	100%	139%
5.50E+06	6037	1	2	10.00%	9.03%	100%	133%
6.00E+06	6032	0	3	9.09%	-0.08%	95%	133%
6.50E+06	6737	0	3	8.33%	11.69%	100%	124%
7.00E+06	6737	0	3	7.69%	0.00%	100%	124%
7.50E+06	7259	2	3	7.14%	7.75%	97%	118%
8.00E+06	7937	0	4	14.29%	17.81%	100%	110%
8.50E+06	7937	0	4	6.25%	0.00%	100%	110%
9.00E+06	8437	1	4	12.50%	6.30%	100%	103%
9.50E+06	8732	0	5	5.56%	3.50%	98%	100%
1.00E+07	9137	0	5	11.11%	8.30%	100%	95%
1.05E+07	9137	0	5	5.00%	0.00%	100%	95%
1.10E+07	9470	0	6	4.76%	3.64%	95%	91%
1.15E+07	10337	0	6	9.52%	13.13%	100%	80%
1.20E+07	10337	0	6	4.35%	0.00%	100%	80%
1.25E+07	10201	0	7	4.17%	-1.32%	93%	82%
1.30E+07	11411	0	7	8.33%	10.39%	99%	67%
1.35E+07	11537	0	7	3.85%	1.10%	100%	65%
1.40E+07	12037	1	7	3.70%	4.33%	100%	59%
1.45E+07	12136	0	8	7.41%	5.19%	97%	58%
1.50E+07	12737	0	8	3.45%	4.95%	100%	50%
1.55E+07	12737	0	8	3.33%	0.00%	100%	50%
1.60E+07	12854	0	9	3.23%	0.92%	95%	49%
1.65E+07	13937	0	9	6.45%	9.42%	100%	35%
1.70E+07	13937	0	9	3.03%	0.00%	100%	35%
1.75E+07	13554	0	10	2.94%	-2.75%	93%	40%
1.80E+07	14769	0	10	5.88%	5.97%	98%	25%
1.85E+07	15137	0	10	2.78%	2.49%	100%	21%
1.90E+07	15137	0	10	2.70%	0.00%	100%	21%
1.95E+07	15137	0	10	5.41%	0.00%	100%	21%
2.00E+07	15137	0	10	2.56%	0.00%	100%	21%

Camp Size: 400 – 1300

Budget	Total refugees taken	# of new small camps built	# of new large camps built	cost % increase	refugees % increase	Occupancy of Camps	Occupancy of Hotspots
5.00E+05	1280	0	0	0	0	82%	192%
1.00E+06	2537	0	0	100.00%	98.20%	94%	176%
1.50E+06	3137	0	0	50.00%	23.65%	100%	169%
2.00E+06	3537	1	0	33.33%	12.75%	100%	164%
2.50E+06	3937	2	0	25.00%	11.31%	100%	159%
3.00E+06	4280	0	1	20.00%	8.71%	99%	155%
3.50E+06	4437	0	1	16.67%	3.67%	100%	153%
4.00E+06	4791	2	1	14.29%	7.98%	96%	149%
4.50E+06	5038	3	1	12.50%	5.16%	95%	145%
5.00E+06	5737	0	2	11.11%	13.87%	100%	137%
5.50E+06	5737	0	2	10.00%	0.00%	100%	137%
6.00E+06	6137	1	2	9.09%	6.97%	100%	132%
6.50E+06	6525	0	3	8.33%	6.32%	96%	127%
7.00E+06	7037	0	3	7.69%	7.85%	100%	121%
7.50E+06	7037	0	3	7.14%	0.00%	100%	121%
8.00E+06	7437	1	3	14.29%	5.68%	100%	116%
8.50E+06	8237	0	4	6.25%	10.76%	99%	106%
9.00E+06	8337	0	4	12.50%	12.10%	100%	105%
9.50E+06	8736	2	4	5.56%	4.79%	98%	100%
1.00E+07	8739	0	5	11.11%	4.82%	95%	100%
1.05E+07	9637	0	5	5.00%	10.28%	100%	89%
1.10E+07	9637	0	5	4.76%	0.00%	100%	89%
1.15E+07	10037	1	5	9.52%	4.15%	100%	84%
1.20E+07	10453	0	6	4.35%	4.14%	97%	79%
1.25E+07	10696	1	6	4.17%	2.32%	97%	76%
1.30E+07	10937	0	6	8.33%	4.63%	100%	73%
1.35E+07	10939	0	7	3.85%	0.02%	93%	73%
1.40E+07	12148	0	7	3.70%	11.05%	100%	58%
1.45E+07	12237	0	7	7.41%	11.87%	100%	57%
1.50E+07	12632	2	7	3.45%	3.23%	98%	52%
1.55E+07	12633	0	8	3.33%	0.01%	96%	52%
1.60E+07	13537	0	8	3.23%	7.16%	100%	40%
1.65E+07	13937	1	8	6.45%	10.32%	100%	35%
1.70E+07	13104	0	9	3.03%	-5.98%	92%	46%
1.75E+07	14291	0	9	2.94%	9.06%	98%	31%
1.80E+07	14837	0	9	2.86%	3.82%	100%	24%
1.85E+07	14837	0	9	5.71%	3.82%	100%	24%
1.90E+07	14790	0	10	2.70%	-0.32%	94%	25%
1.95E+07	16035	0	10	2.63%	8.42%	100%	10%
2.00E+07	16137	0	10	2.56%	0.64%	100%	8%

Camp Size: 1000 – 1000

Budget	Total refugees taken	# of new small camps built	# of new large camps built	cost % increase	refugees % increase	Occupancy of Camps	Occupancy of Hotspots
5.00E+05	1280	0	0	0	0	82%	192%
1.00E+06	2537	0	0	100.00%	98.20%	94%	176%
1.50E+06	3137	0	0	50.00%	23.65%	100%	169%
2.00E+06	3137	0	0	33.33%	0.00%	100%	169%
2.50E+06	3783	0	1	25.00%	20.59%	97%	161%
3.00E+06	4137	0	1	20.00%	9.36%	100%	157%
3.50E+06	4137	0	1	16.67%	0.00%	100%	157%
4.00E+06	5030	0	2	14.29%	21.59%	99%	146%
4.50E+06	5137	0	2	12.50%	2.13%	100%	144%
5.00E+06	5137	0	2	11.11%	0.00%	100%	144%
5.50E+06	6137	1	2	10.00%	19.47%	100%	132%
6.00E+06	6137	1	2	9.09%	0.00%	100%	132%
6.50E+06	6274	2	2	8.33%	2.23%	94%	130%
7.00E+06	7137	2	2	7.69%	13.76%	100%	120%
7.50E+06	7137	2	2	7.14%	0.00%	100%	120%
8.00E+06	7500	2	3	14.29%	5.09%	96%	115%
8.50E+06	8137	2	3	6.25%	8.49%	100%	107%
9.00E+06	8137	3	2	12.50%	8.49%	100%	107%
9.50E+06	8724	3	3	5.56%	7.21%	97%	100%
1.00E+07	9137	3	3	11.11%	12.29%	100%	95%
1.05E+07	9137	3	3	5.00%	0.00%	100%	95%
1.10E+07	9937	3	4	4.76%	8.76%	99%	85%
1.15E+07	10137	3	4	9.52%	10.94%	100%	82%
1.20E+07	9938	4	4	4.35%	-1.96%	93%	85%
1.25E+07	11136	4	4	4.17%	12.05%	100%	70%
1.30E+07	11137	4	4	8.33%	12.06%	100%	70%
1.35E+07	11141	4	5	3.85%	0.04%	95%	70%
1.40E+07	12137	4	5	3.70%	8.94%	100%	58%
1.45E+07	12137	4	5	7.41%	8.94%	100%	58%
1.50E+07	12340	4	6	3.45%	1.67%	96%	55%
1.55E+07	13137	4	6	6.90%	8.24%	100%	45%
1.60E+07	13137	4	6	3.23%	0.00%	100%	45%
1.65E+07	13137	4	6	3.13%	0.00%	100%	45%
1.70E+07	13137	4	6	6.25%	0.00%	100%	45%
1.75E+07	13137	4	6	2.94%	0.00%	100%	45%
1.80E+07	13137	4	6	5.88%	0.00%	100%	45%
1.85E+07	13137	4	6	2.78%	0.00%	100%	45%
1.90E+07	13137	4	6	2.70%	0.00%	100%	45%
1.95E+07	13137	4	6	5.41%	0.00%	100%	45%
2.00E+07	13137	4	6	2.56%	0.00%	100%	45%