Homeless Shelter Optimization in Montreal

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Contents

1 Introduction

Nations all around the world encounter various social, economic, political, and security issues that leave governments no choice but to step in and take action. In Montreal, homelessness has been a major concern over the past couple of years and continues to be so at an increasing rate. Homelessness reflects the social/economic problems that create unstable housing conditions and poverty, leaving many on the streets. This produces a large number of people who encounter daily physical, emotional, and mental struggles to survive that start with obtaining food, clothing, shelter, and warmth. In fact, according to Homeless Hub statistics, the total amount of homelessness in Montreal in 2018 was 3,149 [1]. The CEO of Old Brewery Mission, James Hughes, states that this amount increased by 20% in 2020 due to the COVID-19 pandemic[6].

Due to external pressures such as COVID-19, immense pressure has been put on the capacity of homeless shelters in Montreal. In Montreal, there are three types of shelters which are permanent housing, transitional housing, and emergency shelters. Many of the homeless people mentioned above, did not choose to be on the streets and will be looking for solutions to their situation. One option they will be looking for is an emergency shelter that provides an escape from the streets and an instant state of relief. Another option they would be looking at is a transitional shelter, that provides a period of support for people who cannot pay their bills for a couple of months and need a temporary place to stay. In an ideal world, all homeless people would find solutions and escape the reality they live in. Unfortunately, that is not the case. Access to some shelters and transitional housing is not easily accessible, while other shelters have demand greater than capacity. In fact, homeless people in need of shelter get rejected at such institutions due to improper resource allocation, where resources are wasted even when capacity has not yet been reached.

The aim of the project is to improve the efficacy of homeless shelter services for the homeless population in Montreal. The goal of the optimization models is to minimize the cost given the current capacity of homeless shelters while maximizing the number of the accommodated homeless population. Some of the costs to be considered are the living costs per person at each shelter (e.g., electricity, food, staffing costs) and fixed costs to run operations in the shelters. This project will also recommend shelter locations to account for the overflow demand.

2 Problem Description and Formulation

2.1 Problem Description and Scope

The project presented consists of an optimization model that was built by analyzing the homeless population distribution and the accessible homeless shelters in order to efficiently allocate the homeless people to the most optimal shelter. This optimization model is done in two phases. The first phase is a simulation that aims to maximize the number of homeless people transferred from either metro stations or encampments to existing shelters. The people not allocated are used in the second phase which aims to allocate the homeless people to new potential shelters, while minimizing cost. For the purposes of the project, 81 homeless shelters were considered on Montreal Island, the total number of homeless people was calculated to be 3,566, and 7 new potential locations for shelters were examined. In addition, 10 homeless encampments and 63 metro stations were considered.

2.2 Data Collection and Preparation

Current Capacity and Location of Homeless Shelters on Montreal Island: Upon finding the 81 shelters, the capacity of each shelter was found on 211qc.ca [3] which is an information and referral service which we used to gather information on homeless shelters. The location of each homeless shelter was extracted from Google Maps[16]

Total Expenses of Homeless Shelters: Total costs are assumed to be the sum of all the expenses such mortgage, property taxes, interest and bank charges, office supplies etc. This data was extracted from each of the shelter's financial statements[4]. If multiple locations were related to one organization the capacity of each location was totaled and the ratio between the capacity of one location divided by the total capacity of all locations. This ratio was multiplied by the total cost of the organization to find the adjusted cost for each location. All missing financial values were replaced by the median adjusted cost across all other shelters.

Number of Homeless People in 2020: The homeless population was found to be 3,149 in 2018[1]. As stated earlier, this amount increased by 20% in 2020 due to the impact of the pandemic[6]. The homeless population adjusted for this increase was calculated to be around 3779. However, for the purpose of this project, the victims of domestic abuse form around 5.5% of the homeless population and will not be considered. Hence, the final homeless population in 2020 was calculated to be 3566. The male and female ratio for the homeless population was found to be 70% for males, and 30% for female[5].

Average Cost of Maintaining a Homeless Person: The average monthly cost of maintaining one homeless person in 2013 was found to be $1,932 [2]. This number was adjusted for inflation to be $2,155 in 2020. Therefore the yearly cost of housing a homeless person is $25,860.

Homeless Encampments and Metro Stations (Hotspots): The metro stations considered were the green, orange, and blue lines. This is because this cumulative area covers a big portion of the space in Montreal Island. The total number of these stations is 62 and the location of each station was also collected using Google Maps[16]. 10 homeless encampments were identified by finding news articles highlighting each location.

Homeless Distribution in Hotspots: No information could be found on the distribution of homeless people on Montreal Island. An assumption made was that half the homeless population would be distributed to encampments and half to metro stations. For homeless encampments, 25 people were assigned to West Island because it is a a more affluent area. The rest of the homeless people were distributed equally to all other encampments. For metro stations, the orange, green and blue lines stations were used, except for the stations located off of Montreal Island. To determine the distribution, an assumption was made that the population density of the closest census tract from Stats Canada would be representative of the population density of the homeless surrounding each metro station. Each population density was divided by the minimum density value of all metro stations to create a scaling value[15]. To assign the number of homeless people, the total number of homeless people at metro stations was multiplied by the scaling value divided by the sum of the total scaling values. This was done for each metro station.

New Potential Shelters: These are locations that previously operated as shelters due to emergencies and during COVID-19. These businesses in these spaces have not been an active since. The potential shelters as well as the capacities they hold were discovered on global news webpages, and their respective locations are extracted from Google Maps [7, 8, 9, 10, 11, 12, 13].

Total Expenses of Potential Shelters: This information was limited online as the financial statements correspond to the original business rather than the shelter. In order to calculate the total expenses for each of the new potential shelters, the cost was assumed to be the average of the cost of the 3 closest existing shelters.

Haversine Distance between Shelters and Hotspots: The latitude and longitude for each of the existing shelters, new shelters, homeless encampments and metro stations were taken from Google Maps[16]. For each pair of hotspots and shelters the haversine distance was calculated. The haversine distance was used because it calculates the angular distance along a sphere between latitude and longitude coordinates.

3 Models

3.1 Model A

Two optimization models were created for the allocation of new shelter locations while minimizing cost. First, to maximize the number of homeless people from hotspots to existing shelters subject to distance and gender, Model A was constructed. It focused on maximizing the number of homeless people moving from hotspot locations such as metro stations to existing shelters. Second, Model B uses the unallocated homeless people from Model A to strategically allocate the remaining homeless people to new potential shelters at minimum cost.

3.1.1 Parameters

- $d_{i,j}$: The haversine distance between hotspot i and shelter j
- F_i : Number of females at hotspot i
- M_i : Number of males at hotspot i
- B_j : Bed Capacity of shelter j

- h : Total number of existing hotspots
- s : Total number of existing shelter

3.1.2 Decision Variables

- $x_{i,j,k}$: Integer variable of homeless from hotspot i to shelter j with k in 0 = female , 1= male

3.1.3 Model Formulation

The primary objective focuses on allocating the maximum number of homeless people to existing shelters. These shelters must be within a reasonable distance of 4km (assuming that an average person will be able to travel 4km). Otherwise, they will be considered in Model B for further optimization.

$$Max\left(\sum_{i=1}^{h}\sum_{j=1}^{s}\sum_{k=0}^{1}x_{i,j,k}\right) \text{subject to}$$

$$\sum_{i=1}^{h} x_{i,j,0} \leq B_j \ for\ j\ in\ \{39, 40...67\} \tag{3.1.3.1}$$

$$\sum_{i=1}^{h} x_{i,j,1} = 0 \ for\ j\ in\ \{39, 40...67\} \tag{3.1.3.2}$$

$$\sum_{i=1}^{h} x_{i,j,1} \leq B_j \ for\ j\ in\ \{68, 69...81\} \tag{3.1.3.3}$$

$$\sum_{i=1}^{h} x_{i,j,0} = 0 \ for\ j\ in\ \{68, 69...81\} \tag{3.1.3.4}$$

$$\sum_{i=1}^{h}\sum_{k=0}^{1} x_{i,j,k} \leq B_j \ for\ j\ in\ \{1, 2...37\} \tag{3.1.3.5}$$

$$\sum_{j=1}^{s} x_{i,j,1} \leq M_i \ for\ i\ in\ \{1, 2...h\} \tag{3.1.3.6}$$

$$\sum_{j=1}^{s} x_{i,j,0} \leq F_i \ for\ i\ in\ \{1, 2...h\} \tag{3.1.3.7}$$

$$x_{i,j,k} \times (4 - d_{i,j}) \geq 0 \; for \; i \; in \; \{1, 2...h\} \; for \; j \; in \; \{1, 2...h\} \; for \; j \; in \; \{0, 1\} \tag{3.1.3.8}$$

$$x_{i,j,k} \geq 0 \tag{3.1.3.9}$$

In the objective function, the idea is to maximize the number of homeless people to be allocated from hotspot location "i", to shelter location "j", with respective gender "k", 0 for Females, 1 for Males. The data was sorted through the variable "Code"; 0 for shelters of mixed genders, 1 for Female shelters only, and 2 for exclusive Males shelters.

Constraint (3.1.3.1) ensures that shelters dedicated for females will not exceed the capacity.

Constraint (3.1.3.2)ensures that no males are going to be allocated to female shelters.

Constraint (3.1.3.3) ensures that shelters dedicated for males will not exceed the capacity .

Constraint (3.1.3.4) ensures that no females are going to be allocated to male shelters.

Constraint (3.1.3.5) ensures that the number of males and females allocated to open she will not exceed capacity.

Constraint (3.1.3.6)ensures that number of males allocated to shelters are not greater than the available males in each hotspot location.

Constraint (3.1.3.7) ensures that ensures that number of females allocated to shelters are not greater than the available females in each hotspot location.

Constraint (3.1.3.8) ensures that when the homeless people are assigned to a shelter within 4km distance. This is based on the assumption that an average person can walk up to 4km.

Constraint (3.1.3.9) non negativity constraint to make sure that the number of allocated people would be greater than zero (non-binding constraint since our objective is a maximization problem).

3.2 Model B

The main idea is to find a way to allocate the leftover homeless people captured from Model A in the proposed potential shelters while minimizing the total cost. The total cost of the project is broken down into two; the annual fixed cost and cost to accommodate one person.

3.2.1 Parameters

- $d_{i,j}$: The haversine distance between hotspot i and potential shelter
- R_i : Number of unallocated homeless at hotspot i
- T_j : Bed Capacity of potential shelter j

- hl : Total number of existing hotspots with unallocated homeless
- ps : Total number of potential shelters
- FC_j : Annual Fixed Cost of potential shelter j
- HC_j : Cost of maintaining one bed at potential shelter j
- M : Big M variable = 100000
- α : Desired utilisation allocation

3.2.2 Decision Variables

- $x_{i,j,k}$: Integer variable of homeless from hotspot i to potential shelter j
- D_j : Binary variable if potential shelter j is built or not

3.2.3 Model Formulation

$$Min \left(\sum_{i=1}^{hl} \sum_{j=1}^{ps} HC_j \times x_{i,j} \ + \ \sum_{j=1}^{ps} FC_j \times D_j \right) \text{subject to}$$

$$\sum_{i=1}^{hl} x_{i,j} \leq T_j \ for \ j \ in \ \{1, 2...ps\} \tag{3.2.3.1}$$

$$\sum_{h=1}^{ps} x_{i,j} \leq R_i \ for \ i \ in \ \{1, 2...hl\} \tag{3.2.3.2}$$

$$x_{i,j} \times (4 - d_{i,j}) \geq 0 \ for \ i \ in \ \{1, 2...hl\} \ for \ j \ in \ \{1, 2...ps\} \tag{3.2.3.3}$$

$$\sum_{i=1}^{hl} x_{i,j} \geq \alpha \times \sum_{i=1}^{hl} R_i \ for \ j \ in \ \{1, 2...ps\} \tag{3.2.3.4}$$

$$x_{i,j} \leq M \times D_j \ for \ i \ in \ \{1, 2...hl\} \ for \ j \ in \ \{1, 2...ps\} \tag{3.2.3.5}$$

$$x_{i,j} \geq 0 \tag{3.2.3.6}$$

Constraint (3.2.3.1) captures the capacity of the potential shelters and ensures that the number of people getting allocated to shelter j does not exceed the capacity (number of beds available) in shelter j.

Constraint (3.2.3.2) ensures that the total number of allocated people per hotspot location does not exceed the actual number of people available in that hotspot.

Constraint (3.2.3.3) ensures that the homeless people that are getting allocated from hotspot i to potential shelter j do not have to travel more than a given distance. Note that this distance was tested with 4km as shown in Table 1, and 5km, 6km and various results have been recorded in Table 2.

Constraint (3.2.3.4) captures the desired percentage of homeless allocation. Note that this was run based on different percentages and results are recorded in Tables 1 and 2.

Constraint (3.2.3.5) uses the big M theory to capture the constraint evaluated as; a shelter can host only if it was selected. If dj= 1 meaning the potential shelter is selected, then xj can be smaller than big M predefined as 1000000. However, if dj= 0 meaning it was not selected, then xj will be 0.

Constraint (3.2.3.6) non negativity constraint to make sure that the number of allocated people would be greater than zero (non-binding constraint since our objective is a maximization problem)

4 Numerical Implementation and Results

4.1 Model A

Upon optimizing the model, the total number of homeless people that were allocated to existing shelters within a 4km distance is 3,142. More importantly, the model successfully identified the unallocated individuals to be 424 homeless persons. Among them, 339 are Males and 85 are Females. The unallocated homeless people and their respective locations shall be used in model B to determine the optimal locations for potential shelters.

With 4km being the maximum distance, and as a binding constraint, it restricts the number of possible shelters any homeless people could travel to. This resulted in some of the current shelters not reaching their current capacity because the homeless people were too far away. The table below shows the number and location of all unallocated homeless people. Most of the unallocated homeless population was along the blue metro line.

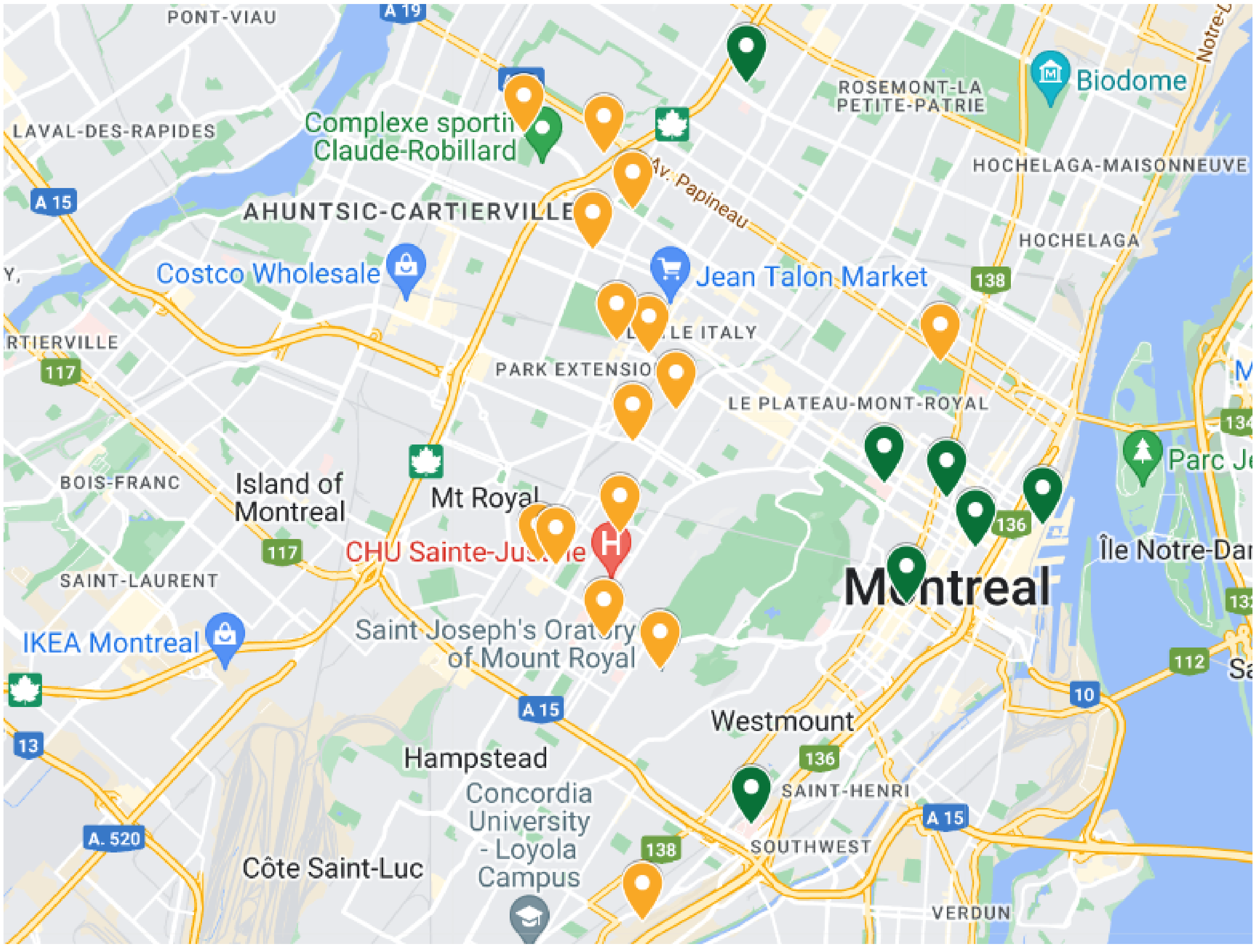

Figure 1. Locations of Unallocated Homeless People and New Potential Shelters

4.2 Model B

A tradeoff between the maximum distance an individual could travel and the minimum percentage of people to be allocated was observed. Table 1 shows the results of the optimization model.

Allocation Utilization (%)	Distance (km)	Cost ($)	Number of shelters selected	Shelters selected	Total people assigned	Total people unassigned
100	4			INFEASIBLE		
95	4			INFEASIBLE		
90	4	$23,165,788	3	3, 5, 7	383	41
85	4	$21,780,108	3	3, 5	362	62
80	4	$21,211,188	2	3, 5	341	85
75	4	$12,608,472	2	3, 7	319	106

Table 1: Model Optimization Results of 4km

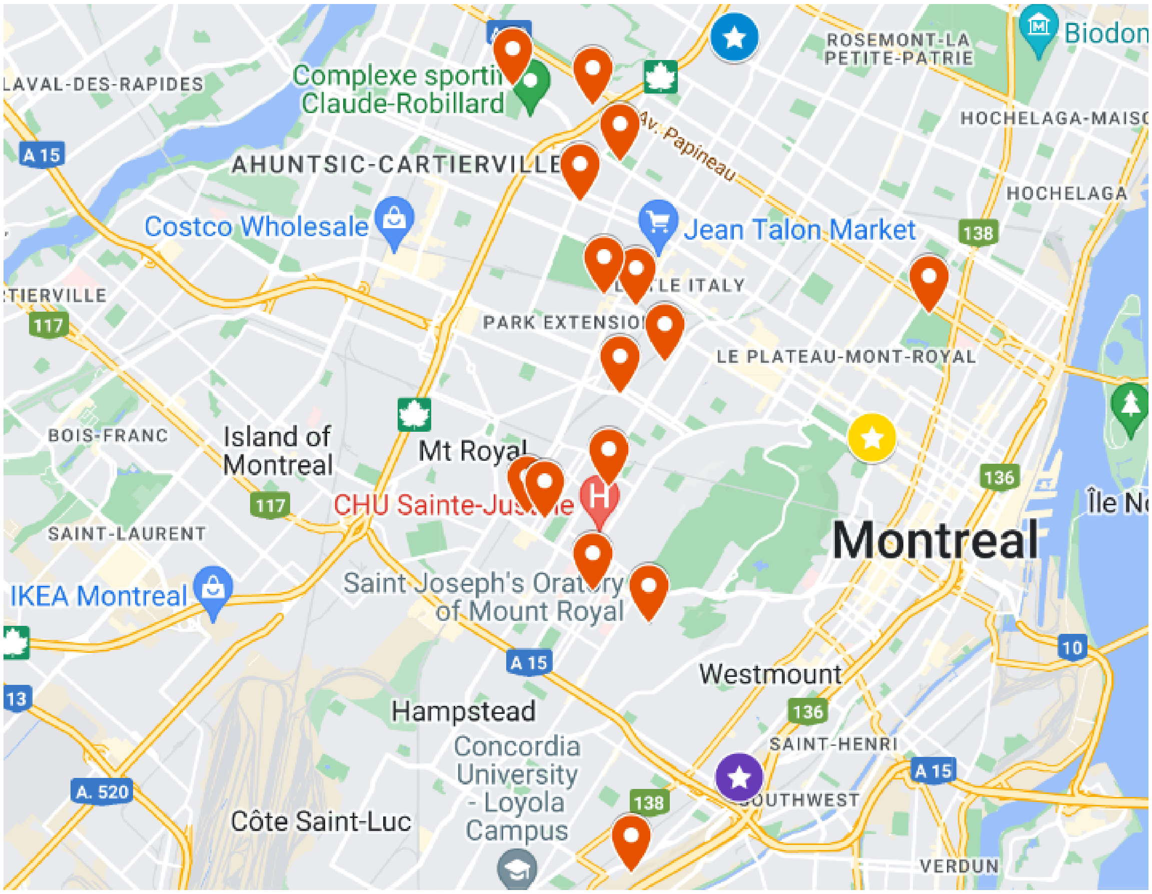

Figure 2. Unallocated Homeless and New Shelters (Stars Blue:3, Purple:5, Yellow:7)

The highest percentage of people that got allocated to the new shelters was 90% at a cost of **$23,165,788**. The potential shelters selected were Stade de Soccer Montreal in Saint Michel, Old Royal Victoria's Hospital, and Hotel Dieu. When the allocation utilization was reduced to 80% or 85% the potential shelters selected were Stade de Soccer Montreal and Old Royal Victoria's hospital. Ultimately, decreasing the minimum allocation to 75% reduces the cost significantly to **$12,608,472**. The shelters selected were Stade de Soccer Montreal and Hotel Dieu.

After Model B, the number of homeless shelters which did not reach capacity between hotspots and existing shelters is 49 shelters. To build on the model, a solution could be to incorporate a shuttle service to allow individuals who are further than 4 km away from any shelter to be moved to one closer.

5 Problem Extensions

5.1 Implementations

Assuming that the government is interested in evaluating whether they should invest $23M and allocating 383 homeless people without shuttle service or $17M by allocating 424 people with shuttle service. According to Montreal Transit Service (MTS), the following prices are shown in Table 3 below[14].

Allocation Utilization (%)	Distance (km)	Cost ($)	Number of shelters selected	Shelters selected	Total people assigned	Total people unassigned
100	5	**$16,907,591**	3	3, 6, 7	424	0
95	5	$16,364,531	3	3, 6, 7	403	21
90	5	$14,263,512	2	3, 7	382	42
85	5	$13,720,452	2	3, 7	361	63
80	5	$13,151,532	2	3, 7	340	85
75	5	$12,608,472	2	3, 7	318	106
100	6	**$16,907,591**	3	3, 6, 7	424	0
95	6	$15,651,967	3	2, 3, 7	403	21
90	6	$14,263,512	2	3, 7	382	42
85	6	$13,720,452	2	3, 7	361	63
80	6	$13,151,532	2	3, 7	340	84
75	6	$12,582,612	2	3, 7	318	106

Table 2: Model with Distance Constraints of 5km & 6km

Passes	**Price**
2 Trip (Return) Fare	$6.50
Unlimited Evening Pass	$5.75
Unlimited Weekend Pass	$14.75
1 Day Pass	$11.00
3 Consecutive Day Pass	$21.25

Table 3: Montreal Transit Service Fares

If the government decides to provide an Unlimited Weekend Pass to accommodate homeless people to also visit their hotspots occasionally, it costs $14.75 per person. This cost applies to the homeless people that were not allocated within 4km, which is $424 - 383 = 41$ people, that were not assigned only because of the distance constraint. Please note that the capacity constraints were not binding and therefore, it was only because of the distance constraint. Therefore, the additional cost that would imply if the government decided to go for the second option and if the government would provide annual transportation is $14.75 *52*41 = $31,447. That means a total cost of $17,031,447. Comparing both options: $23,165,788 - $17,031,447 = $6,134,341.

Upon comparing both models, the shuttle service seems to be a reasonable option. Keeping in mind that this is on an annual basis and is subject to change based on the increase in the homeless population. More importantly, option 2 is allocating all homeless people unlike option 1 which allocated up to 90%. However, with every decision comes a risk, and for option 2 the risks could be the following. Increase in any unpleasant incidents occurring in the metro stations as this option promises 42 homeless people a yearly metro transit. In addition, some homeless people could enjoy staying back and never return to their shelters upon visiting. The final decision can depend on several factors like budget availability, resources acquired and risk tolerance that could define the result.

5.2 Granular Detail on Costs

In our second model, we determined the costs by using the total annual expenses from financial statements and the average cost per homeless person from homelesshub.ca. The total annual expenses covered all the expenses for a single year, but the costs of renovating or creating the building were not considered. These additional costs could have been added as a fixed value to better model the costs of creating the new shelter. Furthermore, the average cost per homeless person was gathered from 2013 and was adjusted according to inflation. To get the average cost of homeless people more research on the cost of electricity, food and other goods should be conducted to get a more accurate representation of the costs of housing one individual.

The incorporation of transportation costs and detailed information on the costs of new homeless shelters would allow for a more robust and accurate model. These additions would provide better recommendations to the municipal government of Montreal and the provincial government of Quebec to gain funding for the projects.

6 Recommendations and Conclusions

In brief, homelessness has been a growing issue in Montreal over the past couple of years, leaving many in dire economic and social states. A plan has been put in place to efficiently allocate the homeless population to homeless shelter services. The research performed has introduced an optimization method to simulate homeless distribution and systematically assign homeless people to new shelter locations. As the assumed travel distance in this project is 4 km, it is important to note that not all the homeless are able to be allocated. At most, the implementation of this project would result in an overall 90% decrease in homelessness, accounting for a cost of $23,165,788.

The main goal of this project is to ideally reduce all the homeless population and satisfy the basic life needs of each individual living in Montreal. Consequently, the model is extended to further note the effect of the change in the assumed travel distances to 5km and 6km. Both assumptions result in the allocation of the entire homeless population, incurring a cost of $16,907,591.

The optimal recommendation suggested to the government is to execute the project by relaxing the travel constraints to 5 km instead of 4 km, resulting in an overall decrease in all homelessness. This can be expanded upon and presented to the municipal and provincial governments of Quebec to gain funding for the creation of new shelters.

The overall project is limited by several factors, leading to the various assumptions mentioned above. In-person visits to the existing homeless shelters were conducted in an attempt to receive granular data regarding distribution of the homeless population, but none was able to be gathered. The inability to provide such information stimulates the assumptions used in the models regarding the distribution (locations and by gender) of homeless people near metro stations and in homeless encampments.

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7 Appendix

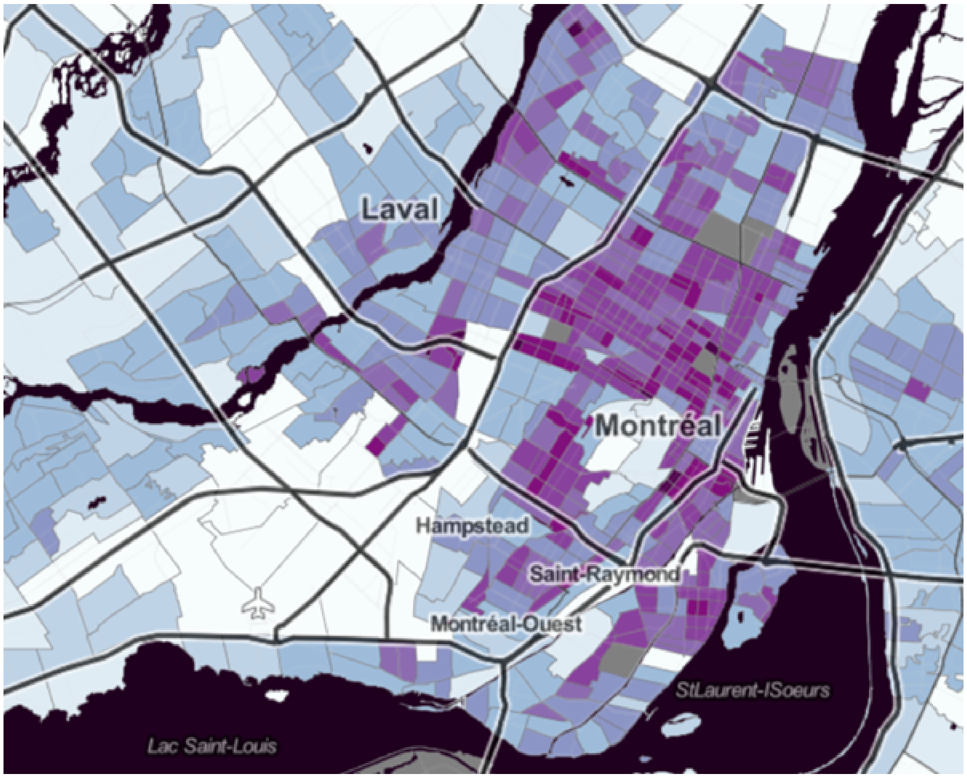

Figure 3. Population per square kilometer from Census Mapper using Stats Canada data [15]

Figure 4. Locations of homeless encampments and metro stations

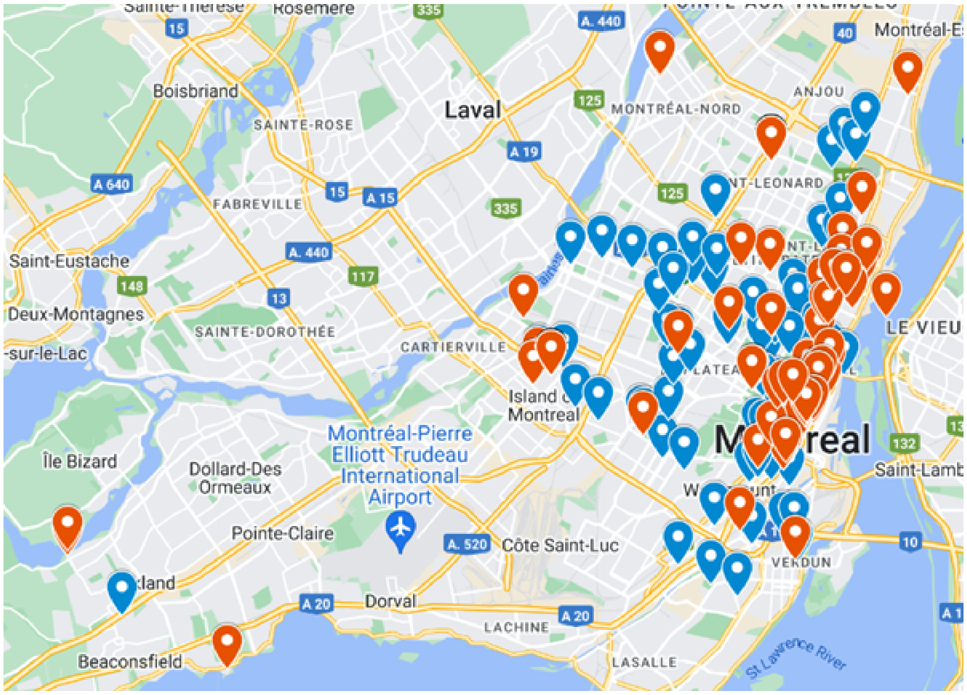

Figure 5. Locations of existing shelters (orange) and hotspots (blue)

Code	Index	Beds	Latitude	Longitude	Total Beds	Adjusted Costs
1	1	12	45.52	-73.59	12	8931650
1	2	26	48.15	-69.72	26	1508801
0	3	185	45.55	-73.54	270	1392954.074
0	4	53	45.56	-73.53	53	1235215
1	5	8	45.62	-73.63	8	2032960
1	6	24	45.49	-73.58	64	877424.625
1	6	40	45.49	-73.58	64	1462374.375
1	7	9	45.51	-73.56	27	677653.3333
1	7	18	45.59	-73.58	27	1355306.667
0	3	70	45.55	-73.55	270	527063.7037
2	8	30	45.52	-73.56	30	7215445

Table 4: Existing Emergency Shelter Raw Data 1

Code	Index	Beds	Latitude	Longitude	Total Beds	Adjusted Costs
1	9	18	45.52	-73.68	18	1589194
1	10	42	45.5	-73.58	214	935419.8785
1	11	54	45.51	-73.57	54	850279
1	12	16	45.52	-73.68	16	1078700
2	13	146	45.49	-73.57	146	24175272
2	10	172	45.51	-73.56	214	3290630.86
0	3	15	45.55	-73.54	270	112942.2222
0	14	48	45.51	-73.56	86	719432.3721
0	14	38	45.51	-73.56	86	569550.6279
0	15	185	45.51	-73.57	185	2032960
0	16	12	45.47	-73.9	12	255797
0	17	50	45.51	-73.57	50	2032960

Table 5: Existing Emergency Shelter Raw Data 2

Code	Index	Beds	Latitude	Longitude	Total Beds	Adjusted Costs
0	0	63	45.43	-73.82	63	1296983
1	1	60	45.59	-73.58	60	1296983
1	2	12	45.52	-73.59	97	1104946.392
1	2	49	45.59	-73.58	97	4511864.433
1	2	15	45.59	-73.58	97	1381182.99
1	2	21	45.52	-73.59	97	1933656.186
0	3	40	45.46	-73.57	40	1499692
2	4	10	45.52	-73.56	10	340839
0	5	12	45.56	-73.55	28	714501
0	5	16	45.59	-73.58	28	952668
0	6	40	45.52	-73.68	40	1296983
0	7	11	45.55	-73.53	26	522590.9615
0	7	15	45.55	-73.53	26	712624.0385
1	9	31	45.62	-73.63	31	1296983

Table 6: Existing Transitional Shelter Raw Data 1

Code	Index	Beds	Latitude	Longitude	Total Beds	Adjusted Costs
2	10	20	45.57	-73.54	20	1296983
0	11	50	45.53	-73.58	50	742161
0	12	19	45.55	-73.55	19	431745
0	13	20	45.55	-73.55	20	1855101
1	14	20	45.52	-73.68	20	2032960
0	15	33	45.53	-73.62	33	889557
1	16	13	45.52	-73.68	40	421519.475
1	16	27	45.52	-73.68	40	875463.525
1	17	21	45.56	-73.58	21	696229
0	18	11	45.54	-73.69	11	146914
1	19	16	45.59	-73.58	16	974785
2	20	66	45.51	-73.56	371	1283610.162
2	20	255	45.51	-73.56	371	4959402.898
2	20	50	45.5	-73.56	371	972431.9407

Table 7: Existing Transitional Shelter Raw Data 2

Code	Index	Beds	Latitude	Longitude	Total Beds	Adjusted Costs
1	21	18	45.52	-73.68	18	1589194
0	22	33	45.59	-73.58	33	718298
0	23	21	45.55	-73.54	21	744212
1	24	11	45.52	-73.68	11	1282954
1	25	110	45.53	-73.56	110	485830
2	26	146	45.49	-73.57	146	24175272
0	27	21	45.54	-73.55	21	1237551
1	28	12	45.54	-73.52	12	1296983
2	29	14	45.51	-73.56	45	3693083.644
2	29	31	45.51	-73.56	45	8177542.356
0	30	45	45.52	-73.55	79	456974.4304
0	30	34	45.61	-73.52	79	345269.5696
0	31	16	45.51	-73.56	16	1288983
2	32	45	45.52	-73.55	45	1985782
0	33	28	45.5	-73.64	28	1296983

Table 8: Existing Transitional Shelter Raw Data 3

Code	Index	Beds	Latitude	Longitude	Total Beds	Adjusted Costs
0	34	33	45.52	-73.68	45	582376.6667
0	34	12	45.52	-73.69	45	211773.3333
0	35	20	45.46	-73.9	20	255797
1	36	8	45.52	-73.68	8	332216
2	37	207	45.49	-73.57	281	2753953.783
2	37	74	45.49	-73.57	281	984505.2171
0	38	9	45.56	-73.59	9	548703
0	39	15	45.54	-73.6	15	1069182
0	40	20	45.52	-73.56	91	441859.3407
0	40	21	45.54	-73.54	91	463952.3077
0	40	25	45.52	-73.55	91	552324.1758
0	40	15	45.54	-73.55	91	331394.5055
0	40	10	45.52	-73.56	91	220929.6703
1	41	24	45.47	-73.59	24	24175272
1	42	34	45.59	-73.58	34	1155893

Table 9: Existing Transitional Shelter Raw Data 4

Location	Latitude	Longitude	Capacity
Hotel des Arts	45.51	-73.57	50
Guy-Favreau Complex	45.51	-73.56	50
Soccer Center	45.56	-73.6	300
Bonsecours Market	45.51	-73.55	108
Old Royal Victoria's Hospital	45.47	-73.6	80
YMCA	45.5	-73.57	50
Hotel Dieu	45.51	-73.58	100

Table 10: Potential Shelter Raw Data

Station	Latitude	Longitude	Homeless	Male	Female
Ville marie Expressway	45.49	-73.58	195	137	58
St Urbain Street	45.51	-73.58	195	137	58
Milton Park	45.51	-73.58	195	137	58
Cabot Square	45.49	-73.58	195	137	58
Notre Dame De Grace	45.46	-73.62	195	137	58
West Island	45.45	-73.87	25	18	7
Hochelaga-Maisonneuve borough	45.55	-73.54	195	137	58
Jacques Cartier Bridge	45.52	-73.54	195	137	58
Chinatown	45.51	-73.56	195	137	58
Plateau Mont Royal	45.52	-73.58	195	137	58

Table 11: Homeless Encampments Raw Data

Station	Latitude	Longitude	Homeless	Male	Female
Angrignon	45.46	-73.6	33	23	10
Monk	45.45	-73.59	29	20	9
Jolicoeur	45.47	-73.59	16	11	5
Verdun	45.47	-73.57	36	25	11
De L'Eglise	45.46	-73.57	29	20	9
Lasalle	45.47	-73.57	27	19	8
Charlevoix	45.49	-73.57	27	19	8
Lionel-Groulx	45.49	-73.58	21	15	6
Atwater	45.5	-73.58	28	20	8
Guy-Concordia	45.53	-73.58	61	43	18
Peel	45.53	-73.58	39	27	12
McGill	45.51	-73.57	84	59	25
Place-des-Arts	45.55	-73.57	62	43	19
Saint-Laurent	45.54	-73.57	30	21	9

Table 12: Metro Station Raw Data 1

Station	Latitude	Longitude	Homeless	Male	Female
Berri-UQAM	45.52	-73.56	32	22	10
Beaudry	45.53	-73.56	40	28	12
Papineau	45.53	-73.55	22	15	7
Frontenac	45.54	-73.55	32	22	10
Prefontaine	45.54	-73.55	24	17	7
Joliette	45.55	-73.55	21	15	6
Pie-IX	45.56	-73.55	29	20	9
Viau	45.56	-73.55	25	18	8
Assomption	45.57	-73.55	14	10	4
Cadillac	45.59	-73.55	12	8	4
Langelier	45.59	-73.54	12	8	4
Radisson	45.59	-73.54	11	8	3
Honore-Beaugrand	45.6	-73.54	10	7	3
Cote-Vertu	45.52	-73.67	12	8	4

Table 13: Metro Station Raw Data 2

Station	**Latitude**	**Longitude**	**Homeless**	**Male**	**Female**
Du College	45.52	-73.68	12	8	4
De La Savane	45.51	-73.67	7	5	2
Namur	45.51	-73.66	14	10	4
Plamondon	45.5	-73.64	27	19	8
Cote-Sainte-Catherine	45.5	-73.63	67	47	20
Snowdon	45.5	-73.63	21	15	6
Villa-Maria	45.49	-73.62	29	20	9
Vendome	45.47	-73.6	32	22	10
Place-Saint-Henri	45.49	-73.59	60	42	18
Georges-Vanier	45.5	-73.58	19	13	6
Lucien-L'Allier	45.5	-73.57	39	27	12
Bonaventure	45.51	-73.57	23	16	7
Square-Victoria-OACI	45.51	-73.56	23	16	7
Places-D'armes	45.52	-73.56	14	10	4
Champ-de-Mars	45.52	-73.56	11	8	3

Table 14: Metro Station Raw Data 3

Station	**Latitude**	**Longitude**	**Homeless**	**Male**	**Female**
Sherbrooke	45.53	-73.57	35	24	10
Mont-Royal	45.53	-73.58	32	22	10
Laurier	45.53	-73.6	29	20	9
Rosemont	45.54	-73.59	33	23	10
Beaubien	45.55	-73.6	29	20	9
Jean-Talon	45.55	-73.61	28	20	8
Jarry	45.55	-73.63	44	31	13
Cremazie	45.56	-73.64	29	20	9
Sauve	45.56	-73.65	12	8	4
Henri-Bourassa	45.56	-73.67	12	8	4
Cote-des-Neiges	45.51	-73.62	29	20	9
Universite-de-Montreal	45.52	-73.62	27	19	8
Edouard-Montpetit	45.52	-73.61	32	22	10
Outremont	45.53	-73.62	23	16	7
Acadie	45.53	-73.62	17	12	5
Parc	45.54	-73.63	33	23	10
De Castelnau	45.55	-73.62	33	23	10
Fabre	45.56	-73.61	33	23	10
D'Iberville	45.55	-73.6	29	20	9
Saint-Michel	45.57	-73.6	31	22	9

Table 15: Metro Station Raw Data 4

Station	Total Pop	Total M	Total F	Remain	Remain F	Remain M
Plamondon	27	19	8	19	0	19
Cote-Sainte-Catherine	67	47	20	67	20	47
Snowdon	21	15	6	21	6	15
Villa-Marie	29	20	9	11	0	11
Sherbrooke	34	23	10	1	0	1
Jarry	44	31	13	41	10	31
Cremazie	29	20	9	20	0	20
Cote-des-Neiges	29	20	9	20	0	20
Universite-de-Montreal	27	19	8	19	0	19
Edouard-Montpetit	32	22	10	22	0	22
Outremont	23	16	7	16	0	16
Acadie	17	12	5	17	5	12
Parc	33	23	10	23	0	23
De Castelnau	33	23	10	33	10	23
Notre Dame De Grace	195	137	58	95	34	61

Table 16: Distribution of Unallocated Homeless Individuals (M: Male, F: Female)

Name	Beds	Remaining
AMCAL FAMILY SERVICES - RESIDENTIAL PROGRAM	63	63
RICOCHET (HÉBERGEMENT/HOMES) - INTEGRATION PROGRAM	20	7
CARE MONTRÉAL - TRANSITIONAL HOUSING	40	38
LOGIS-RAP	11	11
AUBERGE MADELEINE	26	26
PASSAGES	16	16
MAISON MARGUERITE DE MONTRÉAL (LA) - LONG-TERM	18	18
SAKEENAH HOMES	8	8
MÈRES AVEC POUVOIR	110	3
HERSTREET - OLGA HOUSE - TRANSITIONAL HOUSING	20	20
LOGIFEM - APPARTEMENTS DE TRANSITION	13	13
LOGIFEM - MAISON D'HÉBERGEMENT	27	5
MAISONS DE L'ANCRE (LES)	11	11
MAISON MARGUERITE DE MONTRÉAL (LA)	18	18

Table 17: Remaining Capacity of Existing Shelters