Maximizing Housing Resources for the Vancouver Homeless

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A Brief Introduction to Homelessness in Vancouver

A rapidly accelerating social crisis, homelessness, is one of the biggest problems the city of Vancouver has been facing for the past few decades. Generally attributed to the lack of income and the increasing cost of housing, in addition to the federal government cutting down funding for national affordable housing programs during the 1980s, the rate of homelessness in Vancouver has skyrocketed since 1999. The effects of this are most widely seen in Eastside Vancouver, an area now notorious for poverty and crime.

Homelessness is classified as a crisis as the absence of proper shelter, in itself, is a cause for concern. Homelessness is, however, also a cause of several significant health concerns such as mental health issues, alcohol and drug abuse, sexually transmitted diseases, malnutrition, etc. The street homeless, as per the 2011 Metro Vancouver Homeless Count, have much more of a problem securing access to food.

To put things into perspective, a 2010 report from Mario Berti, 'Handcuffed Access: Homelessness and the Justice System', found that homeless women have a 31 times higher death rate over the average Canadian mortality rates, and homeless men have a 9 times higher death rate over the average Canadian mortality rates.

To make matters worse, the homeless in Vancouver have been continually victimized. From the same report by Berti that is mentioned above, it was found that 172 out of 196 (or 88% of the sampled population) reported that they were victimized.

Societal and systematic indifference towards the homeless, in our eyes, must also be declared a crisis. It was mentioned in Berti's report that over half of the people surveyed felt that the judicial system and law enforcement in Vancouver often disregarded or remained unbothered by their situations.

Rationale

To reduce indifference towards the plight of the homeless in Vancouver, and also to utilize the knowledge we gained from our linear programming course, we decided to find the best solution for the homelessness crisis, as students, but more importantly, as concerned citizens that care.

The main problem we will attempt to solve with this project is to help homeless people currently without any shelters to find a place in a shelter catering to their needs (vacancy, meals, location, and the type of shelter).

An additional subproblem we are setting out to determine is the extent to which the maximum capacity of homeless shelters is still insufficient in providing enough places to stay for all of Vancouver's homeless. This will aim to host the homeless without a shelter and to illuminate the need for additional funding just to find a home for everyone in Vancouver.

Our Project

With this project, we wanted to demonstrate how to maximize the number of people that can be in a Vancouver homeless shelter at one point. Unfortunately, as of March 2020, there are at least 2095 people who are currently homeless in Vancouver (Mauboules, 2020); which is significantly more than there are beds available across all of the 19 homeless shelters in the city. It is estimated that there are 1570 homeless men, 546 homeless women, and 54 homeless youth in Vancouver (BC Non-Profit Housing Association, 2020). The term 'youth' refers to people who are age 19 or younger. The limitations we will be using on maximizing the number of homeless people that can simultaneously be provided with a home for a night are due in part to the number of beds in each shelter and the type of shelter (men only, female only, youth, all genders, or females and youth only).

As we can already see, there will be a maximum number of homeless people that can be housed for a night and some will have to be left without a place. The applications of this project suggest that the homeless of Vancouver require more shelters thus a better handling of the situation on a municipal level.

The Data

The primary dataset we will be using for this project, homeless-shelter-locations.csv, was downloaded from Open Data Portal by the City of Vancouver (link), which provides the names of the shelters, the general area for the homeless shelter locations as well as their geographic coordinates, the type of shelter, if the shelter provides meals, if the shelter provides carts, if the shelter provides allows pets, and the phone number for the shelter. While this dataset describes some of the constraints to our linear programming problem, it does not provide the respective capacities of many of the shelters. As the maximum capacity of a homeless shelter can often be confidential, we had to individually get permission from the managers and supervisors of the shelters to use this information for the purposes of this project. Moreover, we even had to sometimes combine information from other online sources about capacity numbers to our dataset to have more accurate maximums. We made sure that we only used sources that were from 2020, and if they were from 2021, they had to provide pre-COVID-19 numbers.

In terms of the effects of COVID-19, the maximum capacity of each shelter varies depending on how the spaces are managed in accordance with the British Columbia provincial health guidelines. For that reason, we will be using the pre-COVID-19 maximum capacities for each shelter as it is the most consistent in how the effects across each shelter have been handled and will provide a better prediction for how the homelessness situation will look after the pandemic.

Below is the fully compiled dataset we used for this project. The capacity columns are listed by the type of shetler, men only (m), female only (f), youth only (y), all genders (m+f), and females and youth only (f+y).

FACILITY	m	f	y	m+f	f+y
Catholic Charities Men's Hostel	85				
First Baptist Church				22	
Covenant House	35	28			
Belkin House	36				29
Grandview Calvary Baptist Church				20	
Lookout Downtown (Al Mitchell Place)				75	
Anchor of Hope	28				
The Beacon	60				
Crosswalk	32	4			
Tenth Avenue Church (EWR)				20	
Yukon Shelter				72	
Dusk to Dawn-Directions Youth Centre			12		
First United Church	40	20			

FACILITY	m	f	y	m+f	f+y
Triage				29	
New Fountain				75	
The Haven	40				
Union Gospel Mission	100				
Aboriginal Shelter	50				
Aboriginal Youth Safehouse (ASH)			2		
Cascade Church				10	
Community Builders Temp (Metson Winter) (EWR)				40	
First Avenue Temporary Shelter				40	
Hornby Street Shelter (temp)				40	
Sutherland Shelter	30				
Women's Emergency Shelter (412 Shelter)		57			
Vi Fineday Family Shelter Society				18	
The Sisterhood		21			
Springhouse					34
Powell Place Shelter For Women (EWR)		52			
The Gathering Place				20	
Marc's Place			1		
SistersShelter (Atira)		16			
UGM Emergency Shelter for Men	72				
Langara YMCA				20	
North Shore EWR				12	
Evelyne Saller Centre EWR				55	
FSGV Safe House			3		

Decision Variables

We have 59 decision variables:

- variables for the number of beds for males m_i, where i = 1,2,...,28
- variables for the number of beds for females f_j, where j = 1,2,...,25
- variables for the number of beds for youths y_k, where k = 1,2,...,6

Each variable is associated with a particular homeless shelter. More specifically,

m1 is for Catholic Charities Men's Hostel (males only)

m2 is for Covenant House (males separated from females)

m3 is for Belkin House (males separated from females and youth)

m4 is for Anchor of Hope (males only)

m5 is for The Beacon (males only)

m6 is for Crosswalk (males separated from females)

m7 is for First United Church (males separated from females)

m8 is for The Haven (males only)

m9 is for Union Gospel Mission (males only)

m10 is for Aboriginal Shelter (males only)

m11 is for Sutherland Shelter (males only)

m12 is for UGM Emergency Shelter for Men (males only)

m13 is for First Baptist Church (all genders)

m14 is for Grandview Calvary Baptist Church (all genders)

m15 is for Lookout Downtown (Al Mitchell Place) (all genders)

m16 is for Tenth Avenue Church (EWR) (all genders)

m17 is for Yukon Shelter (all genders)

m18 is for Triage (all genders)

m19 is for New Fountain (all genders)

m20 is for Cascade Church (all genders)

m21 is for Community Builders Temp (Metson Winter) (EWR) (all genders)

m22 is for First Avenue Temporary Shelter (all genders)

m23 is for Hornby Street Shelter (temp) (all genders)

m24 is for Vi Fineday Family Shelter Society (all genders)

m25 is for The Gathering Place (all genders)

m26 is for Langara YMCA (all genders)

m27 is for North Shore EWR (all genders)

m28 is for Evelyne Saller Centre EWR (all genders)

f1 is for Covenant House (females separated from males)

f2 is for Crosswalk (females separated from males)

f3 is for First United Church (females separated from males)

f4 is for Women's Emergency Shelter (412 Shelter) (females only)

f5 is for The Sisterhood (females only)

f6 is for Powell Place Shelter For Women (EWR) (females only)

f7 is for SistersShelter (Atira) (females only)

f8 is for First Baptist Church (all genders)

f9 is for Grandview Calvary Baptist Church (all genders)

f10 is for Lookout Downtown (Al Mitchell Place) (all genders)

f11 is for Tenth Avenue Church (EWR) (all genders)

f12 is for Yukon Shelter (all genders)

f13 is for Triage (all genders)

f14 is for New Fountain (all genders)

f15 is for Cascade Church (all genders)

f16 is for Community Builders Temp (Metson Winter) (EWR) (all genders)

f17 is for First Avenue Temporary Shelter (all genders)

f18 is for Hornby Street Shelter (temp) (all genders)

f19 is for Vi Fineday Family Shelter Society (all genders)

f20 is for The Gathering Place (all genders)

f21 is for Langara YMCA (all genders)

f22 is for North Shore EWR (all genders)

f23 is for Evelyne Saller Centre EWR (all genders)

f24 is for Belkin House (females and youth only)

f25 is for Springhouse (females and youth only)

y1 is for Dusk to Dawn-Directions Youth Centre (youth only)

y2 is for Aboriginal Youth Safehouse (ASH) (youth only)

y3 is for Marc's Place (youth only)

y4 is for FSGV Safe House (youth only)

y5 is for Belkin House (youth and females only)

y6 is for Springhouse (youth and females only)

Objective Function

The objective function is the sum of all the decision variables mentioned above, $z = m1 + m2 + m3 + m4 + m5 + m6 + m7 + m8 + m9 + m10 + m11 + m12 + m13 + m14 + m15 + m16 + m17 + m18 + m19 + m20 + m21 + m22 + m23 + m24 + m25 + m26 + m27 + m28 + f1 + f2 + f3 + f4 + f5 + f6 + f7 + f8 + f9 + f10 + f11 + f12 + f13 + f14 + f15 + f16 + f17 + f18 + f19 + f20 + f21 + f22 + f23 + f24 + f25 + y1 + y2 + y3 + y4 + y5 + y6$.

We chose this as our objective function because we want to maximize the number of beds in all shelters.

Constraints

For shelters that provide beds for only adults who self-identify as male:

m1 <= 85

m2 <= 35

m3 <= 36

m4 <= 28

m5 <= 60

m6 <= 32

m7 <= 40

m8 <= 40

m9 <= 100

m10 <= 50

m11 <= 30

m12 <= 72

For shelters that provide beds for only adults who self-identify as female:

f1 <= 28

f2 <= 4

f3 <= 20

f4 <= 57

f5 <= 21

f6 <= 52

f7 <= 16

For shelters that provide beds for only youths:

y1 <= 12

y2 <= 2

y3 <= 1

y4 <= 3

For shelters that provide beds for adults:

m13 + f8 <= 22

m14 + f9 <= 20

m15 + f10 <= 75

m16 + f11 <= 20

m17 + f12 <= 72

m18 + f13 <= 29

m19 + f14 <= 75

m20 + f15 <= 10

m21 + f16 <= 40

m22 + f17 <= 40

m23 + f18 <= 40

m24 + f19 <= 18

m25 + f20 <= 20

m26 + f21 <= 20

m27 + f22 <= 12

m28 + f23 <= 55

For shelters that provide beds for youths and adults who self-identify as female:

f24 + y5 <= 29

f25 + y6 <= 34

For the total number of homeless people in Vancouver:

For the total number of homeless adults who self-identify as male:

m1 + m2 + m3 + m4 + m5 + m6 + m7 + m8 + m9 + m10 + m11 + m12 + m13 + m14 + m15 + m16 + m17 + m18 + m19 + m20 + m21 + m22 + m23 + m24 + m25 + m26 + m27 + m28 <= 1570

For the total number of homeless adults who self-identify as female:

f1 + f2 + f3 + f4 + f5 + f6 + f7 + f8 + f9 + f10 + f11 + f12 + f13 + f14 + f15 + f16 + f17 + f18 + f19 + f20 + f21 + f22 + f23 + f24 + f25 <= 546

For the Total number of homeless youth (under the age of 19):

y1 + y2 + y3 + y4 + y5 + y6 == 54

NOTE: the constraint needs '== 54' instead of '<= 54' because we want to guarantee that all youths, at the very least, have access to a shelter.

Code, Output, and Sensitivity Analysis

The Python code can be accessed in the form of a Jupyter Notebook (here).

Results

1. The total number of homeless people who self-identify as male is described by:

   $$= m1 + m2 + m3 + m4 + m5 + m6 + m7 + m8 + m9 + m10 + m11 + m12 + m13 + m14 + m15 + m16 + m17 + m18 + m19 + m20 + m21 + m22 + m23 + m24 + m25 + m26 + m27 + m28$$

   $$= 85 + 35 + 36 + 28 + 60 + 32 + 40 + 40 + 100 + 50 + 30 + 72 + 22 + 20 + 75 + 20 + 72 + 29 + 75 + 10 + 40 + 40 + 40 + 18 + 20 + 20 + 12 + 55$$

   $$= 1176$$

   As there is a total of 1570 homeless people who self-identify as male in total in Vancouver, only 1176/1570 or 74.90% can get access to a bed for a night.

2. The total number of homeless people who self-identify as female is described by:

   $$= f1 + f2 + f3 + f4 + f5 + f6 + f7 + f8 + f9 + f10 + f11 + f12 + f13 + f14 + f15 + f16 + f17 + f18 + f19 + f20 + f21 + f22 + f23 + f24 + f25$$

   $$= 28 + 4 + 20 + 57 + 21 + 52 + 16 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 27$$

   $$= 225$$

   As the total of 546 homeless people who self-identify as female in total in Vancouver, only 225/546 or 41.21% can get access to a bed for a night.

3. The total number of homeless people who are youths is described by:

   $$= y1 + y2 + y3 + y4 + y5 + y6$$

   $$= 12 + 2 + 1 + 3 + 29 + 7$$

   $$= 54$$

We expected this value to be 54 as we have set the number of youth that should be provided with a bed equal to the total number (54) of youth in total in Vancouver. Again, this guarantees that all homeless youth can get access to an inside bed, as they are the most vulnerable being outside at night.

Discussion

While there are currently enough resources and shelters to house the 1176 homeless men, 225 homeless women, and 54 homeless youth in Vancouver, there are still (at least) 546 homeless men and 321 homeless women without access to such facilities. The data we used was pre-COVID-19 maximum capacities of homeless shelters from 2020, as the current 2021 values are much more limited in their accuracy and the total number of homeless in Vancouver has probably increased due to the pandemic. With already a lack of affordable housing, a lack of needed services, and unemployment, among many other factors that lead to homelessness, Vancouver's homeless shelters are currently providing not enough beds and services to the homeless. The impact of COVID-19 has definitely worsened the effects of homelessness by greater unemployment and the shelters having to limit the number of people that can stay for the night in order to keep up with the BC public health orders. Future research on this topic should look more into the effects of COVID-19 on homelessness in Vancouver when there is enough information available. It would better predict the city of Vancouver's responses to other extreme or disaster situations, knowing what we know now about how limited the resources could be.

With this project, we ultimately wanted to demonstrate how the current measures in place to deal with the homelessness crisis in Vancouver are severely insufficient. The maximum number of homeless people in Vancouver that can get access to a roof over their head for the night still does not provide for the 867 (546 men + 321 women) we have calculated, let alone the probable increase seen in homelessness since March 2020. To suggest future solutions, donations are always welcome at any of the shelters listed in the dataset. Accepted donations come in several forms, money being one, used clothing, and items such as non-perishable t also support shelters. To contact local representatives directly, their information can also be found on the City of Vancouver website (link).

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