Rotman School of Management
UNIVERSITY OF TORONTO

Rotman

Student Number: 1007045118

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Course Title: Optimizing Supply Chain Management and Logistics

Instructor Name: Andre Cire

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☐ **1007045118**

Executive Summary

Fullcare has hired a data consultant to create an optimization model to allocate medical practitioners to different regions in Canada for the next 5 years to minimize cost. They have provided data on their capabilities, distance from regions, and past 10-year data of regional demand to help create parameters for the model. Using the constraints that were provided from the case and additional assumptions, an allocation plan was created where MPs were mainly allocated to the regions closest to their centers. This plan led to a total cost of $36,415,608 when meeting all the regional demand from 2021-2025. However, to accomplish this solution overtime hours must be utilized and therefore can lead to a downgrade in the quality of care. Therefore, if possible, it is recommended that Fullcare attempt to increase the max capacity of their centers, remove the hiring limit for their centers, and open even more centers to be able to service demand without needing to work overtime or full capacity.

Introduction

Fullcare is a Canadian home care agency that provides medical care and support to patients at home. Due to the ageing population and extensive incentives from the government, the home care industry has seen significant growth over the years. This growth will only increase with the advent of COVID-19 and the need for more capacity at hospitals with better quality of care.

Due to the high growth, I was hired as a data consultant to generate a five-year plan for Fullcare, with the goal of designing a proposal to allocate medical practitioners (MPs) to different regions in Canada. The plan must provide details on where MPs should serve, from what center and when.

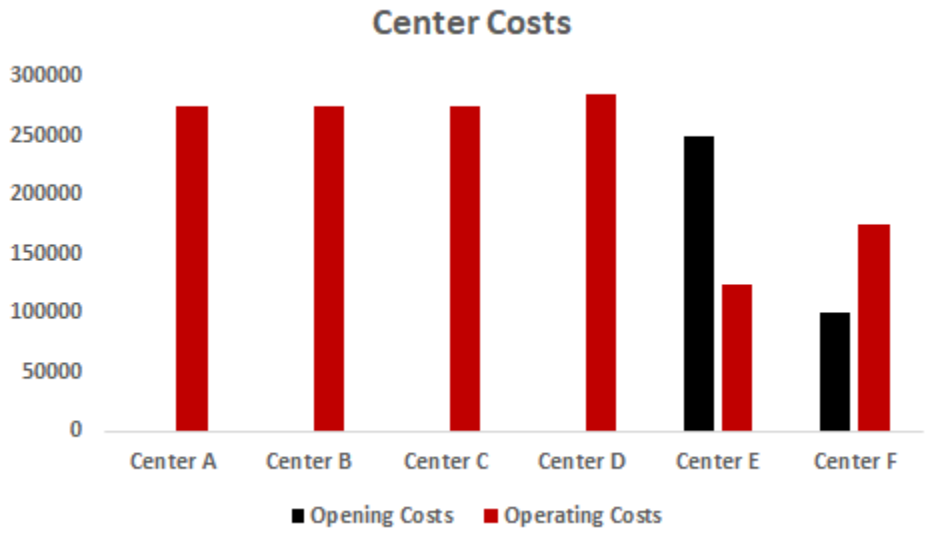
Current Situation

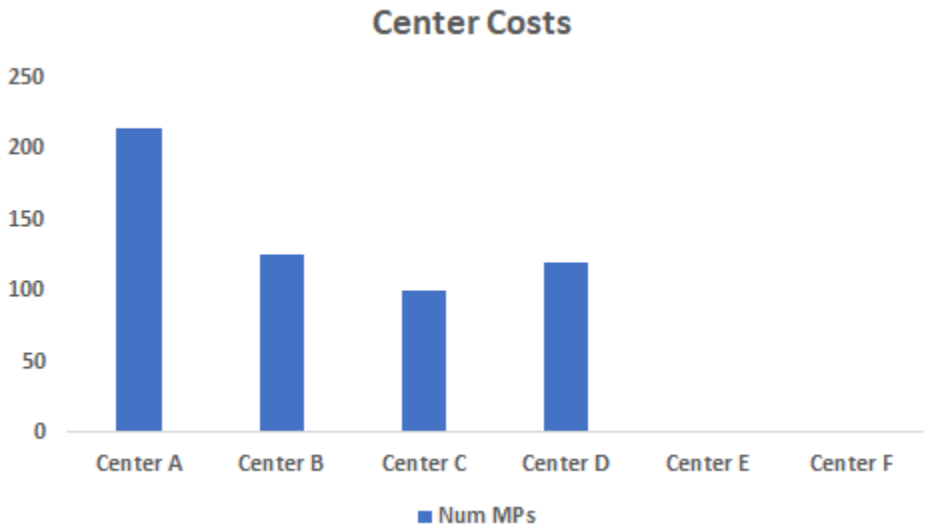
In more detail, Fullcare has provided several managerial questions for us to answer.

1. Should Center E and F be opened in the first year? Are they worth the investment?
2. How many new MPs should be hired for each medical center during the next five years?
3. How should MPs be allocated during the next five years?
4. Is it viable for Fullcare to have flexibility in accepting or rejecting patients?
5. How robust is the model to changes in demand (higher or lower)?

Data

The data provided is information on the various centers under Fullcare describing the operational costs, maximum capacity, and number of employees at each center at the start of 2021. Additionally, it provides information on Center E and F, which are potential new centers that Fullcare can decide to open if they require more capacity to serve their customer base. The descriptions of the centers are illustrated in the two bar graphs below.





Beyond the center data, data on how far each center is from the various regions Fullcare serves is also provided. This data is assumed to not change over time. Finally, regional demand in hours of care for each region in the last 10 years is provided. This number is based on home care requests that Fullcare receives and specifies how many hours of care is needed.

Assumptions

To further help generate our model various assumptions were provided and created to generate a useful model. The assumptions made for our model are listed below:

1. Starting year is 2021 and ending year is 2025
2. Each MP is paid $35 per hour with a government regulated 2.5% increase per year
3. Overtime is allowed and is +50% the standard rate ($52.5 per hour for 2021)
4. Due to travel using Fullcare cars, $0.25/km per hour costs is added to the wages

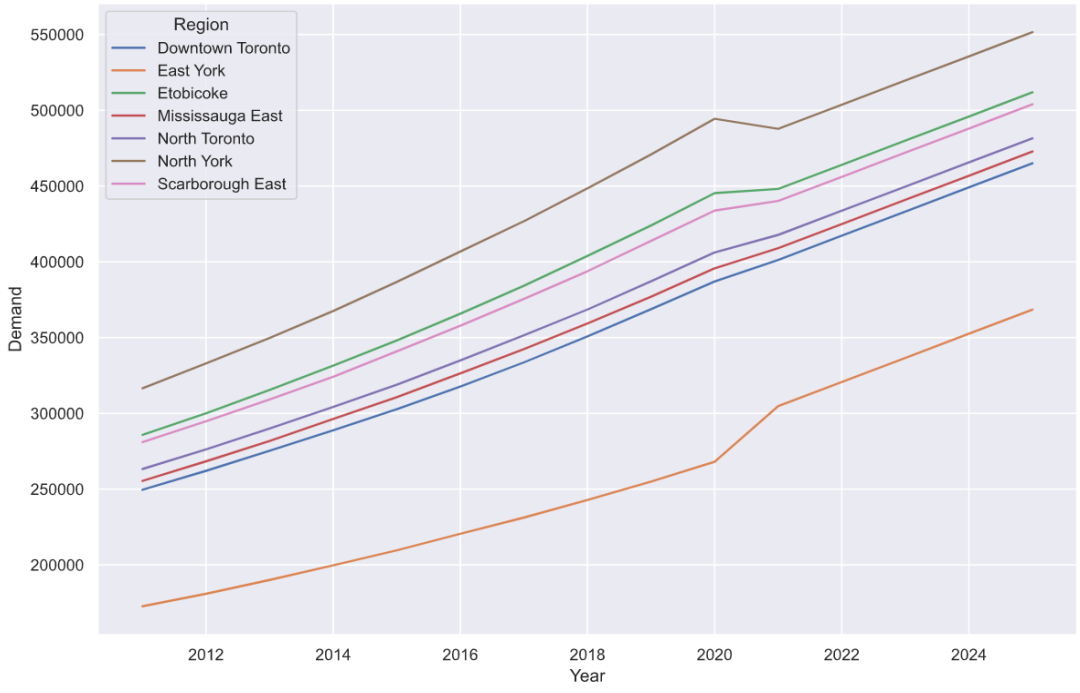
5. The government reimburses each home visit with a $40 per hour rate with no increase per year
6. Hiring an MP costs approximately $15000 per person
7. You can only hire 100 MPs per year per medical center
8. Fullcare can accept or reject patients
9. Distance within regions is negligible
10. Once a medical center is opened it cannot shut down
11. Unopened medical centers cannot hire MPs before opening
12. 6 hour work days maximum before overtime with 250 days in a year

On top of the assumptions listed above, to have a usable model demand must be forecasted as well. To accomplish this, a simple Linear Regression was conducted with the input variable being the year and regions, and the target variable being the demand in hours. The results of the regression are summarized below.

	Year	Downtown Toronto	East York	Etobicoke	Mississauga East	North Toronto	North York	Scarborough East
Coefficient	15942.96	-14248.66	-110807.66	32548.23	-6533.46	2215.54	72226.14	24599.84

R-squared:0.987
Intercept: -31805160.45

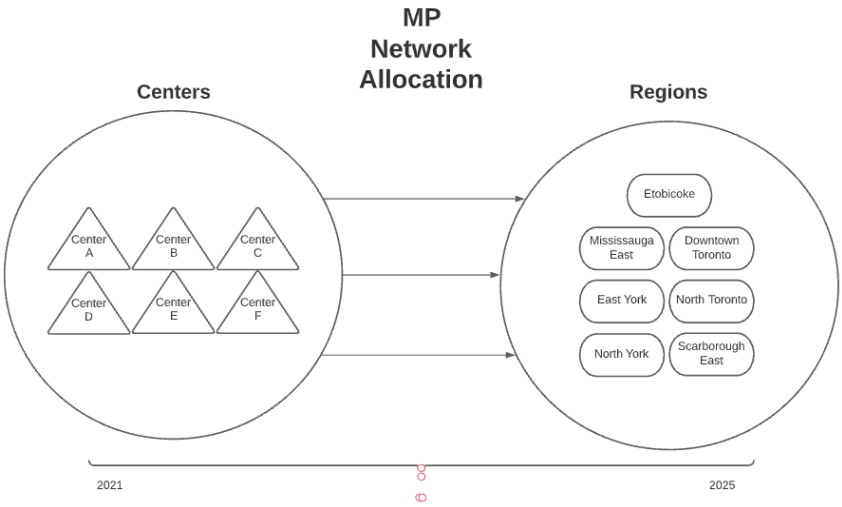
After the regression was completed, the demand was forecasted for the different regions for the next five years and appended to the demands dataset. The details on how this was done is in the python code provided. The results of the forecast are shown below.



As you can see, sometimes demand falls in the future and is not always increasing, which means that the model created must be robust to changes in demand.

Model

As stated previously, the model created must allocate MPs to different regions over the next five years and minimize cost. Cost was chosen as the objective function as the case did not provide how Fullcare generates revenue beyond a government reimbursement, which is more of a negative cost. To accomplish this objective a location model must be created. This can be illustrated by the graph below.



Variables

The variables chosen for the location model are listed below:

1. $Pvar_{i,j,s}$: Number of MPs from medical center *i* allocated to each region *j* at time *s* [Integer Variable]
2. $Wvar_{i,s}$: Worker flow at center *i* and time *s* [Integer Variable]
3. $Nvar_{i,s}$: Number of workers hired for center *i* at time *s* [Integer Variable]
4. $Ovar_{i,j,s}$:Overtime hours allocated from center *i* to region *j* at time *s* [Continuous Variable]
5. $Yvar_{i,,s}$:Center *i* at time *s* opened or not [Binary Variable]

Through optimization this will provide us details on where MPs should allocate their services and how much, while at the same time staying within the assumptions that the case provided.

Parameters

To utilize the data provided by Fullcare parameters were also created to help in building the constraints and objective function for the model. The parameters are once again listed below:

1. Regional Demand: Regional demand at region *j* at time *s*
2. Center MPs: Number of MPs per center *i* at time *s*
3. Center Max Capacity: Maximum capacity of each center *i*

4. Center Operating Cost: Operational cost for each center *i* at time *s*
5. Center Opening Cost: Opening cost for each center *i* at time *s*
6. Center Region Distance Cost: Cost of center *i* to travel to region *j* at time *s* per hour
7. Wages: Standard rate for MPs at time *s*
8. Overtime Wages: Overtime rate for MPs at time *s*
9. Reimbursement: Government reimbursement at time *s*

Constraints

After creating the variables and the parameters constraints were created to make sure the model can run optimally within the assumptions given in the case.

1. Hours Allocated ($Pvar_{i,j,s}$ *6*250 + $Ovar_{i,j,s}$) >= Regional $Demand_{j,s}$
2. Hours Allocated <= Center Max Capacity * $Yvar_{i,s}$
3. $Yvar_{i,s}$==1 for Center A-E
4. $Yvar_{i,s-1}$<=$Yvar_{i,,s}$ (if a store opens it cannot be closed again)
5. 0<=$Nvar_{i,,s}$ <= 100 * $Yvar_{i,,s}$ (if a store is not opened than they cannot hire anyone)
6. Num_Workers =$Wvar_{i,s-1}$ + $Nvar_{i,s}$
7. $Wvar_{i,s}$==Num_Workers
8. Sum($Pvar_{i,j,s}$ *6*250) == 6*250*$Wvar_{i,j,s}$
9. Hours Allocated <=24*250*$Wvar_{i,j,s}$

Objective Function

Finally, all costs associated with allocated MPs to different regions are summarized in a final objective function. The goal is to minimize the total cost for the next five years and not to minimize cost every single year iteratively.

1. Sum(CenterOperatingCost * $Yvar_{i,s}$)
2. Sum(15000 *$Nvar_{i,,s}$)
3. Sum(($Wage_s$ + Center Region Distance Cost + Reimbursement) * $Pvar_{i,j,s}$ *6*250)
4. Sum((Overtime Wages + Center Region Distance Cost + Reimbursement) * $Ovar_{i,j,s}$)
5. Sum(CenterOpeningCost * $Yvar_{i,s}$)

Managerial Question 1

The first question asked by Fullcare is whether it is worth the investment to open Center E and F in the first year. From the results of the model, it was found that without opening Center E and F it is not feasible to service all the patient requests in the next five years within the given constraints. From the optimal solution it is recommended to open Center E and F during 2021 and have 371 and 300 employees by 2025, respectively. Without either center the solution becomes infeasible as the hours allocated would be greater than the maximum capacity. Without that constraint it leads to a total cost of $71360879.61, which is much higher than having both Center E and F open. The table below summarizes this point.

	Center A	**Center B**	**Center C**	**Center D**	**Center E**	**Center F**	**Total Cost**
Without Max Capacity Constraint	692	525	500	520	0	0	$71360879

Additionally, if the constraint that Fullcare must meet all demand is lifted then the model still recommends hiring workers in both Center E and F with a total cost of -$7489421.88 versus a total cost of -$6382848.48 when Center E and F are not opened. In both scenarios the Fullcare performs much better by opening Center E and F.

	Center A	Center B	Center C	Center D	Center E	Center F	Total Cost
Without Needing to Meet Demand	346	204	100	283	0	0	-$6382848.4

Beyond the model, the initial fixed cost for opening the center is outweighed by the overall reduction in costs such as more overtime and distance cost if they did not open. The new centers also allow for better quality care as MPs do not have to work as much overtime, which is a point of significance for Fullcare.

Managerial Question 2

After deciding on opening Center E and F, Fullcare asks us to provide a schedule that describes how many MPs should be hired for each center for the next five years. This is summarized in the table below.

Employee Hiring Schedule

	Center A	Center B	Center C	Center D	Center E	Center F
2021	100	100	100	100	100	100
2022	100	100	100	100	100	100
2023	100	11	9	10	100	100
2024	77	0	0	0	71	0
2025	0	0	0	0	0	0
Final Employee	592	336	309	330	371	300

As you can see some centers hire more employees than others. This is due to the fact some regions have higher demand than others and certain centers mostly only serve those regions. For example, Center A has the highest employee count, and this is because they serve the North York region the most, which according to the forecasted demand graph has the highest demand.

Managerial Question 3

Considering wages, distance, and other constraints Fullcare requested a network be created to allocate MPs to different regions for the next five years. To illustrate the network and where each Center will allocate their employees, two tables were created with one describing the

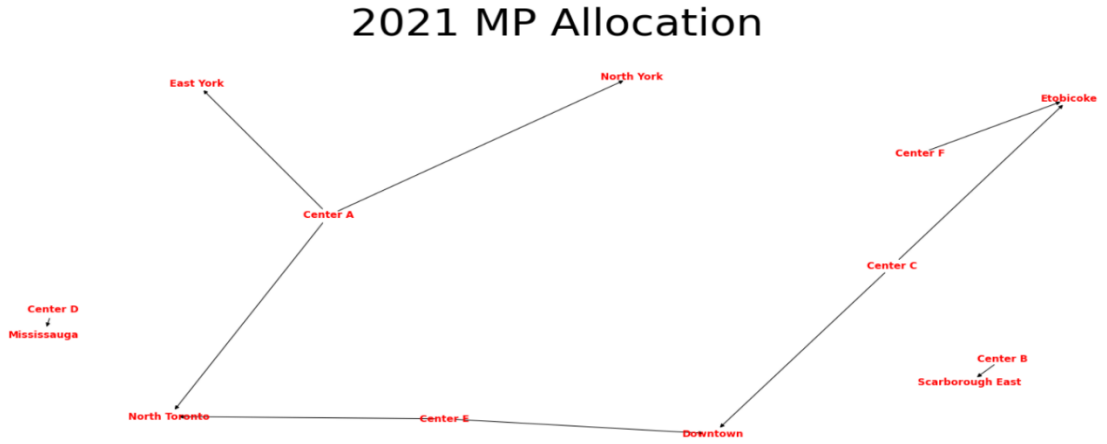
number of employees allocated to a region to work regular hours and the other describing the amount of overtime hours in a year that is required. Additionally, a graph visualizing the allocation in 2021 is created to demonstrate the network.

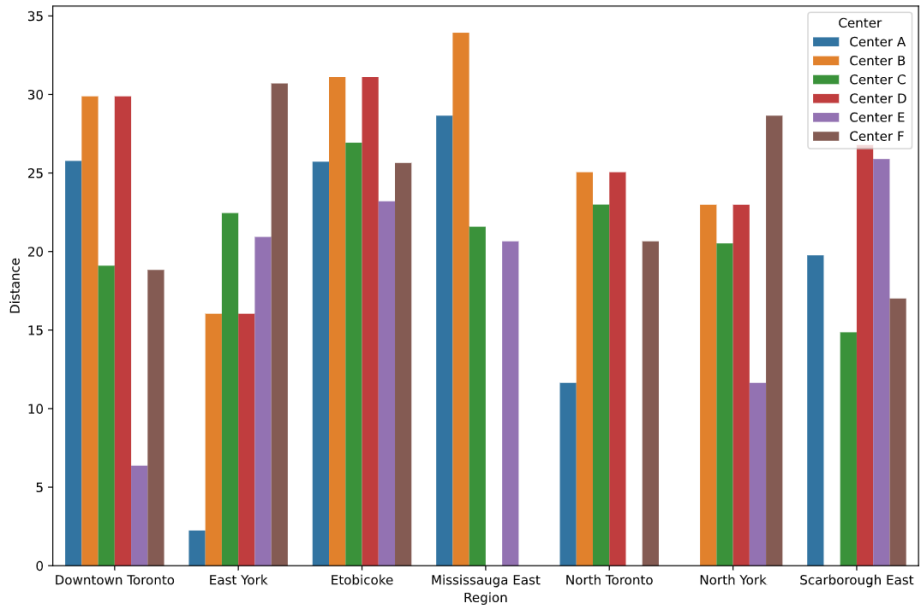
Employees Allocated Regular Hours

Year	Downtown Toronto	East York	Etobicoke	Mississauga East	North Toronto	North York	Scarborough East
2021	C: 146 E: 100		C: 54 F: 100	D: 220		A: 315	B: 225
2022	C: 191	A: 80 B: 21 D: 37	C: 109 F:200	D: 283	E: 200	A: 335	B: 304
2023	C: 289	A: 168 B: 21 D: 36	C: 20 F:300	D: 294	E: 300	A: 347	B: 315
2024	C: 240 E: 60	A: 235	C: 69 F:262	D: 330 F: 38	E: 311	A: 357	B: 336
2025	C: 269 E: 50	A: 224 D: 22	C: 49 F: 292	D: 308	E: 100 E: 321 F: 8	A: 368	B: 336

Overtime Hours per Year Allocation per Center

Year	Downtown Toronto	East York	Etobicoke	Mississauga East	North Toronto	North York	Scarborough East
2021	E: 32320	A: 304761	F: 217117	D: 79035	A: 104 E: 417680	A: 15295	B:102668
2022	E: 130763	A: 113704	E: 560		E: 133727 F: 478	A: 1238	B: 110
2023			E: 3				
2024		A: 90				A: 124	
2025	E: 92		E: 389		E: 56		





As you can see certain centers allocated towards the same regions every year. This is driven by the distance these centers are from these regions. For example, Center A is always serving North York and according to the dataset, it is closest to that center with a distance of 0. Obviously, that is not the only reason, but the distance is the driving force in MP allocation.

Note that overtime hours are limited to 4500 hours per employee max. The maximum overtime capacity for 2025 is listed below to demonstrate the maximum overtime allowed.

	Center A	**Center B**	**Center C**	**Center D**	**Center E**	**Center F**
Final Employee Count	592	336	309	330	371	300
Total Overtime	2664000	1512000	1390500	1485000	1669500	1350000

Managerial Question 4

When it comes to the optimal solution being different depending on the demand constraints, the table below summarizes how it would affect total cost.

Scenario	**Total Cost**
Meet All Demand	$36,415,608
110% Acceptance	$48,941,620
90% Acceptance	$24,671,978
80% Acceptance	$16,293,516
70% Acceptance	$9,457,275

As you can see the greater the ability to reject patients the lower the overall costs will be. This makes sense as the lower the demand the less employees are needed to be hired or allocated towards different regions. The model created also allows for allocating more than the demand if needed as well, which from the table shows will increase costs.

However, as we once again do not know how Fullcare makes revenue, the lower cost associated with rejecting patients may not lead to maximum profits. The model is created to minimize cost and may not consider factors such as ancillary revenue such as selling extra services or the possibility of losing customers to competitors in the future by rejecting too many. However, the flexibility may allow for better quality of care and if Fullcare aims to maximize customer satisfaction instead of gain, then having a flexible policy may be worth it. Additionally, if Fullcare wishes to not force overtime for their workers then this would once again be a viable option to explore. The perfect percentage of rejection flexibility should therefore be discussed, while considering the tradeoffs between quality and quantity.

Managerial Question 5

From the original forecasted demand above, it is shown that the forecast demand can sometimes be lower or higher than the year before. This means a model where you force it to only have capacity equal to the forecasted demand will only be optimal if the demand increases. For example, if demand falls next year, but last year you hired more workers, then the model would be infeasible as you have more capacity than needed when the model requires it to be equal. That is why to make the model robust in changes in demand, the constraint must be set as greater than or equal to allowing for Fullcare to have more capacity than needed when demand falls. This may lead to extra costs but having 100% capacity is not always the best option as seen in other industries. It is always better to have the ability to have extra capacity so that unexpected changes can be taken into consideration. Additionally, the ability to allow for overtime hours will allow the model to consider sudden increases in demand when regular hours and 100 new employees will not cut it. The extra capacity will also allow for less overtime hours and better care.

Conclusion

In conclusion, through the model created Fullcare can determine the optimal placements, hiring, overtime hours, viability of opening new centers, and flexibility rate needed to meet the regional demand for their growing business. The model is robust enough to be implemented regardless of the forecasted demand changing. Although the model provided the optimal solution, it should be said that the solution requires overtime hours that may not be the best idea when it comes to quality of care. Demand may be met in those regions, but it could lead to poor customer satisfaction and overworked employees. Due to this, it is recommended that Fullcare investigate potentially opening more medical centers or dropping the 100-employee hiring limit. This will allow MPs to work regular hours and provide greater care to patients in need. Additionally, having extra MPs will allow for more flexibility in accepting sudden increases in patient requests and will also lower the need to deny requests as well.

Limitations of Model

The model created is robust and provides a guideline on where to allocate MPs, however there are limitations to its design. Firstly, the forecasted demand was created using basic Linear Regression and may not be the most robust model to use. Especially in 2021 where things such as COVID vaccine rates or spreads can greatly influence how much patient care at home is needed. Secondly, although it was stated in the case as negligible, knowing how much it costs to visit multiple patients may be material and would be good to take into consideration. Thirdly, the fact that the new medical centers can only be open in 2021 and not any other years could be suboptimal as it may be needed more in future years than now. Thirdly, the model assumes that MPs can work up to 24 hours a day with regular hours and overtime being included. However, this may not be realistic, and a more realistic limit should be used for the upper bound for hours worked. Fourthly, the model having no capability to hire workers may lead to unused capacity and unnecessary costs. Finally, the model minimizes costs, but if revenue gets added to the equation it may lead to a different allocation of MPs. For example, there may be certain regions that provide more value, and it may be more beneficial to make sure those regions do not receive overtime hours as that can ruin quality of care and customer retention. Having the model consider degradation of quality in cost and value gained in different regions can be an important factor to consider.

Appendix

Mathematical Model Representation

min $\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{s=1}^{n} (CenterOperatingCost_{i,j,s} * yvar_{i,s}) + \sum_{i=1}^{n} \sum_{s=1}^{n} (15000 * nvar_{i,s}) +$
$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{s=1}^{n} (wages_s + CenterRegionDistanceCost_{i,j,s} + reimbursement_s) * 6 * 250 * pvar_{i,j,s} +$
$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{s=1}^{n} (OvertimeWages_s + CenterRegionDistanceCost_{i,j,s} + reimbursement_s) * ovar_{i,j,s} +$
$\sum_{i=1}^{n} \sum_{s=1}^{n} (CenterOpeningCost_{i,s} * yvar_{i,s})$

s.t. $\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{s=1}^{n} 6 * 250 * pvar_{i,j,s} + ovar_{i,j,s} \geq RegionalDemand_{j,s}$
$\sum_{i=1}^{n} \sum_{s=1}^{n} 6 * 250 * pvar_{i,j,s} + ovar_{i,j,s} \leq CenterMax_i * yvar_{i,s}$
$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{s=1}^{n} 6 * 250 * pvar_{i,j,s} == 6 * 250 * wvar_{i,s}$
$\sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{s=1}^{n} 6 * 250 * pvar_{i,j,s} + ovar_{i,j,s} \leq 24 * 250 * wvar_{i,s}$
$\sum_{i=1}^{4} \sum_{s=1}^{5} yvar_{i,s} == 1$
$0 \leq nvar_{i,s} \leq 100$
$num\_workers = wvar_{i,s-1} + nvar_{i,s}$
$num\_workers == wvar_{i,s}$
$yvar_{i,s-1} \leq yvar_{i,s}$

Output Results

```
Center A is opened


      Year 2021:
            Serves Region East York - with hours allocated 0.0 - capacity
filled 0.0
            Serves Region East York - with overtime hours allocated
304761.0 - capacity filled 1.0


Demand in region :304761.0
            Serves Region North Toronto - with hours allocated 0.0 -
capacity filled 0.0
            Serves Region North Toronto - with overtime hours allocated
104.0 - capacity filled 0.0002489324627080022
```

Demand in region :417784.0
Serves Region North York - with hours allocated 315.0 - capacity filled 0.9686446150534548
Serves Region North York - with overtime hours allocated 15295.0 - capacity filled 0.03135538494654517

Demand in region :487795.0
num_employees hired :100.0
num_employees :315.0
Total Capacity Available Regular Time:472500.0
Total Capacity Available Overtime:1417500.0
Total Capacity Overall:1890000.0

Year 2022:
Serves Region East York - with hours allocated 80.0 - capacity filled 0.37417681101576533
Serves Region East York - with overtime hours allocated 113704.0 - capacity filled 0.35454500099780484

Demand in region :320704.0
Serves Region North York - with hours allocated 335.0 - capacity filled 0.9975423732178236
Serves Region North York - with overtime hours allocated 1238.0 - capacity filled 0.0024576267821764487

Demand in region :503738.0
num_employees hired :100.0
num_employees :415.0
Total Capacity Available Regular Time:622500.0
Total Capacity Available Overtime:1867500.0
Total Capacity Overall:2490000.0

Year 2023:
Serves Region East York - with hours allocated 168.0 - capacity filled 0.7485585791645255
Serves Region East York - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :336647.0

Serves Region North York - with hours allocated 347.0 - capacity filled 1.0015759667950146
Serves Region North York - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :519681.0
num_employees hired :100.0
num_employees :515.0
Total Capacity Available Regular Time:772500.0
Total Capacity Available Overtime:2317500.0
Total Capacity Overall:3090000.0

Year 2024:
Serves Region East York - with hours allocated 235.0 - capacity filled 0.9997447460222921
Serves Region East York - with overtime hours allocated 90.0 - capacity filled 0.00025525397770781926

Demand in region :352590.0
Serves Region North York - with hours allocated 357.0 - capacity filled 0.9997684943169088
Serves Region North York - with overtime hours allocated 124.0 - capacity filled 0.00023150568309112364

Demand in region :535624.0
num_employees hired :77.0
num_employees :592.0
Total Capacity Available Regular Time:888000.0
Total Capacity Available Overtime:2664000.0
Total Capacity Overall:3552000.0

Year 2025:
Serves Region East York - with hours allocated 224.0 - capacity filled 0.9117229664643329
Serves Region East York - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :368533.0
Serves Region North York - with hours allocated 368.0 - capacity filled 1.0007850360880908

Serves Region North York - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :551567.0
num_employees hired :0.0
num_employees :592.0
Total Capacity Available Regular Time:888000.0
Total Capacity Available Overtime:2664000.0
Total Capacity Overall:3552000.0

Center B is opened

Year 2021:
Serves Region Scarborough East - with hours allocated 225.0 - capacity filled 0.7667526944257647
Serves Region Scarborough East - with overtime hours allocated 102668.0 - capacity filled 0.2332473055742353

Demand in region :440168.0
num_employees hired :100.0
num_employees :225.0
Total Capacity Available Regular Time:337500.0
Total Capacity Available Overtime:1012500.0
Total Capacity Overall:1350000.0

Year 2022:
Serves Region East York - with hours allocated 21.0 - capacity filled 0.0982214128916384
Serves Region East York - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :320704.0
Serves Region Scarborough East - with hours allocated 304.0 - capacity filled 0.9997566381867572
Serves Region Scarborough East - with overtime hours allocated 111.0 - capacity filled 0.00024336181324282905

Demand in region :456111.0
num_employees hired :100.0

num_employees :325.0
Total Capacity Available Regular Time:487500.0
Total Capacity Available Overtime:1462500.0
Total Capacity Overall:1950000.0

Year 2023:
Serves Region East York - with hours allocated 21.0 - capacity filled 0.09356982239556569
Serves Region East York - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :336647.0
Serves Region Scarborough East - with hours allocated 315.0 - capacity filled 1.0009448071618925
Serves Region Scarborough East - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :472054.0
num_employees hired :11.0
num_employees :336.0
Total Capacity Available Regular Time:504000.0
Total Capacity Available Overtime:1512000.0
Total Capacity Overall:2016000.0

Year 2024:
Serves Region Scarborough East - with hours allocated 336.0 - capacity filled 1.0327932343846375
Serves Region Scarborough East - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :487997.0
num_employees hired :0.0
num_employees :336.0
Total Capacity Available Regular Time:504000.0
Total Capacity Available Overtime:1512000.0
Total Capacity Overall:2016000.0

Year 2025:
Serves Region Scarborough East - with hours allocated 336.0 - capacity filled 1.0001190617930706

Serves Region Scarborough East - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :503940.0
num_employees hired :0.0
num_employees :336.0
Total Capacity Available Regular Time:504000.0
Total Capacity Available Overtime:1512000.0
Total Capacity Overall:2016000.0

Center C is opened

Year 2021:
Serves Region Downtown Toronto - with hours allocated 146.0 - capacity filled 0.5456991926642081
Serves Region Downtown Toronto - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :401320.0
Serves Region Etobicoke - with hours allocated 54.0 - capacity filled 0.18075636496718492
Serves Region Etobicoke - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :448117.0
num_employees hired :100.0
num_employees :200.0
Total Capacity Available Regular Time:300000.0
Total Capacity Available Overtime:900000.0
Total Capacity Overall:1200000.0

Year 2022:
Serves Region Downtown Toronto - with hours allocated 191.0 - capacity filled 0.6866173133012033
Serves Region Downtown Toronto - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :417263.0

Serves Region Etobicoke - with hours allocated 109.0 - capacity filled 0.3523251303710727
Serves Region Etobicoke - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :464060.0
num_employees hired :100.0
num_employees :300.0
Total Capacity Available Regular Time:450000.0
Total Capacity Available Overtime:1350000.0
Total Capacity Overall:1800000.0

Year 2023:
Serves Region Downtown Toronto - with hours allocated 289.0 - capacity filled 1.0006786609603746
Serves Region Downtown Toronto - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :433206.0
Serves Region Etobicoke - with hours allocated 20.0 - capacity filled 0.06249960937744139
Serves Region Etobicoke - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :480003.0
num_employees hired :9.0
num_employees :309.0
Total Capacity Available Regular Time:463500.0
Total Capacity Available Overtime:1390500.0
Total Capacity Overall:1854000.0

Year 2024:
Serves Region Downtown Toronto - with hours allocated 240.0 - capacity filled 0.8015157553506743
Serves Region Downtown Toronto - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :449149.0
Serves Region Etobicoke - with hours allocated 69.0 - capacity filled 0.20869207534691278

Serves Region Etobicoke - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :495946.0
num_employees hired :0.0
num_employees :309.0
Total Capacity Available Regular Time:463500.0
Total Capacity Available Overtime:1390500.0
Total Capacity Overall:1854000.0

Year 2025:
Serves Region Downtown Toronto - with hours allocated 260.0 - capacity filled 0.8385437719848976
Serves Region Downtown Toronto - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :465092.0
Serves Region Etobicoke - with hours allocated 49.0 - capacity filled 0.14358581645630206
Serves Region Etobicoke - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :511889.0
num_employees hired :0.0
num_employees :309.0
Total Capacity Available Regular Time:463500.0
Total Capacity Available Overtime:1390500.0
Total Capacity Overall:1854000.0

Center D is opened

Year 2021:
Serves Region Mississauga East - with hours allocated 220.0 - capacity filled 0.8067769261799113
Serves Region Mississauga East - with overtime hours allocated 79035.0 - capacity filled 0.19322307382008874

Demand in region :409035.0
num_employees hired :100.0

num_employees :220.0
Total Capacity Available Regular Time:330000.0
Total Capacity Available Overtime:990000.0
Total Capacity Overall:1320000.0

Year 2022:
Serves Region East York - with hours allocated 37.0 - capacity filled 0.17305677509479145
Serves Region East York - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :320704.0
Serves Region Mississauga East - with hours allocated 283.0 - capacity filled 0.998875235894564
Serves Region Mississauga East - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :424978.0
num_employees hired :100.0
num_employees :320.0
Total Capacity Available Regular Time:480000.0
Total Capacity Available Overtime:1440000.0
Total Capacity Overall:1920000.0

Year 2023:
Serves Region East York - with hours allocated 36.0 - capacity filled 0.16040540982096974
Serves Region East York - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :336647.0
Serves Region Mississauga East - with hours allocated 294.0 - capacity filled 1.0001791704182836
Serves Region Mississauga East - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :440921.0
num_employees hired :10.0
num_employees :330.0
Total Capacity Available Regular Time:495000.0

Total Capacity Available Overtime:1485000.0
Total Capacity Overall:1980000.0

Year 2024:
Serves Region Mississauga East - with hours allocated 330.0 - capacity filled 1.083473418785459
Serves Region Mississauga East - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :456864.0
num_employees hired :0.0
num_employees :330.0
Total Capacity Available Regular Time:495000.0
Total Capacity Available Overtime:1485000.0
Total Capacity Overall:1980000.0

Year 2025:
Serves Region East York - with hours allocated 22.0 - capacity filled 0.08954421992060413
Serves Region East York - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :368533.0
Serves Region Mississauga East - with hours allocated 308.0 - capacity filled 0.9771428934004784
Serves Region Mississauga East - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :472807.0
num_employees hired :0.0
num_employees :330.0
Total Capacity Available Regular Time:495000.0
Total Capacity Available Overtime:1485000.0
Total Capacity Overall:1980000.0

Center E is opened

Year 2021:

Serves Region Downtown Toronto - with hours allocated 0.0 - capacity filled 0.0
Serves Region Downtown Toronto - with overtime hours allocated 182320.0 - capacity filled 0.45430080733579187

Demand in region :401320.0
Serves Region North Toronto - with hours allocated 100.0 - capacity filled 0.35903720582884935
Serves Region North Toronto - with overtime hours allocated 267680.0 - capacity filled 0.6407138617084427

Demand in region :417784.0
num_employees hired :100.0
num_employees :100.0
Total Capacity Available Regular Time:150000.0
Total Capacity Available Overtime:450000.0
Total Capacity Overall:600000.0

Year 2022:
Serves Region Downtown Toronto - with hours allocated 87.0 - capacity filled 0.3127523887811764
Serves Region Downtown Toronto - with overtime hours allocated 263.0 - capacity filled 0.0006302979176203018

Demand in region :417263.0
Serves Region Etobicoke - with hours allocated 0.0 - capacity filled 0.0
Serves Region Etobicoke - with overtime hours allocated 560.0 - capacity filled 0.0012067405076929708

Demand in region :464060.0
Serves Region North Toronto - with hours allocated 113.0 - capacity filled 0.3907988204561856
Serves Region North Toronto - with overtime hours allocated 264227.0 - capacity filled 0.6092011795438145

Demand in region :433727.0
num_employees hired :100.0
num_employees :200.0
Total Capacity Available Regular Time:300000.0

Total Capacity Available Overtime:900000.0
Total Capacity Overall:1200000.0

Year 2023:
Serves Region Etobicoke - with hours allocated 0.0 - capacity filled 0.0
Serves Region Etobicoke - with overtime hours allocated 3.0 - capacity filled 6.249960937744139e-06

Demand in region :480003.0
Serves Region North Toronto - with hours allocated 300.0 - capacity filled 1.000733871505771
Serves Region North Toronto - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :449670.0
num_employees hired :100.0
num_employees :300.0
Total Capacity Available Regular Time:450000.0
Total Capacity Available Overtime:1350000.0
Total Capacity Overall:1800000.0

Year 2024:
Serves Region Downtown Toronto - with hours allocated 60.0 - capacity filled 0.20037893883766858
Serves Region Downtown Toronto - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :449149.0
Serves Region North Toronto - with hours allocated 311.0 - capacity filled 1.0019050155386555
Serves Region North Toronto - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :465613.0
num_employees hired :71.0
num_employees :371.0
Total Capacity Available Regular Time:556500.0
Total Capacity Available Overtime:1669500.0
Total Capacity Overall:2226000.0

Year 2025:
Serves Region Downtown Toronto - with hours allocated 50.0 - capacity filled 0.16125841768940338
Serves Region Downtown Toronto - with overtime hours allocated 92.0 - capacity filled 0.0001978103256990015

Demand in region :465092.0
Serves Region Etobicoke - with hours allocated 0.0 - capacity filled 0.0
Serves Region Etobicoke - with overtime hours allocated 389.0 - capacity filled 0.0007599303755306327

Demand in region :511889.0
Serves Region North Toronto - with hours allocated 321.0 - capacity filled 0.9998837103057588
Serves Region North Toronto - with overtime hours allocated 56.0 - capacity filled 0.00011628969424116821

Demand in region :481556.0
num_employees hired :0.0
num_employees :371.0
Total Capacity Available Regular Time:556500.0
Total Capacity Available Overtime:1669500.0
Total Capacity Overall:2226000.0

Center F is opened

Year 2021:
Serves Region Etobicoke - with hours allocated 100.0 - capacity filled 0.33473400919849056
Serves Region Etobicoke - with overtime hours allocated 217117.0 - capacity filled 0.4845096258343245

Demand in region :448117.0
num_employees hired :100.0
num_employees :100.0
Total Capacity Available Regular Time:150000.0
Total Capacity Available Overtime:450000.0

Total Capacity Overall:600000.0

Year 2022:
Serves Region Etobicoke - with hours allocated 200.0 - capacity filled 0.6466681291212343
Serves Region Etobicoke - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :464060.0
Serves Region Mississauga East - with hours allocated 0.0 - capacity filled 0.0
Serves Region Mississauga East - with overtime hours allocated 478.0 - capacity filled 0.001124764105436046

Demand in region :424978.0
num_employees hired :100.0
num_employees :200.0
Total Capacity Available Regular Time:300000.0
Total Capacity Available Overtime:900000.0
Total Capacity Overall:1200000.0

Year 2023:
Serves Region Etobicoke - with hours allocated 300.0 - capacity filled 0.9374941406616208
Serves Region Etobicoke - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :480003.0
num_employees hired :100.0
num_employees :300.0
Total Capacity Available Regular Time:450000.0
Total Capacity Available Overtime:1350000.0
Total Capacity Overall:1800000.0

Year 2024:
Serves Region Etobicoke - with hours allocated 262.0 - capacity filled 0.7924249817520456
Serves Region Etobicoke - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :495946.0
Serves Region Mississauga East - with hours allocated 38.0 - capacity filled 0.12476360579953771
Serves Region Mississauga East - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :456864.0
num_employees hired :0.0
num_employees :300.0
Total Capacity Available Regular Time:450000.0
Total Capacity Available Overtime:1350000.0
Total Capacity Overall:1800000.0

Year 2025:
Serves Region Etobicoke - with hours allocated 292.0 - capacity filled 0.8556542531681673
Serves Region Etobicoke - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :511889.0
Serves Region Mississauga East - with hours allocated 8.0 - capacity filled 0.02538033489351892
Serves Region Mississauga East - with overtime hours allocated 0.0 - capacity filled 0.0

Demand in region :472807.0
num_employees hired :0.0
num_employees :300.0
Total Capacity Available Regular Time:450000.0
Total Capacity Available Overtime:1350000.0
Total Capacity Overall:1800000.0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