WonderMarket
Section B – Client Report

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MATH3202 Assignment 2
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Abstract

In this report, we propose a solution to optimise your supply chain logistics, to minimise costs while ensuring all demands are met.

Solution

We have considered your requirements of weekly demand, DC capacity, surge demands, proposed new DCs and labour costs. We propose the following strategy for each communication.

Communication 5

For this communication, we consider surge scenarios but without the northside capacity limit. Additionally, we require each store to be assigned to only one distribution centre.

This resulted in a cost of $205688 per week with the assignments below. This is $6901 more expensive than communication 4, which means the requirement of one DC per store costs more than the savings from removing the northside limit.

Store	DC0	DC1	DC2
S0			100%
S1	100%		
S2			100%
S3		100%	
S4	100%		
S5		100%	
S6		100%	
S7	100%		
S8	100%		
S9	100%		

Communication 6

In this communication, we consider 4 possible sites for a new DC. We add these to our model to determine which (if any) of the new DCs would reduce our cost the most. Our model would only recommend opening a new DC if it reduced the total cost from communication 5.

We determined **opening DC3** would be best. This would reduce the weekly cost to $160486 which is $45202 cheaper than communication 5. The store assignments are below.

Store	DC0	DC1	DC2	DC3	DC4	DC5	DC6
S0				100%			
S1				100%			
S2				100%			
S3		100%					
S4				100%			
S5		100%					
S6		100%					
S7			100%				
S8			100%				
S9				100%			

Communication 7

Communication 7 builds on communication 6. Now, we can open up to 2 new DCs. If we open 2 new DCs, 1 old DC must be closed. We consider if it would be cheaper to build 2 of the new DCs and close an existing one.

Note that in communication 6, DC0 is not used at all despite being available. Thus, closing it would not affect the weekly cost. Moreover, an additional new DC could be opened to further reduce the cost. This communication's model recommends **closing DC0** and **opening DC3 and DC5**.

This results in a weekly transport cost of $140776, $19710 cheaper than communication 6, with the following assignments.

Store	DC0	DC1	DC2	DC3	DC4	DC5	DC6
S0				100%			
S1				100%			
S2				100%			
S3						100%	
S4				100%			
S5		100%					
S6		100%					
S7			100%				
S8			100%				
S9				100%			

Communication 8

Here, we also consider labour costs during regular demand.

Optimising the model results in a cost of \$202276 per week, \$61500 more than comm 7. This is done by **closing DC0** and **opening DC3 and DC5** with the below store and labour assignments. Note that the store and DC assignments are the same as communication 7 so this does not affect those; the additional \$61500 is exactly the cost of the full-time and part-time teams.

Store	DC0	DC1	DC2	DC3	DC4	DC5	DC6
S0				100%			
S1				100%			
S2				100%			
S3						100%	
S4				100%			
S5		100%					
S6		100%					
S7			100%				
S8			100%				
S9				100%			

DC	Part-time	Full-time
DC1	0	2
DC2	3	0
DC3	0	8
DC5	3	0

Communication 9

Finally, we also consider the transport and labour costs of surge scenarios across the whole year.

Solving this model results in a cost of $12576018.00 each year (on average, $241846.50 per week), an increase of $39570.50 per week from communication 8. You should **close DC0** and **open DC3 and DC5** with the below store and labour assignments. Again, the store and DC assignments are the same as communications 7 and 8 but the full/part-time teams have changed.

Store	DC0	DC1	DC2	DC3	DC4	DC5	DC6
S0				100%			
S1				100%			
S2				100%			
S3						100%	
S4				100%			
S5		100%					
S6		100%					
S7			100%				
S8			100%				
S9				100%			

DC	Part-time	Full-time
DC1	0	2
DC2	0	2
DC3	0	8
DC5	0	2

Surge	DC	Casual
Surge 0	DC5	11
Surge 1	DC2	20
Surge 3	DC2	20
Surge 4	DC1	42
Surge 4	DC3	2

(Surge 2 needs no additional casual staff at any DC)

Insights

Cost Breakdown

Below, you can find a table showing the weekly breakdowns of normal demand and surge scenarios. Note that the full-time and part-time teams are employed for all 52 weeks each year.

	Weeks		Transport		FT/PT		
Normal	29 ×		$ 140,776.00	+	$ 3,276,000.00	=	$ 7,358,504.00

	Weeks		Transport		Casuals			
Surge 0	5 ×	(	$ 150,128.00	+	$ 32,461.00	)	=	$ 912,945.00
Surge 1	5 ×	(	$ 153,633.00	+	$ 59,020.00	)	=	$ 1,063,265.00
Surge 2	6 ×	(	$ 142,088.00	+	$ -	)	=	$ 852,528.00
Surge 3	2 ×	(	$ 164,098.00	+	$ 59,020.00	)	=	$ 446,236.00
Surge 4	5 ×	(	$ 258,664.00	+	$ 129,844.00	)	=	$ 1,942,540.00
					Yearly Total		=	$12,576,018.00

General Observations

While optimising the assignments with the data you provided us, we made the following observations.

- The optimal solution to communication 9 uses no part-time teams, despite them being used in communication 8. This is because the additional capacity from full-time staff will be used during surge scenarios, reducing the need for expensive casual workers. Each casual worker only handles 1 truckload, but costs 65% as much as a full-time team which handles 9 truckloads. Note how surge 2 can be handled by the only full-time staff.
- With communication 9, we have a fairly complete picture of WonderMarket's logistics needs and costs. Some DC capacities are never fully utilised, but the model accounts for this and only assigns enough staff to handle the required demand. This means if demand increases, you can simply employ more staff (as long as DC capacity is sufficient). However, we would recommend re-evaluating the model to optimise for the new situation.
- With the construction of DC3 and DC5, your total capacity has increased notably. Even the most demanding surge scenario, surge 4 with 164 truckloads, has 55 truckloads of spare capacity across DC1, DC2 and DC5.
- With that in mind, DC3 is nearing its capacity. There are at most 4 unused truckloads per week. In surge scenario 4, all of its capacity is used.

Marginal Costs

These are the effects of slight adjustments to the capacity of DCs you have provided us. These may be useful to improve your management of distribution centres.

- With the notes on DC capacity above, increasing the DC1, DC2, DC3 or DC5's capacity by 1 does not affect the cost as the DC capacity is no longer a limiting factor.
- If you can close one more DC to open a new site, you should close DC1 and open DC6. This would reduce your yearly cost by $853344 ($16410.46 per week), to $11722674 ($225436.04 per week).
- The solution assigns 5 of the 10 stores to DC3. If DC3 could not be built, your cost would be increased by $1225564 yearly ($23568.54 weekly) to $13801582 yearly ($265415.04 weekly). Using DC0, DC1, DC2 and DC6 would then be optimal.