BNAL 405 Group 6 Project Report

The project that our group had conducted put us in the positions of senior business analysts who was reporting to logistic management and the company CEO. This process included the group having to go through the provided data and clean it up so that we could then run different descriptive analysis reports as well as different predictive analysis reports on the different distribution regions for the first three months of 2020. With that information we were then tasked with providing insight into improving the logistic costs and properly allocate the right resources. Our group consisted of five members, Sorin, Terrilyn, Kelli, Zac, and Sean with Sorin taking the role of project manager/leader. We allocated the tasks for the project as such, Sorin oversaw cleaning up the data, Kelli and Sean ran multiple different descriptive analyses, Terrilyn oversaw the predictive analysis reports, and Zac oversaw compiling all the data that was provided from the analyses to write the report and format the information to give back proper insight. The group consistently met over zoom to have meetings and discussions for each portion of the project. We even made a shared document that tracked our progress and different tasks. We ended up all agreeing that the distribution of each task was divided and equal.

Data Cleaning

To start with the data cleaning Sorin went in and made a change in the PAS table where column G was changed from “disguised cost” to “Disguised Freight Cost” so it would match the other three distribution region data tables. She noted that cleaning the data in the PAS table, many of the data records removed were from ACE Hardware Stores customers which was a result of having a frequency of poor data quality. The four distribution tables had their G columns formatted to be currency and their D columns converted from text to number. The formula that Sorin used for the Zip Code column was a VLOOKUP formula that linked to the “CustomerInformation” table which was what she called the Array all the information that was provided was on. Image provided below for the formula.

```
=VLOOKUP($D2,CustomerInformation,6,FALSE)
```

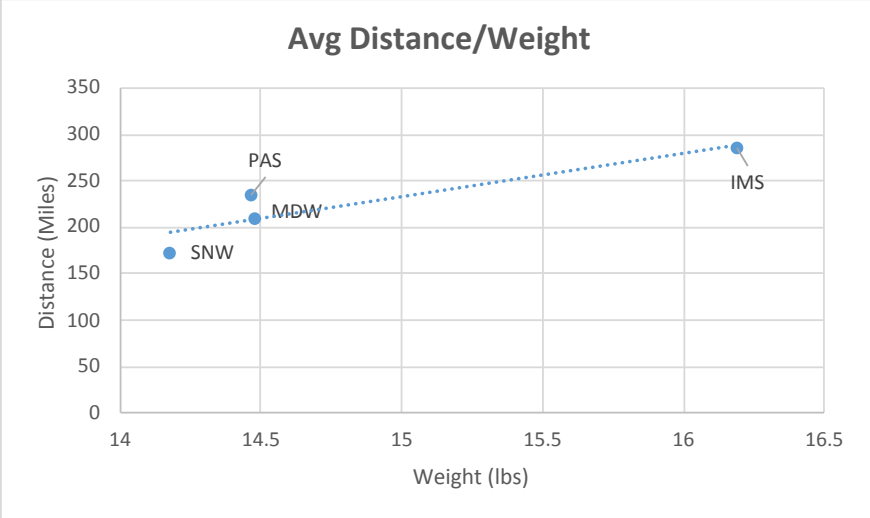
There was VLOOKUP formula used for the Distance column as well but this time it was connected to the "ZiptoZip" table. Image provided below for the formula.

```
=VLOOKUP(H2,ZiptoZip,6,FALSE)
```

Sorin noticed that many of the order numbers were invalid due to not being located within the customer information table. Which resulted in not returning anything locational information helpful to this analysis. This resulted in the order numbers being removed. Sorin also noted that many zip codes were invalid and were not available to generate distance calculations, they weren't on the zip-to-zip table, this resulted in the records being removed because they couldn't be effectively analyzed for the project. For the customer information and zip to zip tables Sorin adjusted the column widths for improved visibility and clarity. There were also blank rows in the zip-to-zip table that provided no distance information, so they were deleted.

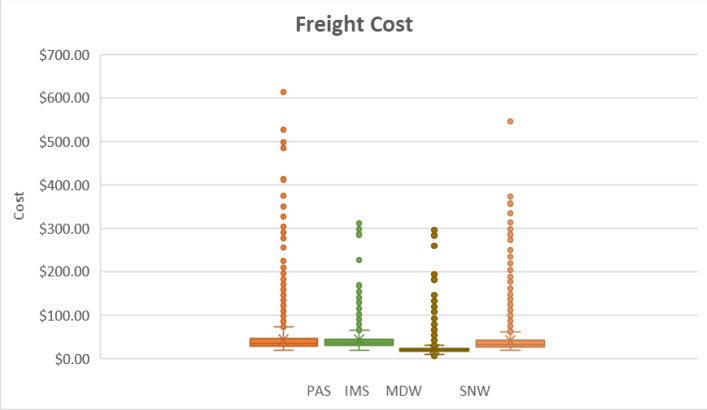
Descriptive Analyses

Next up Kelli and Sean created multiple data visualizations to compare the relationships between costs, distance, and weight. Kelli created a couple of simple graphs that include a scatter plot, a line chart, three box and whisker charts, and a histogram.



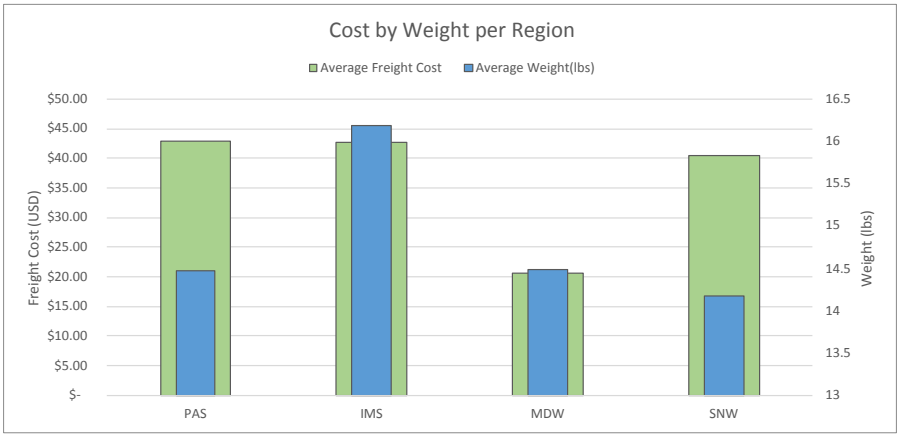
The scatter plot provides a quick insight into the average weight and distances for each of the distribution regions. A trend line was provided to show the increase in weight and distance.

This line chart shows the trend of freight cost to weight of shipments. Kelli notes that the results are fairly like that of the scatter plot. Which essentially means IMS had the highest freight cost and weight.

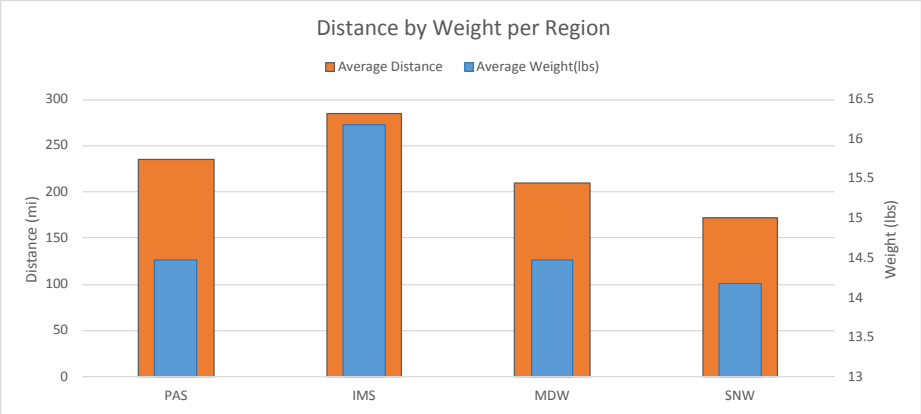


The three whisker plots provide another visualization of the information provided from the line chart. The third chart provides information in the sense that MDW had the greatest outlier when it comes to distance resulting in a skewed variance. Compared to IMS who rarely had any variances.

The other half of the descriptive analyses were covered by Sean by providing a couple comparison charts, a tree map to help emphasize the regions where cost is greatest, and then a couple of waterfall charts.



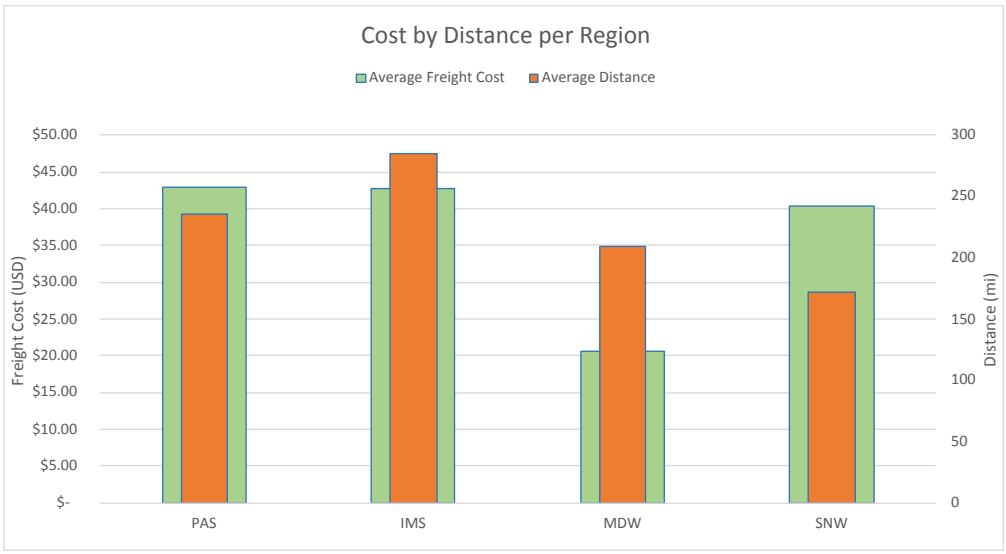
The first comparison chart provides a look at the avg cost by weight per region. Sean's primary assumption entails "Higher Weight = Higher Cost; Higher Distance = Higher Cost." He also adds that the cost to move cargo on the west coast is significantly great than the Midwest and intermountain regions. He also notes that there are many more ramps in the IMS and MDW regions that provide an easier connection to customer origins which he assumes mitigates the cost that PAS and SNW struggle with due to the need to drive cargo over greater distances.



The second comparison chart provides a look at the average distance by weight per region. If you notice the weight is shown to have similar, but less pronounced correlation to distance per region.

- PAS has the second greatest distance but ranks 3rd in weight by a slim margin.
    - Further proves that cost is being defrayed using ramps in this region.
- IMS has the greatest distance and weight of all regions.
    - Assumes to be the cheapest to move the weight in this region.
- MDW
    - 2nd lowest distance, but 2nd greatest weight. The last chart showed there is a favorable weight to cost correlation in the last chart. Further proving heavier cargo is moving farther at a beneficial cost. Almost incentivizing the movement of cargo in this region and IMS.
- SNW
    - Has a similar ration of weight to distance as PAS.

This data lets us assume that a lot of volume is moving in the 2nd most cost-efficient region, IMS, and moving the furthest. Sean also notes “This is the biggest region of the four so this all maybe a byproduct of the geography plus being closer to rail hubs.”



The last comparison chart provides a look at the average cost by distance per region. The Cost to Distance ratio is least favorable in the PAS & SNW regions, whereas it is most beneficial in the IMS & MDW territories.

- SNW has the worst cost ratio by distance.
    - The lack of ramps and reliance on motor carriers to move cargo in the region plus the west coast labor costs are greater.
- PAS has a closer cost balance, but the weight of goods being moved in the region is far less for the distance travelled.
- MDW is heavily urbanized and as a result customer origins plus STIHL distribution centers are all located close to main transit hubs for rail and ramp moves.
- IMS covers the greatest distance but is still favorable cost proposition based on the proximity of customer and distribution centers to transport hubs in the region.

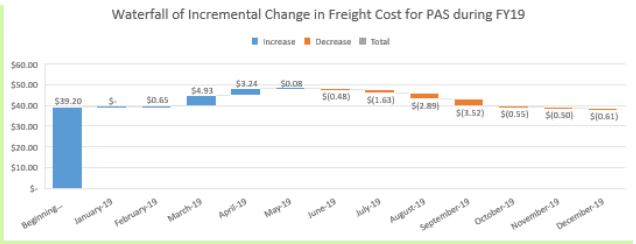
The next chart Sean provides is a Tree map that helps emphasize the regions where cost is greatest.

To read this map would involve you looking at each region and then start with the greatest value. For example, with IMS the data is in descending order vertically so it would highest with MAR then goes to AUG, then MAY – DEC, and finally JUN – NOV with NOV being the month with the lowest freight cost of the region. Now obviously that's not the same for the other three regions but you would just go through them the same way as you did with IMS.

Sean provides four different waterfall charts that each one goes over the change in freight cost for each region in the 2019 fiscal year.

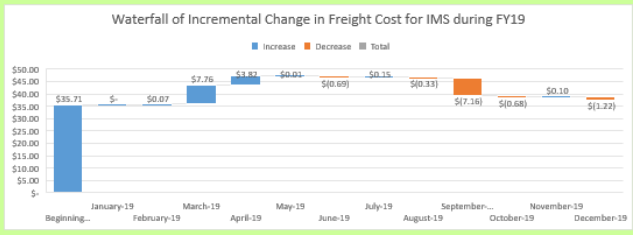
Date	Average Freight Cost PAS
January-19	$39.20
February-19	$39.85
March-19	$44.78
April-19	$48.02
May-19	$48.10
June-19	$47.63
July-19	$46.00
August-19	$43.11
September-19	$39.59
October-19	$39.03
November-19	$38.53
December-19	$37.93

Date	Increment/Decrease
Beginning January-	$ 39.20
January-19	$ -
February-19	$ 0.65
March-19	$ 4.93
April-19	$ 3.24
May-19	$ 0.08
June-19	$ (0.48)
July-19	$ (1.63)
August-19	$ (2.89)
September-19	$ (3.52)
October-19	$ (0.55)
November-19	$ (0.50)
December-19	$ (0.61)



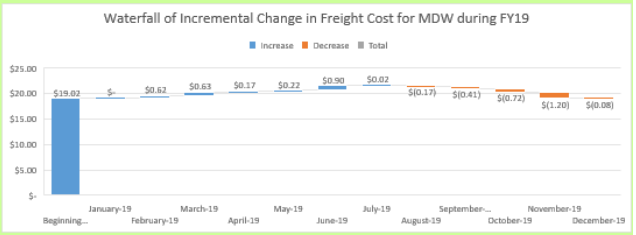
Date	Average Freight Cost IMS
January-19	$35.71
February-19	$35.78
March-19	$43.54
April-19	$47.36
May-19	$47.37
June-19	$46.69
July-19	$46.84
August-19	$46.51
September-19	$39.35
October-19	$38.67
November-19	$38.78
December-19	$37.56

Date	Increment/Decrease
Beginning January-	$ 35.71
January-19	$ -
February-19	$ 0.07
March-19	$ 7.76
April-19	$ 3.82
May-19	$ 0.01
June-19	$ (0.69)
July-19	$ 0.15
August-19	$ (0.33)
September-19	$ (7.16)
October-19	$ (0.68)
November-19	$ 0.10
December-19	$ (1.22)



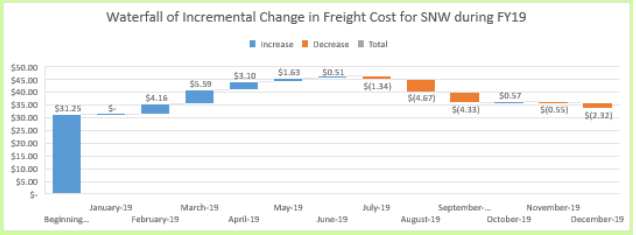
Date	Average Freight Cost MDW
January-19	$19.02
February-19	$19.64
March-19	$20.27
April-19	$20.44
May-19	$20.66
June-19	$21.56
July-19	$21.59
August-19	$21.42
September-19	$21.01
October-19	$20.29
November-19	$19.09
December-19	$19.01

Date	Increment/Decrease
Beginning January-	$ 19.02
January-19	$ -
February-19	$ 0.62
March-19	$ 0.63
April-19	$ 0.17
May-19	$ 0.22
June-19	$ 0.90
July-19	$ 0.02
August-19	$ (0.17)
September-19	$ (0.41)
October-19	$ (0.72)
November-19	$ (1.20)
December-19	$ (0.08)



Date	Average Freight Cost SNW
January-19	$31.25
February-19	$35.41
March-19	$41.00
April-19	$44.10
May-19	$45.73
June-19	$46.24
July-19	$44.90
August-19	$40.22
September-19	$35.89
October-19	$36.46
November-19	$35.91
December-19	$33.59

Date	Increment/Decrease
Beginning January-	$ 31.25
January-19	$ -
February-19	$ 4.16
March-19	$ 5.59
April-19	$ 3.10
May-19	$ 1.63
June-19	$ 0.51
July-19	$ (1.34)
August-19	$ (4.67)
September-19	$ (4.33)
October-19	$ 0.57
November-19	$ (0.55)
December-19	$ (2.32)



Sean states that "The charts are all roughly the same but have some key things to keep in mind. A: The curve of the trend line on these charts would be the inverse of the freight cost on previous charts, and B: A decrease really means a freight cost increase."

- PAS is the highest average cost region
  - The curve matches what we observed in the combo chart
- March and April are months where costs increase
  - Sean suggests we can focus in on which customers, from where, and the weight that is leading to the increase
  - As well as to possibly take advantage of cost savings found in July – September, such as which customers/origins/lanes are helping us reduce costs in those months

- MDW best region for cost efficiency
    - This region is proof of the power of location
        - The costs stay low because customer origins plus stihl warehouse are optimally located near main transportaion hubs which eliminates the need to pay high fees to motor carriers for additional cargo moves.

Somethings Sean would suggest

- Target Months – look into which customers/where from are creating the increased cost – especially in February – April.
- See if we can take better advantage of the cost savings we experience in August and Spetember to offset if unable to mitigate the peak months.
- He asks "Is there a larger customer base we can service based closer to transportaion hubs?" If so that would mitigate the costs even more.

Predictive Analyses

We no move on to Terrilyn's portion of the project where she provided multiple regression analyses for each of the four regions for the first three months of the 2020 fiscal year. These regression analyses also follow up with a pivot table for each region by using the trend function in excel.

Pivot-PAS					
Months	Sum of Disguised Freight Cos	Sum of Weight(lbs)	Sum of Distance	Forecast	Error
Jan-19	$ 565,863.50	230,453.60	3,386,563.40	$ 662,539.87	$ (96,676.37)
Feb-19	$ 416,658.78	151,532.80	2,415,929.79	$ 420,268.91	$ (3,610.13)
Mar-19	$ 495,608.06	171,492.00	2,609,058.88	$ 475,486.60	$ 20,121.46
Apr-19	$ 705,663.32	238,823.65	3,441,530.05	$ 682,686.59	$ 22,976.73
May-19	$ 728,929.16	242,434.79	3,564,342.37	$ 702,837.85	$ 26,091.31
Jun-19	$ 717,682.56	235,044.60	3,486,528.23	$ 681,663.57	$ 36,018.99
Jul-19	$ 670,503.02	223,518.29	3,514,083.46	$ 665,859.02	$ 4,644.00
Aug-19	$ 649,404.66	208,061.99	3,608,727.39	$ 651,337.20	$ (1,932.54)
Sep-19	$ 500,771.94	155,912.72	3,073,795.63	$ 503,558.08	$ (2,786.14)
Oct-19	$ 577,597.98	184,753.02	3,471,558.02	$ 597,071.31	$ (19,473.33)
Nov-19	$ 483,248.42	158,098.03	2,893,064.63	$ 486,259.69	$ (3,011.27)
Dec-19	$ 450,505.48	149,067.11	2,795,581.26	$ 460,107.66	$ (9,602.18)
Jan-20	$ 547,271.25	166,505.86	3,235,375.61	$ 539,695.91	$ 7,575.34
Feb-20	$ 542,128.24	161,936.25	3,242,712.33	$ 533,015.35	$ 9,112.89
Mar-20	$ 537,317.04	157,661.46	3,249,575.71	$ 526,765.79	$ 10,551.25

Image provided is the pivot chart for PAS

- 2020 has a more balanced cost throughout the months compared to 2019
- 2019 fluctuated through the three months but was stead
- 2020 stayed consistent with a gradual decrease leading into March.

Terrilyn concludes that once March arrives, there will normally be a decrease in deliveries for PAS and a relatively good start in the beginning of the year.

Pivot-IMS

Months	Sum of Disguised Freight Cos	Sum of Weight (lbs)	Sum of Distance	Forcast	Error
Jan-19	$ 45,499.50	22,009.70	379,019.12	$ 55,574.84	$ (10,075.34)
Feb-19	$ 35,283.18	14,016.93	274,224.27	$ 32,021.59	$ 3,261.59
Mar-19	$ 50,376.22	22,662.70	315,038.98	$ 50,762.49	$ (386.27)
Apr-19	$ 89,182.70	33,668.02	551,160.63	$ 91,720.87	$ (2,538.17)
May-19	$ 80,438.70	31,915.55	486,172.20	$ 82,655.26	$ (2,216.56)
Jun-19	$ 80,767.82	31,311.55	462,103.34	$ 79,375.63	$ 1,392.19
Jul-19	$ 92,032.32	31,052.15	533,893.29	$ 85,593.87	$ 6,438.45
Aug-19	$ 84,406.82	31,259.85	477,468.54	$ 80,713.12	$ 3,693.70
Sep-19	$ 60,558.68	20,701.21	437,482.67	$ 58,741.38	$ 1,817.30
Oct-19	$ 70,231.96	25,918.69	541,143.95	$ 77,390.21	$ (7,158.25)
Nov-19	$ 54,676.02	18,239.80	450,396.25	$ 55,684.25	$ (1,008.23)
Dec-19	$ 46,347.96	16,841.79	360,567.36	$ 44,924.74	$ 1,423.22
Jan-20	$ 70,289.75	23,467.04	494,295.69	$ 68,800.13	$ 1,489.62
Feb-20	$ 70,988.29	23,232.87	502,922.56	$ 69,196.33	$ 1,791.96
Mar-20	$ 71,641.77	23,013.80	510,992.86	$ 69,566.97	$ 2,074.80

Image provided is the pivot chart for IMS

- Similar to PAS, 2020 has a more balanced cost throughout the months compare to 2019
- 2019 fluctuated through the three months but was steady.
    - There was a drop in February, so they could save on cost in the month in February
- 2020 stayed consistent with a gradual increase leading into March

Terrilyn concludes that IMS should have a gradual increase in their freight cost in the beginning of 2020

Pivot - MDW					
Months	Sum of Disguised Freight Cos	Sum of Weight (lbs)	Sum of Distance	Forecast	Error
Jan-19	$ 201,314.28	142,499.60	2,158,538.61	$ 207,664.65	$ (6,350.37)
Feb-19	$ 123,415.56	83,511.85	1,287,977.23	$ 121,016.03	$ 2,399.53
Mar-19	$ 196,298.84	137,016.90	1,853,301.78	$ 181,136.52	$ 15,162.32
Apr-19	$ 308,621.64	224,080.50	3,107,705.00	$ 306,513.67	$ 2,107.97
May-19	$ 335,892.22	241,749.87	3,385,436.30	$ 333,865.49	$ 2,026.73
Jun-19	$ 390,620.06	253,226.77	3,887,919.55	$ 378,157.62	$ 12,462.44
Jul-19	$ 436,339.34	297,785.55	4,366,481.96	$ 428,865.00	$ 7,474.34
Aug-19	$ 416,290.92	291,293.82	4,187,080.43	$ 412,444.55	$ 3,846.37
Sep-19	$ 366,200.34	263,415.74	3,777,721.32	$ 371,664.62	$ (5,464.28)
Oct-19	$ 348,736.90	255,132.74	3,585,098.03	$ 353,701.22	$ (4,964.32)
Nov-19	$ 223,339.30	159,782.45	2,434,705.64	$ 234,789.67	$ (11,450.37)
Dec-19	$ 194,785.40	144,424.06	2,013,246.72	$ 196,186.63	$ (1,401.23)
Jan-20	$ 350,853.18	251,291.30	3,615,858.17	$ 355,260.85	$ (4,407.66)
Feb-20	$ 359,551.71	258,079.22	3,711,449.13	$ 364,853.98	$ (5,302.28)
Mar-20	$ 367,689.04	264,429.22	3,800,872.92	$ 373,828.21	$ (6,139.18)

Image provided is the pivot chart for MDW

- 2020 has a more balanced cost throughout the months compared to 2019
- MDW had a very similar 2019 to IMS where it fluctuated but was steady and had a drop in February
- 2020 also stayed consistent with a gradual increase leading into March
- Because of the increase in errors Terrilyn suggested to increase the freight cost to combat the raise in demand in 2020

Terrilyn concludes MDW should have a gradual increase in their freight cost in the beginning of 2020.

Pivot-SNW					
Months	Sum of Disguised Freight Cost	Sum of Weight (lbs)	Sum of Distance	Forecast	Error
Jan-19	$ 289,670.88	126,979.91	1,433,705.85	$ 342,952.56	$(53,281.68)
Feb-19	$ 214,497.38	83,575.37	922,443.67	$ 195,319.96	$ 19,177.42
Mar-19	$ 392,412.48	152,470.85	1,513,365.58	$ 385,614.54	$ 6,797.94
Apr-19	$ 512,250.38	187,926.15	1,942,553.26	$ 508,517.04	$ 3,733.34
May-19	$ 529,457.96	180,687.88	2,010,723.37	$ 514,528.49	$ 14,929.47
Jun-19	$ 557,215.30	188,510.53	2,144,842.44	$ 549,516.02	$ 7,699.28
Jul-19	$ 576,749.52	192,427.21	2,280,028.98	$ 580,616.46	$ (3,866.94)
Aug-19	$ 379,515.02	122,622.74	1,638,680.37	$ 379,300.37	$ 214.65
Sep-19	$ 250,423.62	80,556.78	1,217,079.42	$ 250,973.11	$ (549.49)
Oct-19	$ 243,432.18	78,634.22	1,271,127.19	$ 259,745.19	$(16,313.01)
Nov-19	$ 201,569.70	67,935.08	1,044,100.45	$ 203,189.82	$ (1,620.12)
Dec-19	$ 171,394.86	51,761.97	931,048.27	$ 163,642.45	$ 7,752.41
Jan-20	$ 262,703.95	75,713.75	1,279,953.33	$ 258,441.57	$ 4,262.38
Feb-20	$ 247,527.46	67,833.29	1,241,037.28	$ 242,399.95	$ 5,127.51
Mar-20	$ 233,330.10	60,461.26	1,204,631.95	$ 227,393.28	$ 5,936.82

Image provided is the pivot chart for SNW

- 2020 has a more balanced cost throughout the months compared to 2019
- Much like MDW and IMS 2019 fluctuated but was steady, had a drop in February but SNW differs because they then had an increase in March.
- 2020 stayed consistent with a gradual decrease leading into March

Terrilyn concludes SNW should have a gradual decrease in their freight cost at the beginning of 2020.

The data and charts discussed in this report provided insight on the four different shipping regions within STIHL as well as some suggestions from our group members to the logistics manager and CEO of the company. There is more data that goes into more detail in the excel sheet that was compiled with all of the group's work that wasn't discussed in the summaries. If there is one thing we would like to note its that our group member Kelli came to discuss with Sorin and I that they didn't fully turn in their portion of the project by only providing the graphs and charts but nothing for the worksheets by the time of finishing the report. She accepts this and is fully prepared to receive less points compared to everyone else if that is how you see fit.