Abnormal Distribution

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Project Recommendations and Implications:

Increasing Sales and Market Share for GloBiz

Team 5 – Abnormal Distribution

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Overview and Data Summary

Data Source: Kaggle

Overview: Globiz is exploring ways to grow its **sales & profit**. Management has contracted an analytics firm, Abnormal Distribution, to understand what factors they should focus on.

Data Summary

- Total # of Records: 51,290
- Outcome Variables: Sales & Profit Margin
- Other Variables:

Market	Product	Purchase	Sales
Markets Region Country	Product Categories Sub-Category Product ID	Customer ID Order ID Order date	Profit, Sales Quantity Shipping Cost

(Date: 2011-2014)

Methods

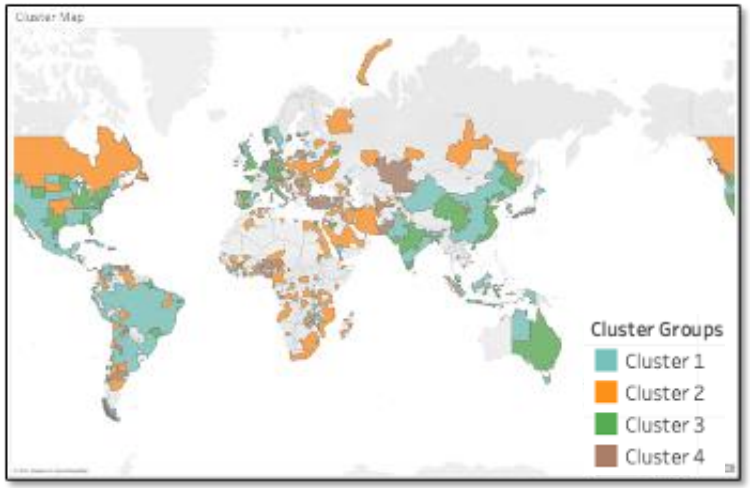
- Profitability Analysis
- Marketing Mix (Product, Place, Promotion)
- K-Means Cluster analysis & RFM (Frequency) (Tableau)
- Step-wise Multiple Regression Analysis (radiant using R)

Criteria for Success

- Identify key variables
- Identify most/least successful product & regions for increased/decreased marketing activities.

Findings from Profitability and Cluster Analysis

Category	% Sales	Profit Margin	Sub-Category	% Sales	Profit Margin
Furniture	32%	7%	Bookcases	12%	11%
Lowest Margin Category			Chairs	12%	9%
			Furnishings	3%	12%
		Lowest Margin	Tables	6%	-8%
Office Supplies	30%	14%	Appliances	8%	14%
			Art	3%	16%
			Binders	4%	16%
			Envelopes	1%	17%
		Low Sales High Margins	Fasteners	1%	14%
			Labels	1%	20%
			Paper	2%	24%
			Storage	9%	10%
			Supplies	2%	9%
Technology	28%	14%	Accessories	6%	17%
		High Sales High Margins	Copiers	12%	17%
			Machines	6%	8%
			Phones	14%	13%



Cluster Characteristics			
	Profit Margin	Customer Size	Purchase Frequency
Cluster 1	Medium	Medium	High
Cluster 2	High	Small	Low
Cluster 3	High	High	High
Cluster 4	Low	Small	Low

Strategy	
Cluster 1	Increase customer base & improve profitability
Cluster 2	Increase customer base & improve purchase frequency
Cluster 3	Top Performance Regions
Cluster 4	Consider to shut down

- Furniture has the lowest margin, only half of the other two categories; Tables have the lowest margin across all sub-categories (-8%)
- Majority of office supplies have extremely high margins
- Accessories, Copiers, and Phones have both high margins and high sales

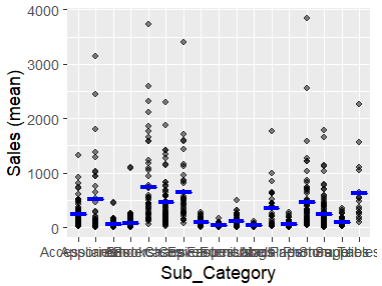
Findings from Multiple Regression Analysis

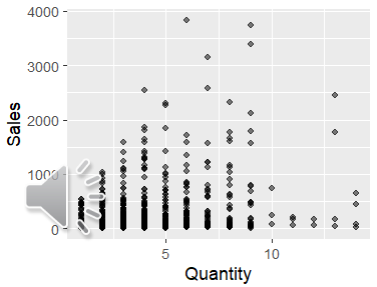
Regression Equation

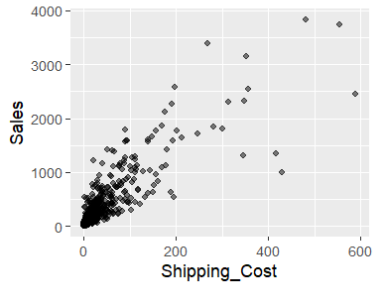
Sales =

Intercept	10
Sub-categories that deliver higher sales	+ 154 * Appliances + 187 * Bookcases + 102 * Chairs + 188* Copiers + 177 * Machines + 127 * Phones + 442 * Tables + 17 * Storage
Sub-categories that lead to lower sales	– 53 * Art – 54* Binders – 58 * Envelopes – 71 * Fasteners – 34 * Furnishings – 78 * Labels – 66 * Paper – 39 * Supplies
Sales Order Components	+ 0.994 * Profit + 21* Quantity + 3 * Shipping Cost
Interactions in Sales Order Components	– 0.032 * Profit * Quantity + 0.297 * Quantity * Shipping Cost

R-squared: 0.695, Adjusted R-squared: 0.695
F-statistic: 5315.196 df(22,51267), p.value < .001
Nr obs: 51,290







Significant Variables:

- Sub-category, Profit, Quantity, Shipping Cost

Impact of product lines (sub categories)

- **High Value Sales Order:** Appliances, book-cases, chairs, copiers, phones, tables and storage drive up sales
- **Low Value Sales Order:** Art, binders, envelopes, fasteners, furnishings, labels, paper and supplies drive down sales.

Impact of sales order components:

- Profit, Quantity and Shipping cost all increase sales order value

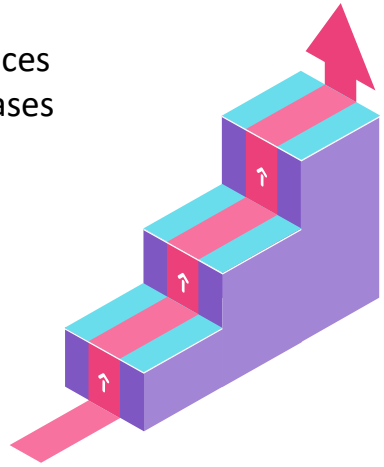
Interaction Terms:

- Model is better explained by interaction terms between Profit, Quantity and Shipping cost
- Sales order values are lower if profit and quantity are high – volume discount effect
- Sales order values are higher if quantity and shipping costs are high – as the shipping cost is baked into sales value and shipping/ handling costs increase as quantity increases

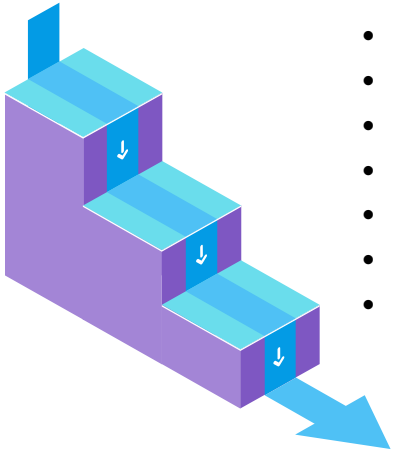
Implications of sales analysis

Deliver higher sales

- Appliances
- Book-cases
- Chairs
- Copiers
- Phones
- Tables
- Storage



Lead to lower sales



- Art
- Binders
- Envelopes
- Fasteners
- Furnishings
- Labels
- Paper and supplies

Marketing MIX

Profit – Increases with sales, reduces sales if quantity is big
Quantity – Increases with sales
Shipping Cost – Increases with sales and quantity

Top selling (66%):
- Chairs
- Appliances
- Storage
- Copiers
- Phones.

Highly profitable:
- Paper & Labels

but only account for less than 3% of total sales

Least Profitable
- Chairs
- Copiers and phones

Growth areas:
Office supplies have low sales but extremely high margins

Implications on K-Means Analysis

2014 What-If Analysis

Cluster Characteristics			
	Profit Margin	Customer Size	Purchase Frequency
Cluster 1	Medium	Medium	High
Cluster 2	High	Small	Low
Cluster 3	High	High	High
Cluster 4	Low	Small	Low

Cluster Characteristics			Profit Margin	Profit		New Profit
Cluster 1	Medium	Medium	6%	63,524	If closing the business in Cluster 4	63,524
Cluster 2	High	Small	24%	137,208		137,208
Cluster 3	High	High	16%	384,992		384,992
Cluster 4	Low	Sm	-103%	-81,558		0
		Total Profit		504,166		585,724

18%

	Customer Size (Distinct Customers)	Purchase Frequency	Increase both by 10%	Customer Size (Distinct Customers)	Purchase Frequency		New Profit
Cluster 1	1670	2.9		2826	2.4		63,524
Cluster 2	1110	1.8		1221	1.98		166,626
Cluster 3	2275	2.7		3094	2.2		384,992
Cluster 4	449	2.1		1026	1.8		0
						Total Profit	615,142

5%

- If the firm would shut down the business in cluster 4 regions, the annual profit would increase by 18%
- If the firm would increase both customer size and purchase frequency by 10% in cluster 2 regions, the annual profit would further increase by 5%
- **Limitation:**
  - Assume that the closing of business in cluster 4 doesn't affect the sales and customer behaviors in other clusters (regions)
  - when calculating the new profit for cluster 2, we assumed the change in customer behavior doesn't affect avg. Order value; Annual recurring profit = avg. Order Value * # of Distinct Customers * Orders/year * Profit Margin

Implications on Firm Profitability

- Regression analysis revealed:
  - Individual order sales are impacted sub-category, profit, quantity, and shipping cost
  - Firm overall sales are impacted by country, quarter (seasonality), sales mix, and product mix
    - Region, sub-region, discount, and order priority variables have no statistically significant impact on sales
- The K-means cluster analysis revealed:
  - Four clusters were distinguishable by profit margin, customer size, and purchase frequency
- Implications
  - GloBiz's use of discounts are neither increasing nor decreasing sales
  - Monitoring countries rather than regions will offer more precise analysis of marketing and firm performance
  - Product offerings vary greatly in profitability
  - Shipping cost impacts profitability

Recommendations

Product

- Focus on high-margin, low volume
- Office supplies
- Maintain position in copiers and phones

Place

- Lean into high-margin countries in all regions
  - Canada (highest profit margin and tiny market penetration)
  - EU, US (large markets with good margins, not saturated), but by country
- Not APAC: high margins but already saturated
- Cluster 3: maintain
- Cluster 4: exit

Research

- Promotion
- Price
- Consider effect of *discount* variable on sales
- Cluster analysis by product and customer

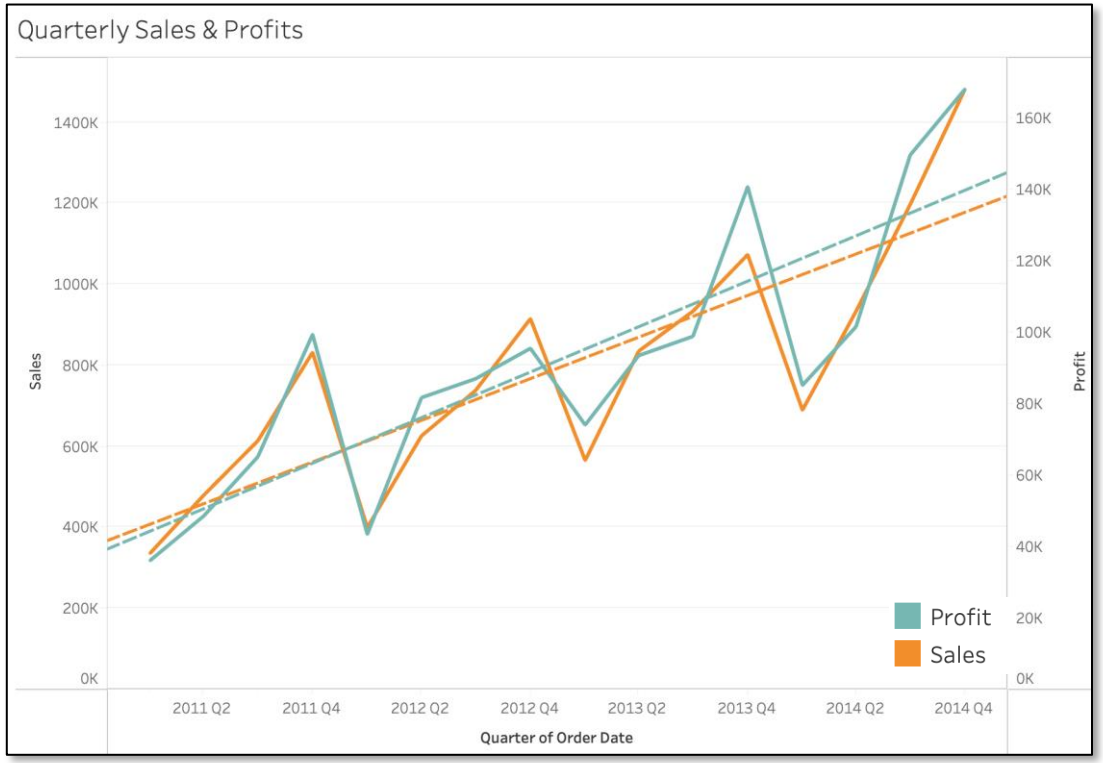
Thank you!
Questions?

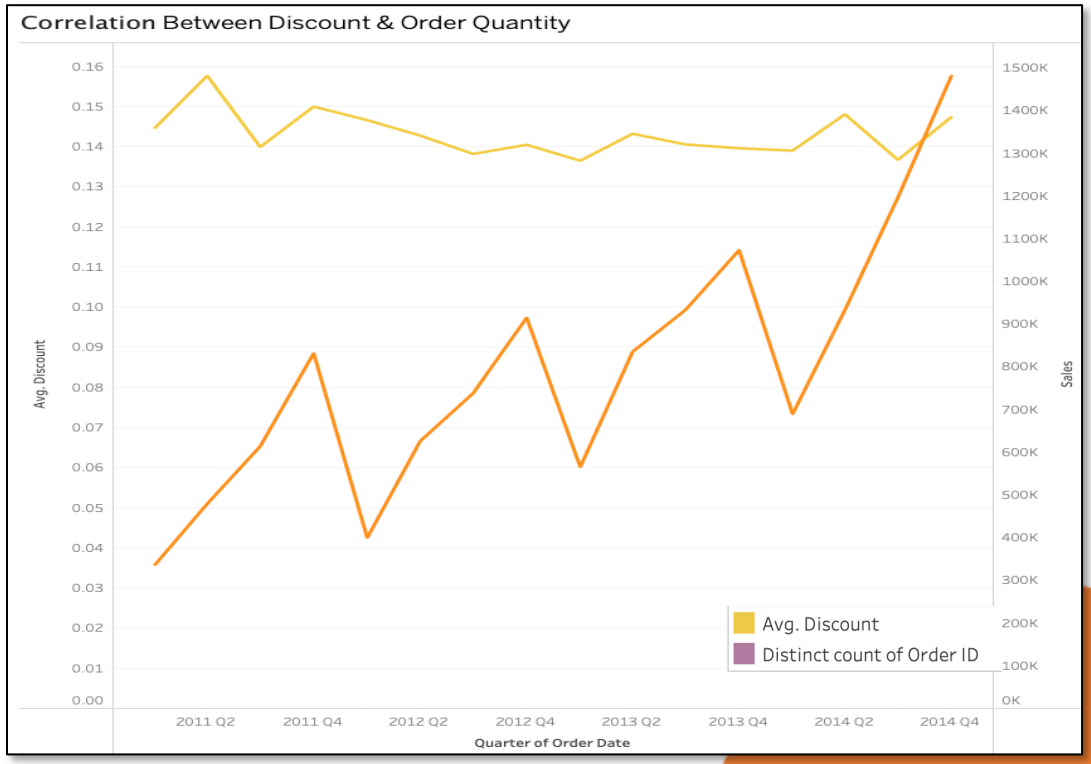
Technical Appendix

Company Level Analysis

- **Upward trends**
- **Seasonality of sales and profits**

- **Don’t see correlation between discount and order quantity**





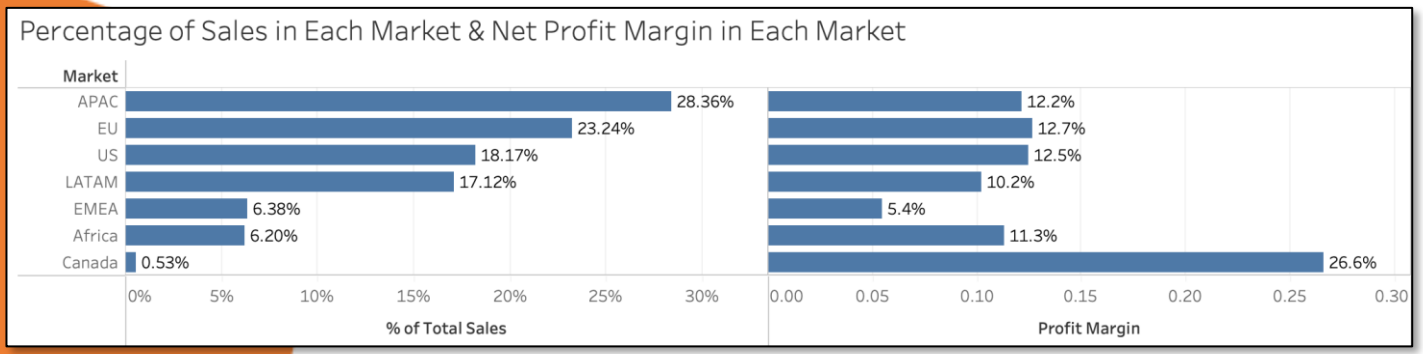
Profitability for Categories

- **Product Categories**
  - Furniture has the lowest margin
  - Sales are evenly distributed across categories
- **Product Sub-Categories**
  - Tables have the lowest margin
  - Top 6 sales sub-categories: Bookcases, Chairs, Appliances, Storage, Copiers and Phones. Accounts for 66% of total sales
  - Paper and Labels are highly profitable, but only account for less than 3% of total sales

Category	% of Sales	Profit Margin
Furniture	32.52%	7%
Office Supplies	29.96%	14%
Technology	37.53%	14%

Category	Sub-Catego..	% of Sales	Profit Margin
Furniture	Bookcases	11.60%	11%
	Chairs	11.88%	9%
	Furnishings	3.05%	12%
	Tables	5.99%	-8%
Office Supplies	Appliances	8.00%	14%
	Art	2.94%	16%
	Binders	3.65%	16%
	Envelopes	1.35%	17%
	Fasteners	0.66%	14%
	Labels	0.58%	20%
	Paper	1.93%	24%
	Storage	8.92%	10%
	Supplies	1.92%	9%
Technology	Accessories	5.93%	17%
	Copiers	11.94%	17%
	Machines	6.16%	8%
	Phones	13.50%	13%

Profitability for Markets & Product Categories



Product Categories

	Market													
	APAC		EU		US		LATAM		EMEA		Africa		Canada	
Category	% of Sales	Profit Margin	% of Sales	Profit Margin	% of Sales	Profit Margin	% of Sales	Profit Margin	% of Sales	Profit Margin	% of Sales	Profit Margin	% of Sales	Profit Margin
Furniture	37.48%	9.4%	26.52%	8.8%	32.30%	2.5%	37.51%	5.1%	28.36%	5.0%	24.83%	8.4%	15.83%	24.7%
Office Supplies	24.66%	11.9%	35.61%	15.3%	31.30%	17.0%	26.05%	14.1%	34.32%	5.4%	34.03%	10.7%	44.88%	26.5%
Technology	37.86%	15.1%	37.87%	13.0%	36.40%	17.4%	36.44%	12.8%	37.32%	5.8%	41.13%	13.7%	39.29%	27.6%

		Market													
		APAC		EU		US		LATAM		EMEA		Africa		Canada	
Category	Sub-Catego..	% of Sales	Profit Margin	% of Sales	Profit Margin	% of Sales	Profit Margin	% of Sales	Profit Margin	% of Sales	Profit Margin	% of Sales	Profit Margin	% of Sales	Profit Margin
Furniture	Bookcases	14.08%	13.4%	12.37%	15.5%	5.00%	-3.0%	13.97%	8.2%	11.38%	8.7%	10.65%	8.6%	8.57%	23.4%
	Chairs	14.31%	12.1%	7.79%	8.6%	14.30%	8.1%	13.96%	9.5%	8.66%	-0.9%	7.15%	5.0%	4.78%	26.8%
	Furnishings	2.82%	16.0%	2.76%	16.8%	3.99%	14.2%	2.89%	0.4%	3.44%	5.2%	2.63%	11.2%	1.21%	14.1%
Lowest margin	Tables	6.28%	-8.9%	3.59%	-19.9%	9.01%	-8.6%	6.69%	-8.5%	4.88%	7.0%	4.41%	11.6%	1.27%	35.3%
Office Supplies	Appliances	8.58%	13.7%	9.37%	16.8%	4.68%	16.9%	8.41%	14.4%	8.47%	4.4%	7.94%	5.9%	11.86%	28.1%
	Art	1.76%	11.6%	5.45%	19.2%	1.18%	24.1%	1.90%	16.9%	4.73%	3.8%	4.90%	10.3%	6.16%	22.2%
	Binders	1.77%	17.0%	3.40%	19.8%	8.85%	14.9%	1.99%	12.3%	3.31%	10.9%	2.85%	11.9%	4.62%	25.4%
Low sales High margin	Envelopes	1.45%	10.0%	1.37%	21.5%	0.72%	42.3%	1.91%	15.2%	1.31%	7.7%	1.24%	15.7%	0.85%	30.2%
	Fasteners	0.78%	6.0%	0.69%	21.8%	0.13%	31.4%	0.88%	13.2%	0.79%	14.9%	0.74%	14.7%	0.71%	29.3%
	Labels	0.62%	11.1%	0.53%	21.0%	0.54%	44.3%	0.63%	17.6%	0.51%	9.5%	0.62%	16.1%	0.63%	30.6%
	Paper	1.67%	11.5%	1.45%	20.9%	3.42%	43.4%	1.76%	15.9%	1.27%	8.7%	1.72%	15.3%	2.27%	24.6%
	Storage	6.03%	11.5%	11.56%	8.2%	9.74%	9.5%	6.56%	11.4%	12.18%	3.5%	12.33%	12.3%	15.82%	27.5%
	Supplies	2.00%	5.9%	1.80%	18.2%	2.03%	-2.5%	2.00%	17.5%	1.76%	7.0%	1.69%	7.8%	1.96%	22.7%
Technology	Accessories	5.19%	8.5%	5.55%	20.5%	7.29%	25.1%	6.55%	19.1%	5.48%	8.1%	5.38%	15.4%	6.68%	29.0%
High sales High margin	Copiers	13.79%	16.3%	12.43%	15.4%	6.51%	37.2%	14.61%	13.0%	9.94%	10.2%	12.28%	14.6%	11.16%	35.7%
	Machines	5.31%	13.9%	7.60%	7.7%	8.24%	1.8%	1.89%	5.8%	7.69%	4.4%	8.82%	8.6%	6.39%	14.2%
	Phones	13.56%	16.7%	12.30%	10.3%	14.37%	13.5%	13.38%	10.4%	14.21%	2.6%	14.65%	15.4%	15.07%	26.6%

- The top 4 markets account for 87% of total sales; profit margins are 10%~13%
- EMEA has the lowest profit margin ~5%
- Canada has the highest profit margin ~27%, but only accounts for 0.5% of total sales

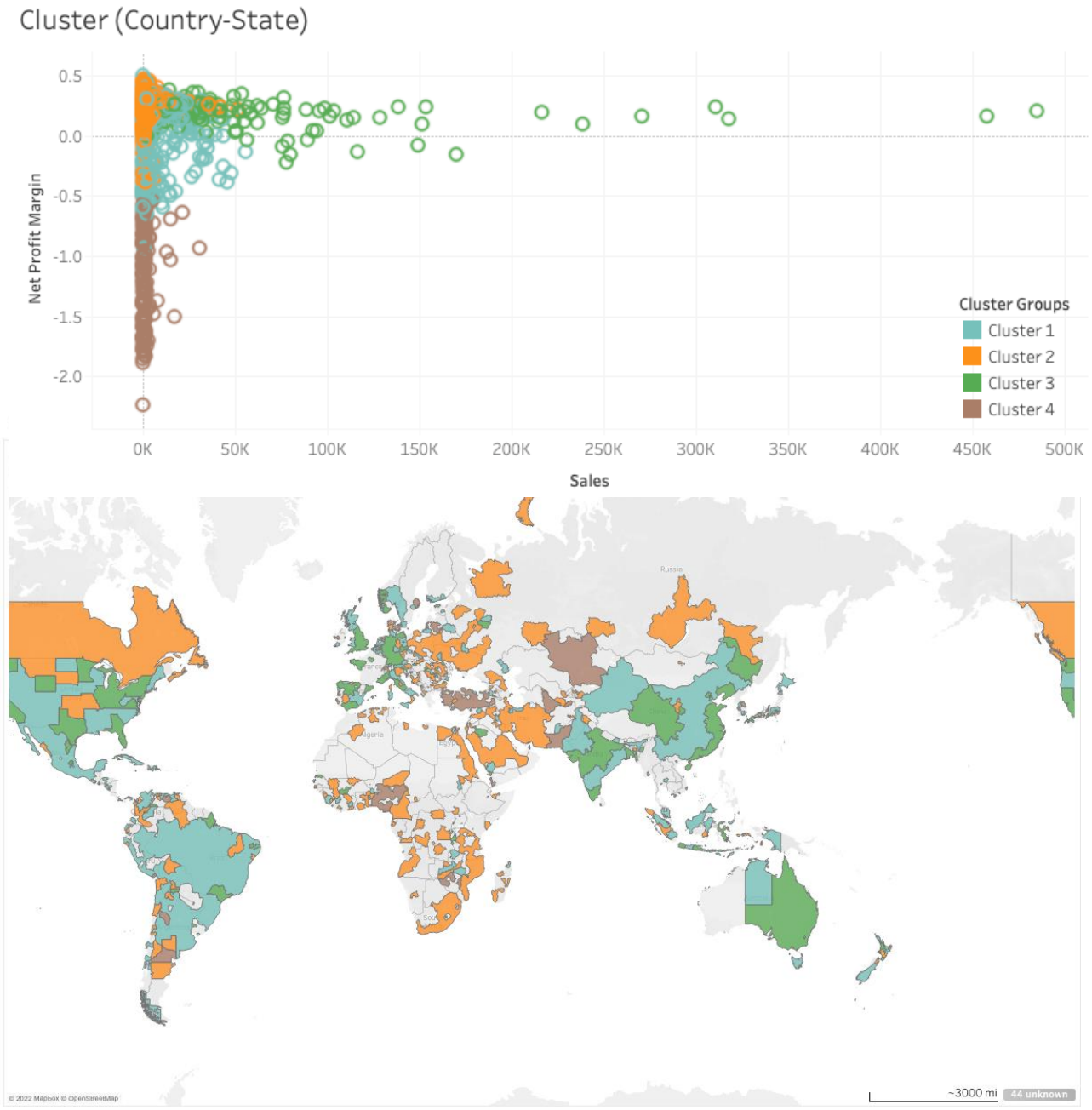
Product Categories

- % sales for each category is slightly different in each market; no category has a major advantage in sales
- Furniture has the lowest margin in each market. Especially in the EU, US and LATAM, the margin of furniture is significantly lower than that of other categories

Product Sub-Categories

- Tables have the lowest margin in the top 4 m arkets
- Majority of office supplies have low sales but extremely high margins [area for growth
- Copiers and phones have both high sales and high margins

K-Means Clustering Analysis



Variables: Sales, Profit margin, # of unique customers, Customer purchase frequency, Order value

		Centers				
Clusters	Number of Items	Sum of Sales	Net Profit Margin	Distinct count of Customer ID	Avg. Purchase Frequency Per Year	Avg. Order Value
Cluster 1	390	8531.7	0.05796	18.856	2.9348	429.91
Cluster 2	441	3695.0	0.20738	9.1769	1.7087	386.84
Cluster 3	152	48991.0	0.19549	69.625	2.639	1034.2
Cluster 4	136	1760.5	-1.1398	10.147	1.8862	174.76
Not Clustered	0					

Cluster Characteristics				
	Sales	Profit Margin	Customer Size	Purchase Frequency
Cluster 1	Medium	Medium	Medium	High
Cluster 2	Low	High	Small	Low
Cluster 3	High	High	High	High
Cluster 4	Low	Low	Small	Low

Strategy	
Cluster 1	Increase customer base & improve profitability
Cluster 2	Increase customer base & improve purchase frequency
Cluster 3	Top Performance Regions
Cluster 4	Consider to shut down

Multiple Regression – Part 1

```
Start:  AIC=572994.2
Sales ~ Category + Order_Priority + Region + Segment + Sub_Category +
    Discount + Profit + Quantity + Shipping_Cost


Step:  AIC=572994.2
Sales ~ Order_Priority + Region + Segment + Sub_Category + Discount +
    Profit + Quantity + Shipping_Cost

                Df  Sum of Sq        RSS    AIC
- Segment        2      74875 3640708576 572991
<none>                       3640633701 572994
- Region        12    5352674 3645986374 573046
- Discount       1    9685262 3650318962 573128
- Order_Priority 3  157469073 3798102773 575160
- Quantity       1  168008992 3808642692 575306
- Sub_Category  16  344024910 3984658610 577593
- Profit         1  614713464 4255347165 580994
- Shipping_Cost  1 2663929461 6304563162 601156

Step:  AIC=572991.2
Sales ~ Order_Priority + Region + Sub_Category + Discount + Profit +
    Quantity + Shipping_Cost

                Df  Sum of Sq        RSS    AIC
<none>                       3640708576 572991
- Region        12    5354523 3646063099 573043
- Discount       1    9684858 3650393434 573125
- Order_Priority 3  157450551 3798159126 575157
- Quantity       1  168034355 3808742930 575303
- Sub_Category  16  343971478 3984680053 577590
- Profit         1  614742905 4255451481 580992
- Shipping_Cost  1 2663925443 6304634018 601153
```

```
Backward stepwise selection of variables
-----------------------------------------------------
Linear regression (OLS)
Data     : Dataset
Response variable    : Sales
Explanatory variables: Category, Order_Priority, Region, Segment, Sub_Category, Discount, Profit, Quantity, Shipping_Cost
Null hyp.: the effect of x on Sales is zero
Alt. hyp.: the effect of x on Sales is not zero
```

	coefficient	std.error	t.value	p.value	
(Intercept)	-187.949	7.579	-24.799	< .001	***
Order_Priority|High	132.628	4.811	27.569	< .001	***
Order_Priority|Low	153.424	6.937	22.116	< .001	***
Order_Priority|Medium	203.911	4.654	43.813	< .001	***
Region|Canada	10.943	14.190	0.771	0.441	
Region|Caribbean	-35.446	7.652	-4.633	< .001	***
Region|Central	-5.246	4.751	-1.104	0.270	
Region|Central Asia	22.418	7.166	3.128	0.002	**
Region|East	-11.192	6.448	-1.736	0.083	.
Region|EMEA	0.880	5.447	0.161	0.872	
Region|North	-9.453	5.584	-1.693	0.090	.
Region|North Asia	4.364	6.867	0.635	0.525	
Region|Oceania	9.973	6.057	1.646	0.100	.
Region|South	-7.826	5.194	-1.507	0.132	
Region|Southeast Asia	1.646	6.284	0.262	0.793	
Region|West	-18.990	6.251	-3.038	0.002	**
Sub_Category|Appliances	135.098	8.023	16.838	< .001	***
Sub_Category|Art	-47.335	6.169	-7.673	< .001	***
Sub_Category|Binders	-52.687	5.916	-8.905	< .001	***
Sub_Category|Bookcases	158.699	7.324	21.669	< .001	***
Sub_Category|Chairs	83.794	6.650	12.601	< .001	***
Sub_Category|Copiers	161.403	7.525	21.447	< .001	***
Sub_Category|Envelopes	-52.301	7.256	-7.208	< .001	***
Sub_Category|Fasteners	-66.047	7.276	-9.078	< .001	***
Sub_Category|Furnishings	-34.469	6.758	-5.100	< .001	***
Sub_Category|Labels	-70.477	7.128	-9.887	< .001	***
Sub_Category|Machines	149.388	8.474	17.628	< .001	***
Sub_Category|Paper	-56.530	6.598	-8.567	< .001	***
Sub_Category|Phones	106.057	6.694	15.844	< .001	***
Sub_Category|Storage	14.625	6.108	2.395	0.017	*
Sub_Category|Supplies	-37.354	7.263	-5.143	< .001	***
Sub_Category|Tables	374.648	10.541	35.543	< .001	***
Discount	70.647	6.050	11.677	< .001	***
Profit	0.715	0.008	93.029	< .001	***
Quantity	27.314	0.562	48.637	< .001	***
Shipping_Cost	5.030	0.026	193.656	< .001	***

- Ran multiple regression analysis with Sales as response variable and Order Priority, Region, Sub Category, Discount, Profit, Quantity and Shipping Cost as input variables.
- Apart from a few of the Region variables, all other factors were statistically significant
- Adjusted R-Square for the model was very high which confirmed this is a good model.

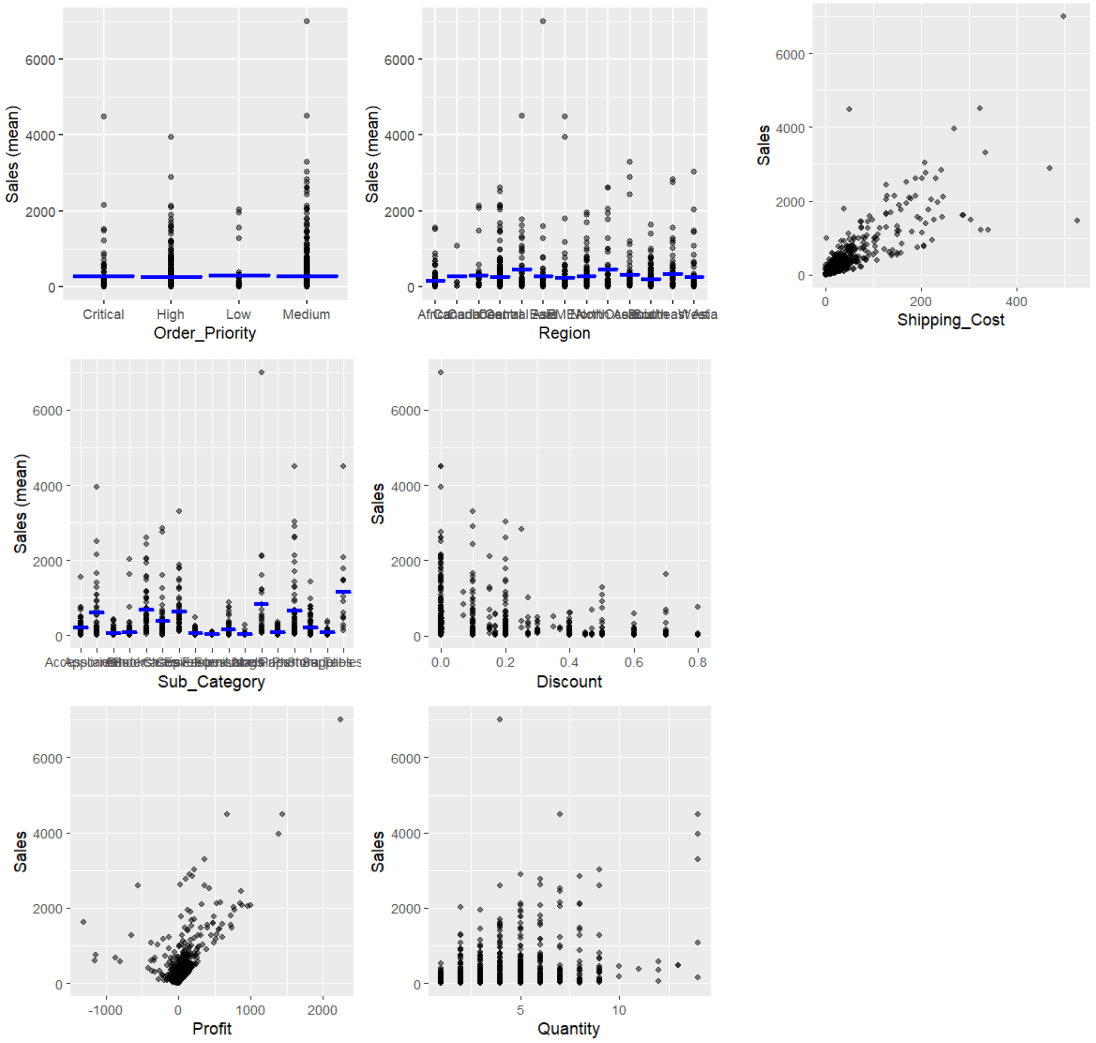
```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

R-squared: 0.701,  Adjusted R-squared: 0.701
F-statistic: 3439.786 df(35,51254), p.value < .001
Nr obs: 51,290

Prediction error (RMSE):  266.426
Residual st.dev   (RSD):  266.52
```

Note: Screenshots are Radiant output using R

Multiple Regression – Part 1 Scatter Plots



- Shipping cost and profits do not seem to have linear relationship with sales hence interaction terms may exist
- Order priority means are all similar hence this may not be an essential factor in regression

Note: Screenshots are Radiant output using R

Multiple Regression Radiant Output Using R – Part 2

```
Linear regression (OLS)
Data     : Dataset
Response variable    : Sales
Explanatory variables: Sub_Category, Discount, Profit, Quantity, Shipping_Cost
Null hyp.: the effect of x on Sales is zero
Alt. hyp.: the effect of x on Sales is not zero
```

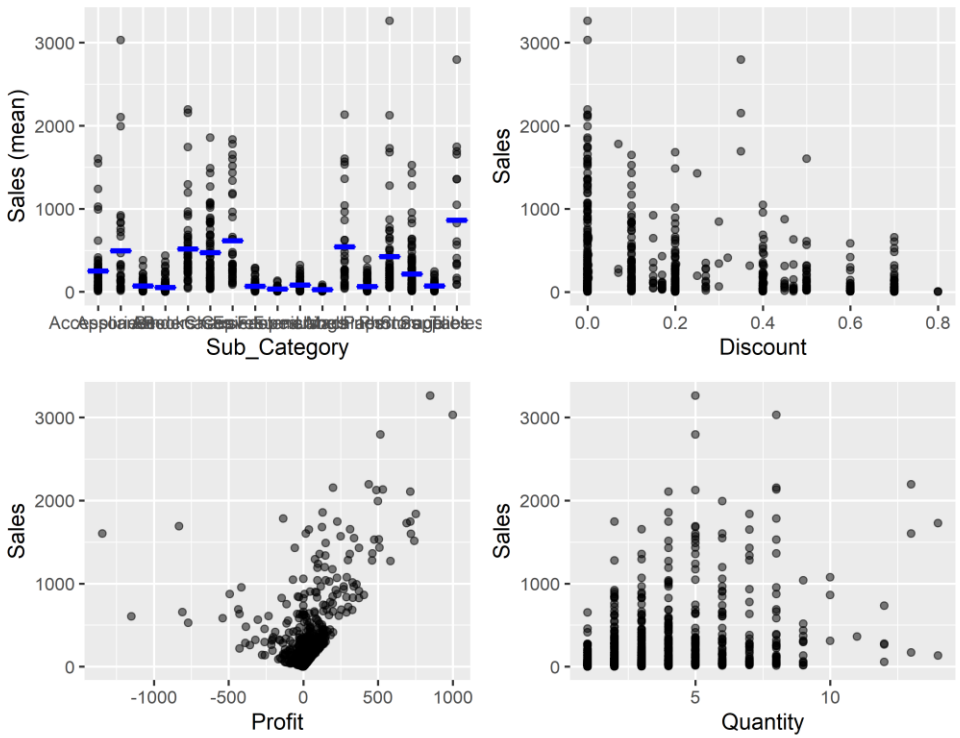
	coefficient	std.error	t.value	p.value	
(Intercept)	3.106	4.870	0.638	0.524	
Sub_Category|Appliances	117.268	7.176	16.342	< .001	***
Sub_Category|Art	-35.886	5.503	-6.521	< .001	***
Sub_Category|Binders	-44.216	5.286	-8.364	< .001	***
Sub_Category|Bookcases	156.873	6.553	23.940	< .001	***
Sub_Category|Chairs	99.473	5.942	16.742	< .001	***
Sub_Category|Copiers	147.290	6.731	21.884	< .001	***
Sub_Category|Envelopes	-40.648	6.477	-6.275	< .001	***
Sub_Category|Fasteners	-47.621	6.499	-7.328	< .001	***
Sub_Category|Furnishings	-20.650	6.039	-3.420	< .001	***
Sub_Category|Labels	-53.608	6.373	-8.412	< .001	***
Sub_Category|Machines	128.728	7.569	17.008	< .001	***
Sub_Category|Paper	-49.134	5.894	-8.336	< .001	***
Sub_Category|Phones	109.014	5.985	18.216	< .001	***
Sub_Category|Storage	26.923	5.448	4.942	< .001	***
Sub_Category|Supplies	-19.983	6.482	-3.083	0.002	**
Sub_Category|Tables	325.397	9.496	34.266	< .001	***
Discount	-14.101	8.976	-1.571	0.116	
Profit	1.834	0.017	105.412	< .001	***
Quantity	16.192	0.645	25.119	< .001	***
Shipping_Cost	2.134	0.052	41.171	< .001	***
Discount:Profit	-2.684	0.026	-104.713	< .001	***
Discount:Quantity	-1.412	2.375	-0.594	0.552	
Discount:Shipping_Cost	5.379	0.161	33.510	< .001	***
Profit:Quantity	-0.019	0.002	-8.173	< .001	***
Profit:Shipping_Cost	-0.001	0.000	-20.042	< .001	***
Quantity:Shipping_Cost	0.228	0.007	31.119	< .001	***

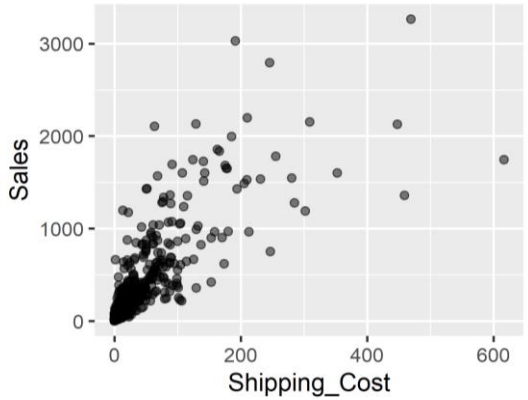
```
R-squared: 0.762,  Adjusted R-squared: 0.762
F-statistic: 6301.668 df(26,51263), p.value < .001
Nr obs: 51,290
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

- Ran multiple regression analysis with Sales as response variable and Sub Category, Discount, Profit, Quantity and Shipping Cost as input variables.
- The model includes interaction terms Discount : Profit, Discount : Quantity, Discount : Shipping Cost, Profit: Quantity, Profit : Shipping Cost and Quantity : Shipping Cost
- Apart from Discount and Discount : Quantity, all other factors were statistically significant
- Adjusted R-Square for the model was even higher 0.762 which confirmed this is a good model.

Note: Screenshots are Radiant output using R

Multiple Regression – Part 2 Scatter Plots





- Shipping cost and profits do not seem to have linear relationship with sales hence interaction terms may exist
- In the next part we plan to add interaction terms between financial terms

Note: Screenshots are Radiant output using R

Multiple Regression Radiant Output Using R – Part 3

```
Start:  AIC=574018.2
Sales ~ Sub_Category + Profit + Quantity + Shipping_Cost + Profit:Quantity +
    Profit:Shipping_Cost + Quantity:Shipping_Cost

                        Df Sum of Sq        RSS    AIC
<none>                                3716222095 574018
- Profit:Shipping_Cost   1   7283574 3723505669 574117
- Profit:Quantity        1  11606456 3727828551 574176
- Quantity:Shipping_Cost 1  94071306 3810293401 575298
- Sub_Category          16 456042522 4172264617 579923
-----------------------------------------------------
Backward stepwise selection of variables
-----------------------------------------------------
Linear regression (OLS)
Data     : Dataset
Response variable    : Sales
Explanatory variables: Sub_Category, Profit, Quantity, Shipping_Cost
Null hyp.: the effect of x on Sales is zero
Alt. hyp.: the effect of x on Sales is not zero


R-squared: 0.695,  Adjusted R-squared: 0.695
F-statistic: 5315.196 df(22,51267), p.value < .001
Nr obs: 51,290

Prediction error (RMSE):  269.175
Residual st.dev   (RSD):  269.235
```

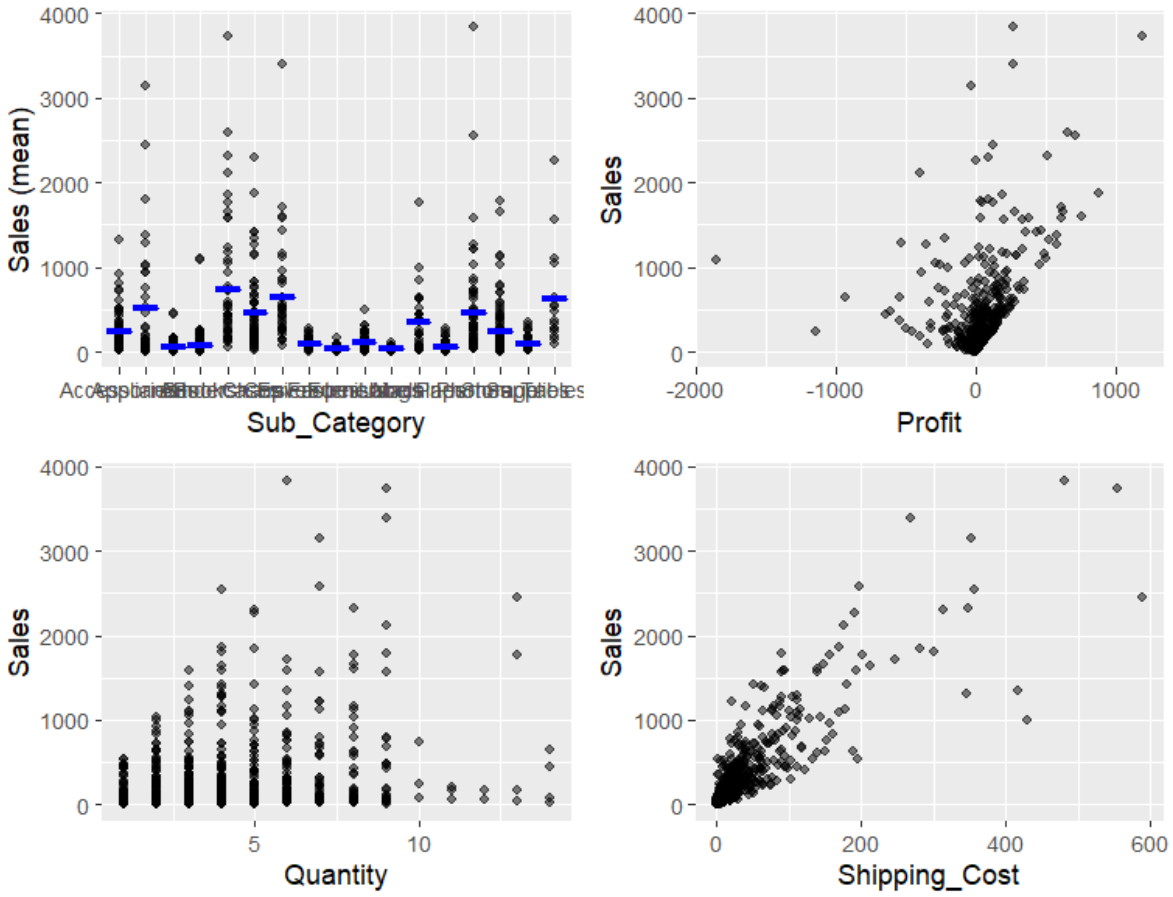
	coefficient	std.error	t.value	p.value	
(Intercept)	10.560	5.285	1.998	0.046	*
Sub_Category|Appliances	154.216	8.105	19.028	< .001	***
Sub_Category|Art	-53.460	6.219	-8.597	< .001	***
Sub_Category|Binders	-53.897	5.972	-9.025	< .001	***
Sub_Category|Bookcases	187.421	7.399	25.332	< .001	***
Sub_Category|Chairs	102.586	6.709	15.292	< .001	***
Sub_Category|Copiers	188.556	7.597	24.819	< .001	***
Sub_Category|Envelopes	-58.073	7.322	-7.931	< .001	***
Sub_Category|Fasteners	-70.991	7.345	-9.666	< .001	***
Sub_Category|Furnishings	-34.277	6.826	-5.021	< .001	***
Sub_Category|Labels	-77.632	7.200	-10.782	< .001	***
Sub_Category|Machines	176.716	8.543	20.685	< .001	***
Sub_Category|Paper	-66.594	6.659	-10.001	< .001	***
Sub_Category|Phones	126.999	6.761	18.783	< .001	***
Sub_Category|Storage	16.850	6.160	2.735	0.006	**
Sub_Category|Supplies	-39.200	7.327	-5.350	< .001	***
Sub_Category|Tables	442.295	10.638	41.577	< .001	***
Profit	0.994	0.017	57.457	< .001	***
Quantity	21.332	0.593	35.983	< .001	***
Shipping_Cost	3.036	0.056	54.542	< .001	***
Profit:Quantity	-0.032	0.003	-12.654	< .001	***
Profit:Shipping_Cost	-0.000	0.000	-10.024	< .001	***
Quantity:Shipping_Cost	0.297	0.008	36.024	< .001	***

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

- Ran multiple regression analysis with Sales as response variable and Sub Category, Profit, Quantity and Shipping Cost as input variables.
- The model includes interaction terms Profit: Quantity, Profit : Shipping Cost and Quantity : Shipping Cost
- All factors were statistically significant
- Adjusted R-Square for the model 0.695 which confirmed this is a good model.

Note: Screenshots are Radiant output using R

Multiple Regression – Part 3 Scatter Plots



- Shipping cost and profits do not seem to have linear relationship with sales hence interaction terms may exist – regression results support this

Note: Screenshots are Radiant output using R