Project 2: Predicting Catalog Demand

Step 1: Business and Data Understanding

Provide an explanation of the key decisions that need to be made. (500 word limit)

Key Decisions:

Answer these questions

1. What decisions needs to be made?

Answer:

Whether we should send the catalogs to new 250 customer.

2. What data is needed to inform those decisions?

Answer:

1.The Avg. sale amount data of old customer file (p1-customers.xlsx).
2.The Customer Segment data of old customer file (p1-customers.xlsx).
3.The Avg Num Products Purchased data of old customer file (p1-customers.xlsx).
4.The Avg Num Products Purchased data of new customer file (p1-mailinglist.xlsx).
5.The Customer Segment data of new customer file (p1-mailinglist.xlsx).
6.The Score_Yes data of new customer file (p1-mailinglist.xlsx).

Step 2: Analysis, Modeling, and Validation

Provide a description of how you set up your linear regression model, what variables you used and why, and the results of the model. Visualizations are encouraged. (500 word limit)

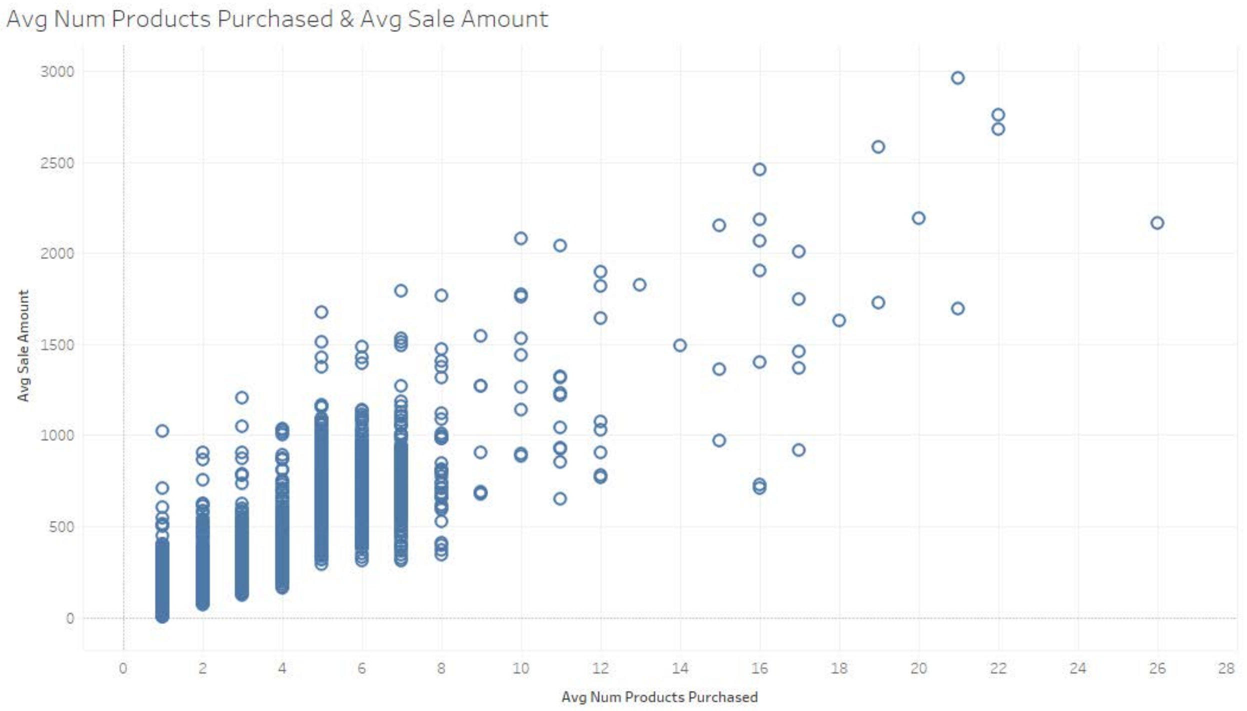
Important: Use the p1-customers.xlsx to train your linear model.

At the minimum, answer these questions:

1. How and why did you select the predictor variables (see supplementary text) in your model? You must explain how your continuous predictor variables you've chosen have a linear relationship with the target variable. Please refer to this lesson to help you explore your data and use scatterplots to search for linear relationships. You must include scatterplots in your answer.

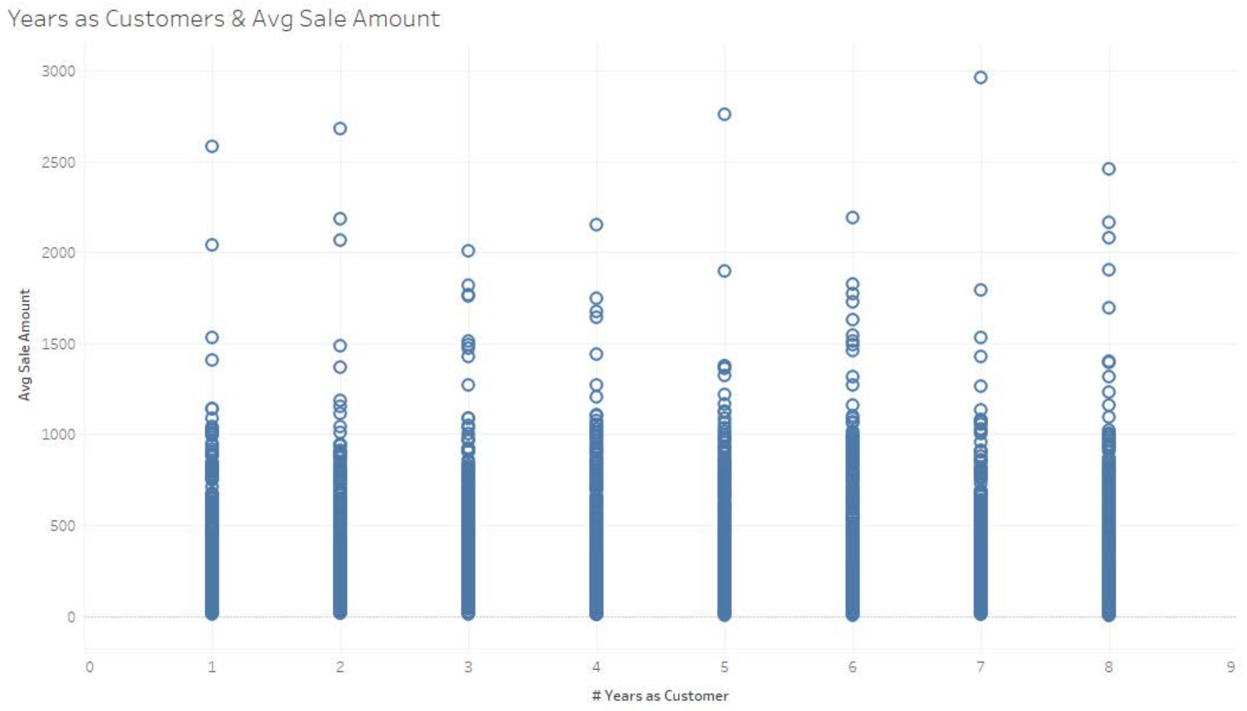
Answer:

Using Tableau i got the graphs below.I take four variables to discuss.
For digital variables:
1.Avg Num Products Purchased and Avg Sale Amount



From the scatterplot we can know that there is a linear relationship.

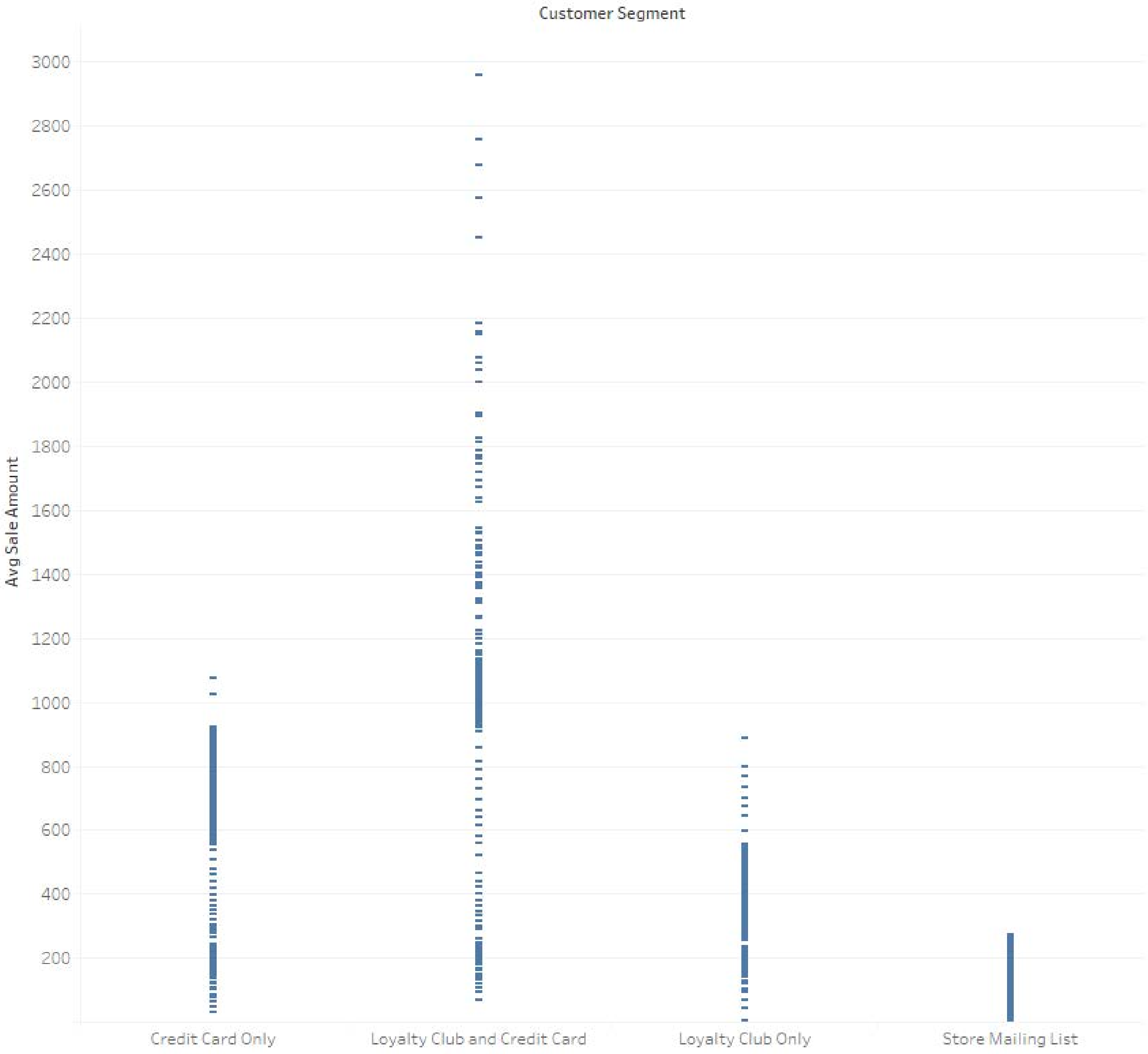
2.Years as Customers and Avg Sale Amount



From the scatterplot we can know that there is no linear relationship.

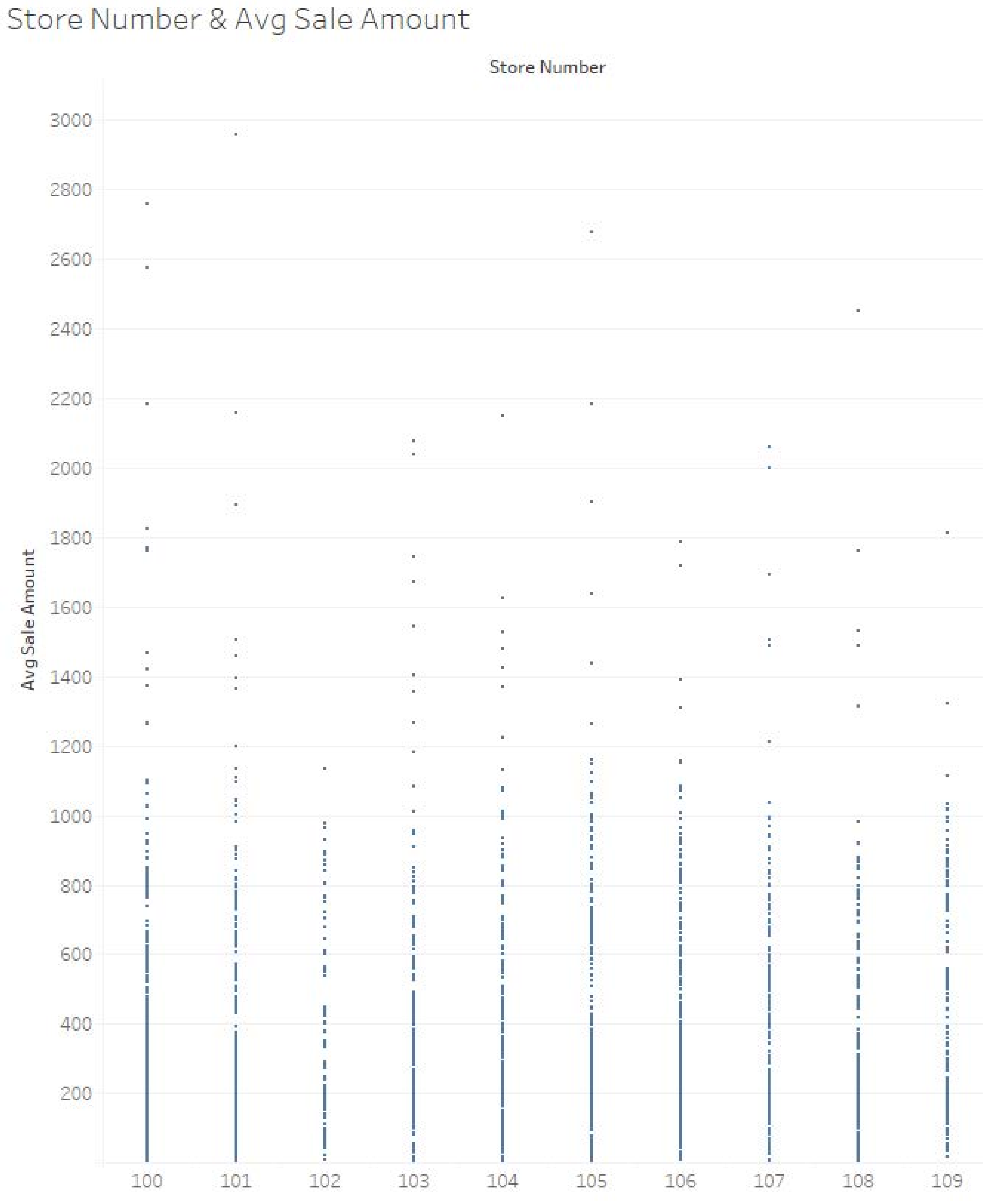
For dummy variables:
3.Customers Segment and Avg Sale Amount

Customer Segment & Avg Sale Amount



From the scatterplot we can know that there is relationship between Customers Segment and Avg Sale Amount.

4. Store Number & Avg Sale Amount

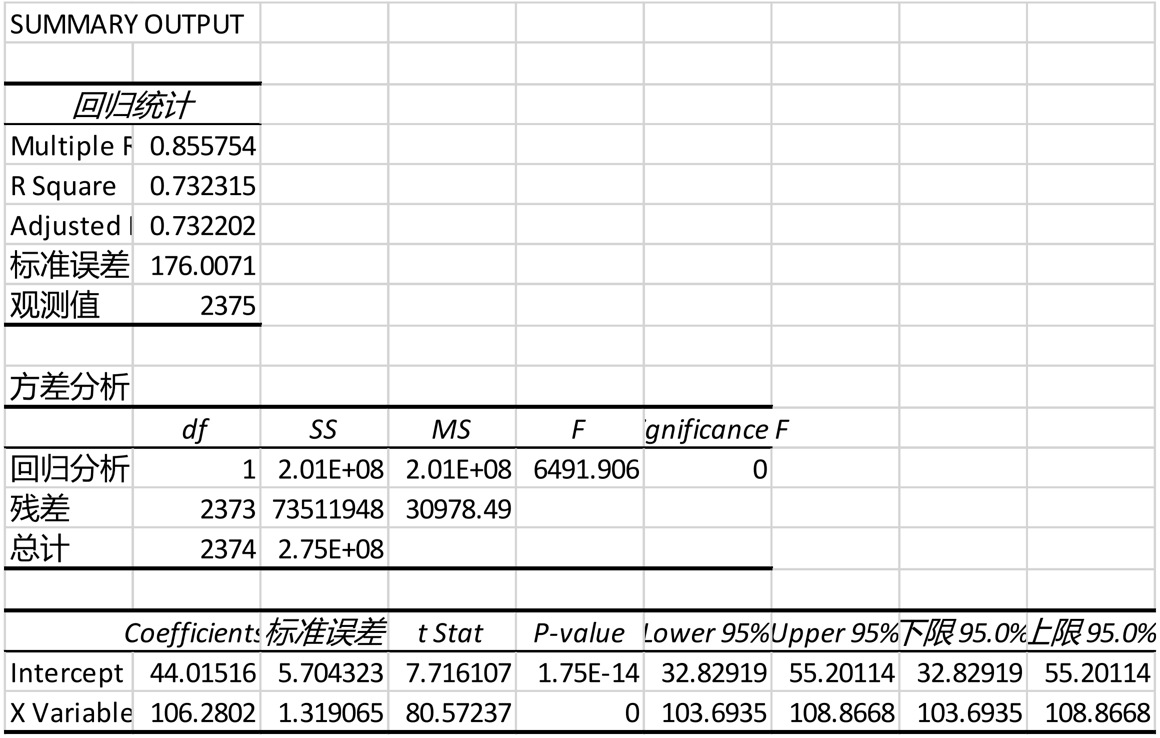


From the scatterplot we can know that there is no relationship between Store Number & Avg Sale Amount.

2. Explain why you believe your linear model is a good model. You must justify your reasoning using the statistical results that your regression model created. For each variable you selected, please justify how each variable is a good fit for your model by using the p-values and R-squared values that your model produced.

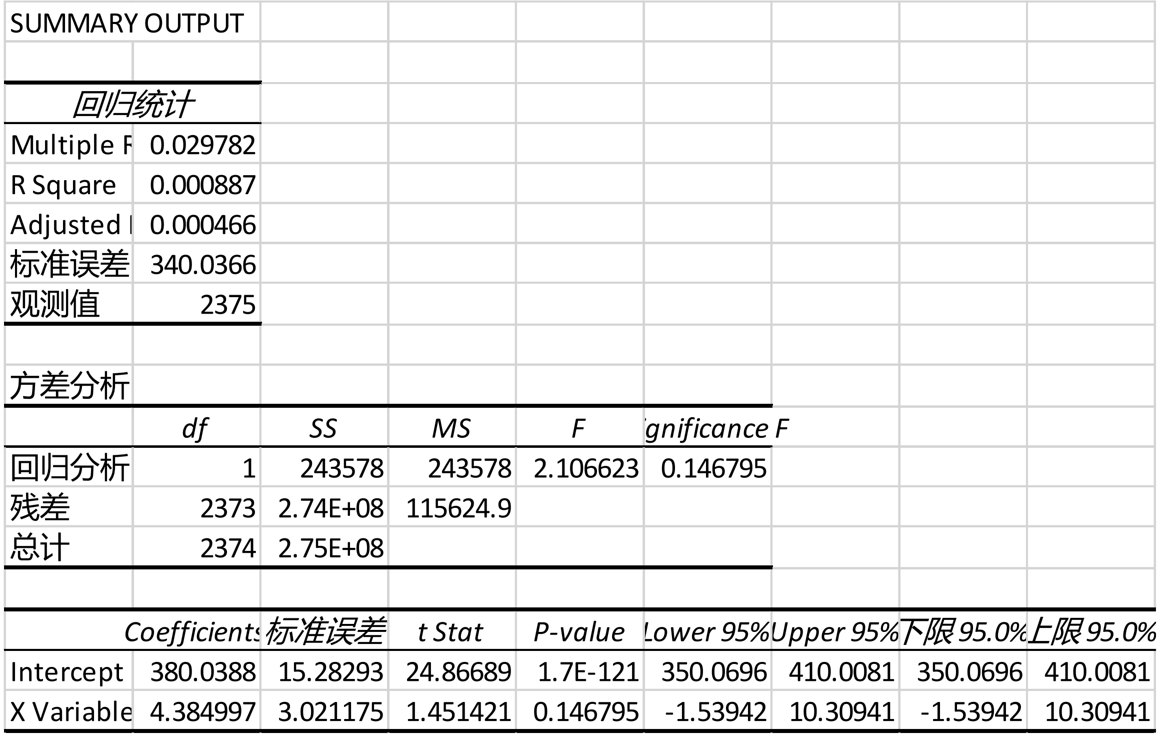
Answer:

Using Excel's we can get the result:



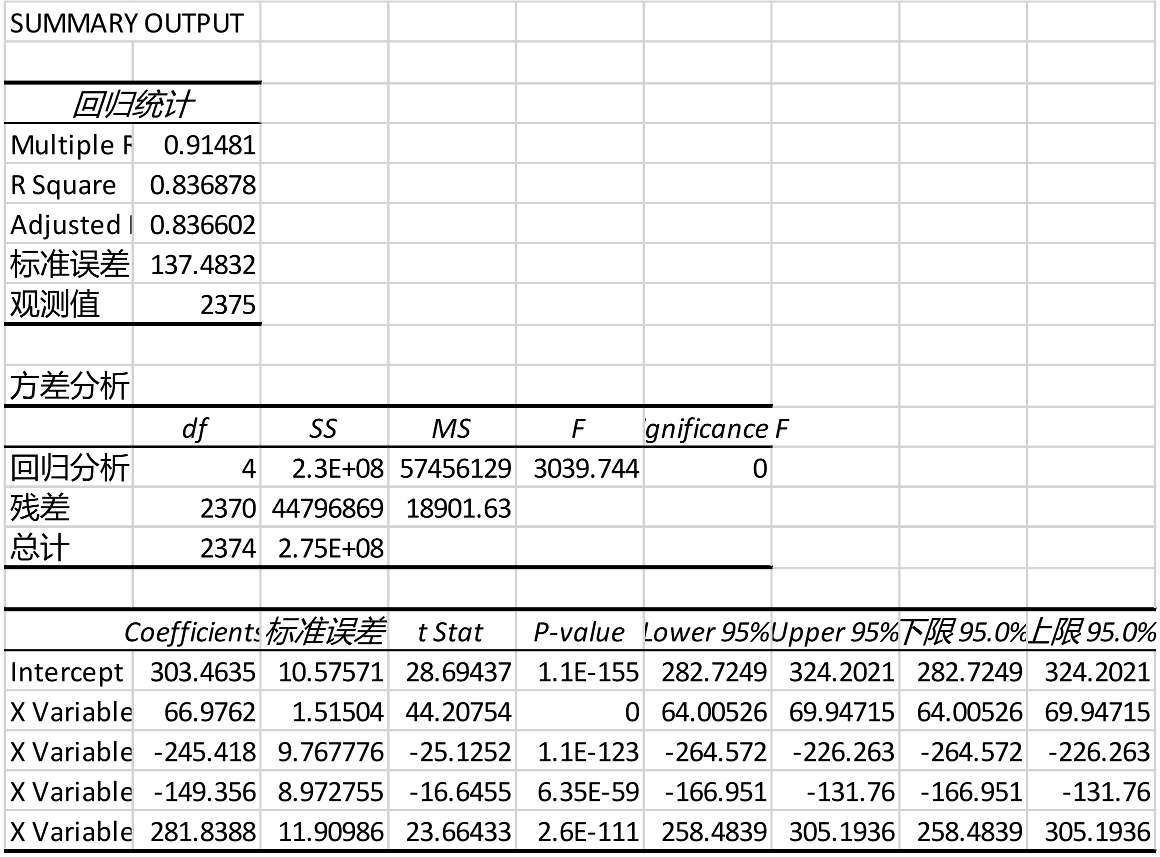
SUMMARY OUTPUT								
回归统计								
Multiple F	0.855754							
R Square	0.732315							
Adjusted I	0.732202							
标准误差	176.0071							
观测值	2375							
方差分析								
	df	*SS*	*MS*	*F*	*gnificance F*			
回归分析	1	2.01E+08	2.01E+08	6491.906	0			
残差	2373	73511948	30978.49					
总计	2374	2.75E+08						
	Coefficients	*标准误差*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*下限 95.0%*	*上限 95.0%*
Intercept	44.01516	5.704323	7.716107	1.75E-14	32.82919	55.20114	32.82919	55.20114
X Variable	106.2802	1.319065	80.57237	0	103.6935	108.8668	103.6935	108.8668

We can learn from the table that p-value is 0 and R-squared is 0.73.So there is a linear relationship between Avg Num Products Purchased and Avg Sale Amount.



SUMMARY OUTPUT								
回归统计								
Multiple F	0.029782							
R Square	0.000887							
Adjusted I	0.000466							
标准误差	340.0366							
观测值	2375							
方差分析								
	df	*SS*	*MS*	*F*	*gnificance F*			
回归分析	1	243578	243578	2.106623	0.146795			
残差	2373	2.74E+08	115624.9					
总计	2374	2.75E+08						
	Coefficients	*标准误差*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*下限 95.0%*	*上限 95.0%*
Intercept	380.0388	15.28293	24.86689	1.7E-121	350.0696	410.0081	350.0696	410.0081
X Variable	4.384997	3.021175	1.451421	0.146795	-1.53942	10.30941	-1.53942	10.30941

We can learn from the table that p-value is 0.15 and R-squared is 0.0001.So there is no linear relationship between Years as Customers and Avg Sale Amount.



SUMMARY OUTPUT

回归统计	
Multiple F	0.91481
R Square	0.836878
Adjusted I	0.836602
标准误差	137.4832
观测值	2375

方差分析

	df	SS	MS	F	gnificance F
回归分析	4	2.3E+08	57456129	3039.744	0
残差	2370	44796869	18901.63		
总计	2374	2.75E+08			

	Coefficients	标准误差	t Stat	P-value	Lower 95%	Upper 95%	下限 95.0%	上限 95.0%
Intercept	303.4635	10.57571	28.69437	1.1E-155	282.7249	324.2021	282.7249	324.2021
X Variable	66.9762	1.51504	44.20754	0	64.00526	69.94715	64.00526	69.94715
X Variable	-245.418	9.767776	-25.1252	1.1E-123	-264.572	-226.263	-264.572	-226.263
X Variable	-149.356	8.972755	-16.6455	6.35E-59	-166.951	-131.76	-166.951	-131.76
X Variable	281.8388	11.90986	23.66433	2.6E-111	258.4839	305.1936	258.4839	305.1936

As we can see in the figure above that once I add the Customer Segment the Adjusted R Square update to 0.84 and the p-value get smaller.I think it is a good fit and I will use this model.

3. What is the best linear regression equation based on the available data? Each coefficient should have no more than 2 digits after the decimal (ex: 1.28)

Answer:

The best linear regression equation is :

$$\begin{aligned} Avg\ Sale\ Amount = 303.46 + 66.98 * Avg\ Num\ Products\ Purchased \\ -245.42 * (If\ Type\text{: } Store\ Mailing\ List) \\ -149.36 * (If\ Type\text{: } Loyalty\ Club\ Only) \\ +281.84 * (If\ Type\text{: } Loyalty\ Club\ and\ Credit\ Card) \\ +0 * (If\ Type\text{: } Credit\ Card\ Only) \end{aligned}$$

Step 3: Presentation/Visualization

Use your model results to provide a recommendation. (500 word limit)

At the minimum, answer these questions:

1. What is your recommendation? Should the company send the catalog to these 250 customers?

Answer:

My suggestion is that we should send the 250 customers catlogs.

2. How did you come up with your recommendation? (Please explain your process so reviewers can give you feedback on your process)

Answer:

In all, the formula is :

$$\begin{aligned} Avg\ Sale\ Amount = 303.46 + 66.98 * Avg\ Num\ Products\ Purchased \\ -245.42 * (If\ Type\colon Store\ Mailing\ List) \\ -149.36 * (If\ Type\colon Loyalty\ Club\ Only) \\ +281.84 * (If\ Type\colon Loyalty\ Club\ and\ Credit\ Card) \\ +0 * (If\ Type\colon Credit\ Card\ Only) \end{aligned}$$

$$Profit = \sum_{n=1}^{n=250} Avg\ Sale\ Amount(n) * Score\_Yes * 0.5 - 6.5 * 250$$

At first, for each customer I consider x variable,and x variable is a vector which is consisted of $v1\colon (a, b, c, d)$.For example, the first customer A Giametti can be consider a vector $x1\colon (3,0,1,0)$ which means he has 3 Avg Num Products Purchased and his segment is Loyalty Club Only.

a:Avg Num Products Purchased,
b:Store Mailing List,
c:Loyalty Club Only
d:Loyalty Club and Credit Card)

Secondly, I use the under formula to calculate the estimated income for each customer.

$$Estimated\ Income = Avg\ Sale\ Amount * Score\_Yes$$

Thirdly, I sum up all 250 customers' estimated income.

$$All\ Estimated\ Income\ = \sum_{n=1}^{250} Estimated\ Income(n)$$

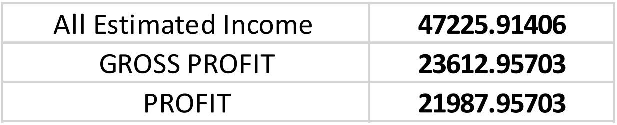
Then, calculate Gross Profit.

$$Gross\ Profit = All\ Estimated\ Income * 0.5$$

Lastly, calculate Profit.

$$Profit = Gross\ Profit - 6.5 * 250$$

And my result is:



All Estimated Income	**47225.91406**
GROSS PROFIT	**23612.95703**
PROFIT	**21987.95703**

3. What is the expected profit from the new catalog (assuming the catalog is sent to these 250 customers)?

Answer:

We can learn from the table above that the profit is 21987.96 dollars, so I hold this point of view that we should send the 250 customers catlogs.