Hightower Department Stores Case Solution

i. Summary and Problem Statement

Hightower Department Stores was a small but profitable company operating 16 full-line department stores in 6 major metropolitan areas in the Eastern US. The company considered itself as a fashion leader in the industry and its name was associated with quality, large selection and good value. TV and newspaper advertising, point-of-sales presentation, and knowledgeable and friendly sales personnel had been important factors to the success of the department chain.

The sales reported by Hightower for the fiscal year 1992 had been $371 million and the net income reported by the management was $17.5 million after taxes. The company expected a small increase in the sales for the fiscal year of 1993 over 1992, but, as in previous years, this increase would not keep up with the general inflation rate.

Julia Brown, the toy buyer for the chain of Hightower Department stores, was responsible for buying toys from all around the world and selling them at a profit for the company. This was a challenging task as the toy department was typically not so profitable because competition from general merchandise sales, mass merchandisers, variety stores, toy supermarkets and toy specialty stores had lowered to toy sales to about 9 percent of the total market. Furthermore, in almost all types of stores, nearly 50 percent toy sales occurred during November and December and thus stock inventory had to be managed strategically.

At the beginning of the year in 1993, important decisions had to be made by Julia Brown in regards to deciding which new toy should be offered to the customers for sales for the 16 department stores for that year. In order to take this decision, Julia had gathered together past sales data on stuffed animals and was preparing to go over test sales data for three important toys, namely raccoon, pig and bear. Along with this, Julia had to also figure out the number of units which were expected to sell in the 1993 season. As a rule of thumb, up till 1992, she ordered 150 percent more goods than the expected number of goods.

Julia had an experience of 15 years with the Hightower Department stores and had been on 10 previous Hightower foreign buying trips. This large base of experience served her well when evaluating new items. In order to make a final decision, the test data of 20 stuffed toys for the previous years had been provided to her and she needed to predict the future sales of the toys based on the test data. Furthermore, she had the test data sales for the three toys (raccoon, pig and bear) for the year of 1992.

The table below shows the summary of the test results obtained from the year 1992:

Animal	Landed Cost	Retail Price	Units Purchased	Units Sold	Closeout Inventory
Bear	$10.86	$24.95	50	10	40
Pig	$12.46	$26.95	50	4	46
Raccoon	$12.96	$26.95	50	32	18

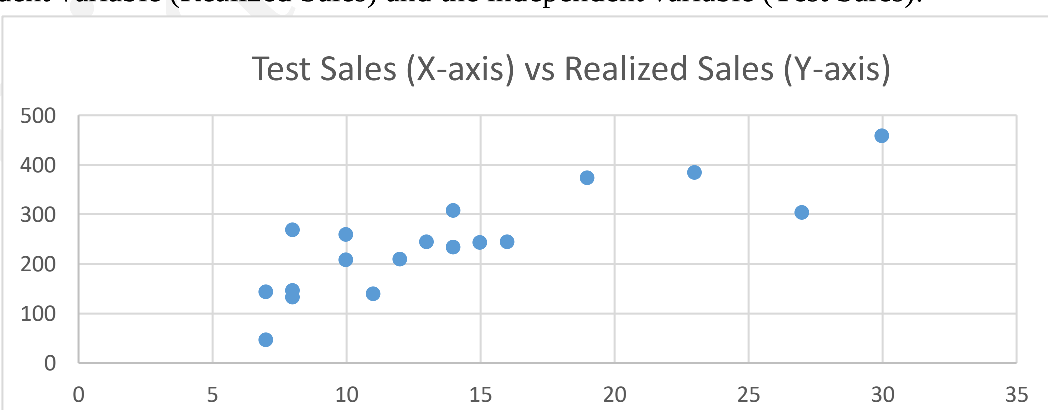
From the above table, the sales for the Raccoon looked promising for the sales season of 1993. Since the buying procedure for stuffed animals differed from other toys as they were imported from Germany, the buying strategy necessitated careful planning and evaluation, and hence the whole process of testing the market first was required. Below, the forecasting approach using regression analysis is discussed in order to determine the ordering quantity of the new toy, the gross margin and the accuracy of the forecast model.

ii. Regression Analysis

The concept of least squares and linear regression is used here in order to predict the sales for the 1993 year and make a final decision regarding the final toy to purchase from Germany. The sales potential for each stuffed animal is the main focus here and then the number of units of the recommended stuffed toy is found for which the order would be placed by Julia Brown.

In order to perform the regression analysis, test sales data for 18 stuffed toys is used which is provided in the Excel sheet. Two of the stuff toys (rabbit and skunk) have been neglected for determining the prediction model because both had very poor sales during their test years. Therefore, the regression analysis is performed on the other stuffed toys provided in the Excel sheet. A step by step analysis for the data using linear regression is discussed below:

First, a scatter plot is constructed to checked if there is a linearity in the relationship between the dependent variable (Realized Sales) and the independent variable (Test Sales):



From the plot above, it is visually noted that the data has an almost linear relationship, such that, the more the test market sales, the greater the Realized Sales. As a result, a linear regression model is suitable to fit through the data.

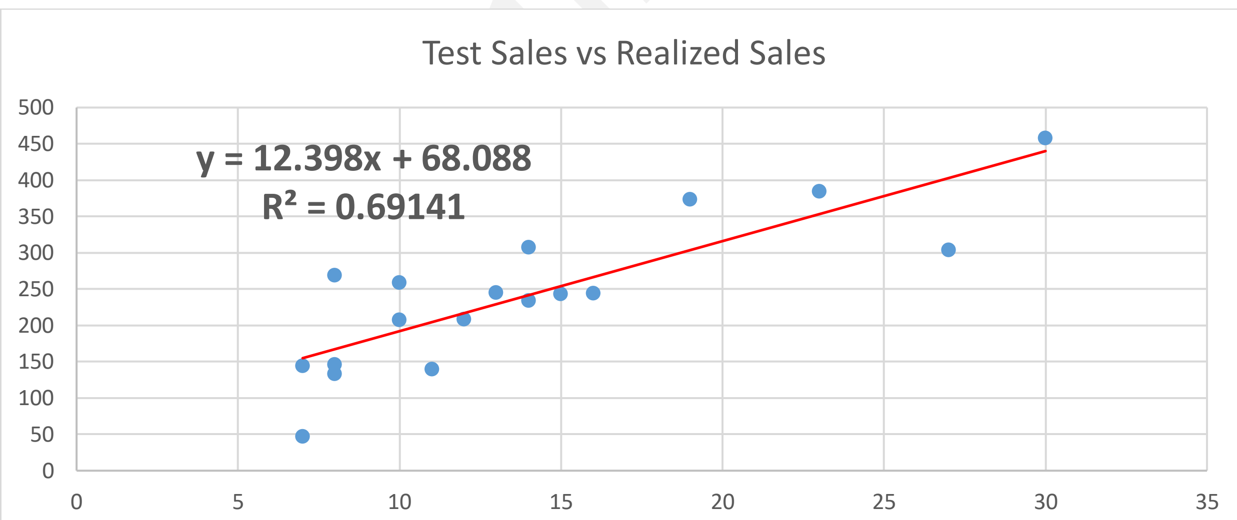
As a next step, Regression Analysis is performed using the Data Analysis tool in Excel. The output of interest for interpretation is summarized in the table below:

Regression Statistics	
Multiple R	0.831508863
R Square	0.69140699
Adjusted R Square	0.672119927
Standard Error	58.12963862
Observations	18

	df	*SS*	*MS*
Regression	1	121133.1218	121133.1218
Residual	16	54064.87817	3379.054886
Total	17	175198	

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	68.08798646	32.06557113	2.123398525	0.049666386
Test Sales	12.39847716	2.070782634	5.987338774	1.89709E-05

The Regression Equation and Trend Line is shown in the plot below:



The regression equation found using Excel is:

$$Realized\ Sales = 68.088 + 12.4(Test\ Sales) + \ Error$$

Interpretation of the Output of Regression Analysis from Excel:

- *Intercept Coefficient:* If there are no test sales value available, the model above would predict the Realized Sales to be 68.088. In this situation, this number is not relevant because a test is always performed to introduce a new stuffed animal.
- *Test Sales Coefficient:* The coefficient of the independent variable (12.34) denotes that if the Test Sales increases by 1 unit, then the Realized Sales go up by 12.34 units. The Realized Sales go up since the sign of the coefficient for Test Sales is non-negative.
- *Residual:* This is a measure of error which indicates the difference between the actual sales and the predicted sales. It is the perpendicular distance from the observation point (actual sale) to the regression line.
- *Adjusted R-Square*: This value shows the variation captured by the model. In this case it is 67%. Usually, the higher the adjusted R-Square value, the better.
- *Standard Error*: This is the number that characterizes the error. The standard error of 58.13 measures the standard deviation of the residuals. Each error associated with the forecast is calculated and the standard deviation of these errors is the Standard Error. With this model, we can have predicted realized sales within plus and minus 58 units.
- *T Stat*: The statistical significance of the independent variable is indicated using the t stat. The higher the absolute t stat value, the better. This is because the null hypothesis for the coefficient is that its value is 0 (not statistically significant). The t stat is a measure of how far away the coefficient is from zero in units of standard error of the coefficient. Notice that the intercept also has a t stat but we rarely drop the intercept value even if it is not statistically significant because in such a case the algebraic equation would not make sense without the intercept.
- *P Value:* An alternate indicator for the statistical significance of the independent variable. Generally, a p-value less than 0.05 is desired (to ensure no type 1 error).

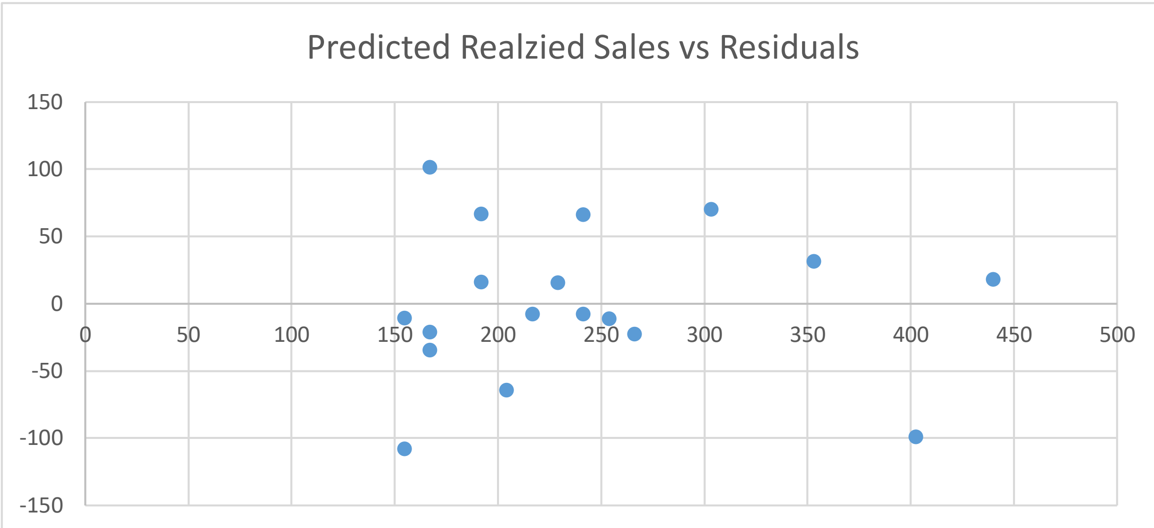
Thus, so far it is interpreted that the above model has a high adjusted r-square (67.21%), a low standard error compared to the forecasted values (58.13) and significant coefficients.

Usually, when performing regression analysis, 4 assumptions are made regarding the relationship between the independent and the dependent variables. A check for all the four assumptions is made below:

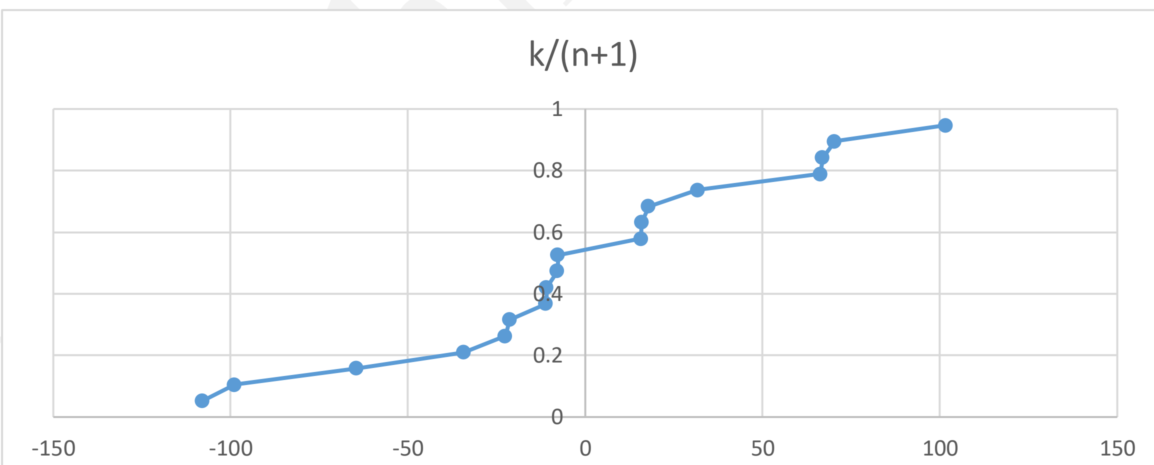
1. Y (Dependent Variable) is a Linear Function of X (Independent Variable) – This check for linearity is performed above in the very first graph of the Test Sales vs. Realized Sales. The R-Square value usually helps reflecting this assumption. As the R-Square value is moderately high, the assumption that the data points have a linear relationship is valid.

2. Homoscedasticity – This indicates that the errors in a forecast are constant across the range of forecasts. Simply, the error values should not increase or decrease with an increase in x. Within a specific range of the predicted value, the residual errors should

ideally add up to zero. A plot of the predicted value vs. the residual values shown below helps confirming this assumption as valid:

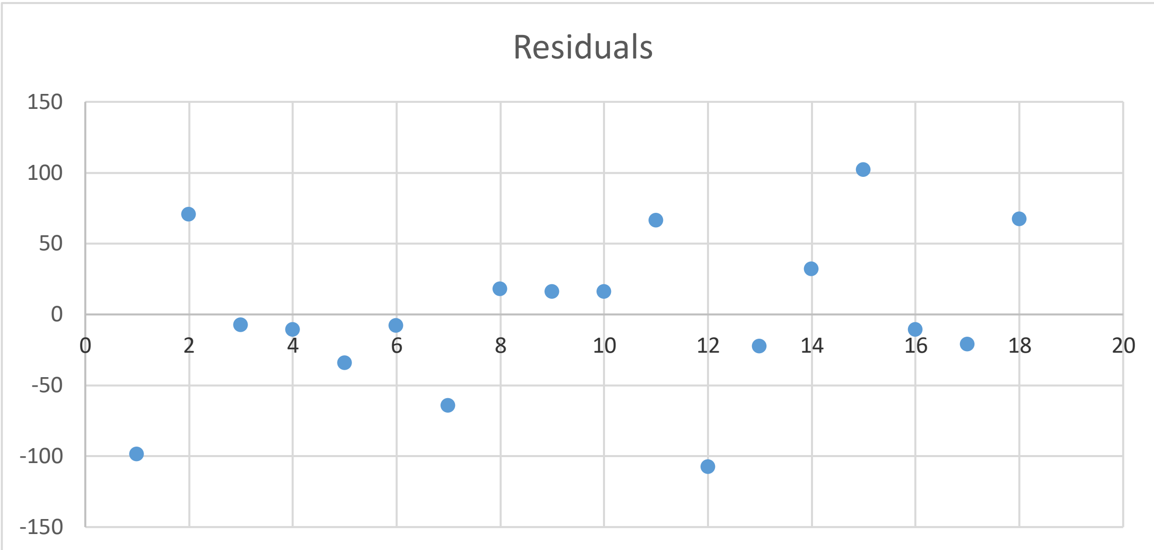


3. Normality of Residuals – To check the normality of residuals, the k/(n+1) method is used here. The residual from the predicted realized sales are first sorted in descending order and the k/(n+1) metric is calculated with the residual and plotted. k here is the residual observation number and n is the sample size. The plot below, an approximate S-shape curve, confirms the validity of the normality of residuals:



4. Temporal Independence – This indicates that the residuals do not vary with time or do not have a pattern with time. The plot below shoes the residuals plotted against time. To validate the assumption, it is to be made sure that not too many residual values are above

or below zero and the residuals points do not alternate between above zero and below zero value. Since this is not the case here, temporal independence is validated as an assumption as well.



Since all the four assumptions have been met and validated as seen above, we now make forecasts to get the predicted Realized Sales for the Bear, Pig and Raccoon. These values are calculated by substituting their Test Sales values in the regression equation.

Using the regression equation, it is possible to predict the Realized Sales with the Test Sales for the Bear, Pig and Raccoon stuffed animals, by substituting the Test Sales for each. The predicted Realized Sales for each is shown in the table below (the error term is ignored for calculations):

Animal	Projected Sales based on Regression	Gross Margin Per Unit	Estimated Total Gross Margin
Bear	192	$7.52	$1443.84
Pig	118	$7.72	$910.96
Raccoon	465	$7.53	$3501.45

If Julia were to choose a domestic animal stuffed toy, she could certainly bring in at least $1150 contributions during the Christmas season. As a result, importing Raccoon stands out to be a clear winner for the 1993 sales season because it yields the highest gross margin.

In order to compare the accuracy of the regression model and the project sales previously forecasted by Julia, three error metrics are used for comparison – the Mean Absolute Deviation (MAD), the Mean Square Error (MSE) and the Mean Absolute Percentage Error (MAPE). The section below shows the comparison for the forecasted accuracy.

Comparison of Forecasting Accuracy:

i. Realized Sales vs. Regression Predicted Realized Sales

The MAD, MSE and MAPE for the realized sales (actual sales) vs the regression predicted sales was calculated by finding the difference between the actual and the predicted sales. Detailed calculations for this process are attached in the Excel sheet. The table below shows the summary of all the 3 error metrics which can be used for comparison:

Men Absolute Deviation	**42.8889**
Mean Square Error	**2990.7778**
Mean Absolute Percentage Error	**28.2049**

From the above table, the mean absolute percentage error is 28.20%. This means that the regression model has a forecasting accuracy of 71.80%.

ii. Realized Sales vs. Projected Sales

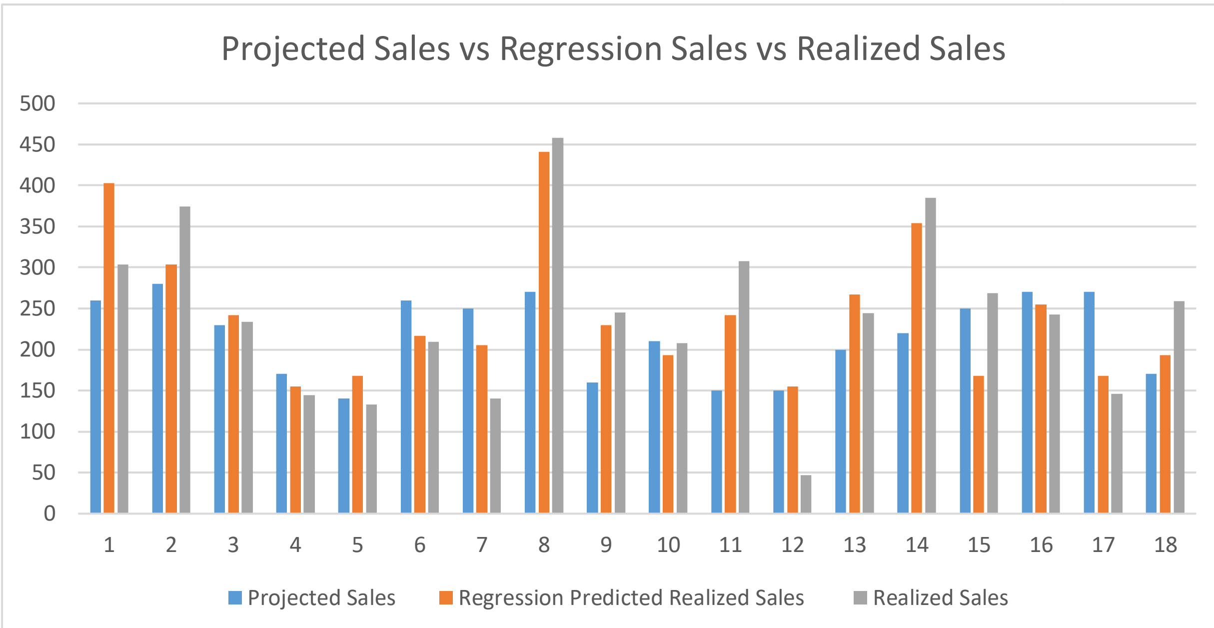
The MAD, MSE and MAPE for the realized sales (actual sales) vs the projected sales was calculated by finding the difference between the actual and the projected sales. The projected sales data was available as a part of the given dataset for analysis. The projected sales figure was established by Julia Brown on the basis of her rule of thumb and past experience. The table below shows the summary of all the 3 error metrics which can be used for comparison:

Mean Absolute Deviation	**74.4444**
Mean Square Error	**8772.6667**
Mean Absolute Percentage Error	**37.7086**

From the above table, the mean absolute percentage error is 37.71%. This means that the projected sales model has a forecasting accuracy of 62.29%.

iii. Summary and Conclusion

Based on the calculated error metrics, it is easy to conclude that the regression model is more accurate that the projected sales made by Julia Brown previously. This is because the regression model has a lower MAD, MSE and MAPE which indicate that the difference between the actual value and the predicted value for sales is lesser than the non-regression model. If Julia decides to import the Raccoon for the year of 1993, according to the regression model she should plan an inventory of 465. This number is not too far from her assumption of importing 500 Raccoons for the 1993 season. With a landing cost of $6.42, she would only save $224.70. However, one advantage of adopting the regression model is that with more test data points, her prediction accuracy would improve. This would however happen with time. In this case, to make the best estimation of the number of toys to buy, she could leverage the results of the regression model and then make a decision on her experience. A chart below shows the comparison between her projected sales, the regression model projected sales and the actual sales.



**** Check the Hightower Department Solution.xls sheet for detailed calculations of the above report.**