Statistical Analysis Report

A-Cat Corporation

Carrie McDowell

Southern New Hampshire University

Author Note

This proposal was prepared for Arun Mittra, Vice-president of A-Cat Corporation

**Introduction**

This is a statistical analysis prepared for stakeholders in the A-CAT Corporation (A-CAT). A-CAT was a leading producer of electrical appliances in India. A-CAT has been in business since 1986, competed in the medium scale industry, and produced and distributed domestic electrical appliances to the Vidarbha region. A-CAT had a partnership with Jupiter Inc., and Global Electricals to produce cabinets and electrical devices respectively.

A-Cat’s primary departments were responsible for sales of Rs. 9,800,000 and employed 40 in purchasing, design, manufacturing, and sales and service. A-Cat’s primary product was a voltage regulator that were used for various purposes, mainly in TV and refrigerator production. A-CAT offered 100 different models of electrical appliances and catered to the rural areas where pricing was sensitive.

**Stakeholders**

Stakeholders can be internal or external people effected by a company’s functions. Internal stakeholders include all employees. External include shareholders, customers, the government and creditors. Basically a stakeholder is anyone effected by the operations of a company. A-Cat’s stakeholders include all of the above. Internally, they range from board members to the janitorial crew, all will depend on managers making the right decisions to keep the company moving forward. Externally, clients and customers rely on A-Cat’s ability to regulate costs and efficiencies. Shareholders count on A-CAT making a profit which is also dependent on the control of costs. The government and creditors will benefit from payments (Priyanka , 2017).

**Quantifiable Factors**

A-CAT offers nearly 100 different models of electrical appliances to a rural population who are most effected by price, therefore any change in production costs will effect sales. Performance measures are important to the progress of a business. Knowing how each area of the business performs is beneficial to manage growth, as well as decline if the business or product takes a down-turn ("Measure performance and set targets").

1. Data analysis should be performed on each model of electric appliance separately and used to order components meant for each system. This will minimize shelf costs. A-Cat’s sales division uses an outdated method to forecast the need for transformers. Using updated sales figures to calculate the mean of year-over-year sales for each appliance will provide a more accurate forecast.
2. Quantifiable factors that A-CAT should analyze include the length of time a transformer sits on the shelf before being used. The number of days from the date of order a transformer arrives. The number of faulty transformers received. The number of transformers used per appliance. Mean sales, and the year-over-year variance will be the driving factor when ordering product.

**Key Challenges**

Vice-president Arun Mittra challenged his manufacturing operations head Ratnaparkhi to first analyze and report on available data. This report should be easy to understand. Next, Ratnaparkhi must devise a new method to accurately forecast the need for transformers based on refrigerator sales.

**The Process**

In the past, to predict sales and the need for transformers were based off of the last few months’ sales and then a historical look at sales in quarters of the previous two years. This resulted in an inaccurate guess rather than a precise prediction.

Ratnaparkhi assigned his operations manager, Betty Miller, the task of analyzing the data provided to him. Ratnaparkhi provided descriptive analysis for the year 2006 to Betty and gave her the task to develop descriptive statistics for the remaining years, 2007—2010. These stats were then submitted to the quality control department for inspection.

Once proven accurate, A-Cat’s president, Greg Lynn, asked Mittra to share the estimate of the mean number of transformers that are needed to produce voltage regulators. Betty, using a one-way analysis of variance compared the data given to calculate the mean number of transformers required up to 2010.

Using data provided by Betty, Ratnaparkhi is tasked with developing a new model to predict transformer requirements based on refrigerator sales. Based on the mean number of transformers needed for each refrigerator, accounting for the variable of faulty transformers, managers can accurately calculate the number to order for each appliance that uses a transformer. Additionally, Ratnaparkhi will develop a report that can be understood and used by all members of A-CAT Corporation.

**Problem Statement Current State Assessment**

 Recently, sales of voltage regulators have dropped, and they have not been able to accurately calculate the number of transformers they need to keep on hand. They are either over or understocked. For this reason, A-CAT managers began to question their policy for purchasing and storing components in house. Some managers wanted to continue to store transformers as it is a primary component of the voltage regulator, but this tied up company funds. Others wanted to order as needed, however this proposed a new set of problems.

 Typically orders for the voltage regulator that came in, were on a rush order and if not stored in-house it may take one or more weeks to acquire transformers. Managers feared that if not ordered on a regular basis, the price of transformers will go up which will drive the price of the appliance to low end patrons sensitive to price adjustments.

**Tools and Methods**

The issue A-Cat Corporation has experienced in forecasting can be resolved by various relationship testing. To access the correlations between refrigerator sales and transformers, I will look at a correlation study and then analyze the data using parametric testing. The statistical tools that I have identified to perform parametric testing is an analysis of variance (ANOVA), and regression testing. An ANOVA has already been performed on data retrieved from 2006 – 2008, and sales data has been provided for years 2009 and 2010 on a quarterly basis.

A correlation study will provide a rating of how closely the variables are related (Li, 2013). In this case the correlation is high at 1:1 and signifies a strong relationship between the numbers of refrigerators sold and the number of transformers needed.



Regression analysis is a model used to expose variables that effect an outcome (Gallo & Thomas H. Davenport and Jinho Kim, 2017). The adjusted R measures a portion in the dependent variable (Li, 2013). If the adjusted R is a low number, then the regression is not significant. In this case, it is indeed significant at 85%. 

In our sample we use a regression model to analyze the number of transformers needed to each refrigerator produced. We used five years of sales data from 2006 to 2010. The Y axis (the dependent variable) is the number of transformers needed, and the X-axis is the number of refrigerators sold.

The multiple R describes the 93% relationship between refrigerator sales and the need for transformers. The correlation coefficient R squared is an indicator of correlation as it ranges from 0 – 100%. .8559, or 86% is a very high number so it supports an increase in the need for transformers over time, and as indicated by the co-efficient, the increase is a rate of .315 per refrigerator sold.

The ANOVA test is in the parametric test family, and performs tests on normally distributed numerical data. Parametric data analysis tests how the means of two groups differ. The one way ANOVA test has one dependent variable, and one independent variable. A regular ANOVA can investigate multiple independent variables to one dependent variable (Siegle).

ANOVA tests differences within a group and between groups. The within group variances cannot be accounted for. It is the between group variances that we investigate by comparing the F-test statistic. The F-test statistic reveals the ratio of the variation of the group means to the variations within the group by measuring the mean squares.

The numerator measures the variation between the groups and is called the mean square due to treatments (MSTr). The denominator measures variations with the group and is called the mean square due to error (MSE). As seen below, our MSTr is 59689819.23 and is divided by our MSE; 1027297.441 to get an F-statistic of 58.10373593 (Staff). The ANOVA F-test statistic tests the null hypothesis. When the F-test statistic is higher than the F-critical value, reject the null hypothesis. Therefore Mittra was correct that more than 1,000 transformers are needed each month.

ANOVA of Sales of Refrigerators and Transformer Requirements (2006-2010):

 

**Recommendation**

I selected this family of tools to analyses the data provided by Mittra to specifically prove dependence. The regression model revealed a direct correlation between the sale of the refrigerators and the need for transformers, and how these numbers have increased over time. In addition, normality, homogeneity, linearity, and independence requirements applied to this analysis. Some regression analysis require a linear correlation, and often ANOVA testing require homogeneity (Zaiontz). Most always parametric tests require that the data follow a normal distribution.

The data provided can be categorized as time series data. Time series patterns consist of trends and seasonality (W). As seen in the time series chart, it captured seasonality in sales as well as the linear trend line. This chart confirms the relationship as shown in the regression model.

Prior to analyzing sales data, managers took a “good guess” of the transformers needed. This resulted in under or overstocking costing the company customers, and a loss of profits. Data analytics takes the guess work out of the equation and provides a sound model in which the manager may use to predict sales and order product. The regression model will be most helpful to forecast for future sales and transformer needs. In addition, the linear model outlines the seasonality of demand which is useful. Managers can use this same model to apply to all of A-Cat’s products to adequately order a correct amount of transformers and other materials as needed.

**Forecasting Sales**

 Accurate sales forecasts will enable A-Cat corp. to make informed business decisions and predict performance. Base on past sales data of refrigerators and other components that use the transformer, data analytics will prove economic trends and sales cycles as they fluctuate throughout the year (White). Fluctuation of the need for transformers is a natural occurring instance. Using a control chart, one may see data points varying but keeping within the upper and lower control level. Control charts are set with an upper and lower limit, and a center line (central control limit) which is the average of all data and can be viewed as a graphical hypothesis test.

The control chart can also identify when the need for transformers are trending upward over time. It is natural that, data move within the pre-set limits, this is caused by common cause variables. Over time, the control chart will display variances and for the most part the common cause variables run consistently across time. Common cause variables happen naturally and do not demand a change in process or to control chart limits. Unlike common cause variables; special cause variables or type II variables, stretch outside of the upper or lower pre-set limits. Special cause variables may demand a change in process or to the control limits.

A-Cat Corp. will need to have an out of control action plan in place to handle special cause variables. Out-of-control refers to rejecting the assumption that the current data are from the same population as the data used to create the initial control chart limits. Most use the WECO rules to signal an out of control process. It is important to have a process to deal with out of control data, this is called an out-of-control action plan (OCAP). The OCAP is a flow chart companion to the control chart to analyze what appears to be type II errors and to recommend action.

Using 20 quarters of data taken from years 2006 to 2010, the central limit assigned to transformers is 2924.9, with a standard deviation of 462.55. The upper control limit is set to 3387.45 and the lower; 2462.35. Over time, the data proved the hypothesis that the need for transformers had indeed increased. As seen in the chart the below, the control points appear to be consistently trending upward and indicating a process out of control.

**Operational Improvements**

Recognizing the need to analyze data to better forecast the need for transformers is a step in the right direction. Data analysis should be used on all products to better manage company funds and profits. How data is collected and treated is key to data analytics. It must be accurate on the front end. Consistency in the treatment of data is also important. Constancy across departments and managing how data is used day to day, month to month, and year over year. Once a good model is developed, it should not be changed. Comparing apples to oranges will result in miscalculations.

Moving forward, A-CAT should use the same method used to accurately predict refrigerator sales to better predict sales in each appliance category. The data should be updated each month and a new analyses performed as new data is added. The report should be available to all who order supplies. The sales report should be made available to all stakeholders.

The report can be used to better forecast the need for transformers so that A-Cat can have the right amount on hand when needed rather than submitting rush orders costing higher prices. This should also provide a more stable environment and better working relationship with the supplier, A-Cat should be able to negotiate a better price and negate their fear of a price increase.

Additionally, A-Cat should look at improving production costs. I recommend they use a control chart to better control outliers.

**Results**

 The original hypothesis statement was solved. Using parametric testing we reject the null hypothesis. The sale of refrigerators and the need for transformers are not independent and Mittra was correct in that more than 1,000 transformers are needed each month. Using data to solve business problems is just sound practice. Numbers do not lie, and while some may try to manipulate the results, they are what they are.

**Conclusion**

Relationship testing between pairs of variables is important in business planning and forecasting as it outlines the relationship between two or more variables. In our example, the number of transformers needed can easily be identified using relationship testing to identify patterns using past sales data (Cross). This will eliminate over or understocking supplies, which will increase profit.

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