CASE STUDY

Precision Consulting

About the Company

- Leading manufacturer and marketer of peanut butter, packaged coffee, and health and natural foods beverages in the US and Canada
- Has been operating for 100+ years
- Diversified into dozens of major brands, including a large coffee chain with over 10,000 stores worldwide

Goals

- Review the manufacturing process for sources of variation in peanut butter quality
- Create a model that can explain the variation in final product consistency
- Use the model results to adjust the manufacturing process, improving the quality of the product

Approach

- Use Principal Component Analysis to simplify existing statistical model and reduce the multicollinearity among the predictor variables
- Construct a model that explains the variation of the final product consistency

Fortune 500 Consumer Product Company hires Precision Consulting to Help Remove Variability in Final Product Consistency

The company produces consumer goods and was having problems identifying the source of variation for the consistency of the final product. The company had been studying the large scale manufacturing process for decades and had concentrated on this specific outcome measure for 8 years prior to contacting Precision.

At each phase of the manufacturing process, the company kept detailed data. Each decision point, or point where the company had control of the process (such as oven temperature, mixing speed, and drying time), was time-stamped. This allowed the company to keep detailed records of the potential sources of variation, but also added another level of complexity to the dataset. Precision Consulting was retained to conduct an analysis of the numerical data provided by the company and build a statistical model to explain the variation of the final product consistency. The objectives of the analysis were as follows:

- Simplify the manufacturing process to its key factors that were known to likely have the highest degree of impact on the final product consistency
- Create a model that explained the variation in the consistency of the final product

Solution

Precision's Chief Operating Officer visited the manufacturing facility and was taken through each phase of the manufacturing process, which contained over 20 different phases and dozens of machines implementing numerous processes. The factory was dedicated to taking raw goods and converting them into the final product after cleaning, baking, sorting, mixing, and cooking, to name just a few processes. The raw goods themselves were sourced from various suppliers, each with its own source of variation.

After the manufacturing process was reviewed and understood, Precision Consulting requested a number of datasets from the company. These datasets included information about the steps in the process that the company could adjust. Our objective was to develop a statistical model that would relate those specific adjustments to the main variable of interest, a measure of the consistency of peanut butter.

Results

- Produced a model that explained the possible sources of variation of final product consistency
- Recommended experiments for bench factory testing
- Results of the bench factory test aligned with the expected results from the proposed model, which allowed the company to reduce the variance in final product consistency

Once the data were reviewed, the first step in the statistical modeling process was to conduct a Principal Component Analysis. This procedure, commonly used in analytical chemistry, reduces the universe of potential predictors to a small number of uncorrelated factors. This has the benefit of reducing multicollinearity (a problem that can seriously affect statistical modeling) and simplifying the problem to its most important parts.

Once the main factors were identified through Principal Component Analysis, Multiple Linear Regression was used to relate those factors to final product consistency. Results of the analysis revealed a number of variables that were associated with consistency. The analysis was also able to quantify the extent to which changes in those factors affected consistency.

Benefits

The results produced by Precision Consulting allowed the company to manipulate them in order to optimize the peanut butter consistency and improve the quality of the product.

The procedure we followed prevented the company from potentially spending a great deal of time and money in trial and error benchmark tests to find which variables affected product consistency. Applying rigorous statistical analyses to the data that had already been collected by the company allowed us to optimize the product's quality, without incurring the costs of experimentation with alternative formulas.