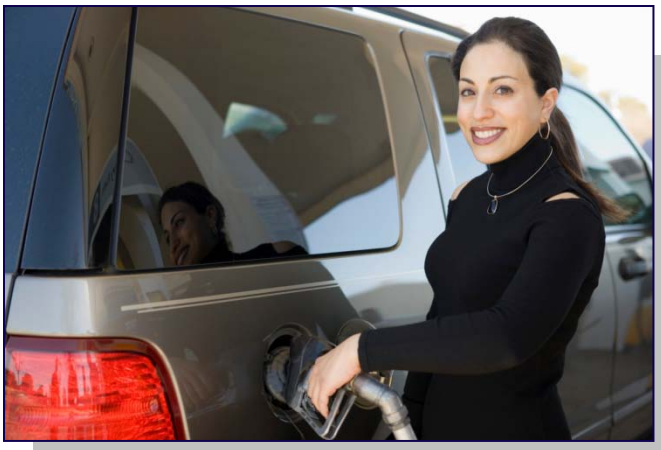


CONSISTENTLY PREDICTING COMPETITOR PRICES AS THE BASIS FOR IMPROVED PRICE TARGETING

1.0 INTRODUCTION

One of the many challenges in pricing petroleum products at the rack is to consistently meet price positioning targets. These targets are often defined as positions with respect to competitor prices, either individual competitors or combinations, for example setting own price at some differential to the lowest two competitors. In order to meet these price targets, analysts use their intuition, market knowledge, analysis of past competitor behavior and an appraisal of current market conditions in order to take a view as to how competitors are likely to price, The resulting ability to hit price targets can vary considerably – with targets being met on some occasions and on other occasions being missed by a significant margin. The opportunity to improve price targeting therefore has significant and immediate business value, in the form of:

- increased margin;
- greater control and predictability of both volume and margins;
- more consistent price positioning leading to enhanced supplier perception in the marketplace.

KSS Fuels, a world leader in price modeling and optimization for the petroleum industry, has developed a capability as part of our RackPrice wholesale fuels pricing system to consistently and reliably improve the regular prediction of competitor price tendency, by product, channel and rack, through the statistical analysis of market factors and past pricing behavior. This paper seeks to outline this unique capability and present the results of real world KSS Fuels experience working with petroleum suppliers.

Although the work described in this paper is based on data available in the public domain, additional customer-specific factors may be incorporated to further improve the models and tailor them to individual customer needs.

2.0 IMPROVING PRICE TARGETING

The key business objective addressed in this paper is to improve price targeting, in a consistent and sustained manner, across all product/rack/channel combinations. We assume in this white paper that the pricing team has already established a target competitive price position which will deliver the optimal balance of volume and margin – improving the setting of these targets is the goal of another RackPrice module and the subject of another white paper. Given this assumption, the objective of improving the ability to hit this target breaks down further into the following components:

- To reduce the variability of price around a target
- To reduce individual analysts bias and eliminate the potential for errors in setting price
- To make competitor price prediction a more systematic process and make the process auditable

Achieving this objective requires the application of statistical techniques to existing data sources, qualified by analyst judgment, within a predictive model which is constructed and parameterized automatically by the automated pricing system. (The process of parameterization defines the unique values of coefficients that are used by a predictive model to generate price predictions together with an initial set of diagnostics). The final component is an automated monitoring capability which both generates on-going predictions and updates the diagnostics to continually assess the accuracy and reliability of the price predictions, alerting

users to situations where the predictive models require tuning.

3.0 Price Prediction Models

The predictive models use the following data sources:

- Own and competitor rack price history
- Spot prices for petroleum products
- Market prices for crude oil
- Street (retail) prices

Statistical analysis of this data then allows the calculation or estimation of 50+ factors that form the basis for the prediction model. Listed below are just some of these factors (for a given competitor C):

- Change in various spot market prices including current and prior period lags and moving average effects
- Time-lagged values of change in competitor C's rack price
- Differentials between the price of C and other competitors
- Differentials between competitor C's price and rack average prices
- Changes in rack average price
- Differentials between rack prices and spot prices (implied margins) & changes in margin
- Refining margins (using various spot prices)
- Change in crude prices

The initial process studies simple relationships to sort through many variables rapidly and begin to establish key correlations. This process helps provide the foundation for more advanced statistical analysis and fitting. The charts below display examples of some of the relationships that can be found:

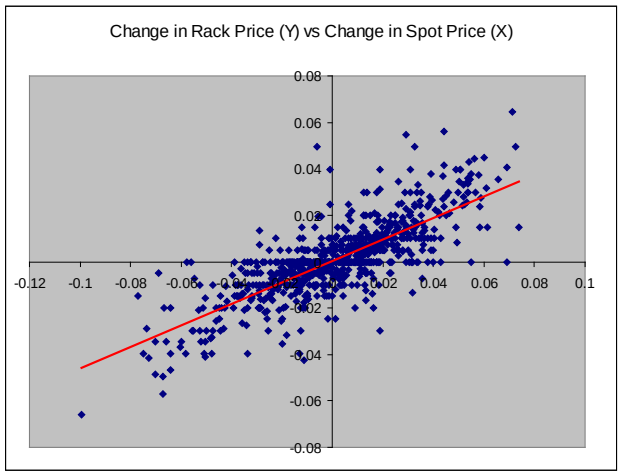


Fig 1 – relationship to change in spot

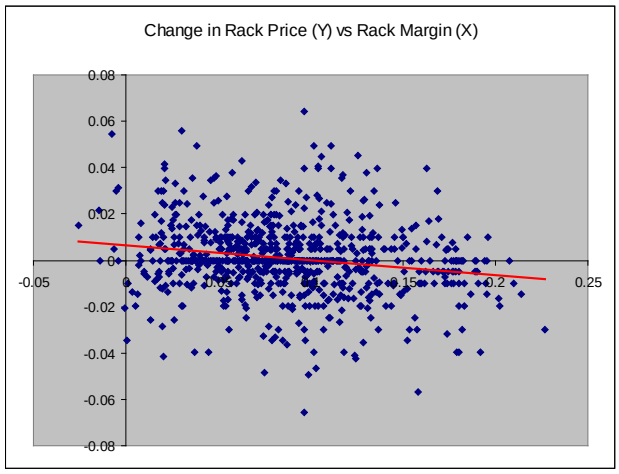


Fig 2 – relationship to rack margin

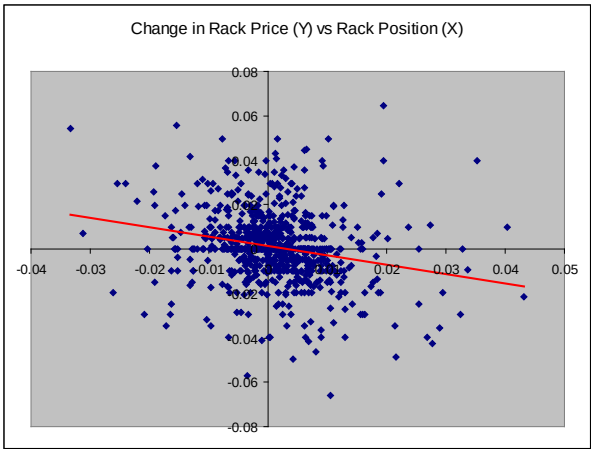


Fig 3 – relationship to rack position (differential to rack average)

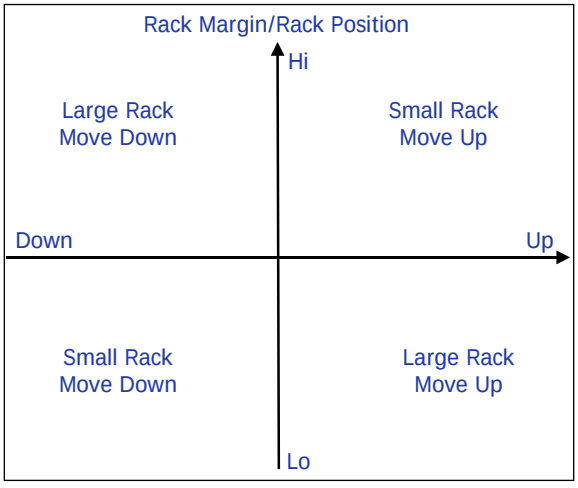
The relationships above show some expected trends:

- In general, changes in rack prices are strongly positively correlated with changes in spot prices
- In general, changes in rack prices are weakly negatively correlated with changes in rack margins
- In general, changes in rack prices are weakly negatively correlated with changes in competitive position

These graphs also highlight serious potential flaws in utilizing only simple measures to develop a target rack price. For example, considering the change in spot price by itself (which has reasonably good correlation), could still lead to significant errors in price prediction. There is also considerable scatter in the diagrams indicating that a simple rule, such as moving price by a fixed percentage of the change in spot, is likely to lead to a high degree of volatility in price targeting.

It is only through the combination of variables and deeper understanding of relationships, that sufficiently accurate models can be built and utilized.

These relationships can be summarized as follows:



4.0 Building Price Prediction Models

The process of building competitor price prediction models involves the following primary steps:

Capturing Detailed Relationships

Building models for a given competitor (C) for a given product, channel and rack involves capturing the general relationships referred to in section 3.0 above and then identifying which of the 50+ factors deliver the optimal description of these relationships as well as identifying whether there are specific relationships unique to that competitor/product/rack/channel combination, such as dependency on refining margins. A model for competitor C will also differ to other models depending on whom competitor C appears to be targeting (in terms of their competition) when setting their prices.

Parameterization

This is the means by which model coefficients are estimated in order to deliver price predictions. This is an automated process wherein the user simply selects the market (rack), product, competitor and channel for which they wish to create a model and the automated pricing system does the rest.

The process consists of the following steps:

- Pre-processing – the gathering, organizing, cleaning and validation of data (including gross and statistical outlier detection)

- Parameter estimation – the development of model coefficients which includes:
  - Dealing with co-linearity (where groups of variables are highly correlated)
  - Selecting an optimal subset of the 50+ factors described above (via stepwise regression)
  - Production of diagnostic data on a test set of market data to establish goodness-of-fit

- Post-processing – a patent-applied-for process known as price point conditioning is applied to exploit the fact that some wholesalers frequently use a relatively small number of discrete price moves

ON-GOING MONITORING OF PREDICTIVE PERFORMANCE

The models are designed to perform in real-world situations where data may not always be available or the quality of certain data points may not always be sufficient for analytical purposes. RackPrice overcomes these practical issues to ensure data integrity by making use of the following:

- Range of diagnostics available to the user to build confidence in price predictions and provide early warning of any deterioration in performance
- Default input values for certain non-critical missing data values in order to allow the prediction process to continue through short-term data supply disruptions
- Alert flags to focus user attention to critical data being absent and/or a failure of the prediction process due to the absence of critical data
- Continuous monitoring of predictive performance which generates an alert flag if performance falls below statistically significant thresholds – if this occurs the user is prompted to initiate re-parameterization of the model
  - The parameterization process is re-run on latest available data in order to capture changes in the market relationships which may have caused the deterioration in performance

5.0 CASE STUDY RESULTS

To demonstrate the business value of using competitor price prediction to improve price targeting, KSS Fuels has studied both the quantitative and qualitative benefits of this approach in real world situations with petroleum customers. The objective of these studies was to identify whether the use of the price prediction component of RackPrice results in reduced volatility in achieving specific price targets, and hence higher profitability. The studies considered the changes in volatility and price targeting before and after the implementation of the RackPrice models.

5.1 CASE STUDY 1 – SCALE OF IMPROVEMENT OVER LEADING-EDGE PRICING SYSTEM

In terms of qualitative benefit, RackPrice was found to further improve the pricing process by:

- Considering a broader range of data than the pricing analysts had the time or tools to exploit
- Using automated statistical techniques to optimize the

process of drawing predictive inferences from this data set

- Reducing manual processing errors and human bias to negligible levels

Over a 30 day period when the average daily spot move was 1.5 cents per gallon, the outcome was as follows:

	After	Before	Improvement
% pricing days within +/- 0.5 cpg	74%	67%	10%
Average daily deviation from target	-0.03 cpg	-0.15 cpg	
St Dev of daily deviation from target	0.45 cpg	0.53 cpg	15%

The table indicates a 10% improvement in the number of days when the variation to the desired price target was 0.5cpg or less. (The 0.5cpg number was selected as it represented 1/3rd of the daily spot price change, an industry acceptable and meaningful measure of accuracy). The analysis goes on to show that, on average over the 30 days, the price target was met to within a reasonable accuracy (i.e. < 0.2cpg) both before and during the application of RackPrice. However the third row of the table is the most compelling, indicating the standard deviation of the variation from target. This is a critical measure of the variability around the target and one which sees price prediction make a significant improvement by narrowing the extent of the variation by 15%. Another way of visualizing this effect is shown in figure 4 below:

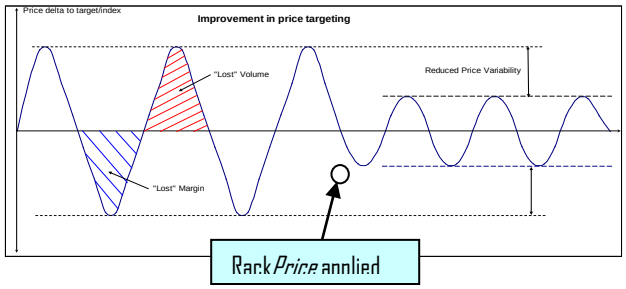


Fig 4 – Reducing price variability or "not leaving

Analyzing the deviation from price target as a histogram (fig 5 below) indicates that, after price prediction is applied, the range of deviations from target becomes narrower, indicating reduced variability and there's a higher concentration around the desired price target, indicating a higher number of occasions where the target is met.

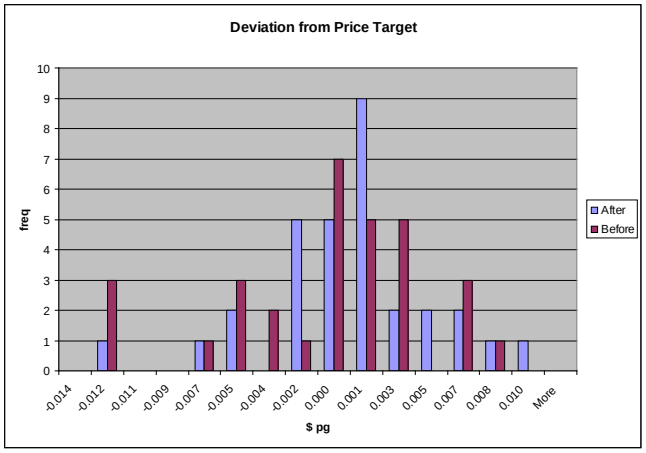


Fig 5 – Histogram of price target deviations

5.2 Case Study 2 – Scale of Improvement against Less Sophisticated Manual Process

In this study the qualitative benefits were observed to be as follows (in addition to those in case study 1):

- Consistent organization of input data and ready availability for efficient data analysis
- Systematizing of basic predictive relationships into model-based rules
- Consistent application of predictive rules independent of short-term pressures and biases on pricing strategy

Over a 30 day period when the average daily spot move was 1.5 cents per gallon, the outcome was as follows:

	After	Before	Improvement
% pricing days within +/- 0.5 cpg	80%	33%	142%
Average daily deviation from target	0.07 cpg	0.01 cpg	
St Dev of daily deviation from target	0.45 cpg	0.72 cpg	37%

The table indicates a very significant 142% improvement in the number of days when the variation to the desired price target was 0.5cpg or less. The analysis goes on to show that, on average over the 30 days, the price target was met to within a reasonable accuracy (i.e. < 0.2cpg) both before and during the application of RackPrice. However, as with case study 1 the third row of the table indicates an improvement of 37% in the standard deviation of the variation from target. This indicates that price prediction, as applied to price targeting, is providing more effective control over the variability of rack price around the desired target. The histogram in fig 6 graphically illustrates the reduction in the spread of price target deviations and an improvement in the number of occasions where the price target is met:

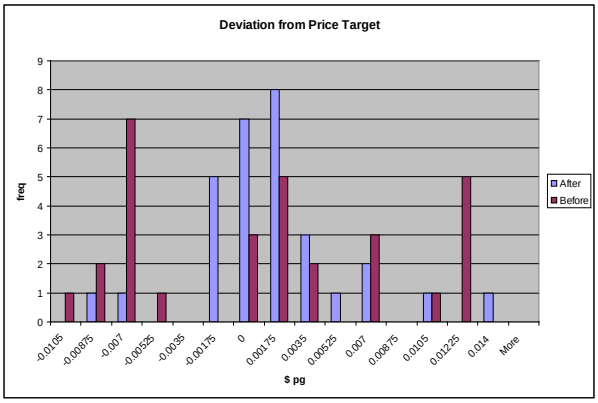


Fig 6 – Histogram of price target deviations

6.0 Conclusions

The application of competitor price prediction to the targeting of rack price positions has been demonstrated to deliver measurable quantitative benefits as well as qualitative pricing process improvements. These benefits result from a significant reduction in the variability of price around a desired target, reducing the instance of excessive price deviation (which unchecked could lead to lost margin or lost volume depending whether the price variation is downwards or upwards) and an increase in the number of occasions when the desired target is met.

The case study work also proves that a systematic approach to capturing market data and applying statistical techniques to predict competitor rack prices results in sufficiently high levels of predictive accuracy and robustness. These are essential qualities for a system if it is to be capable of being applied in a real-world dynamic marketplace.

Adopting reliable techniques for estimating competitor prices will also provide greater control over the inevitable variability around the same targets, resulting from differences in predicted versus actual competitor closing positions. The methods outlined in this white paper have been demonstrated to fulfill these goals – they can also act as an invaluable source of knowledge regarding the market positioning and pricing behavior of key competitors.

7.0 Recommendations

KSS Fuels recommend the introduction of straightforward measuring and monitoring techniques to establish a baseline of how well price targets are currently being met, as the basis for locating opportunities to improve the existing process and identifying potential gains from a more sophisticated approach such as competitor price prediction. Applying advanced decision-support tools such as RackPrice will improve an organizations ability to meet price targets as well as help in validating whether the targets themselves are consistent with corporate performance goals.

Having this kind of system in place will also permit automated early warning of specific issues or trends (whether by terminal, analyst, competitor or otherwise) that will enhance the responsiveness and effectiveness of the pricing process. In support of these goals therefore we recommend the following:

(a) create a baseline of current pricing performance by measuring the ability of each analyst, and the company as a whole, to meet it's price targets;
(b) schedule daily updates of this analysis and distribute in summary form to those responsible for performance;
(c) configure alerts to situations where performance falls outside user-defined tolerances;
(d) analyze the performance over time to establish any trends with respect to key market factors;
(e) use the analysis to appraise individual analyst and/or team performance.

Establishing the baseline referred to in (a) above involves the following steps:

1. Systematically gather and store relevant own and competitor price data and internal estimates of market closing prices (spot prices);
2. Organize the data in a form such that it can be efficiently analyzed – by rack, competitor, product and channel;
3. Gain clear understanding of, and document, the current price targets;
4. Develop simple analytical routines to establish the company's current ability to meet those targets – to include the analysis of expected versus actual price index by looking at the pre and post-market close figures – this will baseline the "as-is" position;
5. Configure the routines such that the analysis can be automatically repeated on a daily basis and the outcome stored for review.

Estimating the potential improvement that could be gained by applying an automated pricing system then involves calculating the impact of reducing the target variability by 10, 15 and 20% and by meeting the target on more occasions (for example 10%, 15%, 25%).

ABOUT KSS FUELS

KSS Fuels is the leading global provider of pricing software, analytics and consulting services to fuel retailers and wholesalers in the oil & gas, convenience store, grocery and retail industries. Providing "Knowledge beyond the numbers," KSS Fuels helps fuel marketers and distributors implement effective pricing solutions and increase profitability through the use of knowledge and numbers. The company's US headquarters are located in Florham Park, New Jersey, and its international headquarters are based in Manchester, United Kingdom. For more information about KSS Fuels, please visit www.kssfuels.com.

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