

# Engineering Wine

Ashley Heller and Craig Whitnack

## Executive Summary

An existing methodology for the development of consumer products is applied to winemaking. Consumer's needs and preferences are identified, allowing the data generated by market analysis to be related to wine properties. These wine properties are easily measured throughout the winemaking process and can be manipulated by the manufacturer at little cost. The manipulation of these characteristics affects the consumer's satisfaction obtained from the enjoyment of wine.

This new consumer function can be incorporated into a demand model that allows for the manipulation of the selling price of a bottle of wine. Based on the consumer and the demand models, maximization of the profit can be performed.

Wine is evaluated by the consumer with the following characteristics:

- Clarity
- Color
- Bouquet
- Acidity
- Sweetness
- Bitterness
- Body/Texture
- Finish/Aftertaste

Bouquet was examined in detail to identify specific compounds which contributed to the consumer-identified aromas of the bouquet of wine stored in a toasted oak barrel. Important aromas include butterscotch/caramel, clove, vanilla, and oak/coconut. In turn, toasting can be categorized by different intensities from light to heavy toasts. Medium toasts offer the most potential for flavor, as heavy toasts tend to breakdown important compounds contributing toward the bouquet.

All of the above characteristics are evaluated individually by the consumer's level of preference attained. Once the utility of the consumer is identified, these characteristics are evaluated by their relation to physical attributes that can be manipulated. Multiplied by weights predetermined by the consumer's ranking of priority, the summation of the products of each attribute and their corresponding weights allow for the development of a preference function using the published methodology for consumer products<sup>55</sup>. The value of satisfaction of the consumer is then compared to that of the competition, forming the superiority function that governs the demand model.

An inferiority function is employed to allow the evaluation of the consumer's overall knowledge and familiarity with the product. This is a function of time and can be manipulated with advertisement. However, this adds operating cost and is optimized for three scenarios of alpha values: high (\$2 million), medium (\$1 million), and low (\$0.2 million). A high alpha level is predominantly used when performing profit analysis.

Without uncertainty incorporated into the demand or business model, the optimum production capacity was found to be 2.5 million bottles per year with a selling price of \$36. These values, when incorporated into the business model, yield a return on investment of 223%, a net present worth of \$187 million, and a pay out time of four years. These values are all found with the assumption of 20% variance in the alpha and beta values as well as a variance of \$10 in the competitor's selling price of \$30. When uncertainty is incorporated into the model, the optimum scenarios result in a tremendous amount of risk, showing that the most profitable scenario is not necessarily the best decision. An extensive risk analysis was performed to evaluate profitable scenarios and their associated risk. Cumulative risk curves were generated using @Risk<sup>®</sup> Decision Tools. Expected net present values and return on investments were documented and summarized along with opportunity values to display several different profitable decisions. This summary allows vineyards to pick a specific production rate and bottle selling price based on their desired profitability and acceptable level of associated risk.

The superiority beta ( $\beta$ ) function was further manipulated to examine the effects it had on associated risk. It was found that manufacturing a wine of lower consumer utility (higher beta) can, in some cases, reduce the risk at similar aspiration levels.