THE RELATIONSHIP BETWEEN WINE RATING, PRICE, QUANTITY PRODUCED, AND APPELLATION AMONG 2006 CALIFORNIA CHARDONNAYS WITH SMALL PRODUCER RECOMMENDATIONS

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Abstract

Wine Spectator, the leading publication of the wine industry, has stated that "price has little to do with quality." This study tests that premise by examining the market for 2006 California Chardonnays from various appellations. Using Wine Spectator's database of over three hundred California Chardonnays, an analysis reveals a statistically significant positive correlation between price and quality. The quantity produced and appellation was also significantly related to price. These results have strategy implications relative to promoting a particular winery within an appellation versus individual brand promotion, especially for smaller producers.

JEL Classification*: D220, D430, M210, M310*

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1. INTRODUCTION

Because of the global nature of the wine industry, there are thousands of wineries to choose from and many of those wineries have dozens of products under one label, with each product consisting of many individual years or vintages. In addition, no two vintages are the same and regional differences can amplify those differences. As a result, the consumer is forced to make choices among many brands and appellations that change in quality and quantity each year. The market has responded to this problem by producing many Publications that rate particular wines. These publications have been around for over thirty years and have developed a reputation for accurately assessing the quality of the wines they review. The experience of the publication's wine experts becomes a proxy used by many inexperienced wine consumers when making quality/price purchasing decisions.

Rao and Monroe write that many intrinsic and extrinsic cues are used by consumers to form quality perceptions (1989). Intrinsic cues are derived directly from the product. Extrinsic cues are not directly related to product performance, such as price (Olsen, 1973). When buying wine, can price be used as an accurate quality cue? If so, how strong is the relationship between price and quality? Are there other factors that influence the price of wine, such as quantity produced and the area (appellation) the wine was produced in? Rao (2005) quoting Rao and Monroe in a 1989 study found in a review of over forty studies that "the evidence for a robust (though moderate) price-perceived quality effect appeared to be incontrovertible." These studies used many product categories. However, the relationship between objective or actual product quality across product categories is relatively low (r = 0.27) according to Tellis and Wernerfelt using *Consumer Reports* data (1987). Because it is hard for a consumer to determine the objective quality of a product, most consumers revert back to using price as an indicator of quality (Rao and Monroe, 1988). Rao writes that the why of the process is that it is cognitively efficient for the consumer to do so for many products (2005).

Although objective quality is hard to determine (see Curry and Riesz, 1988 for a discussion of previous research on objective quality), it is particularly so with wine. Because of the wide variety, assortment, and vintages available to consumers and the relatively low involvement with the product category, wine consumers look to publications that rate wines using various criteria. Consumers buying wine look to ratings that approximate, at least to their satisfaction, the quality of wine using such sources as *Wine Spectator*, *The Wine Advocate*, *International Wine Cellar*, and *Wine Enthusiast*, among others. Consumers often revert to quality rating publications whenever they believe it is expeditious for them to do so. This use of ratings can be found among many product categories such as automobiles (J.D. Powers and Associates), movies (Roger Ebert), consumer products (Consumer Reports), and others.

1.1 Reliability and Validity of Wine Spectator Ratings

In a study conducted at the Center for Hospitality Research at Cornell University (2008) Thompson et. al. compared the scores of *Wine Spectator*, *The Wine Advocate*, and *International Wine Cellar* relative to forty-four Bordeaux wine producers. The researchers found that *Wine Spectator* and *The Wine Advocate* had the highest correlation at 0.84. The lowest correlation was between *The Wine Advocate* and *International Wine Cellar*, at 0.71. Thus, a high level of correlation existed between these raters in the study. This can be interpreted to mean that, according to the authors, "One possible explanation is that wines themselves have intrinsic characteristics that raters are capturing in their scores. Further, it would be a necessity that the raters are keying off the same (or related) intrinsic characteristics of the wines." From this it is reasonable to state that over time generally accepted quality cues have evolved for the evaluation of wine and these quality cues allow for the rating of wine that has been found to be reliable and valid over time.

Shewbridge (1998) used a linear regression model to determine the consistency of ratings between two of *Wine Spectator's* editors rating the same wine. The author found that, on average, the difference was within +/- 4 or 5 points on a 100 point scale across all varietals. Then he compared the ratings of *Wine Spectator* to *The Wine Advocate* using six different varietals. Here he found California Chardonnays with a standard deviation of difference of 2.6 between the two publications. This was the lowest deviation found among the six varietals used in the scoring (the range was from 2.76 to 5.7 standard deviation of difference). Again, this study is another indicator as to the reliability and validity of *Wine Spectator* ratings in general and in particular with California Chardonnays.

2. *HYPOTHESES*

James Laube, Senior editor for *Wine Spectator* (2008) stated that price has little to do with quality. From this it can be inferred that price should not be used as a quality cue. A skeptical interpretation of this statement can be that if there was a significant and high correlation between quality and price there would be a diminished need for publications of this type. Consumers could simply buy based on price and receive the quality associated with that price. However, as previously stated, research has shown a positive correlation, although small, between quality and price across product categories. Can this correlation between price and quality be applied to the 2006 California Chardonnays *Wine Spectator* has rated? This is particularly important to consumers as Chardonnay is the most consumed white wine in the United States. Is there a positive, significant and strong correlation between 2006 California Chardonnays quality rating and price? How do other factors, such as quantity produced and appellation, affect the price of a wine in a particular year? How do all three factors influence the price of 2006 California Chardonnays? Given the above discussion of price and quality rating, this research addresses five hypotheses:

H1: There is a positive relationship between the sales price of 2006 California Chardonnay and the *Wine Spectator* quality rating.

H2: There is a negative relationship between the sales price of 2006 California chardonnay and the number of cases produced.

H3: *Wine Spectator* quality rating predicts the price of 2006 California Chardonnay.

H4: *Wine Spectator* quality rating and the number of cases produced predicts the price of 2006 California Chardonnay.

H5: *Wine Spectator* quality rating and the number of cases produced predicts the price of 2006 California Chardonnay with differences among appellations.

3. *RESEARCH DESIGN*

3.1 The Problem

The relationship between wine price, quality, quantity produced and appellation among California Chardonnays are of interest to wine experts, wineries, wine sellers, grape growers, and wine consumers. The sale price for a given wine will vary depending on the price set by the seller, the quality of the wine, the quantity produced, the appellation, marketing efforts, the state of the wine markets and the economy. The purpose of this research study is to examine the relationship between the sales price of 2006 California Chardonnays and three independent variables: the two quantitative variables, *Wine spectator* quality rating and the number of cases produced, and the qualitative variable, California wine appellations (seven levels). There are two objectives to this study. The first objective is to determine whether the data indicate that quality rating and number of cases produced are related to sales price. That is, do the data provide sufficient statistical evidence to indicate that these variables are significantly related to sales price? The second objective is to develop a prediction model relating the quality of the wine and the quantity of wine produced to the sale price and to determine whether this relationship is the same for a variety of appellations.

3.2 The Data

It has been established that there are generally accepted quality cues associated with wine that are known among wine rating publications. In addition, the major wine rating publications have been found to have a high degree of correlation between them. From this, *Wine Spectator* was chosen as the database for California Chardonnay wine scores because it is a major quality rating magazine (2.4 million readers, according to the magazine), has a sample size that aids in establishing the validity of the findings, and rates more wines than any other publication (201,415 as of February of 2009). In addition, *Wine Spectator* is a reliable source for a winery's suggested retail price, production data, vintage, and vineyard location (appellation). The vintage chosen was 2006 and the varietal is California Chardonnay. The 2006 offerings were chosen because most wineries had fully aged the wines produced in that year and released them to market as of the date of this article. Seven appellations (Sonoma, Other California, Bay Area/Central Coast, Mendocino Lake, Carneros, South Coast, and Napa Valley) were identified by *Wine Spectator* along with the retail price, and the number of cases produced. The data consisted of 464 total observations. The following chart shows producers' relative share of California Chardonnay vintage 2006. Sonoma is clearly the largest producer and offered many varieties of Chardonnays, an industry leader.

Insert Figure 1 here

3.3 The Models

The functional relationship between price and quality, as considered in this research, is assumed linear. Therefore, the retail sales price of wine, Price is used as the dependent variable. The independent variables are: *Wine Spectator* quality rating, the natural logarithm of number of cases produced instead of the number of cases produced, and appellations. Three models are suggested to explain this relationship.

Model 1 is the mean sale price as reported by *Wine Spectator*, as a function of quality rating and a random error. This is a first-order model relating price to quality rating and assumes that the relationship between the sale price and the quality rating is the same for all appellations. The equation for this model is

$$Price_i = \beta_0 + \beta_1 quality_i + \varepsilon_i$$

Model 2 is the first-order mean model of the sale price, as a function of quality rating and natural log of number of cases produced. The rationale behind using the natural logarithm is wide range and thus the standard deviation on wine production. The relationship is assumed to be the same for all appellations. The model is

$$Price_i = \beta_0 + \beta_1 quality_i + \beta_2\ lncases + \varepsilon_i$$

Model 3 assumes that the relationship between price and quality rating and the natural log of cases produced (lncases) is first order but it allows for appellation differences where a binary (dummy) variable is used bay=1 if Bay Area/Central Coast, zero otherwise, carneros=1 if Carneros, zero otherwise, other=1 if Other California, zero otherwise, mendo=1 if Mendocino Lake, zero otherwise, south =1 if South Coast, zero otherwise, napa =1 if Napa Valley, zero otherwise, and the base level used is Sonoma. Model 3 is:

$$Price_i = \beta_0 + \beta_1 quality_i + \beta_2\ lncases + \beta_3 bay + \beta_4 carneros_i + \beta_5\ other + \beta_6 mendo + \beta_7 south + \beta_8\ napa + \varepsilon_i$$

4. RESULTS/FINDINGS

4.1 Descriptive Statistics

Table 1-A, and Table 1-B below report means, standard deviations for price, quality rating, number of cases produced, the natural log of cases, and wine Appellation.

Insert Table1-A and Table 1-B here

The average retail sales price (dependent variable), 2006 California Chardonnay, is $34.53 with a standard deviation of $18.86). The distribution of the retail price is skewed to the right, meaning that retail price is concentrated at the low end of the price scale with few expensive wines. Wine quality rating (the first independent variable), (*Wine Spectator* 100 point scale), appears to be normally distributed with a mean of 87 point and a standard deviation of approximately 3.5 points. The mean of the second independent variable, number of cases produced, is 20,972.53 and a standard deviation of 137,505.03 cases resulting in a coefficient of variation (CV) of 665.6%. Due to extremely large relative variability in the number of cases produced, the natural log of number of cases is used to test the fourth and fifth hypotheses, i.e.; H4 and H5. Sonoma wines are the most expensive with an average price of $41.76 while Mendocino Lake and Bay Area Central Coast tied for the least expensive.

4.2 Correlation and Regression

Table 2 below shows pair-wise Pearson correlation coefficient between price, quality rating, number of cases produced, the natural log of cases, and wine Appellation.

Insert Table 2 here

Before conducting the analyses to address the proposed three models, Pearson correlation coefficients were performed to test the first two hypotheses. Hypothesis 1 stated that there is a positive relationship between the sales price of 2006 California Chardonnay wine and the *Wine Spectator* quality rating. The correlation confident indicates a relatively strong positive, linear relationship between price and quality rating of wine by Wine Spectator. This leads us to fail to reject hypothesis H1. Hypothesis 2 predicted a negative relationship between the sales price of 2006 California Chardonnay wine and the number of cases produced. The result of the study confirms the existence of a significant negative linear relationship between the price and number of cases produced. The relatively weak relationship as indicated by the correlation coefficient (- 0.17) may be due to the fact that the relationship is nonlinear. When we used the natural log of number of cases, the correlation coefficient indicated a more significant and a much stronger negative relationship, both measures of quantity produced leads us to fail to reject H2.

Linear regression analysis is used to test hypothesis three through hypothesis five (H3 – H5). Table 3 shows the three different models to test the last three hypotheses.

Insert Table 3 here

Hypothesis 3 proposed that the *Wine Spectator* quality rating would predict the price of 2006 California Chardonnay wine. Based on the regression results above, an increase in the Wine spectator ranking score by one unit will increase the average sale price of a bottle of Chardonnay by $3.25. The estimated coefficient is significantly different from zero implying a statistically significant positive relationship between price and quality rating. The result is also confirmed in the graph below. The quality measure explained approximately 37% of the variability in the price of wine. *Wine Spectator* quality rating was significantly related to the price and we fail to reject hypothesis H3.

To test hypothesis 4 which states that the *Wine Spectator* quality rating and the number of cases produced would predict the price of 2006 California Chardonnay wine, we estimated model 2. Instead of using the number of cases produced, we used the natural log of cases produced. Based on model selection criteria, adjusted coefficient of determination (adjusted R^2), and the significantly larger correlation coefficient, the natural log of cases produced would be a better predictor of average price of Chardonnay the number of cases. Holding the number of cases produced constant, an increase in quality rating score by one unit increases the average price of wine by $2.59. The estimated coefficient is significantly different from zero as indicated by large t-ratio. Holding quality score constant, an increase in wine production by 1% will decrease the average price by $0.04. The explanatory power of the model increased after adding the log of cases from 0.37 to 0.49 a 32.4%. The estimated coefficient of the number of cases was not significantly different from zero (t = -1.58, p-value 0.1158). The graph below shows a negative relationship between price and the natural log of cases produced.

Insert Figure 2 and Figure 3

The final hypothesis, Hypothesis 5, predicted that the *Wine Spectator* quality rating and the log of the number of cases produced predicts the retail price of 2006 California Chardonnay while allowing for appellation differences. Is Model 3 improved by the addition of the wine appellations? That is, do the data provide sufficient evidence to indicate that Model 3 is a better predictor of retail sales price than Model 2? Model 3 showed a slight improvement over model 2. Adjusted R^2 increased from 0.49 to 0.52 and the average price for several appellations were significantly lower than the average price of the control group (Sonoma), holding quality and wine production constant. The hypothesis is supported (F = 62.91, p-value <.0001); the adjusted multiple coefficient of determination, R-square = 0.52 indicates that Model 3 explains 52% of the variability in the retail sales price of 2006 California Chardonnay. Model 3 provides an improvement over Model 2 and entering appellations into the model provides additional information for predicting sales price. The subset of sales, quality, and cases data pertinent to the seven appellations are different. Predicted prices for 2006 California Chardonnay are consistently and significantly lower for the Mendocino, Bay Area, South Coast, and other California appellations than and Sonoma appellation. Again, the log of the number of cases produced and quality rating are significant. From strictly model selection criteria, including appellations in the final model are justified, since the estimated coefficients and their statistical significance of quality and log of cases did not change due to the addition of appellations. This means that appellations are relevant variables and should be included in the regression equation.

Model 3 is the best model, but how well does the model predict the retail price of 2006 California Chardonnay? Although the model explains 52% of the variability in the retail sales price, reveals a slightly large standard error of $13.11, and a mean of the dependent variable of $34.53 resulting in a CV ratio of 37.96%. The large standard error could be a symptom of a violation of the Classical Linear Model Assumption (CLM) of constant variance of the regression line, i.e., the variance of the regression line is independent of the values assumed by the independent variables. It appears that the assumption of homoscedasticity is violated and is confirmed when we tested whether or not the variance of the regression line is constant. The null hypothesis of constant variance was reject (Chi-Square = 45.86 p-value 0.0031). A more appropriate estimation procedure is to use robust regression or heteroscedasticity corrected standard errors of coefficients. No other violations of the (CLM), such as multicollinearity were observed.

Approximately 95% of the predicted sales price values will fall within two standard deviations of their actual values. This relatively large value may lead to large errors of prediction for some appellations. Large prediction intervals would indicate that the prediction equation is of little practical value in predicting wine retail sale prices. Because expert wine raters tend to overrate or underrate wines in specific price ranges, for example, very low-priced or very high-priced wines, the functional relationship between price and quality could be considered curvilinear, not linear as assumed in this research study. Under a curvilinear assumption the natural logarithm of the retail sales price might yield a better prediction equation. In addition, a log prediction model might be improved by the addition of interactions between appellation and quality and cases produced.

5. *CONCLUSIONS*

The results of the correlation analyses indicate that the retail sales price of 2006 California Chardonnay is positively correlated with the *Wine Spectator* quality rating and negatively correlated with the number of cases produced. The regression analyses results indicate that the relationships between retail wine sale prices and both quality rating and number of cases produced are different from one appellation to another. In addition, the prediction intervals are large indicating that other variables and a second-order model with interaction terms might be necessary to improve the prediction of retail sales price values.

6. *DISCUSSION AND APPLICATION*

The wine industry is made up of a few, major global players that own hundreds of brands (Constellation Brands, the largest, has a portfolio of over 200 brands in the wine, spirits and imported beer categories and reported net sales of eight hundred seventy seven million dollars for the second quarter, fiscal year 2010), intermediate sized companies with national and some international distribution, and hundreds of smaller, independent wineries. The Wine Institute reports 2,843 bonded wineries in California (2008) alone. Most of these would be considered small businesses by U. S. government standards.

The literature review has shown that when making product quality/price comparisons across product categories the relationship is weak (r=0.27). This research has shown that a stronger (although moderate) relationship between product quality and price exists in 2006 California Chardonnays among various appellations (r=0.61, p<.001, as shown in model 1). In addition, this research reports on the great variability between price and quality that exists. Often it is the small business that cannot realize the full value their product represents (and as a result cannot command the full price premium for their non-commodity products) because of limited marketing resources and limited distribution. Because of their limited ability to communicate their product offering outside of the local market they may not be realizing their full pricing potential (see, Leszcyc and Rao, 1989). A strategy these high-scoring (relative to price) local producers may want to pursue is to form selling groups to market and distribute their brands. A logical organizational structure would be by appellation. The principle selling proposition could be the value their brand represents by comparing their selling price to the quality scores they have received by various wine publications.

This is a common strategy used by larger, branded producers and is reflected in the many ads appearing in wine publications. In this way smaller producers could buy advertising space more cheaply, advertise using a larger variety of media, and approach the major distributors with additional selling clout. Another strategy would be to sell direct to end-user consumers by way of the internet. This would allow smaller producers to realize the additional revenues obtained by others in the distribution channel. The smaller, premium Oregon Pinot Noir producers use these strategies by selling to, or owning, Oregon Pinot "wine clubs." Maybe it is time for the smaller, under-valued California Chardonnay wine producers to do the same.

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Figure 1: 2006 Production of California Chardonnay by region

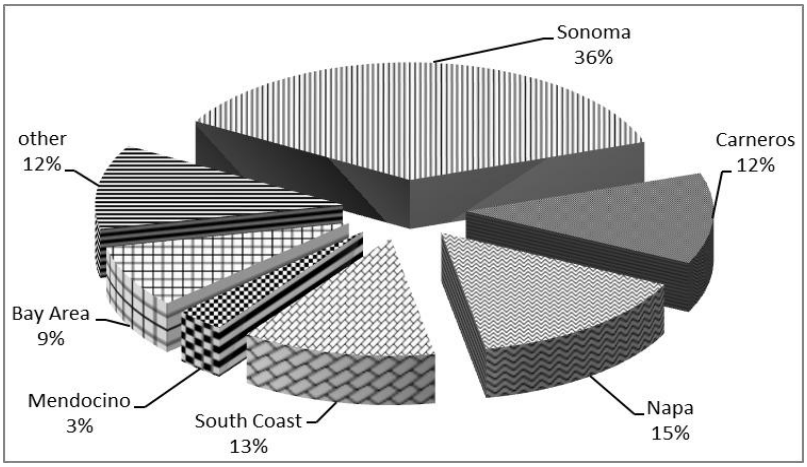

Table 1-A: Descriptive Statistics N = 464

Variable	Mean	Std. Dev.	Min	Max
Quality*	86.99784	3.521915	78	96
Price	34.53	18.86	7	175
Cases	20,972.53	137,505	75	2600000

* Quality is scalar ranking of wines by Wine Spectator

Table 1-B: Descriptive Statistics by Appellation

Region	***N***	***Price***		***Rank***		***Number of Cases***	
		Mean	***Std. Dev.***	***Mean***	***Std. Dev.***	***Mean***	***Std. Dev.***
Bay Area Central	40	28.75	15.66	86.80	3.62	14,672.20	34,982.66
Carneros	58	36.86	13.87	88.26	2.99	5,489.24	13,543.31
Mendocino Lake	15	28.80	15.31	86.20	3.38	10,372.07	30,638.14
Napa Valley	69	36.68	17.29	87.30	3.51	6,857.97	24,873.59
Other California	54	18.33	13.92	84.07	3.37	112,522.44	384,354.78
Sonoma	169	41.76	21.39	87.89	3.51	6,857.97	24,873.59
South Coast	59	29.24	10.45	85.85	2.46	14,074,.95	60,879.25
Overall	464	34.53	18.86	87.00	3.52	20,972.53	137,505.03

Table 2 Pair-wise Correlation Coefficients, N = 464

	Price	Quality	Cases	Log cases
Price	1.0000			
Quality	0.6066*	1.0000		
Cases	-0.1683*	-0.1833*	1.0000	
Log cases	-0.5320*	-0.3274*	0.4051*	1.0000
Bay Area	-0.0943*	-0.0173	-0.0141	0.0454
Carneros	0.0467	0.1354*	-0.0426	-0.0437
Mendocino Lake	-0.0556	-0.0415	-0.0141	-0.0481
Napa Valley	0.1726*	0.2191*	-0.0346	-0.0478
Other California	-0.3121*	-0.3016*	0.2419*	0.3037*
Sonoma	0.2904*	0.1927*	-0.0778	-0.1534*
South Coast	-0.1073*	-0.1248*	-0.0192	-0.0914*

*Coefficient is significant α= 5%

Table 3: Regression Results for the Price of the 2006 California Chardonnay Wines (N = 464)

Independent Variables	***Model 1***	***Model 2***	***Model 3***
Constant	-248.1*** (-14.39)	-162.9*** (-9.35)	- 139.1*** (- 7.78)
Quality	3.25*** (16.40)	2.59*** (13.79)	2.36*** (12.19)
Log of cases		-3.75*** (-10.63)	-3.66*** (-10.25)
Bay Area			-8.03*** (-3.46)
Carneros			-5.16*** (-2.58)
Mendocino			-9.39** (-2.65)
Napa			-1.51 (-0.80)
Other California			-7.29*** (-3.28)
South Coast			-7.96*** (-3.93)
Adjusted R^2	0.3666	0.4903	0.5168
F Value	269.03***	223.66***	62.91***

t values are in parentheses
Sonoma is the control group for model 3
*** Coefficient is significant at 99.9%
** Coefficient is significant at 95%

Figure 2: Price-Quality Relationship Fitted Line for 2006 California Chardonnay Wine

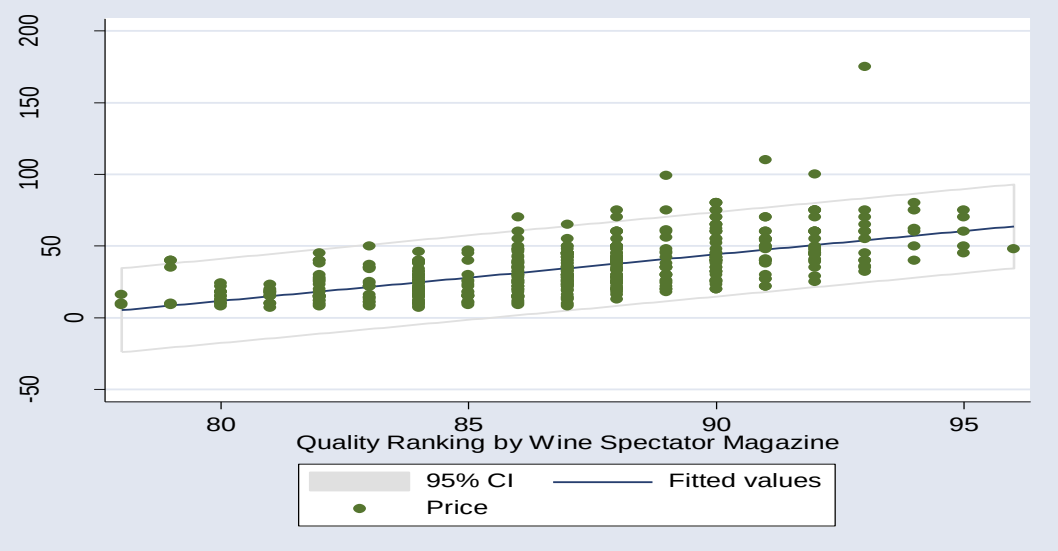

Figure 3: Price-Quantity Relationship Fitted Line for 2006 California Chardonnay Wine