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WINE AND JUICE MANAGEMENT AND MARKETING DECISIONS: THE CASE OF THE FRENCH PARADOX

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ABSTRACT

Because of a growing body of medical research which links moderate red wine consumption to health benefits, demand for red wine in the U.S. has increased in recent years. The popular press, starting with a broadcast by the television news program "60 Minutes" entitled "The French Paradox," has contributed to this increased demand by popularizing the health attributes of moderate red wine consumption. In this study, the impact of an increase in demand for red wines on small- to medium-sized southern wineries is examined. Representative wine and juice manufacturing plants of six different size capacities are examined in an economic decision-making model. The model is formulated in a known life equilibrium framework and solved using linear programming. Net returns generally increase with winery size and five of the six winery sizes examined are profitable. A sensitivity analysis explores the effects of an increase in demand for red wine due to phenomenon such as the French Paradox. Profits, profitability and the amount of red wine in the product mix all increase with red wine price. Although certain more profitable white wines always remain in the production mix, red wines peak at 50 percent of wine marketed under a relatively modest (25 percent) red wine price increase.

INTRODUCTION

On November 17, 1991 the television news program "60 Minutes" aired a television report entitled "The French Paradox." The report suggested that the lower per capita heart failure of French people with diets similar to Americans may be explained by their greater level of red wine consumption. The broadcast discussed the theory that moderate consumption of red wine can prevent arterial blockage by removing or "flushing" platelets from arterial walls. Platelets are small, beneficial blood cells which cause blood to clot. However, they also cling to rough, fatty deposits on artery walls which can eventually build up and cause heart attacks (60 Minutes, 1991).

The reaction to the broadcast in the United States was dramatic. Over the next five four-week periods, sales of red wine increased by an average of 40 percent over prior year's sales. Although a large consumer response to a 60 Minutes story is not uncommon (i.e. the Alar story[I]), a large body of medical research conducted and/or published after the 60 Minutes story was aired has continued to support the belief that moderate levels of alcohol consumption provide health benefits (Perdue, 1992).

On November 5, 1995, 60 Minutes aired a follow-up segment on the French Paradox in which results from the Copenhagen City Heart Study were discussed (Gronbeck et al., 1994). This 12-year study by Danish researchers followed the health of over 13,000 men and women of ages 30-79. A significant finding was that abstainers of alcohol had a 37 percent higher risk of dying (from any cause) than moderate drinkers (one to six beverages per week).

The specific types of alcohol consumed by participants in the Copenhagen City Heart Study is examined in Gronbaek et al. (1995). This study found that subjects who consumed three to five glasses of wine per day experienced a significantly lower mortality rate (49 percent) than those who never drank wine. A number of possible protective compounds present in red wine also are discussed.

Economic theory suggests that the demand for red wine may increase because of perceived health benefits associated with its moderate consumption. Indeed, the consumption of wine in the U.S. has been steadily increasing in the 1991-1995 period by over four percent per year on average (Wine Business Monthly, 1996). To take advantage of these changes, managers of wineries must have specific information for business planning and decision making. The purpose of this paper is to examine the effect of a phenomenon such as the French Paradox on the profitability and production decisions of small- to medium-sized wineries in the southern United States. Mathematical programming procedures are used to model the complex constrained optimization problem facing a representative wine/juice manufacturing facility.

A winery located in the southern United States is an appropriate business to study because the wine industry makes an important contribution to the regional economy. The combined region of Arkansas, Missouri and Texas had a 1992 total industry output of over $24 million. Using the IMPLAN software (Olson and Lindall, 1994), the authors estimate the value added of this output at $9.5 million. In addition, many southern states have experienced major increases in wine production in the 1989 to 1992 period: Texas, 127 percent; Florida, 59 percent; Missouri,.75 percent and Alabama, 100 percent (Hiaring, 1994).

THE DECISION MODEL

The economic decision model employed in this study characterizes the business and technological environment facing an established, representative southern winery/juice production facility under a long-run equilibrium situation. The model is formulated and solved using mathematical programming techniques and employs data from previous research, surveys and judgments of industry experts. Mathematical programming is an appropriate technique to use because it parallels the winery manager's decision-making environment (maximizing returns subject to a series of constraints).

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The winery sizes investigated represent six levels of annual fermenting capacity in gallons: 5,000; 10,000; 20,000; 40,000; 80,000; and 100,000. The objective function of the model[2] maximizes net returns (NR) to the winery:

$$\text{MAX NR} = \Sigma_V \Sigma_L \; PW_{V,L} \; QW_{V.L} + \Sigma_V \Sigma_L \; \Sigma_J \; [PJ_{V<L} * \; QJ_{V,L,J} + PB_{V,L} * QB_{V,L,J}] -$$

$$(1 - 0.5 * I) * VC\,(QW,QJ,QB) - FC$$

Where V is an index denoting varietal of wine or cultivar of grapes, L is an index denoting level of sale (retail or wholesale) and J is an index identifying the juice manufacturing method (hot or cold press). The variables PW, QW, PJ, QJ, PB and QB are prices and quantities of wine, juice and blended juice. The variables I, VC and FC are an interest rate on borrowed funds, variable costs (a function of wine, juice and blended juice output) and fixed costs, respectively.

The objective function maximizes winery net returns by subtracting variable and fixed production costs from revenues associated with wine, juice and blended juice production and sales. Wine revenues are dependent on the varietal of wine sold and level of sales. Juice and blended juice revenues are dependent on the type of juice, level of sales and juice manufacturing method. Variable costs include those associated with grape production, harvesting, processing and purchases, apple juice purchases, labor, maintenance and repairs, insurance and advertising. To reflect interest expenses on operating capital, annual variable costs are increased by one-half of an annual production loan interest rate under the assumption that these costs are financed over a six-month period. Fixed costs include opportunity costs on capital and land, property taxes and depreciation on building and equipment.

The model also includes twenty-two constraints. They are of three types: production, processing and sales balance equations; resource availability controls; and sales volume and varietal mix constraints.

The production, processing and sales balance equations ensure that: 1) grape production is less than or equal to available acreage times yield; 2) grape harvest is less than or equal to available production; 3) grape processing is less than or equal to harvest plus grape purchases; and 4) sales are less than or equal to the amount processed. A time index is included in the processing constraints because it is assumed that no grapes are stored; that is, grapes are processed as soon as they are harvested and/or purchased.

The resource availability controls ensure that capital (plant and processing equipment) and labor use are less than or equal to capital and labor availability. Labor is a noncontinuous variable and all units of labor are for full-time yearly employees.

The sales volume constraints restrict wineries to a predefined maximum proportion of retail wine and/or juice sales by volume. Ideally, a winery would prefer to sell 100 percent of production at the retail level. However, large wineries rarely have the ability to do this so upper limits are placed on retail sales volumes[3]. These levels were determined based on conversations with industry experts. Similarly, certain varietals of grapes produce higher value wine and juice products. However, in order for retail and wholesale sales to occur it is necessary for wineries to produce a mix of wine and juice products. Hence, varietal mix constraints also are imposed which specify minimum and maximum limits on the proportion of production of any given varietal. These model parameters also are based on expert opinion.

Unlike juice wine must undergo an appropriate aging process. Therefore, wine prices are discounted using net present value techniques based on a sales schedule dependent on wine type and a 10 percent discount rate. This methodology greatly simplifies the mathematical programming formulation without loss of information.

The multiple year dynamics of the problem include wine sales activities which occur on an ongoing basis. The unknown points of wine sales, however, follow an assumed pattern of sales distribution across years. This assumed sales schedule after proper wine aging (one to three years depending on the varietal) is 50 percent for the first year and 25 percent for the second and third years. This creates a known life model. A steady state equilibrium model is therefore assumed wherein the plan is repeated every year (i.e. -replanting a portion of the vineyard, aging the same volume of wine, producing the same varietals of wine, etc.). For further information on these types of models, see El Nazar and McCarl (1986).

DATA

Data utilized in the analysis include wine and juice prices, technical wine and juice production coefficients, wine and juice marketing limitations, equipment information, grape production and purchase information, fruit juice price and requirements for blended juice, land costs, processing and miscellaneous costs and labor requirements and costs. Expert opinion and unpublished data from Post (1992) and Metz (1991) also are employed.

Results from a survey of Ozark Region winery managers are used to estimate appropriate wine prices. This informal survey asked for varietal wines sold and the retail price per 750 ml. The resulting average retail wine prices per 750 ml bottle by variety range between $3.50 and $9.00 (Table 1). Wholesale prices are determined by discounting retail prices by 50 percent[4]. There are no price differentials between varietal grape juices whether pure ($3.00 retail per 750 ml) or blended ($2.50 retail per 750 ml).

The cost of apple juice is assumed to be $0.09 per gallon and is obtained from suppliers of apple juice concentrate. For blended juice production, a one-half apple juice and one-half grape juice blend is used. Grape requirements are estimated using the following product conversions: Red and white wine - 165 gal/ton of grapes; Hot pressed juice - 190 gal/ton; and Cold pressed juice - 155 gal/ton (Dillon et al., 1994a).

Grape production data (i.e. grape yields, grape production costs, custom harvest costs, and alternative grape purchase prices) are obtained from Kirchner (1988). Weighted averages across an expected thirty-year vineyard life are used for production costs and yields (including the initial years of establishment with no grape yields).

Depreciation costs and capacity rates are calculated from machinery cost data obtained from Metz (1991). Additional procedural details are in Dillon et al. (1994b).

Table 1. Retail and Wholesale Prices for Wine/Grape Varieties.

Variety	Retail Price / 750 ml	Wholesale Price / 750ml
White Wines		
Chardonnay	7.85	3.93
Vignoles	7.50	3.75
Vidal & Seyval	5.30	2.65
Reisling	6.20	3.10
Niagara	4.10	2.05
Red Wines		
Cabernet Sauvignon	9.00	4.50
Cynthiana	6.50	3.25
Chambourcin	6.00	3.00
Chancellor	5.00	2.50
Concord	3.50	1.75

Capital requirements for equipment, buildings and nonvineyard land are obtained from survey results. Fixed costs associated with vineyard land include property taxes and a land rental opportunity cost as revised from Ward (1991). The resultant land costs are $62.11 per acre.

Processing, labor and miscellaneous costs make up the remaining data requirements and are obtained from Metz (1991) and Post (1992). Processing costs include prices of bottles, corks, labels, yeast, utility expenses and wine excise taxes. The total yearly payroll for full-time employees ranges from $39,000 for the 5,000 gallon winery to $224,000 for the 100,000 gallon winery. Miscellaneous costs include building and equipment insurance, property taxes, advertising expenses, repairs and maintenance, office supplies, building depreciation, fringe benefits and interest expenses.

RESULTS

The economic analysis of this study focuses on net returns and profitability associated with winery production and marketing decisions. Results for the base price and cost structure are presented for six winery sizes. This discussion is followed by a sensitivity analysis which examines changes in red wine prices.

Base Case

Volume, revenue, cost and net returns results using the base price and cost structure are presented in Table 2 by winery size. All wineries produce the maximum wine volume allowed by their size, and juice sales volumes are all at constraint maximums. Blended juice products are not produced by any size of winery indicating a preference for pure rather than blended grape juice production under the price and cost structure of the model. Retail sales for both wine and juice products are at maximum constraint levels reflecting the higher profitability associated with retail sales. Wine and juice revenues as a percent of total revenues remain constant at 97.2 and 2.8 percent, respectively, across all winery sizes because of wine and juice volume constraints.

With the exception of a decrease for the 20,000 gallon winery, net returns increase steadily with winery size. The highest net returns are realized by the 100,000 gallon winery at $84,426 annually. The smallest winery (5,000 gallons) experiences a slight loss of $195 per year. This level approaches zero economic profits because the model's net returns include all potential economic expenses (e.g., owner's labor and capital) except taxes on inventory and income. The return on capital to the wineries parallel the net return results with a generally increasing trend with increasing winery size. The exception to this trend is the large return for the 10,000 gallon winery.

There are at least two reasons why net returns and returns on capital do not increase smoothly with winery size for the 10,000 and 20,000 gallon capacity wineries. First, production capacity increases relatively more than capital requirements for every expansion except between the 10,000 and 20,000 gallon wineries. For example, doubling capacity requires only a 79 percent greater capital outlay when going from 5,000 to 10,000

gallons while a .104 percent increase in capital is needed to increase from 10,000 to 20,000 gallons. Fixed costs of asset ownership (e.g., depreciation, interest, repairs, maintenance, property taxes) consequently disadvantage the 20,000 gallon winery because it is a production level which requires greater automation.

Table 2 Revenues, Costs, Sales Volumes and Returns by Winery Size

	Winery Size (Annual Fermenting Capacity in Thousand Gallons)					
Item,	5	10	20	40	80	100
Wine Volume (GAL)	5,000	10,000	20,000	40,000	80,000	100,000
Wine Revenue - Retail ($)	131,832	263,663	342,754	421,861	527,326	580,053
Wine Revenue - Wholesale ($)	0	0	92,286	316,396	790,989	1,028,289
Wine Revenue ($)	131,832	263,663	435,040	738,257	1,318,316	1,608,342
Wine Revenue ($/GAL)	26.37	26.37	21.75	18.46	16.48	16.08
Wine Revenue (% of TR)	97.2	97.2	97.2	97.2	97.2	97.2
Juice Volume (Gal)	250	500	1,000	2,000	4,000	5,000
Juice Revenue - Retail ($)	3,750	7,500	9,750	12,000	15,000	16,500
Juice Revenue - Wholesale ($)	0	0	2,625	9,000	22,500	29,250
Juice Revenue ($)	3,750	7,500	12,375	21,000	37,500	45,750
Juice Revenue ($/GAL)	15.0	15.0	12.37	10.50	9.37	9.15
Juice Revenue (% of TR)	2.8	2.8	2.8	2.8	2.8	2.8
Blended Juice Volume (GAL)	0	0	0	0	0	0
Total Revenue($)	135,582	271,163	447,415	759,257	1,355,816	1,654,092
Variable Cost ($)	94,251	180,395	287,228	489,527	880,895	1,071,382
Variable Cost (% of TC)	69	71	66	67	68	68
Fixed Cost ($)	41,525	73,743	144,841	238,883	411,080	498,284
Fixed Cost (% of TC)	31	29	34	33	32	32
Total Cost	135,777	254,137	432,069	728,411	1,291,974	1,569,105
Net Returns ($)	(195)	17,026	15,346	30,846	63,842	84,426
Capital Required ($)	173,270	309,590	632,195	1,015,215	1,694,895	2,050,105
Return on Capital (%)	-0.11	5.50	2.43	3.04	3.77	4.12

[1] TR refers to total revenue, TC to total cost and GAL to Gallons. Net returns considers all expenses other than inventory and income taxes and therefore include a payment to all capital, labor and management.

Manual operations, however, may be relied on to a higher degree for the 10,000 gallon winery which therefore results in a return on capital of 5.50 percent (return over the 12 percent opportunity cost included in the model). This return is even greater than the 4.12 percent return of the 100,000 gallon winery. Also, because of the "lumpiness" of asset acquisition, some equipment is under-utilized in the 20,000 gallon winery. This results in larger fixed costs as a percent of total costs (34 percent) than for other winery sizes.

The second reason is a change in the marketing ability of the 20,000 gallon winery. At this size, the increased product volume dictates a switch from 100 percent retail sales to a combination of retail and wholesale sales. The greatest marginal decrease in average wine revenue and juice revenue per gallon occurs between the 10,000 and 20,000 gallon levels because of this constraint.

Optimal product mix decisions are depicted for the 100,000 gallon level winery in Table 3 (the results are proportional for the other five winery sizes). White wine comprises 65,000 gallons (65 percent) of total wine sales with red wine accounting for the remaining 35,000 gallons (35 percent). Certain varietal wines (Chardonnay, Vignoles, Riesling, Cabernet Sauvignon and Chambourcin) experience relatively favorable profit margins as indicated by the fact that they are sold at the maximum allowable percentage. Not surprisingly, these are in general the higher-priced wines.

The profitability of individual varietal juices are nearly opposite those found for wine, with Chambourcin and Cynthiana as notable exceptions. Given a constant price across different varietal juices, those with the lowest grape acquisition costs are produced at the maximum amount permissible. Concord juice is an extremely favorable selection followed closely by Chancellor, Chambourcin and Niagara.

Raw product acquisition results also are presented in Table 3. It is interesting to note that the least cost alternative for Niagara, Chancellor and Concord grape acquisition is to purchase as opposed to produce the grapes. This is because these varietals are produced elsewhere in large quantities by large commercial vineyards and are readily available at prices below winery costs of production.

Red Wine Price Sensitivity Analysis

The results presented above indicate that five of the six winery sizes can operate profitably under the representative economic data used in the analysis. In this section, the sensitivity of net returns and optimal production decisions is examined relative to changes in the demand for red wines due to a phenomenon such as the French Paradox. The analysis is conducted by holding current white wine prices constant while systematically altering all red wine prices by increases and decreases of 5, 10 and 25 percent. Results are presented for the largest size of winery examined, the 100,000 gallon capacity winery.

Revenue, cost and return information is presented in Table 4 by red wine price level. Wine revenues increase at a greater rate than total costs, resulting in higher net returns and return on capital with each successive red wine price increase. Costs do not increase linearly with red wine prices because of grape varietal production substitutions.

Table 3. Optimal Wine and Juice Sales Volume and Grape Production, Harvest and Purchases for the 100,000 Gallon Winery by Wine/Grape Vines.

	Sales by Variety		Raw Product Acquisitions		
Variety	Wine Sales Volume	Juice Sales Volume	Production	Harvest	Purchase
White Wines	---- Gallons ----		-Acres-	---- Tons -----	
Chardonnay	**10,000**[a]	125	15.02	61.26	0.00
Vignoles	**20,000**	500	27.3>	123.84	0.00
Vidal & Seyval	22,500	1,000	28.79	141.62	0.00
Reisling	**10,000**	125	12.57	61.26	0.00
Niagara	2.500[b]	**500**	0.00	0.00	17.78
Total White	65,000	2,250	83.73	387.99	17.78
Red Wines					
Cabernet Sauvignon	**10,000**	125	15.02	16.26	0.00
Cynthiana	2.500	125	4.34	15.81	0.00
Chambourcin	**20,000**	**1,000**	22.07	126.48	0.00
Chancellor	2.500	**500**	0.00	0.00	17.78
Concord	0	**1,000**	0.00	0.00	5.27
Total Red	35,000	2,750	41.43	203.55	23.05
Total	100,000	5,000	125.15	591.54	40.84

[a]**Bold type** indicates production at the maximum percentage allowed.
[b]Underline indicates production at the minimum percentage allowed.

That is, as different varietals are produced in higher or lower quantities with increasing red wine price, yield differences between varieties cause variable and fixed costs to increase or decrease.

Although the 100,000 gallon capacity winery is profitable over the whole price range, returns on capital are quite low when red wine prices fall below those of the base case scenario. At the high extreme of red wine prices (25 percent higher than base), net returns are nearly triple those of the base case and return on capital is more than double. This illustrates potentially great profit opportunities for wineries to capture under very favorable demand conditions such as those caused by the French Paradox.

Table 4. Revenues, Costs and Returns for the 100,000 Gallon Winery by Percent of Base Red Wine Price Level

Red Wine Price Level (% of Base Case)							
Item[1]	75	90	95	100	105	110	125
Wine Revenue- Retail ($)	546,416	566,080	571,984	580,053	592,163	603,769	641,260
Wine Revenue - Wholesale ($)	968,659	1,003,518	1,013,984	1,028,289	1,049,757	1,070,331	1,136,794
Wine Revenue ($)	1,515,074	1,569,597	1,585,968	1,608,342	1,641,919	1,674,100	1,778,054
Wine Revenue ($/GAL)	15.15	15.70	15.86	16.08	16.42	16.74	17.78
Wine Revenue (% of TR)	97.1	97.2	97.2	97.2	97.3	97.3	97.5
Juice Revenue ($)	45,750	45,750	45,750	45,750	45,750	45,750	45,750
Total Revenue ($)	1,560,824	1,615,347	1,631,718	1,654,092	1,687,669	1,719,850	1,823,804
Variable Cost ($)	1,053,857	1,070,393	1,072,129	1,071,382	1,078,713	1,082,125	1,091,873
Fixed Cost ($)	498,328	498,447	498,447	498,284	498,485	498,485	497,911
Total Cost ($)	1,552,186	1,568,840	1,570,575	1,569,666	1,577,198	1,580,609	1,589,784
Net Returns ($)	8,639	46,507	61,143	84,426	110,471	139,241	234,020
Return on Capital (%)	0.42	2.27	2.98	4.12	5.36	6.79	11.42
Change in Net Returns	(75,786)	(37,919)	(23,283)	NA	26,045	54,815	149,594

[1]TR refers to total revenue, TC to total cost and GAL to Gallons. Net returns considers all expenses other than inventory and income taxes and therefore include a payment to all capital, labor and management.

Table 5 presents varietal wine volumes as a percent of total wine volume by red wine price level. At 75 percent of the base case price level, all red wines are produced at the minimum levels that model constraints allow. This reduces red wine production to only 12.5 percent of total wine volume in favor of more profitable white wines. Red wines enter the optimal solution at the maximum amount permitted by model constraints in the following order: Cabernet Sauvignon at 90 percent of base prices, Chambourcin at 100 percent, Cynthiana at 105 percent and Chancellor at 125 percent. Concord, another red wine, never enters the optimal solution. Red wine represents an ever increasing percentage of total wine sales as the red wine price level is increased. The peak of the optimal production is at 50 percent of total volume under the 25 percent price increase scenario. Chardonnay and Vignoles, two white wines, were sold at the maximum amount allowed throughout all red wine price levels indicating their strong profitability. All increases in red wine production come at the expense of Vidal and Seyval production indicating that it is the most marginally profitable white wine varietal except for Niagara.

The results of the sensitivity analysis demonstrate the importance of conducting appropriate and timely marketing analyses for pricing and marketing decisions. They also highlight potentially large economic opportunities which could by realized by winery managers if close attention is paid to current trends in product demands.

CONCLUSIONS

Because of a growing body of medical research which links moderate red wine consumption to health benefits, demand for red wine in the U.S. has increased in recent years. The popular press, starting with a broadcast by the television news program "60 Minutes" entitled "The French Paradox," has contributed to this increased demand by popularizing the health attributes of moderate red wine consumption.

In this study, the impact of an increase in demand for red wines on small- to medium-sized southern wineries is examined. Representative wine and juice manufacturing plants of six different size capacities are examined in an economic decision-making model. The model is formulated in a known life equilibrium framework and utilizes mathematical programming, budgeting and discounting procedures.

The base case solutions are examined across six winery sizes. Net returns generally increase with larger winery sizes up to $84,426 annually for the 100,000 gallon winery. The 20,000 gallon winery exhibits a slight decrease in net returns which is associated with an increase in equipment costs and marketing outlet changes. The smallest winery examined (5,000 gallon capacity) results in the lowest and only negative net returns (-$195). However, since the model includes nearly all economic costs, this result approaches "zero economic profits." That is, payments to owner/operator labor, capital and management are included. The base case results demonstrate potentially profitably economic opportunities for established southern wineries.

A sensitivity analysis which explores the effects of an increase in demand for red wine caused by phenomena such as the French Paradox also is conducted. Profits, profitability and the amount of red wine in the product mix all increase with red wine price. Although certain more profitable white wines always remain in the production mix, red wines peak at 50 percent of wine marketed under a relatively modest (25 percent) price increase associated with an increase in demand.

Overall, study results indicate that planning and management are key components to economic success or failure in the winery business. Even if profits are not the primary motivation for owning and operating a winery, they are often pertinent to cash flow and winery survival. Detailed attention to production of premium grapes and the making of high quality wine at the sacrifice of developing and following adequate business practices can result in poor financial performance. Wine industry sources verify that the transition from grape grower to wine marketer can be difficult. Winery owners and operators who make this conceptual transition will be the most economically successful.

Table 5. Wine Production Volume for the 100,000 Gallon Winery by Percent of Base Red Wine Price Level

	Red Wine Price Level (% of Base Case)						
Item	75	90	95	100	105	110	125
	------- Wine Volume as a Percent of Total Volume (100,000 Gallons) ------						
White Wines							
Chardonnay	**10.0**[a]	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**
Vignoles	**20.0**	**20.0**	**20.0**	**20.0**	**20.0**	**20.0**	**20.0**
Vidal & Seyval	45.0	37.5	37.5	22.5	15.0	15.0	7.5
Riesling	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**
Niagara	2.5[b]	2.5	2.5	2.5	2.5	2.5	2.5
Red Wines							
Cabernet Sauvignon	2.5	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**
Cynthiana	2.5	2.5	2.5	2.5	**10.0**	**10.0**	**10.0**
Chambourcin	5.0	5.0	5.0	**20.0**	**20.0**	**20.0**	**20.0**
Chancellor	2.5	2.5	2.5	2.5	2.5	2.5	**10.0**
Concord	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total White	87.5	80.0	80.0	65.0	57.5	57.5	50.0
Total Red	12.5	20.0	20.0	35.0	42.5	42.5	50.0

[a]**Bold type** indicates production at the maximum percentage allowed.
[b]Underline indicates production at the minimum percentage allowed.

ENDNOTES

1. The 60 Minutes report "'A' is for Apple" aired on February 29, 1989 and caused great public concern about the safety of the United States' apple supply. Alar, a pesticide and growth regulator used in apple production, was soon removed from the market by its manufacturer, Uniroyal Chemical Company. The apple industry estimates that they lost $100 million as a result (Gets, 1993).
2. The abbreviated version of the model presented here is only for discussion purposes. A complete version of the model is available from the authors on request.
3. The maximum percentage retail sales volumes are 100, 100, 67, 40, 25 and 22 percent and the maximum juice sales volumes are 250, 500, 1,000, 2,000, 4,000 and 5,000 gallons for the 5,000 through 100,000 gallon capacity wineries, respectively.
4. This is a standard discounting method which allows for a 33'/a percent markup at the wholesale level and then a 50 percent markup at the retail level.

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