Equipment Costs for Small-Sized To Medium-Sized Wineries

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Capital Requirements by Equipment Type or Category and Winery Size

Table 1

	Plant Size (Annual Capacity in Thousand Gallons)					
item	5	10	20	40	so	100
EQUIPMENT'	- - - - Dollars (s) - - - -					
Receiving & Crushing	14920	22455	65990	71905	129675	130015
Cellar	6310	29335	33925	66900	119600	119600
Juice Line	21000	21000	31000	38000	48000	55000
Tanks	37600	50180	84500	118570	209860	227670
Refrigeration	0	20000	40000	40000	55000	55000
Barrels	12020	23900	48060	96120	192240	240300
Bottling	7420	18720	104720	149720	156520	173520
TOTAL WINE & JUICE CAPITAL	99270	185590	408195	581215	910895	1001105
Buildings & non vineyard land	74000	124000	224000	434000	784000	1049000
TOTAL (EQUIPMENT & BUILDINGS)	173270	309590	632195	1015215	1694895	2050105
	- - - - Square Feet of Buildings and Sales Area - -					
SQ FT	2400	4400	8400	15400	29400	40000
	- - - - Dollars (s) - - - -					
CAPITAL PER SQ FT	72.20	70.36	75.26	65.92	57.65	51.25

-Equipment capita requirements ate taken from David Ward, Planning Guidelines for Small and Medium-a Sized Wineries/Juice Plants in Arkansas. (unpublished MS Thesis).

"What are the equipment units and costs that should be included in order to achieve a small- to medium-sized winery production level?" Answers to this question have been included in University of Arkansas research which has been designed to provide practical economic guidelines for managers of wineries ranging between 5,000 and 100,000 gallons in total annual fermenting capacities.

Two previous articles have outlined results from a mathematical programming model. "Economic Considerations for Small-Sized to Medium-Sized Wineries," which appeared in the 1992 Wine East Buyers' Guide, made estimates to project the capital requirements and annual operating costs, revenues and net returns for small- to medium-size wineries. "Adding a Juice Line to a Winery," in the May/June, 1992, issue of Wine East, summarized economic operational decision guidelines for the same six small- to medium-size plants: 5,000, 10,000, 20,000, 40,000, 80,000 and 100,000 gallons in annual fermenting capacities. This article is coordinated with the previous two which were reporting results of the mathematical programming model. It also utilizes data from a third article, "Packaging Line Considerations for Small Wineries," which appeared in the 1991 Wine East Buyers' Guide.

In this article, the examination will include only the details of equipment capacities and costs by operational stage for wineries with juice processing equipment. The framework for the model's production and marketing decision procedures have

already been outlined in the two articles based on the mathematical programming model and will not be directly addressed here. In each of these articles, annual capacities are being defined by both the operating rate of each equipment unit and the time constraint included in the relatively short harvest period required to maintain optimal quality of the final product.

Table 1 gives an overview of the total capital costs by operating stage by winery/juice plant size. While this is an update of Table 4 on page 10 of the article in the 1992 Wine East Buyers' Guide and includes the cost of grape juice line equipment, it will be helpful to the reader to have a "birds-eye" view of the framework for the discussion which will follow. The entries in Table 1 also show the cost of buildings and non-vineyard land and expected square feet in building and sales area which provide a basis for the winery/juice plant operation. However, there is no intention of recommending a plant design or sales floor layout. The focus of this article will be on the components within each operational stage as it would occur in the plant. The equipment items will be discussed in order and in some cases the irregular changes in costs and capacity flows will be singled out for examination.

An important component to consider in equipment acquisition is the trade-off of capital and labor. Examples of specific features will be discussed but the substitution of capital for labor is possible at every stage of winemaking. Increasing demands on time are evident with increases in winery size. While more labor is needed, greater levels of capital investment are also needed with the time savings they offer. Quality of labor often becomes more and more limited as wineries expand, therefore increasing the advisability of investment in quality equipment.

Receiving and Crushing Stage

In Table 2, the equipment items are listed with the estimated capacities and costs that were entered in the model for calculations of (1) expected output, (2) revenue, (3) operational costs, and (4) net returns. The 5,000 gallon plant was projected as needing only a $500 pallet jack to move the loaded picking bins for the initial delivery of grapes to the building's unloading dock. With the addition of a forklift to the pallet jack for the 10,000 gallon plant, the cost of the equipment showed a eight-fold jump to $4,000. However, for the other size plants, the equipment and costs for this operation had only one more increase when at 20,000 gallons a larger forklift was needed. The forklift is used for other operations in addition to moving bins during the crushing stage. It is the key unit in moving case goods, unloading bottles off trucks, moving barrels, etc.

While the costs of pallet loading for plants increased evenly with size, the costs and capacities of the receiving hopper and hoist tended to be irregular. This is due to the fact that the sizes and costs of equipment available from manufacturers do not always conform exactly to small- to medium-size plant output needs. For example, based on the availability of equipment sizes, the 4 ton per hour ($4,100) unit could handle both the 5,000 and 10,000 gallon plants, the 7-11 ton per hour ($6,000) unit would accommodate both the 20,000 and 40,000 gallon plants, and the 20 ton per hour ($10,000) unit would be required to provide for the receiving hopper and hoist for the 80,000 and 100,000 gallon plants.

Capacity and cost changes were even more erratic for the crusher-stemmer and pressing operations in this stage. While the 4 ton per hour ($4,100) unit could accommodate both a 5,000 and 10,000 gallon plant, the larger plants required increasingly more expensive crusher-stemmer units. This and the previous operations in this stage illustrate the problems in equipment buying and cost for the small- to medium-sized winery. For example, in the model, both the 5,000 and 10,000 gallon plants used the equipment units with 4 tons per hour capacity for the receiving and crusher-stemmer operations. However, for the grape press, the 1/2 to 3/4 ton per hour ($4,000) unit was deemed adequate for the 5,000 gallon plant, the 2 to 4 ton per hour ($8,000) unit was needed for the 10,000 gallon plant, and the 71/2 to 11 ton per hour ($37,900) unit would be required to provide for both the 20,000 and 40,000 gallon plants

In almost all cases there is some underutilization of equipment for the smaller plants, and the cost and capacity increments become irregular between the plant sizes. Thus, even though it may appear as if two $4,100 machines are more cost effective than one $13,000 machine that has only twice the capacity, there are considerations of additional features obtained from the greater investment in equipment.

The crusher is a good example of this. There is a vast difference in the technology used in a $4,100 crusher for the 5,000 gallon winery and the $13,000 crusher for a 20,000 gallon winery. As the winery grows, the winemaker's expectations grow along with the production capacity, and it is necessary to consider the influences that the attributes of the equipment have on the control of techniques and wine quality. Closer inspection of this crusher example leads to several insights:

5,000 gallon winery crusher $4,100

- Production capacity: 4 tons per hour
- Stainless steel machine with built-in receiving hopper
  - Crushes before destemming
  - No control over stem/destem or crushing
  - Built-in paddle type must pump

20,000 gallon winery crusher $13,000

- Production capacity: 7-9 tons per hour
- Stainless steel machine with no receiving hopper
  - Destemming before crushing
  - Counter rotating destemming drum with adjustable speed
  - Stems or destemming selectable
  - Crush or no crushing selectable
  - No pump provided, open bottomed

Upon casual observation, it would seem like the operator of the 20,000 gallon winery should buy two 5,000 gallon winery type crushers. After all, the larger crusher needs a more expensive must pump and a receiving hopper. However, several questions need to be addressed.

TABLE 2 Stage #1: Receiving and Crushing Equipment Listing by Item Cost and Capacity

Equipment Items	Plant Size (Annual Capacity in Thousand Gallons) 5	10	20	40	80	100
	- - - Cost in Dollars ($) - - - - Capacities					
Forklift	$ 500 Pallet Jack only	$ 4, 000 1 ton to 11/2 ton & pallet Jack	$ 5.500 2 ton to 2'h ton & pallet Jack	5 500 (same)	$$ 5-500500 (same)	$ 5.500 (same)
Pallets	$ 70 10 @ $7 ea	105 15 @ $7 ea	140 20 @ $7 ea	245 35 @ $7 ea	420 60 @ $7 ea	$ 560 80@ $7 ea
Receiving Hopper & Hoist	$4,100 4 tons per hr.	$4,100 (same)	$6,000 7-11 tons per hr.	$6, 000 (same)	$10.000 20 tons per hr.	$10.000 (same)
Crusher - Stemmer	$4,100 4 tons per hr.	$4,100 (same)	$13,000 7-9 tons per hr.	$15,500 11-16 tons per hr.	$22,000 33 tons per hr.	$22,000 (same)
Press	$4,000 ½ to ¾ tons/hr.	$8,000 2-4 tons per hr.	$37.900 7 ½ to 11 tons/hr.	$37.900 (same)	$75,000 16 1/2 to 27 tons/hr.	$75.800 (same)
Must Pumps	$1,275 (1) 70 gal/min 60 mm (2" hopper	$1,275 (same)	$ 2,100 (1) 150 gal/min	$5,000 rotating lobe	$12,780 Flexible impeller	$12,780 (same)
Must Lines	$150 50' of 2 3/8' 60mm hose $3/ft	$150 (same)	$300..... 100' of 2 3/8' 60mm hose	$300 (same)	$300 (same)	$300 (same)
Cellar Hose	$725 165' of 2" hose 20 end fittings @ $20 ea	$ 725 (same)	$1,050 330' of 2" hose 20 end fittings	$1,460 (same) 40 end fittings	$1,975 487½ ' of 2" hose 50 end fittings	$2,175 (same) 60 end fittings
Total Stage Cost	$14,920	$22,455	$65.990	$71,905	$129,675	$130,015

1. Does the winemaker want the stylistic control over crushing the larger crusher provides? These features cost more due to the added mechanical complexity.

2.Will the larger winery be receiving its grapes in bins rather than lug boxes? If so, the built-in hopper on the smaller crusher is inadequate and a hopper that will hold tons of grapes at a time is required.

3.Will the larger winery be using a must chiller in line with the crusher? This precludes using the simple pump of the smaller crusher.

It is important to note that none of these things is absolutely necessary to make wine! However, from day one, the winemaker may want them to practice his/her art. Consequently, the smaller crusher may no longer fit either the expectations of the winemaker or the entire system of the crush pad.

Equipment purchases display "economies of size" when the equipment capacities are able to handle two plant increments such as purchasing one unit that would serve both 5,000 and 10,000 gallon wineries, lowering the cost per gallon as size increases. While this is for the present an inescapable fact of life based on the demands to manufacturers for different sizes of winery/juice plant equipment, it serves to demonstrate some of the reasons for the cost and profit structure differences projected in the first two articles in this series. This same pattern is followed in the costs and capacities of the pump and hose equipment items needed for operations in this stage as the grapes are received, processed, and converted into juice (Table 2).

Cellar Stage. Equipment needs in capacities and costs in the cellar stage follow a similar pattern of sometimes irregular changes between the six winery sizes (Table 3). For example, for the 5,000 gallon winery the projected needs include only a $10 oar or paddle for an agitator, a $990 (28 gal/min) cellar pump, and a $10 bucket for a diatomaceous earth mixer. As plant size increases to 10,000 gallons for these operations within the cellar stage, the cost of the mechanical agitator shows a 100-fold increase and the cellar pump cost a three-fold jump. On the other hand, there is a relatively minor increase in the total stage cost between 10,000 and 20,000 gallons as opposed to the doubling that takes place as winery size increases to 80,000 gallons.

The estimated cost of filtration equipment increased more than four times between the 5,000 and 10,000 gallon wineries. This was due to the addition of lees and diatomaceous earth filtration units for the 10,000 gallon and succeeding size plants. The next change in equipment and costs for this operation is a jump at the40,OOO gallon facility. Again this is evidence that the standard sizes and capacities of equipment units provided by manufacturers do not always fit exactly into the output levels of small- to medium-sized wineries. The resulting over- or underutilization of equipment capacities is a factor to consider in designing a wine and juice processing plant.

Wineries need to make plans for potential expansion. In this regard the equipment manufacturer is faced with the problem of trying to hit a moving target. For example, in a given winery a machine that is perfectly sized for 10,000 gallons in production may be too small for a 20,000 gallon capacity operation and too large for smaller capacities. Also, in a given year, you may expect grape yields of 6 tons per acre and in actuality have yields at 9 tons or a 50% increase in yield brought into your fixed equipment size/production goal equation. Often the equipment capacity must be sequenced to the time available to do certain operations.

Table 3 Stage #2: Cellar Equipment Listing by Item Cost and Capacity

Equipment Items	Plant Size (Annual Fermenting Capacity in Thousand Gallons) 5	10	20	40	80	100
	- - - Cost in Dollars ($) - - - - Capacities					
Agitator	$10 oar or paddle	$1,100 mech. agitator with fittings	$1,100 (same)	$2,200 (same)	$3,300 (same)	$3,300 (same)
Assorted Clamps and Fittings	$ 600	$1,200	$2,400	$4,800	$7,200	$7.200
Cellar Pumps	$990 28 gal/min	$3,500 1-70 gal/min 1-80 gal/min	$3,500 (same)	$13,495 (same plus 1-100 gal/min	$13,495 (same plus 2-100 gal/min	$13,495 (same)
Diato-Maceous Earth Mixer and Doser	$10 Bucket	$10 (same)	$3,400 1001iter muting tank & doser	$3,400 (same)	$5,300 2-100 liter mixing tank & doser	$5,300 (same)
Centrifuge fuge	N/A	N/A	N/A	N/A	$46.000	$46,000
Plate & Frame Filtration	$4,400 21-40cm stainless steel	$4,400 (same plus lees Filter)	$4,400 (same)	$5,900 41-00cm plates & Lees Filter	$7,200 60-4Ocm plates & Lees Filter	$7,200 (same)
Diato Maceous Earth Filtration	NIA	$6,700 1000 to 1500 gal/hr.	$6,700 (same)	$17,000 1500 to 2400 gal/hr	$17.000 (same)	$17,000 (same)
Barrel Washer	$300 Midget or stenjorg	$525 washer with stand	$525 (same)	$525 (same)	$525 (sate)	$ 525 (same)
Lees Filtration	N/A	$11,900 20-40cm plate	$11,900 (same)	$19,580 30-50cm plate	$19,580 (same)	$19,580 (same)
Total Stage Cost	$6,310	$29,335	$33,925	$66,900	$119,600	$119,600

Fermentation/Storage, Juice Line, Aging, and Refrigeration Stage

Economies of size are evidenced by the estimated requirements for fermentation/storage tanks in this stage (Table 4). This is seen in that the cost per gallon in tank capacity declined in relatively even increments from $5.41 in cost per gallon for the 5,000 gallon plant to $1.71 in cost per gallon for the 100,000 gallon plant. The requirements and costs for barrels for wine aging also increased in exact step with capacities while the costs within the fermentation stage for the juice line and refrigeration operations showed some erratic jumps between plant sizes.

Filtration equipment is an area of difficulty for owners of small wineries. For 10,000 gallons production, a simple pad type filter will suffice. The $11,900 lees filter is nonetheless more desirable and economical because of production efficiency. If they press 10,000 gallons of white juice, over 1,000 gallons will be lost as settling and fermentation lees. The lees filter eliminates 90% of this loss. This is very important to the small producer for what they are losing is not only juice but potential sales. 1,000 gallons of juice is actually $25,650 worth of retail sales in the tasting room.

Gal. of lees x recovery % x bottles per gal. x average retail price of the wine in the tasting room = sales

1,000 x .90 x 5 x $5.70 = $25,650

The additional cost of a lees filter results in a considerable increase in gross revenues assuming retail sales with average white wine price of $5.70. Nonetheless, most small (under 20,000 gallons) wineries don't own one due to the initial capital cost. While this $25,650 is not pure profit because of additional expenses (bottles, wine taxes, etc.), the results do demonstrate the economic desirability of lees filtration. Admittedly, the exact percentage of recovery, ability to rely upon retail sales, and limits of other equipment capacity may also influence these results.

Bottling Line Stage

Because of changes from mostly manual to more mechanized operations in this stage, these are the most dramatic increases in equipment requirements and costs in this study (Table 5). For example, total stage costs double between the 5,000 and 10,000 gallon plants but increase five-fold from the 10,000 to the 20,000 gallon winery. Increases in cost between sizes for the more mechanized wineries (20,000 gallon and larger), tend to be more in proportion to the changes in capacities.

Changes in the equipment costs within each operational stage between plant sizes are even more sharply defined than the total stage cost differences. For example, the estimated requirements and costs for the cleaning and sparging increases almost 1000-fold as plant size increases beyond the 5,000 and 10,000 gallon capacities. In this case as you leave the two lower capacity plants, there is a move from a $25 equipment cost for a 700 bottle-per-hour hand-made machine increasing to a 9-spout automatic in-line, 1,500 bottle-per-hour machine costing $24,000 for the 20,000 gallon capacity. The same comparison holds true as we move from the 10,000 gallon to the 20,000 gallon capacity plant for other within bottling stage operations such as: (1) a more than twenty-fold cost increase in cost for filling and corking; (2) a ten-fold increase in cost for capsuling; and (3) a six-fold increase in the labeling operation cost.

Small changes in capacity can cause great changes in cost of machines. This is evident in the 50 bottle-per-minute (BPM) speed "wall" on bottling lines. Under 50 BPM, labor can unscramble (place on the line) and pack bottles in cases by hand. Due to the high cost of automatic case packing machines, they are not cost effective at 50 BPM or less. Corking also has an effect on the cost effectiveness of a line. Under 50 BPM a single head corker can be used. Above 50 BPM a much more expensive rotary multiple head corker is required. The result is that wine packaging lines are rarely built for speeds between 50 and 100 BPM. Total automation of the casing becomes practical again over 100 BPM.

Equipment suppliers' observations have demonstrated that many wineries at 10,000 gallon capacity will purchase an automated bottling line as they expand capacity to accommodate 20,000 gallon in production. This purchase may not be cost effective from an accounting standpoint but will be economically effective because the key person no longer has time available to accomplish their highest priority tasks. The management of the winery must be aware and focused upon items of capital-labor substitution such as this.

Another factor is sanitation and consistency of packaging. Totally sterile filling is difficult to do by hand. Automated machines allow very precise quality control. Fill heights and label placement will be consistent from bottle to bottle. This is an important consideration for wines placed in wholesale distribution.

Summary and Implications

Some of the cause and effect relationships in this small- to medium-sized winery study are revealed in the examination of the lists of equipment requirements and costs for each plant size. Based on the estimated annual revenues, operational costs, and net returns updated for wine price and recent survey and equipment cost information, the 5,000 gallon winery is estimated to produce *-$195*, an annual loss and a -0.11% return to capital when juice production is included (Table *6)*. However, with the adjusted model and no juice production, the result for the *5,000* gallon winery is a *$2,012* profit and *1.32%* rate of return. The 10,000 gallon winery is estimated to be able to produce a profit of *$17,026* when including juice products, and this is the highest profit per dollar invested, a *5.50%* return to capital over interest expense in the sixth year of operation. In comparison, the *20,000* gallon winery with juice production returns only a *$15,346* profit with a *2.43%* return

Stage #3: Fermentation /Storage, Juice Line, Aging and Refrigeration Equipment

Listing by Item Cost and Capacity

Equipment Items	Plant Size (Annual Capacity in Thousand Gallons) 5	10	20	40	80	100
			- - - Cost in Dollars ($) - - --- Capacities -			
Fermentation & Storage Tanks	$37,600 Tanks: 8-250 gal 2-330 gal 4-440 gal 2-550 gal 2-880 gal Drums: 1-55 gal 7,335 gallon capacity	$50,180 Tanks: 8-250 gal 2-330 gal 2-440 gal 2-550 gal 2-880 gal 2-1000 gal 2-1250 gal 2-1500 gal Drums: 10-55 gal 14,450 gallon capacity	$84,500 Tanks: 8-250 gal 2-330 gal 2-440 gal 6-550 gal 2-880 gal 2-1000 gal 1-1250 gal 1-1500 gal 1-1800 gal 1-2000 gal 1-2200 gal 1-2500 gal 1-2800 gal 1-3300 gal Drums: 10-55 gal 28,500 gallon capacity	$118,570 Tanks: 8-250 gal 2-330 gal 2-440 gal 6-550 gal 2-880 gal 2-1000 gal 1-1200 gal 1-1500 gal 1-1800 gal 1-2000 gal 1-2200 gal 1-2500 gal 1-2800 gal 1-3300 gal 2-5000 gal 2-5500 gal 1-6600 gal Drums: 10-55 gal 56,050 gallon capacity	$209,860 Tanks: No. Gal. 8-250 2-330 2-440 6-550 2-880 2-1000 1-1500 1-2500 1-3300 1-3800 1-4400 2-4800 2-5500 2-6100 2-6800 2-8800 2-10000 Drums: 10-55 gal 110,650 gallon capacity	$227,670 Tanks: No. Gal. 8-250 2-330 2-440 6-550 2-880 2-1000 1-1500 2-2500 2-3300 1-3800 1-4400 2-4800 4-5500 3-6100 2-6800 2-8800 2-10000 Drums: 10-55 gal 133,550 gallon capacity
Juice Line						
Heat Exchangers	**$2,750** 1 gal/min	**$2,750** (same)	**$2,750** (same)	**$4,500** 5 gal/min	**$4,500** (same)	**$6,250** 10 gal/min
Small						
Large	**$8,250**	**$8,250**	**$8,250**	**$13,500**	**$13,500**	**#18,750**
	1 gal/	(same)	(same)	5 gal/min	(same)	10 gal/
Boiler	**$10,000**	**$10,000**	**$20,000**	**$20,000**	**$30,000**	**$30,000**
Total Equipment	**$21,000**	**$21,000**	**$31,000**	**$38,000**	**$48,000**	**$55,000**
Aging (in Oak Barrels -- 59 gal., 225L -- For all red wines and Chardonnay)						
American @ $140	**$ 3,220**	$ **6,300**	**$12,460**	$ **24,920**	$ **49,840**	$**62,300**
French @$400	$**8,800**	**$17,600**	**$35,600**	**$71,200**	**$142,400**	$178,000
Total Cost	**12,020**	**23,900**		**48,060**	**96,120**	
192,240	**240,300**					
	2,655 gal capacity	5,251 gal capacity	10,502 gal capacity	21,004 gal capacity	42,008 gal capacity	52,510 gal capacity
Refrigeration	**N/A** Self Contained	**$20,000** 5 ton system'	**$40,000** 25 ton systems[2]	**$40,000** (same)	**$55,000** 70 ton system3	**$55,000** (same)
Total Stage Cost	**$70,620**	**$115,080**	**$203,560**	**$292,690**	**$505,100**	**$577,970**

'With chiller 50 gallon glycol, ¾ hp centrifugal pump.
[2]1-15 ton 1-10 ton with chiller 2 hp circulation pump.
[3]2-15 ton 2-20 ton 5 hp circulation pump 150-gallon glycol pump.

Table 5 Stage #4: Bottling Line Equipment Listing by Item Cost and Capacity

Equipment Items	Plant Size (Annual Fermenting Capacity in Thousand Gallons) 5	10	20	40	80	100
			- - - Cost in Dollars ($) - - - - Capacities -			
Cleaning & Sparging	$25 700 btls/br. (hand made)	$25 (same)	$24,000 9-spout auto in-line 1500 btls/hr.	$31,400 9-spout auto in-line 1500 btls/hr.	$76,100 Two stages: GAI 2503 12-spout rinser & sparger auto in-	$76,100 (same)
Filling & Corking	$1,275 6-Spout Gravity: 800 btls./hr.	#1,275 (same)	$27,00 GAI 1000 auto in-line 8-spout 1000 btls./hr.	$37,900 GAI 2500 auto in-line 12-spout 2500 btls./hr	line filler/ corker 2500 btls./hr.	
Capsuling	$800 1000 to 2000 btls./hr. pushon, oven, spinner	$800 (same) part of	$10,000 Mono-block as filler	$25,700 GAI 416401 4-head in-line foil spinner out to capsule dist.	$27,000 (same)	$25,700 (same)
Labeling	$4,900 700 btls/hr. semi-auto pressure sensitive	$4,900 (same)	$32,000 Auto pressure sensitive capsule dist/appl front and back label	$43,000 Auto rotary glue fixed magazine front & back label	$43,000	$60,000 (same) (same)
Handling	$ N/A Custom	$11,300 (same)	$11,300 (same)	$11,300 (same)	$11,300 (same)	$11,300
Case Closure	$150 Staple gum	$150 (same)	$150 (same)	$150 (same)	$150 (same)	$150 (same)
Case Coding	$270 Serial number machine	$270 (same)	$270 (same)	$270 (same)	$270 (same)	$270 (same)
Total Stage Cost	$7,420	$18,720	$104,720	$149,720	$156,520	$173,520

Table 6 Cash Flow Analysis by Year and Winery Size

ITEM	YEAR I	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6 & Beyond
100,000 GALLON WINERY						
Wine Revenue($)	0.00	**473,442.33**	**954,572.66**	**1,392,823.18**	**1,558,045.97**	**1,608,350.21**
Juice Revenue($)	**45,749.92**	**45,749.92**	**45,749.92**	**45,749.92**	**45,749.92**	**45,749.92**
Total Revenue($)	**45,749.92**	**519,192.25**	**1,000,322.58**	**1,438,573.10**	**1,603,795.89**	**1,654,100.13**
Total Cost($)	**1,569,666.39**	**1,569,666.39**	**1,569,666.39**	**1,569,666.39**	**1,569,666.39**	**1,569,666.39**
Net Cash Flow($)	**-1,523,916.47**	**-1,050,474.14**	**-569,343.81**	**-131,093.29**	**34,129.50**	**84,433.74**
80 000 GALLON WINERY						
Wine Revenue($)	0.00	**388,068.18**	**782,438.02**	**1,141,660.41**	**1,277,089.17**	**1,318,315.80**
Juice Revenue($)	**37,500.00**	**37,500.00**	**37,500.00**	**37,500.00**	**37,500.00**	**37,500.00**
Total Revenue($)	**37,500.00**	**425,568.18**	**819,938.02**	**1,179,160.41**	**1,314,589.17**	**1,355,815.80**
Total Cost($)	**1,291,974.29**	**1,291,974.29**	**1,291,974.29**	**1,291,974.29**	**1,291,974.29**	**1,291,974.29**
Net Cash Flow($)	**-1,254,474.29**	**-866,406.11**	**-472,036.27**	**-112,813.88**	**22,614.88**	**63,841.51**
40,000 GALLON WINERY						
Wine Revenue($)	0.00	**217,318.18**	**438,165.29**	**639,329.83**	**715,169.93**	**738,256.85**
Juice Revenue($)	**21,000.00**	**21,000.00**	**21,000.00**	**21,000.00**	**21,000.00**	**21,000.00**
Total Revenue($)	**21,000.00**	**238,318.18**	**459,165.29**	**660,329.83**	**736,169.93**	**759,256.85**
Total Cost($)	**728,410.61**	**728,410.61**	**728,410.61**	**728,410.61**	**728,410.61**	**728,410.61**
Net Cash Flow($)	**-707,410.61**	**-190,092.43**	**-269,245.32**	**-68,080.78**	**7,759.32**	**30,846.24**
20,000 GALLON WINERY						
Wine Revenue($)	0.00	**128061.24**	**258202.00**	**376744.22**	**421435.27**	**435039.93**
Juice Revenue($)	**12374.88**	**12374.88**	**12374.88**	**12374.88**	**12374.88**	**12374.88**
Total Revenue($)	**12374.88**	**140436.12**	**270576.88**	**389119.10**	**433810.15**	**447414.81**
Total Cost($)	**432068.56**	**432068.56**	**432068.56**	**432068.56**	**432068.56**	**432068.56**
Net Cash Flow($)	**-419693.68**	**-291632.44**	**-161491.68**	**-42949.46**	**1741.59**	**15346.25**
10000 GALLON WINERY						
Wine Revenue($)	0.00	**77613.64**	**156487.60**	**228332.08**	**255417.83**	**263663.16**
Juice Revenue($)	**7500.00**	**7500.00**	**7500.00**	**7500.00**	**7500.00**	**7500.00**
Total Revenue($)	**7500.00**	**85113.64**	**163987.60**	**235832.08**	**262917.83**	**271163.16**
Total Cost($)	**254137.47**	**254137.47**	**254137.47**	**254137.47**	**254137.47**	**254137.47**
Net Cash Flow($)	**-246637.47**	**-169023.83**	**-90149.87**	**-18305.39**	**8780.36**	**17025.69**
5000 GALLON WINERY						
Wine Revenue($)	0.00	**38806.82**	**78243.80**	**114166.04**	**127708.92**	**131831.58**
Juice Revenue($)	**3750.00**	**3750.00**	**3750.00**	**3750.00**	**3750.00**	**3570.00**
Total Revenue($)	**3750.00**	**42556.82**	**81993.80**	**117916.04**	**131458.92**	**135581.58**
Total Cost($)	**135776.69**	**135776.69**	**135776.69**	**135776.69**	**135776.69**	**135776.69**
Net Cash Flow($)	**-132026.69**	**-93219.87**	**-53782.89**	**-17860.65**	**-4317.77**	**-195.11**

Note: The total costs are figures reflecting the annual costs of operation such as depreciation, the cost of grapes and repairs and maintenance. They include a 12% interest rate (or rate of return on personal investment) and a salary for the owner, but exclude taxes on income and inventory. It should be noted that these are not the initial building and equipment costs which are shown in Table 1.

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Filtration, crushing, and bottling were discussed as examples, but space will not permit a case by case examination of the benefits possible.

For purposes of planning similar new winery/juice plant equipment purchases, the owners and managers would have to consider the operational results from the first five years. These have also been projected by the model and are displayed in Table *6.* The excess of costs over revenues in years one through four can be viewed as an investment period when some of the wines are in the aging process maturing for later sale. One potential operational change that could be considered to minimize the cost overrun during these years would be to purchase grapes for pressing and immediate sale as unfermented juice. This, however, would require planning and sales coordination. If used equipment were available, the individual situation of the specific winery should accordingly reflect this opportunity. The mathematical programming model could be adapted for an individual winery to project costs, etc., if consultant arrangements were made and the new capacity and equipment costs were entered.

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