

## Using Pearson's Square

by Matt Mathews

You may have seen Pearson's Square (or Pearson Square) mentioned in books on winemaking, but few sources actually say what it's for. This article shows examples and explains how to use it.

Pearson's Square handily solves the problem of how to mix two solutions of known percentages without having to solve sets of simultaneous equations. If you love algebra, you just keep on solving those simultaneous equations. Pearson's Square is for the rest of us and it's just as accurate. You can do it on the back of an envelope.

Some practical applications for using Pearson's Square are:

- Adding sugar syrup to increase the Potential Alcohol of a must
- Sweetening a dry wine with sugar syrup
- Fortifying a wine by adding brandy or neutral grain spirits to make Port
- Adjusting the Titratable Acidity of two wines by blending.
- When blending two wines (for taste) you can find out the alcohol content of the blend. You can probably figure out how to back into this solution. It's not covered in this article.

### Increasing the Sugar Content of a Must

The volume of alcohol in a finished wine is directly related to how much fermentable sugar (by weight) the must contains. A triple-scale hydrometer (with Specific Gravity, Potential Alcohol, and Brix/Balling scales) lets you read the predicted value directly. Let's say you have a juice that is 12 Brix and you want to add enough sugar to it to bring it up to 24 Brix. You can make a sugar solution of known concentration (discussed in next month's article) and determine how much syrup to add. Of course, part of the sugar solution is water, which increases the must's volume.

### Sweetening a Finished Dry Wine

If you sweeten a finished wine, always use sugar syrup; never use dry sugar. If you plan to sweeten and bottle a wine, you must use sorbate preservative to prevent renewed in-bottle fermentation (and possible explosions!). Alternatively, you can sweeten the wine in a decanter and mix well before serving.

- Dry wines, by definition, have less than 1% residual sugar (Brix reading of -1.0 to +0.9).
- Semi-sweet wines range from 1-4 Brix.
- Dessert wines may be as high as 10 Brix.

Measure the Brix of the wine before and after sweetening, and let taste be your guide. Sweetness balances the taste of the alcohol and may make fruit flavors more prominent. Test on a 6 fl. oz. serving and add proportionately to the remainder of

the bottle. It's best to under-sweeten and then have to add a little more.

The complete Pearson's square looks like the following grid, but it is often shown as just the five letters in the same arrangement as the 5 side on dice.

**Table 1. Pearson's Square**

	%		Parts
Weak Solution (juice):	A		D
Target Solution (must):		C%	
Strong Solution (syrup):	B		E

Where,

A = sugar concentration of juice. Here it's 12% sugar by weight (12 Brix)

B = sugar concentration of syrup, 65% (65 Brix)

C = target concentration of A+B mixed, 24% (24 Brix).

Note that A, B, and C are all in terms of percentage (Brix is percent sugar by weight).

To find D and E (Parts), simply subtract diagonally across the square (always subtract the smaller number from the larger), thus:

$$D = B - C = 65 - 24 = 41$$

$$E = C - A = 24 - 12 = 12$$

$$\text{Total parts} = D + E = 53$$

Now this is as far as most instructions go. At this point, we know that to make a 24 Brix must, it takes 41 "parts" of juice and 12 "parts" of sugar syrup, but this solution is not usable yet. How do you measure a "part?"

### Carrying on where Pearson left off

To get to how much juice and syrup to use, we have to get "parts" in terms we can measure, like fluid ounces (fl. oz.). If we know the percentages of each solution to use and the total volume to make, we can easily find out how much of each to use.

First, let's convert the "parts" to proportions by first totaling the parts: add  $D + E = 53$ .

Since 53 "parts" is 100% of the desired volume, if we divide both D and E by it, we get the proportions of each solution. The sum of the proportions equals 1.00. Then, if you want it in terms of percentage, multiply the proportions by 100. This little step is unnecessary though.

$$D = 41 / 53 = 0.77 \text{ or } 77\%$$

$$E = 12 / 53 = 0.13 \text{ or } 13\%$$

$$(D + E) / 53 = 1.00 \text{ or } 100\%$$

Whew! The hard part is over, but we still don't know exactly to measure each solution. The next step is to consider how much must to make. One gallon is 128 fl. oz., so multiply 128 times the desired number of gallons, then times each proportion. Table 2 uses one gallon.

**Table 2. Obtaining proportions and amounts from Pearson's Square**

	Percent		Parts	Proportion	Amount (fl. oz.)
Juice	12%		= 41	41/53 = 0.83 (83%)	<b>99.02</b>
Must		24%			
Syrup	65%		= 12	12/53 = 0.13 (13%)	<b>28.98</b>
			53	1.00 (100%)	<b>128 fl. oz. = 1 gallon</b>

For our purposes, it's enough to round the amounts to the nearest ounce. One gallon (128 fl. oz.) of 24 Brix must contain:

Juice (12%)      99 fl. oz.

Syrup (65%)      29 fl. oz.

Make the mixture and recheck the Brix with your hydrometer. If your math and measurements are accurate, the Brix of the must is spot on at 24.0.

Table 3 shows an example of fortifying a wine with neutral grain spirit to make port with 18% alcohol.

**Table 3. Fortifying wine to make port**

	% Alcohol	Target	Parts	Proportion	Amount
Wine	12%		77	77 / 83 = 0.927	119
Port		18%			
Spirit	95%		6	6 / 83 = 0.073	9
Total			83	1.000	128 fl. oz.

### Automating Pearson

As easy as it is to use Pearson's Square, it is much faster and accurate to put the formulas in a spreadsheet on your

computer or PDA. The following formulas work in Microsoft™ Excel, but you may have to adapt them for other programs. In cells with underlined contents, enter a number or label. For ease of reading, set all cells to show 2 decimal places.

To add a cell where you enter the **Alcohol % in finished wine** (see cell E1 in Table 4), change C5 to =E1/0.54. Remove italics from C5 and lock the cell. Italicize cell E1 and enter a number.

**Table 4. Formulas for Pearson's Square in a spreadsheet**

	A	B	C	D	E	F
1	<b>Pearson's Square</b>	% Alcohol in finished wine:			<u>11.00</u>	
2		<b>Brix</b>		<b>Gallons :</b>	<u>1.00</u>	=128*E2
3	<b>Solution</b>	<b>Percent</b>	<b>Target Percent</b>	<b>Parts</b>	<b>Proportion</b>	<b>Volume (fl. oz.)</b>
4	<i>Juice</i>	<u>A</u>		=B5-C4	=D3/D6	=F1*E3
5	<i>Target Mixture</i>		<u>C</u>			
6	<i>Standard Solution</i>	<u>B</u>		=C4-B3	=D5/D6	=F1*E5
7	<i>Sum</i>			=D3+D5	=E3+E5	=F3+F5

If you use a standardized sugar solution (B) and often make wines of similar strength (cell E1 or C5), the only number you have to adjust for a new batch is A (in cell B4).

The Pearson's Square in (Microsoft Excel spreadsheet format) is available at the Guild's web site on the Download Software page ([www.northtexaswinemakers.org/downloads-software.html](http://www.northtexaswinemakers.org/downloads-software.html)).