Grading Error in the California Prune Industry

by

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Food demand in the U.S. is rather stable. As their incomes rise, most people do not consume more food; rather, they eat better, higher-quality foods. Thus, the quality dimension of the U.S. food industry has become increasingly important. The most successful growers and marketers have been those who are consistently able to provide high-quality products to consumers.

Grading of farm commodities is one way for the food industry to encourage production of high-quality products, since prices will vary according to grade. In the absence of grades, products of various quality levels are pooled and receive a common price based on the average quality. This discourages growers from adopting the costly production practices necessary to increase quality.

Unfortunately, grading is almost never done perfectly. Grading errors can emerge both as a consequence of sampling errors and from imperfect testing. In a recent study, we showed that grading with error can result in the same problems caused by the absence of grades, namely reduced incentive to produce high quality.

California produces nearly all U.S. prunes and about 70% of the world's supply. Size is the main quality criterion for dried prunes and is the crucial characteristic in determining prune value. Official grading is done by the Dried Fruit Association (DFA), for purposes of determining payments to growers, based on a 40-lb. sample collected at the time the prunes are graded by the processor. Prunes are graded by size into one of five categories, A (largest) through D (smallest) and U (undersized), and growers are paid based on a separate price negotiated for each grade, with the U grade valued at zero. The largest prunes can be sold in gourmet retail packs at a premium price. Moderately large prunes can be pitted and sold as pitted prunes, while the smallest prunes are useful only for juice, paste and other industrial products and sell for a lower price per pound.

Industry participants often complain of an "oversupply" of small prunes. Prune size may be enhanced through cultural practices, such as pruning, shaker thinning and delaying harvest. Field sizing may also be used to eliminate the smallest prunes and to avoid incurring the cost of handling them. Growers have been encouraged to adopt these practices, with limited success to date. Our study looks at the extent to which grading errors reduce the profitability of such practices.

Figure 1 represents the grader used for California prunes. As the figure suggests, small prunes may not fall into their designated screen and may, instead, travel on to screens for larger prunes, but large prunes cannot fall into the categories designated for smaller prunes. Thus, a portion of lower-quality prunes receives a higher-quality ranking, but the reverse cannot occur.

Grading Errors and Market Prices

Errors in grading prunes mean that the measured quantity of prunes in each grade is not the actual

Figure 1. DFA Prune Grading System

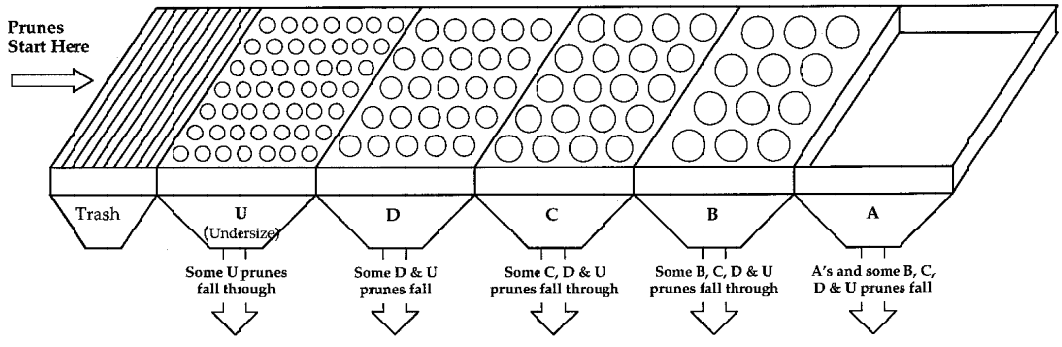

Table 1. Proportions of Shipments (by weight) Measured as and Actually belonging to each Grade

Grade	Measured	Actual
A	0.36	0.29
B	0.44	0.42
C	0.13	0.18
D	0.04	0.06
U	0.03	0.05

quantity of the prunes meeting the grade standard. As a result, the price paid to growers for all grades except the lowest will be less, because of the "contamination" by prunes from the lower grades.

We estimated the errors in valuation of prunes as the difference between the value of correctly graded prunes and the grower price for a particular measured grade. The undervaluation of a particular grade is determined by (a) the extent to which prunes from lower grades move up in grade, and (b) the difference in value between prunes that are correctly graded and prunes of lower grades. For example, the market price of grade B is discounted based on the relative amounts of grade C, D and U prunes that receive a grade of B, and the differences in value between grade B and these lower grades.

There is an offsetting effect on the revenue from grade B prunes—the grower is paid more than market value for grade B prunes that end up in grade A due to grading error. A similar effect occurs for the lower grades, which can also move up and receive the price associated with the higher grade. How do these effects play out on balance?

First, the average farm revenue for undersized prunes is higher than their actual value, because some undersized prunes end up being measured and paid as higher grades. Second, grade A prunes always earn less than their true value, because all grade A prunes receive the A-screen price, which is discounted due to the presence of smaller prunes misclassified as grade A. Offsetting effects of both types occur for the intermediate grades B, C and D. There is a gain in revenue obtained by a portion of grade B, C and D product migrating into higher grades and a loss in revenue from the reduction in grower prices relative to actual values.

Estimated Effects of Grading Errors

We estimated the differences between the actual value and the grower price, and between the average farm revenue and the actual value, for each grade of prunes for the 1996 crop year. These estimates were based on the grade sheets completed for all 1,487 samples graded by the DFA in 1996 and on detailed information for two 40-lb. samples of prunes provided by the Prune Bargaining Association (PBA). These samples consisted of prunes from a variety of Sacramento Valley sites and conformed closely in size distribution to the overall harvest.

After each PBA sample was graded, the weight of each individual prune was recorded. Thus, for each prune in the PBA samples, we knew which screen it fell through and its actual size. In other words, the measured and actual size distributions were known for these two samples.

We also obtained the grading sheets for all 1,487 actual shipments made in the 1996 crop year. Each sheet reports the total weight and the average prune size in each of the measured grades A, B, C, D and U based on the 40-lb. sample taken from each shipment after drying. We used the detailed information from our two 40-lb. PBA samples to infer the size distributions for each actual shipment.

We estimated the proportions of prunes of each grade that were measured in each of the five grades. The averages of these proportions over all 1996 shipments are reported in tables 1 and 2.

Table 2. Shares of Actual Grade Products Classified into each Measured Grade (by weight)

	Measured Grade				
Actual Grade	A	B	C	D	U
A	1.00				
B	0.15	0.85			
C	0.02	0.42	0.56		
D	0.00	0.12	0.50	0.38	
U	0.00	0.02	0.17	0.25	0.56

Table 1 contains the measured and actual proportion of prunes in a grade for each grade. Differences between the actual and measured proportions are readily apparent, but the degree of measurement error is further clarified in table 2. Each row of table 2 refers to the actual prune grade, and each column refers to the measured prune grade. Individual cells in the table contain the proportion of the prunes actually belonging to a particular grade that received any other grade, so that the diagonal elements represent proportions of correctly graded prunes. The numbers below the diagonal represent the percentage of prunes of each actual grade migrating to higher grades.

Table 2 shows that the probability of grading errors is greatest in the lower grades. This result is not surprising, because products in these grades have the greatest opportunity to migrate into higher grades. All A-quality prunes were graded correctly by construction of the grading process, and 85% of B-quality prunes were graded correctly, with the remaining 15% masquerading as A-quality prunes. However, only 56% of C-quality prunes were graded correctly, with 42% masquerading as B prunes. Only 38% of true D-quality prunes were graded as D, with 50% and 12% migrating into the C and B screens, respectively.

The information contained in tables 1 and 2 and the actual grower prices for each grade, determined through negotiations between the handlers and the PBA, enable us to solve for the actual value of each grade. Grower prices, actual values, and average grower revenue for each grade are presented in columns 2, 3, and 4 of table 3. The differences between grower prices and actual values for each grade indicate the extent to which grower prices were discounted because of grading error and are listed in column 5 of table 3. For all grades except the lowest, U, the grower price is lower than the actual value. The price of grade A prunes is lower than its true value by 2.28 cents / lb., or 4%, while B-grade prunes are undervalued by 3.43 cents / lb., or 7.7%.

The difference between the average grower revenue and the actual value of prunes in each grade is shown in the last column of table 3. Since A-grade prunes cannot masquerade as any other grade, their average grower revenue equals their price, and the difference is again 2.28 cents / lb. The average grower revenue of undersized prunes is higher (by over 6 cents / lb.) than the actual value of zero. The average grower revenue is lower than the actual value for grade B (by 3.4%), but higher for grades C and D (by 16.7% and 73.2%, respectively). The negative spread for grade B indicates, for example, that the decrease in average grower revenue for grade B prunes associated with the migration of lower grades into grade B, more than offsets the gain in revenue associated with some of the B prunes being classified as grade A.

These findings are consistent with the pattern of "oversupply" of small prunes in recent years and illustrate that continuing to produce relatively greater numbers of small prunes, rather than, for example, shaker thinning to produce larger prunes, may well be a rational response to current incentives. The industry can partially address the problem of oversupply of small prunes by improving the accuracy of the grading process. Examples include increasing screen length or adding additional screens on the DFA grader. Alternatively, the industry might consider a graduated payment system that offers premiums and discounts based on average prune size within each measured grade, rather than a single price per grade, as is the current practice.

Table 3. Grower Price, Actual Value and Average Farm Revenue for Each Grade

	1. Grower Price	2. Actual Value	3. Ave. Farm Revenue	4. Grower Price-Actual Value	5. Farm Value-Actual Value
Grade			***Cents per Pound***		
A	54.25	56.53	54.25	-2.28 (-4%)	-2.28 (-4%)
B	41.00	44.43	42.96	-3.43 (-8%)	-1.47 (-3%)
C	21.75	26.09	30.45	-4.34 (-17%)	4.36 (-17%)
D	7.00	10.70	18.54	-3.70 (-35%)	7.84 (-73%)
U	0.00	0.00	6.21	0.00	6.21

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