

Pigs and the Tyson Foods Marketing Grid

Impact of Sorting Errors on Sort Loss and Optimal Market Weight for Market Pigs

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Highlights

Decreased market prices relative to feed costs reduce the optimal market weight of pigs.

The accuracy with which pigs are sorted for marketing affects the distribution of carcass weights.

Decreased accuracy of sorting pigs for market reduces the optimal market weight and producer profits.

Producers should identify means to sort pigs more accurately for market.

Introduction

Pork processors have established marketing grids that discount the value of carcasses that are heavier or lighter than a specified weight range. To avoid these discounts, most commercial producers visually evaluate the body weight of pigs and try to identify the heaviest pigs at two to four marketing days spread out over a 17- to 28-day period.

Pork producers usually target a specific number of heavy pigs in each pen to be marketed each marketing day. Marketing errors occur when the heaviest pigs in the pen are not marketed, resulting in sort loss, which is the amount by which each carcass is discounted for being too light or too heavy. The accuracy with which the pigs are sorted for market has been shown to impact the optimal market weight. The market price of the pigs relative to feed costs is a major factor impacting profitability. The optimal market weight could be affected by the market price of the pigs relative to the feed costs. Error associated with visual estimation of body (body weight estimation error; BWEE) contributes the most to marketing error and the resulting sort loss. The objective of this research was to evaluate the impact of sorting accuracy and market price on the optimal marketing weights for a large pork processor.

Materials and Methods

A model of pig growth, daily feed intake, carcass composition and carcass measurements was developed from a large nutrition trial. Simulation data for a 4,000-head wean-to-finish barn were used to produce variation in pig growth rates, body weights and carcass weights. The model predicted the daily and total costs for the pigs in the barn. Feed prices were corn, \$3.50 per bushel; DDGS, \$158.00 per ton; and 48% soybean meal, \$325.00 per ton. Base prices of \$60, \$65 and \$75 per hundred-pound carcass weight (cwt) were used, including premiums for predicted carcass lean percentage. The current marketing grid for Tyson Foods Inc. was used to determine carcass weight and value. The growth and marketing of a single average pig was simulated to evaluate the optimal market weight to maximize profit per pig or profit per pig per day for an individual average pig.

A population of pigs was simulated that reproduced the variation in body weight, carcass weight and predicted percent lean. A conventional marketing strategy was assumed in which 25% of the pigs were targeted to be marketed at 169 days of age, 25% at 179 days of age, and the remaining 50% marketed at 193 days of age. The timing of marketing was shifted in 7-d intervals with mean

marketing ages of 155.5 to 211.5 d with mean carcass weights of 167 to 240 pounds. Body weight estimation error rates were simulated to represent a range of visual assessment accuracy (standard deviations of 0 to 8% of each pig's actual body weight).

Results

The profit per pig and profit per pig per day relative to mean age and carcass weight for an individual average pig are shown in Figures 1 to 4. The profit per pig and profit per pig per day increased before the sort loss occurred. The greater the base price, the greater the profit per pig increased from 160 to 188 days of age for an individual average pig. The increased profits per pig from 160 to 188 days of age were 8.23, 4.32 and 2.37 dollars for the 75, 65 and 60-dollar base prices. The profit per pig with heavy pigs, with carcass weights of 219 lbs. and greater, does not decrease a small amount in the first two heavyweight categories of sort loss (\$1.33 and 2.67 per cwt in the Tyson marketing grid) until the carcass weight CW hits the third category (\$4.67 per pig). With the feed costs and market prices used, the best overall maximum profit for an individual pig is achieved the day before the first heavyweight sort loss is applied. Because of the carcass weight categories for sort loss, there is decreased profit each time the amount of sort loss per 100 lb. of carcass weight increases. Overall, pigs sold from 219 to 225 lbs. have profit losses of \$2.29 per pig when not marketed on the optimal marketing day. Pigs in the next carcass weight category, 226 to 233 lbs., have an average profit loss of \$4.47 per pig when not marketed on the optimal marketing day. Pigs in the 234 to 240 lb. carcass weight category have an average profit loss of \$8.64 per pig when not marketed on the optimal marketing day.

The distribution of the carcass weights for each level of sorting accuracy in the Tyson weight categories is shown in Figure 5. The distribution of carcass weights into 10 lb. weight categories is shown in Figure 6. As the accuracy of sorting decreases, the variation in carcass weight increases.

The means and standard deviations for carcass weight for each week of marketing and level of body weight estimation error are shown in Table 2. With less accurate sorting, the mean carcass weight decreases for the first marketing cut and increases for the third marketing cut (barn close out). The standard deviations in carcass weight increase as body weight estimation error increases for each cut and overall.

The relationship between sort loss per pig and carcass weight for three levels of sorting accuracy are shown in Figure 7 for a market price of \$75 per cwt. Average sort loss per pig was minimized at average carcass weights of approximately 203 pounds. Average sort loss increased as BWEE increased. The average sort loss per pig increased more rapidly with less accurate sorting. For example, as the average carcass weight

increases above 213 lbs. (mean age of 184 days), the additional amount the pigs are discounted is greater for higher levels of BWEE. With the least accurate sorting (BWEE = 8%) from 216 to 225 lb. average carcass weight, the sort loss per pig was \$0.64 to \$ 0.97 per pig greater than with accurate sorting.

The daily increase in carcass value including sort loss and daily costs with a market price of \$75 per cwt is shown in Figure 8. The optimal marketing is determined at the point of marginal cost equals marginal return. The mean carcass weight when pigs are sold in three marketing cuts is 219 lbs. for accurate sorting and decreases to 216 lb. for the least accurate sorting when the market price is \$75 per cwt.

The relationship of average profit per pig to average carcass weight with a market price of \$75 per cwt is shown in Figure 9. At carcass weights below 201 lbs., the impact of any of the three levels of inaccurate sorting on profit per pig or profit per pig per day are small. As average carcass weight increases with increased marketing age, the impact of inaccurate sorting increases and is maximized at a range of 220 to 250 lb. carcass weight. When BWEE is at 0%, maximal profit per pig reaches \$25.08 with mean CW of 218 lb. and mean age of 188 d. When BWEE is at 4%, maximal profit per pig reaches \$24.82 with mean CW of 218 lb. and mean age of 188 d. When BWEE is at 8%, maximal profit per pig reaches \$24.26 with mean CW of 216 lb. and mean age of 186 d. In general, with decreased sorting accuracy, the optimal mean CW or age to reach the maximal profit per pig decreases.

The optimal mean marketing ages and carcass weights for each market price and level of BWEE are shown in Table 3. As the market price decreases, the optimal mean market ages and carcass weights decrease. With the lowest market price of \$60 per cwt and BWEE of 8%, the optimal mean marketing age is decreased 8 days and mean carcass weight increased 10.67 lbs. as compared to the higher market price (\$75 per cwt and BWEE of 0 or 4%).

The profit per pig per day above feed and other costs for each level of sorting accuracy with a market price of \$75 per cwt is shown in Figure 10. When BWEE is at 0%, maximal profit per pig per day reaches \$0.139 with mean CW of 213 lb. and mean age of 184 d; when BWEE is at 4%, maximal profit per pig per day reaches \$0.138 with mean CW of 213 lb. and mean age of 184 d; when BWEE is at 8%, maximal profit per pig per day reaches \$0.136 with mean CW of 209 lb. and mean age of 181.d. In general, with the increasing of sorting accuracy, the optimal mean CW or age to reach the maximal profit per pig per day increases.

The optimal mean marketing ages and carcass weights to maximize profit per pig per day for each market price and level of BWEE are shown in Table 3. At the same level of BWEE, as

the market price decreases, the optimal mean market ages to maximize profit per pig per day either do not change or decrease by only one day. With the lowest market price of \$60 per cwt and BWEE of 8%, the optimal mean marketing age is decreased 3 days and mean carcass weight decreased 4.0 lbs. as compared to the higher market price (\$75 per cwt and BWEE of 0 or 4%).

Summary

Currently, statistics have been developed to evaluate the accuracy of sorting, including: (1) the estimated number of pigs sold correctly each marketing day and overall; (2) the increased standard deviation for carcass weight overall and especially for the second day; and (3) the distribution and magnitude of the estimated sorting errors. With new procedures to estimate the accuracy of sorting market pigs, pork producers could adjust their marketing strategy for their estimated level of sorting accuracy.

The Tyson Foods marketing grid does not greatly discount pigs with carcass weights of 219 to 225 pounds. For this reason, the optimal mean carcass weights range from 207 to 218 pounds, just below carcass weight above the pork processors' acceptable (non-discounted) weight. In the simulation described here, the level of sorting accuracy (8 % body weight estimation error) is less than that found for a sample of Midwest pork producers. Pork producers with less accuracy in sorting pigs should reduce their target carcass weights. Ideally, pork producers with lean, feed efficient pigs should target a high percentage of pigs to be marketed with carcass weights from 205 to 233 lbs. carcass weight on the current Tyson's marketing grid and reduce the target market weights as the market price decreases.

Pork producers should consider methods that result in more accurate sorting of market hogs to maximize their daily returns and to minimize the variation of carcass weights for the pork processor. Methods to increase the accuracy of sorting include: (1) taking more time in the evaluation of body weight for each pig; (2) weighing and marking a few sentinel pigs as a comparison to other pigs; (3) measuring some of the pigs with a heart girth tape (BWEE of approximately 5%); (4) using 3-D cameras with software to estimate each pig's body weight; (5) using technologies in which pigs are run across a scale and automatically marked based on their current body weight; and (6) the use of auto-sort barns that sort pigs in marketing pens based on their current bodyweight. Further research is needed, however, to estimate the relative increases in accuracy and costs of each alternative method to improve the accuracy of sorting pigs for market.

Acknowledgements

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Table 1. Carcass weight discount rates for different carcass weight classes (Tyson Foods, Inc.)

Carcass weight, lb	Discount, \$/CWT
< 139	18.71
140-146	14.62
147-155	11.82
156-163	8.08
164-171	3.37
172-218	0
219-225	1.33
226-233	2.67
234-240	4.67
241-248	7.00
249-255	9.00
256-263	10.67
264-271	12.67
> 272	15.28

Tyson Fresh Meats, Inc (2012).

Figure 1. Relationship between profit per pig and age at three different market prices on an individual pig basis. The profit per pig increases as age increases and then decreases as heavyweight sort loss is applied. The increase in profit per pig from 160 to 186 d of age is less as market price decreases.

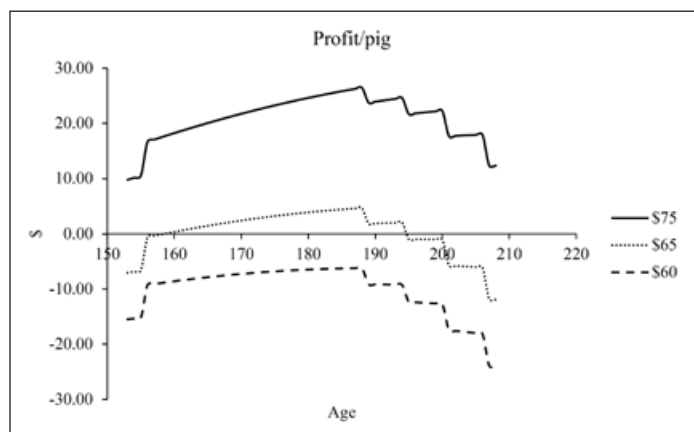


Figure 2. Relationship between profit per pig per day and age at three different market prices on an individual pig basis. The profit per pig per day increases as age increases and then decreases as heavyweight sort loss is applied. The increase in profit per pig per day from 160 to 186 d of age is less as market price decreases.

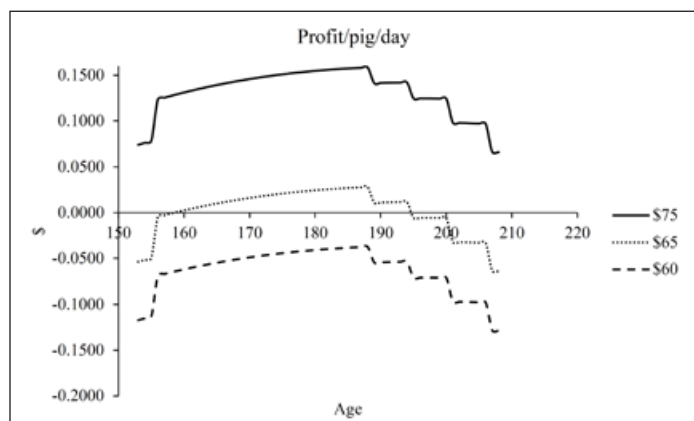


Figure 3. Relationship between profit per pig and CW at three different market prices on an individual pig basis. The profit per pig increases as carcass weight increases and then decreases as heavyweight sort loss is applied. The increase in profit per pig from 175 to 217 lb. carcass weight is less as market price decreases.

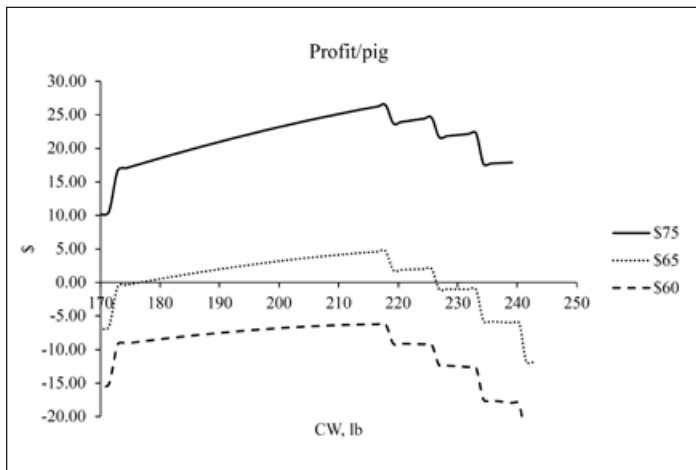


Figure 4. Relationship between profit per pig per day and CW at three different market prices on an individual pig basis. The profit per pig per day increases as carcass weight increases and then decreases as heavyweight sort loss is applied. The increase in profit per pig per day from 175 to 217 lb. carcass weight is less as market price decreases.

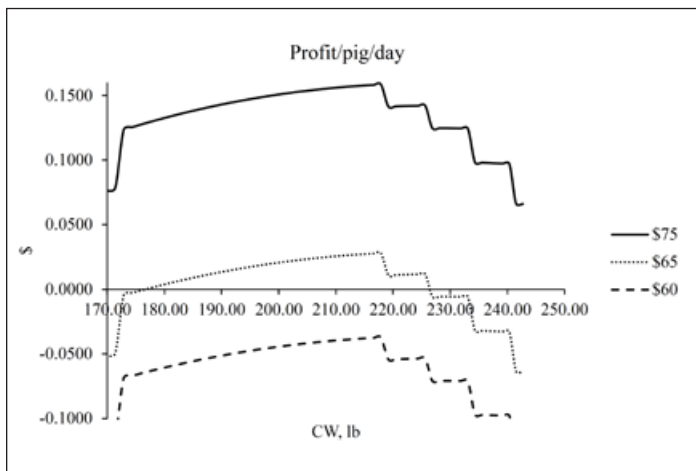


Figure 5. Carcass weight distribution based on the Tyson market grid categories. The distribution of carcass weight is affected by the sorting accuracy.

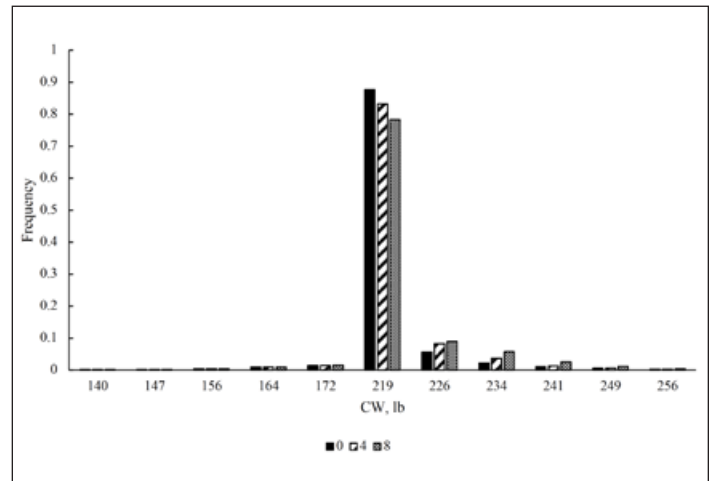


Figure 6. Overall carcass weight distribution with different levels of magnitude of body weight estimation error (BWEE = 0, 4 and 8%). The distribution of carcass weight is affected by the sorting accuracy.

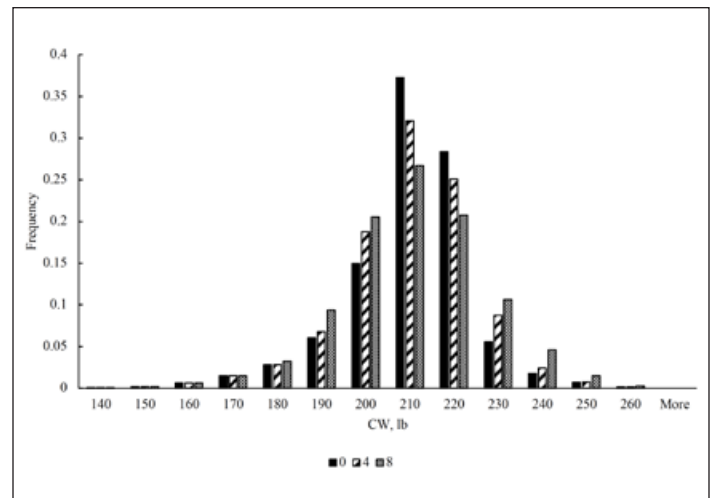


Figure 7. The mean sort loss (\$/pig) relative to CW for three levels of BW estimation error (BWEE = 0, 4 and 8%). Sort loss is greater with less accurate sorting from 213 to 231 lbs. carcass weight.

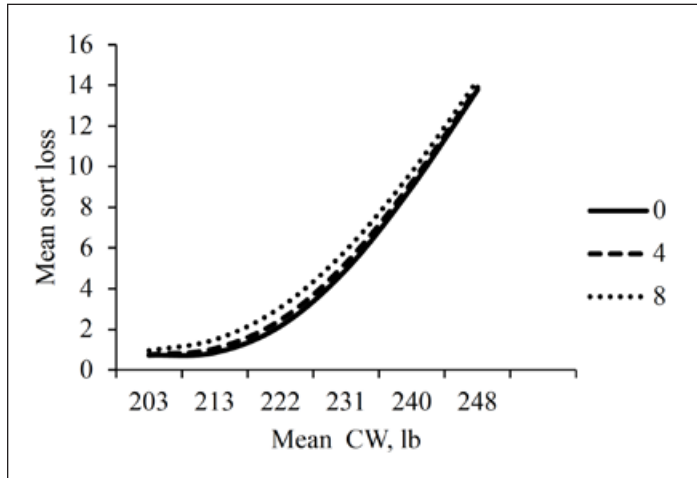


Figure 9. Relationship of mean profit per pig (\$/pig) to carcass weight (CW) for three levels of sorting errors (BWEE = 0; 4; 8) at carcass price (\$0.75/lb.). Optimal market weight is decreased 2 to 3 lbs as the accuracy of sorting decreases.

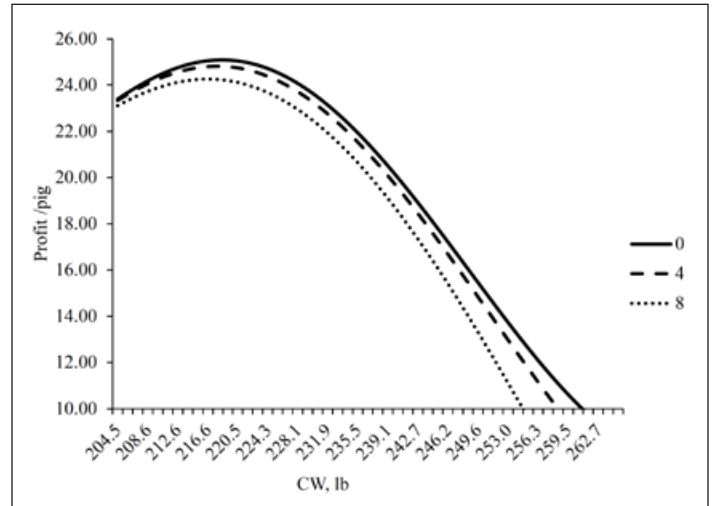


Figure 8. Daily increase in carcass value (\$/pig/d) including sort loss and daily costs for three levels of BW estimation error (BWEE = 0, 4 and 8%) at carcass price (\$0.75/lb.). Optimal market weight is decreased 2 to 3 lbs as the accuracy of sorting decreases.

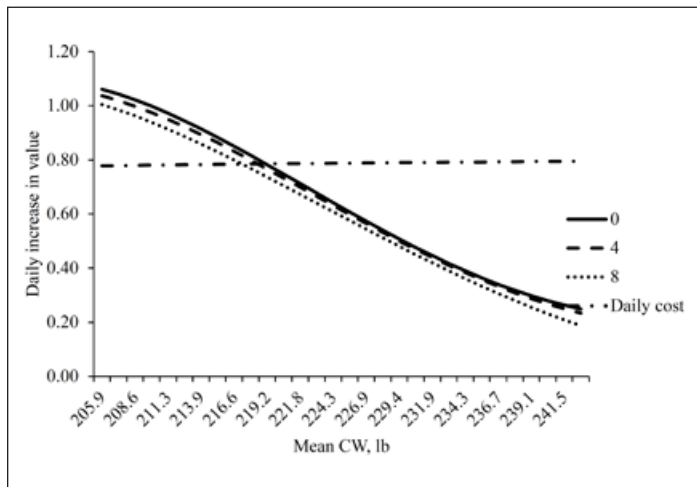


Figure 10. Relationship of mean profit per pig per day (\$/pig/d) to carcass weight (CW, lb.) for three levels of sorting errors (BWEE = 0; 4; 8) at carcass price (\$0.75/lb.).

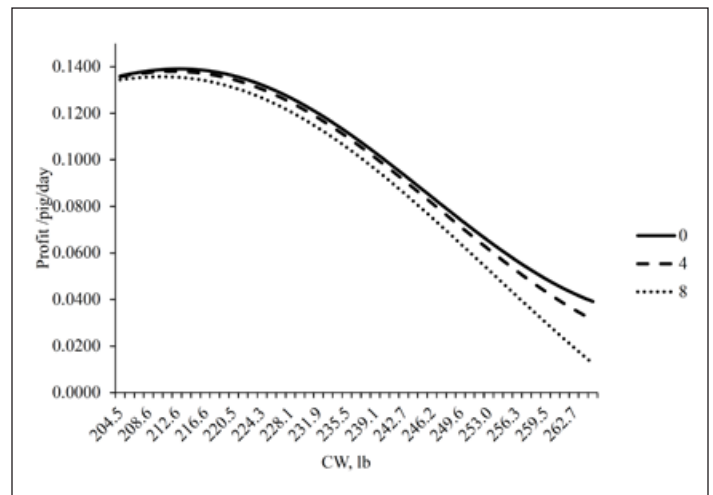


Table 2. Mean and SD of carcass weight (CW) for each marketing cut with three levels of sorting accuracy^a

Mean CW, lb.	BWEE, PNVE = 0,0		BWEE, PNVE = 4,0		BWEE, PNVE = 8,0	
	Mean, lb.	SD	Mean, lb.	SD	Mean, lb.	SD
First MCUT						
183.3	184.2	10.0	183.3	11.0	181.0	12.8
193.5	194.4	10.6	193.3	11.6	191.0	13.5
203.3	204.2	11.1	203.2	12.2	200.7	14.2
212.9	213.5	11.6	212.6	12.8	210.1	14.9
222.1	222.9	12.1	221.8	13.3	219.1	15.5
231.0	231.9	12.6	230.7	13.9	227.9	16.1
239.6	240.4	13.1	239.2	14.4	236.3	16.7
247.9	248.6	13.5	247.4	14.9	244.4	17.3
Second MCUT						
183.3	179.1	5.2	178.8	7.4	178.1	10.5
193.5	188.9	5.5	188.6	7.8	187.9	11.0
203.3	198.5	5.8	198.1	8.2	197.4	11.6
212.9	207.8	6.0	207.4	8.6	206.6	12.1
222.1	216.7	6.3	216.3	9.0	215.5	12.6
231.0	225.4	6.6	225.0	9.3	224.1	13.1
239.6	233.7	6.8	233.3	9.7	232.4	13.6
247.9	241.7	7.0	241.2	10.0	240.4	14.1
Third MCUT						
183.3	162.7	11.0	163.5	11.8	165.9	14.2
193.5	171.6	11.6	172.4	12.4	175.1	15.0
203.3	180.3	12.2	181.2	13.0	184.0	15.8
212.9	188.7	12.7	189.6	13.7	192.5	16.5
222.1	196.9	13.3	197.8	14.2	200.8	17.2
231.0	204.7	13.8	205.7	14.8	208.8	17.9
239.6	212.3	14.3	213.3	15.3	216.6	18.6
247.9	219.6	14.8	220.6	15.9	224.0	19.2
Overall						
183.3	175.3	8.7	175.2	10.0	175.0	12.5
193.5	185.0	9.2	184.8	10.6	184.7	13.2
203.3	194.3	9.7	194.2	11.2	194.0	13.8
212.9	203.4	10.1	203.2	11.7	203.1	14.5
222.1	212.2	10.6	212.0	12.2	211.8	15.1
231.0	220.7	11.0	220.4	12.7	220.3	15.7
239.6	228.8	11.4	228.6	13.1	228.4	16.3
247.9	236.6	11.8	236.4	13.6	236.2	16.9

^a BWEE = BW estimation error as a percentage of the actual value. PNVE = percent of pigs not visually evaluated.

Table 3. Mean carcass weight and mean age at the maximum profit/pig or maximum profit/pig/day at 3 market prices ^a

Market Price (\$/lb)	BWEE, PNVE	Profit/pig			Profit/pig/d				
		Mean age, d	Mean CW, lb	Population sort loss	Profit/pig	Mean age, d	Mean CW, lb	Population sort loss	Profit/pig/d
0.60	0,0	181.5	209.9	0.71	-7.09	183.5	212.6	0.83	-0.0401
	4,0	180.5	208.6	0.81	-7.23	182.5	211.3	0.93	-0.0411
	8,0	179.5	207.2	1.07	-7.54	180.5	208.6	1.14	-0.0432
0.65	0,0	183.5	212.6	0.83	3.49	183.5	212.6	0.83	0.0196
	4,0	183.5	212.6	1.03	3.30	182.5	211.3	0.93	0.0186
	8,0	181.5	209.9	1.23	2.89	181.5	209.9	1.23	0.0164
0.75	0,0	187.5	217.9	1.38	25.08	183.5	212.6	0.83	0.1391
	4,0	187.5	217.9	1.65	24.82	183.5	212.6	1.03	0.1380
	8,0	186.5	216.6	1.99	24.26	181.5	209.9	1.23	0.1357

^a BWEE = BW estimation error as a percentage of the actual value. PNVE = percent of pigs not visually evaluated.