Using a Stochastic Model to Evaluate Swine Production Management with Paylean® IV: Return of Accurate Sorting for Marketing

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Introduction

Recently, many studies were conducted on value-based pig marketing and were aimed at reducing sort loss by the packer's grid. One of the often-suggested solutions to reduce sort loss was to weigh each pig before marketing. Because weighing pigs by hand is practically too expensive, the solution is not feasible for most producers. Recently, however, the idea of weighing pigs before marketing has become possible because of an innovation to grow-finish barns, which is the Automatic Sorting Technology (AST). The primary improvement of AST barns is to equip the barns with one or more electronic scales, which can automatically weigh, record, and sort the weights of the animals when pigs pass through the scales to access food or water. The only labor input is to set a threshold weight in the scale; therefore, the cost is almost zero to perform the task of sorting pigs before marketing. In addition, the recorded weight gives the producer precise information on the growth performance of the group as a whole, which helps producers to make the correct decisions regarding the time to market the animals. Hence, accurate sorting and marketing timing can be realized by the AST barns, and with AST sorting, sort loss received from pigs outside the desired weight ranges supposedly would be reduced compared with traditional hand sorting. One of the goals of this research is to investigate the potential saving of sort loss through accurate sorting by the AST barn.

With accurate sorting and marketing decisions, the optimal production management of dietary lysine and Paylean (ractopamine, RAC) may shift. Particularly, with the use of Paylean; the Paylean onset time, dietary lysine concentrations and marketing time require precise management to obtain the full potential benefit from the RAC feed additive. Therefore, the second aim of the research was to investigate the optimal production and marketing strategies of Paylean with the AST barn.

Note that this research focuses only on assessing the savings of AST by accurate sorting, and it is not an economic evaluation of the AST barn. It was reported by other research that the AST barns have many potential benefits other than saving the sort loss (Conner and Lowe, 2002; Neutkens, 2002). Therefore, readers interested in the complete economic evaluation of the AST barn should refer to other research results as well.

Assumptions

The stochastic model was used to evaluate the return for two types of sorting practices: AST versus hand sorting. The model assumed that the accuracy of weight by AST was 0.22 lb. The model was used to simulate multiple runs of hand sorting with three levels of inspection errors to produce unbiased results. There were two types of visual inspection error incorporated by the model: pig-specific error and daily bias. The daily bias is the amount the producer via visual inspection over or under predicts the true mean weight of the pigs in the facility. The pig-specific error is the error by which the producer under or over predicts the weight of the specific pig relative to the mean weight of the pigs in the facility.

The standard deviations of the these two errors were assumed to be the same, with values of 8.8 lbs, 11 lbs, and 13 lbs; for experienced, average and inexperienced visual evaluators, respectively. In simulating hand sorting, the model used the optimal lysine concentrations, Paylean concentration (if fed) and sort weight derived for visual inspection error free cases (see Tables 3 and 4 in Part I). The marketing system used was the one typically used by producers. Pigs were sold above 271 lbs, which was close to 201 lb carcass weight, the middle of the pork processor's optimal carcass weight range. This sort weight was close to optimal given the level of visual errors, as it was close to minimum sort loss.

The marketing days were allowed to be optimized at a weekly marketing basis, i.e., each marketing day had to be 7 days apart. The first marketing day was identified as the first day in which the weekly inspection resulted in 170 pigs appearing to be above the 271 lb sort weight. Pigs were sold weekly by whole semi-load groups of 170 head.

The optimal management was derived for four payment schemes: (1) carcass payment with discounts on underweight and overweight carcasses; (2) carcass merit payment system adopted from Hormel's Carcass Lean Value Program; (3) lean to fat price ratio of 2:1, with discounts on underweight and overweight carcasses; and (4) lean to fat price ratio of 4:1, with discounts on underweight and overweight carcasses. The carcass weight discount grid for payment schemes 1, 3 and 4 was also adopted from Hormel's Carcass Lean Value Program, which was the standardized grid for 0.51-0.90 inch last rib backfat. Payment schemes 1 and 2 reflected the marketing approaches by independent producers. Payment scheme 3 simulated the producers under limited coordination with packers, while payment scheme 4 reflected vertically integrated producers, because the lean to fat ratio of 4:1 allowed producers to capture the full benefit of the increase in carcass value.

Results

The optimal return and marketing management for AST sorting is displayed in Table 1 for both control and Paylean-treated pigs. Results for hand sorting are shown in Table 2a and 2b for the control pigs and Table 3a and 3b for the Paylean-treated pigs. It was found that for control pigs, the difference in daily return per barn were approximately $21 to $27 between AST sorting and hand sorting with medium level of visual inspection error. A daily difference of $27.4 corresponds to an annual level of $10,000 for a 1,000 head barn. For control pigs, the difference of daily return between medium and low error were $3, and between high and medium were $4.

For Paylean-treated pigs, the differences in returns between AST and hand sorting were higher than those for control pigs. Averaging over all three error levels, the differences in daily return per barn were $34, $38, $44 and $51 for payment schemes 1 to 4, respectively. When converted into annual returns, the optimal marketing and accurate sorting increased annual profits by approximately $12,000 to $19,000 for a 1,000 pig barn when using Paylean. These analyses were based on the mean of return. If a greater group to group variance in profitability was associated with the return for hand sorting than for AST sorting, the benefit of accurate sorting would be even higher.

The marketing ages of the first batch and last batch for hand sorting were also given in Tables 1, 2a and 2b, and 3a and 3b. Compared with AST marketing ages, pigs were marketed earlier in the first batch and later in the last batch with hand sorting. Also, with hand sorting, it was optimal to market pigs in more batches than with accurate sorting. The sort weights were not optimized for hand sorting; therefore, it was not comparable with those from AST.

Tables 2a and 2b and 3a and 3b show that the number of overweight pigs and the sort loss from overweight pigs seemed very high with hand sorting. Thus, additional research was

conducted by lowering sort weight for hand sorting to 262 lbs (data not shown). This resulted in an approximate 7 lb decrease in the average weight of the pigs sold. For Paylean fed pigs, the daily returns were nearly identical. For control pigs, the 262 lb sort weight decreased daily returns by $2 to $3 per day. The number of pigs sold too heavy was reduced and the number of pigs sold too light was increased for control pigs. In future research, the sort weight of hand sorting could be optimized to further examine the benefit of accurate sorting.

Application

The development of a near optimal marketing strategy and implementation of the strategy by AST can substantially increase the profitability of pork producers. The initial analysis indicated that the annual increased profits were approximately $10,000 for pig production without Paylean and well above $10,000 with Paylean for a 1,000 head barn. The estimated number was based on the mean value of return, and if risk factors were added in the analysis, the benefit of AST sorting and marketing would increase. This research did not include any labor cost associated with hand sorting as compared with AST sorting, which would also increase the benefit of AST sorting if considered. It is important to realize that the combined development of the optimal marketing strategy, Paylean use strategy, and the use of an AST to implement the optimal marketing system are required to achieve the additional profits predicted by this research. The increased profits achieved are the result of a complete systems analysis approach which can only be implemented well with the use an AST system.

References

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Table 1. Optimal marketing management and predicted sort loss for AST sorting with control and Paylean-treated pigs (SEW gilts; 1,000 head)

Payment system	1	2	3	4
		Control treatment		
Return, $/day,barn	230.96	258.89	287.75	302.34
Marketing age of 1st batch	154	154	154	154
Marketing age of 2nd batch	160	160	160	160
Marketing age of 3rd batch	164	163	164	162
Marketing age of 4th batch	165	N/A	N/A	N/A
Sort weight lbs	269.8	270.3	270.3	270.3
% underweight carcasses	4.5	6.7	5.9	7.5
% overweight carcasses	6.0	6.2	5.8	5.6
Sort loss by underweight, $/1,000 head	328.64	691.53	425.64	600.45
Sort loss by overweight, $/1,000 head	383.36	802.86	401.43	392.18
		Paylean treatment		
Return, $/day-barn	245.68	282.49	315.64	346.65
Marketing age of 1st batch	152	152	151	149
Marketing age of 2nd batch	158	157	157	155
Marketing age of 3rd batch	160	N/A	N/A	N/A
Sort weight lbs	271.4	272.0	270.5	266.8
Average day on Paylean	24.3	27.2	28.0	29.0
% underweight carcasses	4.5	7.3	7.5	9.8
% overweight carcasses	11.7	10.7	10.5	5.5
Sort loss by under-weight, $/1,000 head	355.60	676.55	578.08	803.32
Sort loss by under-weight, $/1,000 head	707.61	1,238.44	675.49	385.99

Table 2a. Return, sort loss and marketing ages for control pigs with hand sorting (SEW gilts, 1,000 head/barn) for payment systems 1 and 2

Payment system, error level	Return, $/day-barn	First batch, d	Last batch, d	Batches	Average wt.	Under-wt pigs, head	Over-wt pigs, head	Sort loss ($,under-wt)	Sort loss, ($,over-wt)
Payment 1: Low error									
mean	213.51	150.47	172.66	3.30	272.78	18.73	204.10	131.11	2,102.09
SD	5.11	2.98	2.10	0.61	3.39	9.58	71.49	58.54	899.57
Payment 1: Medium error									
mean	210.38	148.53	172.54	3.27	271.14	32.75	199.52	215.39	2,093.74
SD	5.53	3.35	2.07	0.63	3.79	22.26	70.57	154.40	824.27
Payment 1: High error									
mean	206.54	147.44	172.64	3.29	270.05	48.59	197.69	327.87	2,214.38
SD	6.78	3.48	2.07	0.70	4.05	28.79	75.39	218.61	1,011.22
Payment 2: Low error									
mean	240.07	149.32	172.42	3.46	271.78	20.27	185.81	213.21	3,113.49
SD	6.20	2.78	2.08	0.59	3.45	13.37	71.01	133.10	1,281.09
Payment 2: Medium error									
mean	237.10	147.73	172.58	3.44	270.09	35.30	176.77	352.95	2,977.59
SD	6.99	3.29	2.10	0.64	3.60	21.68	66.08	223.58	1,281.84
Payment 2: High error									
mean	233.12	146.41	172.38	3.47	268.69	55.40	175.63	582.04	3,101.17
SD	6.59	3.46	1.98	0.73	4.14	31.22	71.37	360.31	1,333.69

Table 2b. Return, sort loss and marketing ages for control pigs with hand sorting (SEW gilts, 1,000 head/barn) for payment systems 3 and 4

Payment system, error level	Return, $/day-barn	First batch, d	Last batch, d	Batches	Average wt.	Under-wt pigs, head	Over-wt pigs, head	Sort loss ($,under-wt)	Sort loss, ($,over-wt)
Payment 3: Low error									
mean	265.35	149.36	172.39	3.46	271.70	20.81	184.82	145.41	2,037.67
SD	6.34	2.78	2.07	0.59	3.49	13.41	71.78	89.83	900.33
Payment 3: Medium error									
mean	262.05	147.66	172.58	3.42	270.06	36.03	177.55	240.77	1,978.43
SD	6.94	3.34	2.10	0.64	3.63	21.66	66.78	153.91	901.75
Payment 3: High error									
mean	258.08	146.49	172.46	3.48	268.74	55.67	176.81	402.84	2,091.33
SD	6.78	3.41	1.97	0.73	4.12	31.45	72.05	262.86	929.58
Payment 4: Low error									
mean	277.84	149.32	172.42	3.46	271.78	20.28	185.76	146.56	2,054.19
SD	6.70	2.78	2.08	0.59	3.45	13.36	71.02	92.00	898.07
Payment 4: Medium error									
mean	274.88	147.66	172.58	3.44	270.06	35.62	176.78	244.29	1,971.59
SD	7.17	3.34	2.10	0.64	3.59	21.74	66.17	158.29	910.20
Payment 4: High error									
mean	271.30	146.41	172.38	3.48	268.61	55.79	174.43	412.07	2,044.36
SD	6.75	3.46	1.98	0.73	4.19	31.96	71.57	271.67	936.63

Table 3a. Return, sort loss and marketing ages for Paylean-fed pigs with hand sorting (SEW gilts, 1,000 head/barn) for payment systems 1 and 2

Payment system, error level	Return, $/day-barn	First batch, d	Last batch, d	Batches	Average wt	Under-wt pigs, head	Over-wt pigs, head	Sort loss ($,under-wt)	Sort loss, ($,over-wt)
Payment 1: Low error									
mean	214.62	148.24	172.53	3.58	274.75	8.93	299.84	61.40	3,186.98
SD	7.38	2.74	2.06	0.59	3.07	7.77	83.18	46.20	1,115.95
Payment 1: Medium error									
mean	211.94	147.18	172.80	3.70	273.57	16.12	291.32	100.91	3,183.03
SD	7.21	3.01	2.08	0.64	3.46	14.27	85.29	86.32	1,135.27
Payment 1: High error									
mean	209.24	145.84	172.37	3.67	271.78	30.92	276.53	199.34	3,143.75
SD	7.40	3.02	1.93	0.68	4.37	22.34	94.98	158.70	1,339.14
Payment 2: Low error									
mean	246.58	147.83	172.89	3.68	274.99	7.99	307.55	81.86	4,649.00
SD	7.36	2.65	2.12	0.65	2.71	7.25	75.95	62.51	1,363.05
Payment 2: Medium error									
mean	244.33	146.56	172.74	3.71	273.56	14.99	296.36	137.68	414.51
SD	6.98	2.83	2.01	0.69	3.54	12.14	87.99	107.37	1,556.73
Payment 2: High error									
mean	241.72	145.33	172.42	3.74	271.53	28.50	272.90	261.88	4,439.12
SD	7.07	2.72	1.97	0.76	4.40	21.05	93.29	208.05	1,755.82

Table 3b. Return, sort loss and marketing ages for Paylean-fed pigs with hand sorting (SEW gilts, 1,000 head/barn) for payment systems 3 and 4

Payment system, error level	Return, $/day-barn	First batch, d	Last batch, d	Batches	Average wt	Under-wt pigs, head	Over-wt pigs, head	Sort loss ($,under-wt)	Sort loss, ($,over-wt)
Payment 3: Low error									
mean	273.69	147.68	172.88	3.68	274.82	7.68	307.07	54.63	3,391.58
SD	7.82	2.66	2.14	0.65	2.73	7.09	77.30	45.14	1,070.81
Payment 3: Medium error									
mean	271.19	146.55	172.73	3.74	273.51	14.29	297.11	91.54	3,462.14
SD	7.64	2.84	2.01	0.68	3.44	11.84	87.07	75.75	1,202.23
Payment 3: High error									
mean	268.85	145.33	172.42	3.74	271.48	27.90	273.30	185.99	3,360.34
SD	7.85	2.72	1.97	0.76	4.34	21.20	91.99	159.83	1365.93
Payment 4: Low error									
mean	293.02	145.44	172.65	3.89	266.64	27.89	230.37	67.76	2,620.84
SD	19.15	2.44	1.97	0.68	16.44	57.25	80.28	47.03	1,069.37
Payment 4: Medium error									
mean	295.83	144.67	172.11	3.84	267.56	31.45	210.81	144.88	2,424.55
SD	11.82	2.30	1.86	0.73	8.36	42.30	76.33	109.06	1,130.89
Payment 4: High error									
mean	293.43	143.98	171.77	3.72	266.96	42.82	211.52	280.22	2,559.87
SD	9.88	2.05	1.76	0.77	6.50	34.63	78.77	252.32	1,090.37