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Jeffrey Apland and Joanne Geigel

Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture, Forestry and Home Economics
St. Paul, Minnesota 55108

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Jeffrey Apland and Joanne Geigel*

* Assistant Professor and Research Assistant, respectively, Department of Agricultural and Applied Economics, University of Minnesota

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Introduction

The high rates of interest of recent years have had marked impacts on costs of production for the farm firm and thus production, financial and market decision making. The costs of finishing livestock are especially sensitive to changes in interest rates. A feeder cattle enterprise, for example, involves an initial outlay for feeder calves - the largest component of production costs for the enterprise. The interest expense on the cost of the feeder calves, the cost of feed and other operating costs represents the third largest component of production costs for feeder cattle (feed costs are the second largest, after feeder calves). The use of high grain feed rations will increase feed costs, but a higher rate of gain will be achieved. Thus, while operating expenses increase when more grain is fed, the length of the production process, and interest cost per dollar of operating expenses, will decrease. For a given overall rate of gain, the weight at which the slaughter cattle are marketed can be reduced, also shortening the production process and interest expense. The purpose of the research reported here is to examine how changes in the interest rate influence the optimal number of days on feed for slaughter cattle at given market weights. The sensitivity of optimal market weights to changes in the rate of interest are examined, also.

Minimum Cost Daily Feed Ration Model

Minimum cost daily feed rations were generated for cattle in 6 weight classes and at several rates of gain. The following optimization problem represents a general specification of the model.

MINIMIZE: DAILY RATION COST = $\sum_{i=1}^{n} c_i X_i$ (1-1)

SUBEJCT TO: $\sum_{i=1}^{n} a_{2i} X_i \leq b_1$ (1-2)

$$\sum_{i=1}^{n} a_{2i} X_i - \sum_{j=1}^{m} (b_2/\alpha_j) S_j \geq 0 \quad (1\text{-}3)$$

$$\sum_{i=1}^{n} a_{3i} X_i - \sum_{j=1}^{m} (b_3/(1-\alpha_j)) S_j \geq 0 \quad (1\text{-}4)$$

$$\sum_{i=1}^{m} S_j = 1 \quad (1\text{-}5)$$

$$\sum_{i=1}^{n} a_{4i} X_i \geq b_4 \quad (1\text{-}6)$$

$$\sum_{i=1}^{n} a_{5i} X_i \geq b_5 \quad (1\text{-}7)$$

$$\sum_{i=1}^{n} a_{6i} X_i \geq b_6 \quad (1\text{-}8)$$

$$\sum_{i=1}^{n} a_{5i} X_i - d_1 Y_1 \geq 0 \quad (1\text{-}9)$$

$$\sum_{i=1}^{n} a_{5i} X_i - d_1 Y_1 \leq 0 \quad (1\text{-}10)$$

$$\sum_{i=1}^{n} a_{7i} X_i - d_3 Y_2 \geq 0 \quad (1\text{-}11)$$

$$\sum_{i=1}^{n} a_{6i} X_i - Y_1 = 0 \quad (1\text{-}12)$$

$$\sum_{i=1}^{n} a_{1i} X_i - Y_2 = 0 \quad (1\text{-}13)$$

$$X_1, \ldots, X_n; S_1, \ldots, S_m; Y_1, Y_2 \geq 0 \quad (1\text{-}14)$$

Referring to equations (1-1) through (1-14) activities X_i ; $i=1,\ldots,n_j$ represent the quantities of each of n feeds considered for the feed rations. Parameter c_i represents the unit cost of the ith feed, thus the objective function (1-1) is the total cost of the daily feed ration, which is minimized. Constraint parameters a_{1i}, a_{2i}, a_{3i}, a_{4i}, a_{6i} and a_{7i} are the nutrient contents of the ith feed, representing the pounds of dry matter, megacalories of net energy for maintenance, megacalories of net energy for gain, pounds of total protein, calcium, phosphorus and potassium, respectively, per pound of feed. Constraint (1-2) limits the dry matter content of the ration to no more than level b_1. Constraints (1-3) and (1-4) represent the net energy requirements of the animal. A separable programming specification was used for these constraints. Net energy requirements for steers follow those suggested by Lofgreen and Garrett. The requirements can be summarized as follows:

$$\sum_{i=1}^{n} a_{2i}X_i \geq b_2/\alpha \qquad (1)$$

$$\sum_{i=1}^{n} a_{3i}X_i \geq b_3/(1-\alpha) \qquad (2)$$

$$0 < \alpha \leq 1 \qquad (3)$$

Where: α is the proportion of the ration going to maintenance energy requirements, $(1-\alpha)$ is the portion of the ration going to gain energy requirements, b_2 and b_3 are the net energy requirements for maintenance and gain respectively, and other parameters and variables follow previous definitions. To capture the non-linear restrictions implied by equations (1), (2) and (3) in a linear programming formulation, special variables S_j $(j=1,\ldots,m)$ were defined to represent m values of α $(\alpha_1 < \alpha_2 < \alpha_3 \ldots < \alpha_m)$ covering the relevant range of the parameter (generally, $0.0 < \alpha \leq 1.0$).

Thus, equations (1-3), (1-4) and (1-5) provide a piecewise linear approximation of constraints (1), (2) and (3), [Brokken].

Constraints (1-6), (1-7) and (1-8) maintain the minimum requirements of total protein, calcium and phosphorus in the ration. Equations (1-12) and (1-13) define variables Y_1 and Y_2 as the total phosphorus and dry matter contents of the ration, respectively. Constraints (1-9) and (1-10), then, restrict the ratio of calcium to phosphorus in the ration to a minimum of d_1 and a maximum of d_2 (values used in this study were $d_1 = 1.2$ and $d_2 = 5.0$). By constraint (1-11), the ratio of potassium to total dry matter in the ration must be greater than or equal to d_3 ($d_3 = 0.0066$, here). Finally, the usual non-negativity restrictions apply to all of the linear programming activities.

Minimum Total Feed Cost Model

Results from the minimum cost daily feed ration model were used in a second model to find the minimum cost feeding strategies for a given market weight and a given number of total days on feed. A general specification of the model follows.

$$\text{MINIMIZE: TOTAL RATION COST} = \sum_{i=1}^{n_4} P_i F_{1i} \qquad (2\text{-}1)$$

$$\text{SUBJECT TO: } \sum_{k=1}^{n_{2j}} \sum_{\ell=1}^{n_{3jk}} g_{kj} Y_{jk\ell} = G_j \quad j=1,\ldots,n_1 \qquad (2\text{-}2)$$

$$\sum_{j=1}^{n_1} \sum_{k=1}^{n_{2j}} \sum_{\ell=1}^{n_{3ik}} 1.0\ Y_{jk\ell} \leq T \qquad (2\text{-}3)$$

$$\sum_{j=1}^{n_1} \sum_{k=1}^{n_{2j}} \sum_{\ell=1}^{n_{3ik}} a_{ijk\ell} Y_{jk\ell} - F_{1i} = 0 \quad i=1,\ldots,n_4 \qquad (2\text{-}4)$$

$$\sum_{k=1}^{n_{2j}} \sum_{\ell=1}^{n_{3jk}} a_{ijk\ell} Y_{jk\ell} - F_{2ji} = 0 \quad i=1,\ldots,m_{4j} \quad j=1,\ldots,n_1 \qquad (2\text{-}5)$$

$$\sum_{k=1}^{n_{2j}} \sum_{\ell=1}^{n_{3jk}} 1.0\, Y_{jk\ell} - D_j = 0 \quad j=1,\ldots,n_1 \qquad (2\text{-}6)$$

$$Y_{jk\ell},\ F_{1i},\ F_{2i},\ D_j \geq 0 \quad j=1,\ldots,n_1;\ k=1,\ldots,n_{2j};\ \ell=1,\ldots,n_{3jk};\ i=1,\ldots,n_4 \qquad (2\text{-}7)$$

The feeding process is specified in the model by including feed requirements in each of n_1 stages of growth, where a "stage" represents a range in the animal's weight (e.g. 500 to 600 lb., 600 to 700 lb., etc.). Activities $Y_{jk\ell}$ are defined as the use of the ℓth alternative daily feed ration ($\ell=1,\ldots,n_{3jk}$), for feeding to the kth rate of gain ($k=1,\ldots,n_{2j}$) in the jth stage of growth. The units of the feeding activities are days. Activity F_{1i} is defined as the total use of feed i ($i=1,\ldots,n_4$) and activities F_{2ji} represent the quantity of feed i used in the jth stage.

Parameter p_i is the unit price of the ith feed. Thus, the objective function (equation 2-1) is total feed cost per head, which is minimized. G_j is the gain required in stage j and g_{kj} is the kth daily rate of gain in the jth stage. The left hand sides of constraints 2-2, then, give the gain in each of the n_1 stages of growth associated with given feeding strategies (vectors $Y_{k\ell}$) in those stages. Total gain in each stage is constrained to level G_j, the gain associated with the jth stage of growth. Constraint 2-3 limits the total days on feed to no more than T days.

Parameter $a_{ijk\ell}$ represents the quantity of the ith feed in the ℓth daily feed ration with the kth daily rate of gain in stage j. Equations 2-4 sum the use of each feed over all stages into activities F_{1i}. Equations 2-5 are accounting rows which sum the use of each feed in each stage into activities F_{2ji}. Constraints 2-6 are also accounting rows to sum the days on feed for each stage into activities D_j. Constraints 2-7 are non-negativity restrictions on each of the linear programming activities.

Alternative daily feeding strategies used in the model may in general be limited to a set of efficient strategies, though the optimization of the model will insure such efficiency in the solution.[1/] If all feeds are available in infinitely elastic supply, and all feed is purchased at the beginning of the feeding process, alternative feed rations need include only the least cost daily rations for each animal weight class and each rate of gain derived using the market prices of the feeds. With infinitely elastic supply, feed values have no endogenous components. If all feed is purchased at the same time, interest expense is proportional to the market prices of the feeds and does not influence the relative feed values between stages in the feeding process.

Table 1 contains an abbreviated linear programming tableau to further illustrate the formulation of the minimum total feed cost model. For illustrative purposes, five stages are used. The five stages represent the feeding process from 500 to 600, 600 to 700, 700 to 800, 800 to 900 and 900 to 1000 lb., respectively. "Accounting" rows used to report feed use by stage and days on feed by stage are omitted from the tableau for the sake of clarity.

Row 1 is the objective function row--total feed costs. Coefficients in this row are feed prices per pound for the five alternative feeds -- corn silage, corn grain, dicalcium phosphate, ground limestone and soybean meal, respectively. Constraints 2 through 6 maintain the necessary total gain

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1/ Efficiency here implies minimum cost for the relevant range in implicit and/or explicit feed values. The opportunity set must be convex so that linear combinations of the daily rations specified are feasible and a global optimum is insured.

Table 1: An Abbreviated Linear Programming Tableau of the Minimum Total Feed Cost Model.

	Y111	Y121	Y131	Y211	Y221	Y231	Y311	Y321	Y331	Y411	Y421	Y431	Y511	Y521	Y531	F1	F2	F3	F4	F5		RHS
1 OBJ (MIN)																.0096	.0509	.1585	.0308	.0980		
2 GAIN STAGE 1	1.50	2.00	2.50																		EQ	100.0
3 GAIN STAGE 2				1.50	2.00	2.50															EQ	100.0
4 GAIN STAGE 3							2.00	2.25	2.50												EQ	100.0
5 GAIN STAGE 4										2.00	2.25	2.50									EQ	100.0
6 GAIN STAGE 5													2.00	2.25	2.50						EQ	50.0
7 MAX DAYS	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0						LE	240.0
8 FEED USE 1	27.63	32.24	9.70	31.94	37.38	16.91	42.56	37.48	14.79	45.93	36.39	11.93	52.45	43.23	15.20	-1.0					LE	0.0
9 FEED USE 2		.16	8.45			8.73		2.63	10.30	.51	4.54	11.96		4.02	12.68		-1.0				LE	0.0
10 FEED USE 3	.033	.044		.021	.028		.007	.004										-1.0			LE	0.0
11 FEED USE 4	.005	.006	.122	.002	.001	.112		.025	.143		.044	.176		.033	.182				-1.0		LE	0.0
12 FEED USE 5	1.058	1.028	2.558	.993	1.067	1.860	.853	.779	2.780	.647	.625	3.828	.460	.452	3.768					-1.0	LE	0.0

in each of the stages of growth. The "a_{ij}'s" in rows 2 through 6 on the daily ration use activities are daily rates of gain. Constraint 7 limits the total time on feed to no more than 240 days. Coefficients on the daily feed ration use activities in constraints 8 through 12 are the quantities of each of the five feeds in the daily rations. These restrictions constrain total feed use to be less than or equal to the quantities of each feed purchased (optimization will insure equality here).

Sensitivity analysis can be performed in a relatively straight forward manner. To capture the impacts on total feed costs of changes in total days on feed, the right-hand side of constraint 7 can be altered. The market weight of the animal can be changed with the appropriate adjustment of the gain required in stage five for weights ranging from 900 to 1000 pounds. As set in Table 1, the market weight is constrained to 950 lb. by requiring 50 lb. of gain in stage 5 (the right-hand side of constraint 6). To set the market weight at 900 lb., gain in stage 5 would be set at zero. For a market weight of 850 lb., gain in stage 5 would be zero and gain in stage 4 would be set at 50 lb. Additional feeding activities for a sixth stage of growth were added when final weights of 1050 and 1100 lb. were considered.

Analysis and Results

Market weights for steers considered in this study were 1000, 1050 and 1100 pounds. Six growth stages were used: 500 to 600 lb., 600 to 700 lb., 700 to 800 lb., 800 to 900 lb., 900 to 1000 lb., and 1000 to 1100 lb. Minimum cost daily feed rations were generated for animals weighing 550, 650, 750, 850, 950 and 1050 lb. and were assumed to be representative of feed requirements over each of the six growth stages. Nutrient requirements used in the minimum cost daily feed ration model were based upon 1976 National Research Council findings as reported in Ross and Sewell. Rations were generated for daily rates of gain in 0.25 lb. increments from 1.00 to 2.50 lb./day for stage 1, 1.50 to 2.50 lb./day for stage 2, and 2.00 to

2.50 lb./day for stages 3 through 6.[2/]

Five alternative feeds were considered in the rations -- corn silage, corn grain, dicalcium phosphate, ground limestone and soybean meal. Prices for dicalcium phosphate, ground limestone and soybean meal were set at 1982 levels and are reported in Table 2. The relative costs of daily feed rations at different rates of gain are especially sensitive to corn silage and corn grain prices. Nine combinations of corn and corn silage prices were considered in the analysis. The feed prices for each of the nine price sets are given in Table 2. Corn grain was priced at $2.85 per bushel for feed price sets 4, 5 and 6, $2.25 for price sets 1, 2 and 3, and $3.45 for price sets 7, 8 and 9. A medium corn silage price was calculated based upon each corn price. The silage price per ton was calculated as six times the price of corn per bushel, plus $2.00 -- a "breakeven" price assuming a 120 bushel per acre yield for grain, 20 tons per acre for silage and a $2.00 per acre difference in variable costs of production. Silage prices so derived for corn grain prices of $2.25, $2.85 and $3.45 were $15.50, $19.10 and $22.80, respectively and were used in feed price sets 2, 5 and 8. So that the sensitivity of the results to changes in the relative prices of corn grain and corn silage could be examined, low and high silage prices were used for each corn price which were $3.00 per ton less and $3.00 greater than the breakeven prices. The low prices ($12.50, $16.10

2/ The minimum daily rate of gain for each stage was the lowest rate for which nutrient requirements were available. Nutrient requirements for rates of 1.25, 1.75 and 2.25 lb./day were calculated by linear interpolation of requirements at 1.00 and 1.50, 1.50 and 2.00, and 2.00 and 2.50 lb./day respectively, except net energy requirements. Equations were published for calculating net energy for gain requirements at each rate of gain used.

Table 2: Alternative Feed Price Combinations Used in the Analysis.

	Feed Price Set ...								
	1	2	3	4	5	6	7	8	9
Corn Silage ($/ton)	12.50	15.50	18.50	16.10	19.10	22.10	19.80	22.80	25.80
Corn Silage ($/lb.)	.0063	.0078	.0093	.0091	.0096	.0111	.0099	.0114	.0129
Corn Grain ($/bu.)	2.25	2.25	2.25	2.85	2.85	2.85	3.45	3.45	3.45
Corn Grain ($/lb.)	.0402	.0402	.0402	.0509	.0509	.0509	.0616	.0616	.0616
Corn Grain/Silage Price Ratio (lb.)	6.381	5.154	4.323	6.284	5.302	4.586	6.222	5.404	4.775
Dicalcium Phosphate ($/lb.)	.1585	.1585	.1585	.1585	.1585	.1585	.1585	.1585	.1585
Ground Limestone ($/lb.)	.0308	.0308	.0308	.0308	.0308	.0308	.0308	.0308	.0308
Soybean Meal ($/lb.)	.0980	.0980	.0980	.0980	.0980	.0980	.0980	.0980	.0980

and \$19.80 per ton) were used in feed price sets 1, 4 and 7. The high relative silage prices (\$18.50, \$22.10 and \$25.80) were used in feed price sets 3, 6, and 9.

Minimum cost daily feed rations were generated for each growth stage and rate of gain for use in the model to minimize total per head feed costs. Minimum cost feeding strategies were generated for steers at market weights of 1000, 1050 and 1100 pounds. Total days on feed were constrained to 200, 220 and 240 for the 1000, 1050 and 1100 pound steers, respectively (representing an average daily rate of gain of 2.50 pounds). Solutions were then generated with total days on feed increased in 10 day increments up to 240 days for 1000 lb. steers, 260 days for 1050 lb. steers and 290 days for 1100 lb. steers. Optimal feeding strategies were derived for each market weight and these alternative numbers of days on feed subject to each of the nine feed price sets described.

Once optimal feeding strategies were derived, cash flows were projected for each of the market weights and days on feed and under each feed price set. All feed was assumed to be purchased at the beginning of the production process. Thus initial expenses include all feed costs and the cost of the 500 lb. steers. Feeder calves were priced at \$68.97 per hundredweight. A purchasing commission and trucking costs totaling \$475 were also initial expenses in the cash flow. Veterinary expenses, insurance, and building repairs totaling \$6.35 were charged in the fourth month of production. Expenses for machine operation, utilities and straw were charged evenly per month and totaled \$12.70. Hauling to market was an expense of \$7.80 per head and was charged at the end of the production process.

The results of the analysis are reported in Tables 2.1 through 2.9 (respectively) for each of the nine feed price sets. The tables

TABLE 2.1: NET RETURNS BY DAYS ON FEED AND MARKET WEIGHT AT VARIOUS ANNUAL INTEREST RATES--FEED PRICE SET 1.

WEIGHT	1000	1000	1000	1000	1000	1050	1050	1050	1050	1050	1100	1100	1100	1100	1100	1100
DAYS	200	210	220	230	240	220	230	240	250	260	240	250	260	270	280	290
REV $	637.00	637.00	637.00	637.00	637.00	668.85	668.85	668.85	668.85	668.85	700.70	700.70	700.70	700.70	700.70	700.70
OP EXP	520.28	482.80	459.53	451.57	448.42	540.40	501.27	475.16	463.55	459.40	562.48	521.56	491.91	476.75	472.13	468.98
INT RATE	INTEREST EXPENSE. . .															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0	27.57	26.84	26.67	27.42	28.44	31.53	30.54	30.19	30.61	31.58	35.91	34.57	33.89	34.11	34.97	36.00
12.5	34.46	33.55	33.34	34.28	35.55	39.41	38.18	37.74	38.27	39.47	44.89	43.22	42.36	42.63	43.71	45.00
15.0	41.35	40.26	40.01	41.13	42.67	47.29	45.81	45.29	45.92	47.37	53.87	51.86	50.83	51.16	52.46	54.01
17.5	48.24	46.97	46.68	47.99	49.78	55.17	53.45	52.84	53.58	55.26	62.85	60.50	59.30	59.69	61.20	63.01
20.0	55.14	53.68	53.35	54.84	56.89	63.05	61.08	60.39	61.23	63.16	71.83	69.14	67.77	68.21	69.94	72.01
22.5	62.03	60.39	60.02	61.70	64.00	70.93	68.72	67.94	68.88	71.05	80.80	77.79	76.24	76.74	78.68	81.01
25.0	68.92	67.10	66.69	68.56	71.11	78.82	76.35	75.49	76.54	78.95	89.78	86.43	84.71	85.27	87.43	90.01
INT RATE	NET REVENUE. . .															
0	116.72	154.20	177.47	185.43	188.58	128.45	167.58	193.69	205.30	209.45	138.22	179.14	208.79	223.95	228.57	231.72
10.0	89.15	127.36	150.80	158.01	160.14	96.92	137.04	163.50	174.69	177.87	102.31	144.57	174.90	189.84	193.60	195.72
12.5	82.26	120.65	144.13	151.15	153.03	89.04	129.40	155.95	167.03	169.98	93.33	135.92	166.43	181.32	184.86	186.72
15.0	75.37	113.94	137.46	144.30	145.91	81.16	121.77	148.40	159.38	162.08	84.35	127.28	157.96	172.79	176.11	177.71
17.5	68.48	107.23	130.79	137.44	138.80	73.28	114.13	140.85	151.72	154.19	75.37	118.64	149.49	164.26	167.37	168.71
20.0	61.58	100.52	124.12	130.59	131.69	65.40	106.50	133.30	144.07	146.29	66.39	110.00	141.02	155.74	158.63	159.71
22.5	54.69	93.81	117.45	123.73	124.58	57.52	98.86	125.75	136.42	138.40	57.42	101.35	132.55	147.21	149.89	150.71
25.0	47.80	87.10	110.78	116.87	117.47	49.63	91.23	118.20	128.76	130.50	48.44	92.71	124.08	138.68	141.14	141.71
	QUANTITIES OF FEED PER HEAD--IN POUNDS. . .															
SILAGE	2741	5463	7655	9051	10039	3099	5916	8285	9799	10993	3396	6305	8739	10458	11784	12772
CORN	2084	1405	769	416	165	2348	1648	973	576	274	2631	1916	1258	776	448	197
DP	0	.04	2.38	3.16	3.80	0	0	1.60	3.16	3.35	0	0	.89	3.16	3.16	3.80
GL	29.40	17.35	8.33	4.64	1.54	33.08	20.60	10.59	6.16	2.96	37.20	24.27	13.79	7.67	4.64	1.54
SBM	592	316	198	172	180	665	375	234	180	186	753	447	259	190	193	201

FEED PRICES PER POUND: SILAGE=$.0063, CORN=$.0402

TABLE 2.2: NET RETURNS BY DAYS ON FEED AND MARKET WEIGHT AT VARIOUS ANNUAL INTEREST RATES--FEED PRICE SET 2.

WEIGHT	1000	1000	1000	1000	1000	1050	1050	1050	1050	1050	1100	1100	1100	1100	1100	1100
DAYS	200	210	220	230	240	220	230	240	250	260	240	250	260	270	280	290
REV $	637.00	637.00	637.00	637.00	637.00	668.85	668.85	668.85	668.85	668.85	700.70	700.70	700.70	700.70	700.70	700.70
OP EXP	524.39	491.00	471.01	465.12	463.44	545.05	510.15	487.58	478.23	475.85	567.58	531.02	505.02	492.44	489.77	488.09
INT RATE	INTEREST EXPENSE. . .															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0	27.79	27.31	27.36	28.27	29.43	31.81	31.10	31.01	31.62	32.75	36.25	35.22	34.82	35.26	36.32	37.52
12.5	34.74	34.13	34.20	35.34	36.78	39.76	38.87	38.76	39.52	40.93	45.31	44.02	43.52	44.08	45.40	46.90
15.0	41.69	40.96	41.04	42.41	44.14	47.71	46.65	46.51	47.42	49.12	54.37	52.83	52.22	52.90	54.48	56.27
17.5	48.64	47.79	47.89	49.48	51.50	55.66	54.42	54.26	55.33	57.31	63.43	61.63	60.93	61.71	63.56	65.65
20.0	55.58	54.62	54.73	56.54	58.85	63.61	62.20	62.02	63.23	65.49	72.49	70.44	69.63	70.53	72.64	75.03
22.5	62.53	61.44	61.57	63.61	66.21	71.56	69.97	69.77	71.14	73.68	81.55	79.24	78.34	79.34	81.72	84.41
25.0	69.48	68.27	68.41	70.68	73.57	79.51	77.74	77.52	79.04	81.86	90.62	88.04	87.04	88.16	90.80	93.79
INT RATE	NET REVENUE. . .															
0	112.61	146.00	165.99	171.88	173.56	123.80	158.70	181.27	190.62	193.00	133.12	169.68	195.68	208.26	210.93	212.61
10.0	84.82	118.69	138.63	143.61	144.13	91.99	127.60	150.26	159.00	160.25	96.87	134.46	160.86	173.00	174.61	175.09
12.5	77.87	111.87	131.79	136.54	136.78	84.04	119.83	142.51	151.10	152.07	87.81	125.66	152.16	164.18	165.53	165.71
15.0	70.92	105.04	124.95	129.47	129.42	76.09	112.05	134.76	143.20	143.88	78.75	116.85	143.46	155.36	156.45	156.34
17.5	63.97	98.21	118.10	122.40	122.06	68.14	104.28	127.01	135.29	135.69	69.69	108.05	134.75	146.55	147.37	146.96
20.0	57.03	91.38	111.26	115.34	114.71	60.19	96.50	119.25	127.39	127.51	60.63	99.24	126.05	137.73	138.29	137.58
22.5	50.08	84.56	104.42	108.27	107.35	52.24	88.73	111.50	119.48	119.32	51.57	90.44	117.34	128.92	129.21	128.20
25.0	43.13	77.73	97.58	101.20	99.99	44.29	80.96	103.75	111.58	111.14	42.50	81.64	108.64	120.10	120.13	118.82
	QUANTITIES OF FEED PER HEAD--IN POUNDS. . .															
SILAGE	2741	5463	7655	9005	9975	3099	5916	8285	9776	10947	3396	6305	8739	10458	11738	12708
CORN	2084	1405	769	416	165	2348	1648	973	576	274	2631	1916	1258	776	448	197
DP	0	.04	2.38	3.16	3.83	0	0	1.60	3.16	3.35	0	0	.89	3.16	3.16	3.83
GL	29.40	17.35	8.33	4.64	1.54	33.08	20.60	10.59	6.16	2.96	37.20	24.27	13.79	7.67	4.64	1.54
SBM	592	316	198	175	184	665	375	234	182	189	753	447	259	197	193	206

FEED PRICES PER POUND: SILAGE=$.0078, CORN=$.0402

TABLE 2.3: NET RETURNS BY DAYS ON FEED AND MARKET WEIGHT AT VARIOUS ANNUAL INTEREST RATES--FEED PRICE SET 3.

WEIGHT	1000	1000	1000	1000	1000	1050	1050	1050	1050	1050	1100	1100	1100	1100	1100	1100
DAYS	200	210	220	230	240	220	230	240	250	260	240	250	260	270	280	290
REV $	637.00	637.00	637.00	637.00	637.00	668.85	668.85	668.85	668.85	668.85	700.70	700.70	700.70	700.70	700.70	700.70
OP EXP	528.50	499.19	482.33	478.62	478.32	549.70	519.02	499.68	492.89	492.27	572.67	540.48	517.96	508.12	507.38	507.08
INT RATE	INTEREST EXPENSE. . .															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0	28.02	27.78	28.04	29.12	30.40	32.08	31.65	31.80	32.62	33.91	36.58	35.86	35.73	36.42	37.66	39.02
12.5	35.02	34.72	35.05	36.40	38.00	40.11	39.57	39.75	40.77	42.39	45.72	44.83	44.67	45.52	47.08	48.78
15.0	42.02	41.67	42.06	43.68	45.60	48.13	47.48	47.70	48.92	50.87	54.87	53.79	53.60	54.63	56.50	58.53
17.5	49.03	48.61	49.07	50.96	53.20	56.15	55.39	55.65	57.08	59.34	64.01	62.76	62.53	63.73	65.91	68.29
20.0	56.03	55.55	56.08	58.24	60.80	64.17	63.31	63.60	65.23	67.82	73.16	71.73	71.47	72.84	75.33	78.04
22.5	63.04	62.50	63.09	65.52	68.40	72.19	71.22	71.55	73.39	76.30	82.30	80.69	80.40	81.94	84.75	87.80
25.0	70.04	69.44	70.11	72.80	76.00	80.21	79.14	79.50	81.54	84.78	91.45	89.66	89.33	91.05	94.16	97.55
INT RATE	NET REVENUE. . .															
0	108.50	137.81	154.67	158.38	158.68	119.15	149.83	169.17	175.96	176.58	128.03	160.22	182.74	192.58	193.32	193.62
10.0	80.48	110.03	126.63	129.26	128.28	87.07	118.18	137.37	143.34	142.67	91.45	124.36	147.01	156.16	155.66	154.60
12.5	73.48	103.09	119.62	121.98	120.68	79.04	110.26	129.42	135.19	134.19	82.31	115.39	138.07	147.06	146.24	144.84
15.0	66.48	96.14	112.61	114.70	113.08	71.02	102.35	121.47	127.04	125.71	73.16	106.43	129.14	137.95	136.82	135.09
17.5	59.47	89.20	105.60	107.42	105.48	63.00	94.44	113.52	118.88	117.24	64.02	97.46	120.21	128.85	127.41	125.33
20.0	52.47	82.26	98.59	100.14	97.88	54.98	86.52	105.57	110.73	108.76	54.87	88.49	111.27	119.74	117.99	115.58
22.5	45.46	75.31	91.58	92.86	90.28	46.96	78.61	97.62	102.57	100.28	45.73	79.53	102.34	110.64	108.57	105.82
25.0	38.46	68.37	84.56	85.58	82.68	38.94	70.69	89.67	94.42	91.80	36.58	70.56	93.41	101.53	99.16	96.07
	QUANTITIES OF FEED PER HEAD--IN POUNDS. . .															
SILAGE	2741	5463	7528	9005	9883	3099	5916	8030	9776	10947	3396	6305	8611	10458	11738	12615
CORN	2084	1405	820	416	188	2348	1648	1075	576	274	2631	1916	1309	776	448	220
DP	0	.04	2.44	3.16	3.80	0	0	1.73	3.16	3.35	0	0	.96	3.16	3.16	3.80
GL	29.40	17.35	8.95	4.64	1.77	33.08	20.60	11.84	6.16	2.96	37.20	24.27	14.41	7.67	4.64	1.77
SBM	592	316	188	175	182	665	375	213	182	189	753	447	249	197	193	204

FEED PRICES PER POUND: SILAGE=$.0093, CORN=$.0402

TABLE 2.4: NET RETURNS BY DAYS ON FEED AND MARKET WEIGHT AT VARIOUS ANNUAL INTEREST RATES--FEED PRICE SET 4.

WEIGHT	1000	1000	1000	1000	1000	1050	1050	1050	1050	1050	1100	1100	1100	1100	1100	1100
DAYS	200	210	220	230	240	220	230	240	250	260	240	250	260	270	280	290
REV $	637.00	637.00	637.00	637.00	637.00	668.85	668.85	668.85	668.85	668.85	700.70	700.70	700.70	700.70	700.70	700.70
OP EXP	547.52	507.68	481.54	472.27	468.19	571.10	529.56	500.68	487.33	482.07	596.75	553.41	521.10	503.87	498.08	494.01
INT RATE	INTEREST EXPENSE. . .															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0	29.05	28.26	27.99	28.72	29.74	33.37	32.32	31.87	32.24	33.19	38.16	36.75	35.96	36.11	36.95	37.99
12.5	36.32	35.33	34.99	35.90	37.17	41.71	40.39	39.83	40.30	41.48	47.70	45.93	44.95	45.13	46.19	47.48
15.0	43.58	42.39	41.99	43.08	44.61	50.05	48.47	47.80	48.36	49.78	57.23	55.12	53.94	54.16	55.43	56.98
17.5	50.84	49.46	48.99	50.26	52.04	58.39	56.55	55.77	56.42	58.08	66.77	64.30	62.92	63.19	64.67	66.47
20.0	58.11	56.53	55.99	57.44	59.48	66.74	64.63	63.73	64.47	66.37	76.31	73.49	71.91	72.21	73.91	75.97
22.5	65.37	63.59	62.99	64.62	66.91	75.08	72.71	71.70	72.53	74.67	85.85	82.68	80.90	81.24	83.15	85.47
25.0	72.63	70.66	69.99	71.80	74.35	83.42	80.79	79.66	80.59	82.97	95.39	91.86	89.89	90.26	92.39	94.96
INT RATE	NET REVENUE. . .															
0	89.48	129.32	155.46	164.73	168.81	97.75	139.29	168.17	181.52	186.78	103.95	147.29	179.60	196.83	202.62	206.69
10.0	60.43	101.06	127.47	136.01	139.07	64.38	106.97	136.30	149.28	153.59	65.79	110.54	143.64	160.72	165.67	168.70
12.5	53.16	93.99	120.47	128.83	131.64	56.04	98.90	128.34	141.22	145.30	56.25	101.36	134.65	151.70	156.43	159.21
15.0	45.90	86.93	113.47	121.65	124.20	47.70	90.82	120.37	133.16	137.00	46.72	92.17	125.66	142.67	147.19	149.71
17.5	38.64	79.86	106.47	114.47	116.77	39.36	82.74	112.40	125.10	128.70	37.18	82.99	116.68	133.64	137.95	140.22
20.0	31.37	72.79	99.47	107.29	109.33	31.01	74.66	104.44	117.05	120.41	27.64	73.80	107.69	124.62	128.71	130.72
22.5	24.11	65.73	92.47	100.11	101.90	22.67	66.58	96.47	108.99	112.11	18.10	64.61	98.70	115.59	119.47	121.22
25.0	16.85	58.66	85.47	92.93	94.46	14.33	58.50	88.51	100.93	103.81	8.56	55.43	89.71	106.57	110.23	111.73
	QUANTITIES OF FEED PER HEAD--IN POUNDS. . .															
SILAGE	2741	5463	7655	9005	9975	3099	5916	8285	9776	10947	3396	6305	8739	10458	11738	12708
CORN	2084	1405	769	416	165	2348	1648	973	576	274	2631	1916	1258	776	448	197
DP	0	.04	2.38	3.16	3.83	0	0	1.60	3.16	3.35	0	0	.89	3.16	3.16	3.83
GL	29.40	17.35	8.33	4.64	1.54	33.08	20.60	10.59	6.16	2.96	37.20	24.27	13.79	7.67	4.64	1.54
SBM	592	316	198	175	184	665	375	234	182	189	753	447	259	197	193	206

FEED PRICES PER POUND: SILAGE=$.0081, CORN=$.0509

TABLE 2.5: NET RETURNS BY DAYS ON FEED AND MARKET WEIGHT AT VARIOUS ANNUAL INTEREST RATES--FEED PRICE SET 5.

WEIGHT	1000	1000	1000	1000	1000	1050	1050	1050	1050	1050	1100	1100	1100	1100	1100	1100
DAYS	200	210	220	230	240	220	230	240	250	260	240	250	260	270	280	290
REV $	637.00	637.00	637.00	637.00	637.00	668.85	668.85	668.85	668.85	668.85	700.70	700.70	700.70	700.70	700.70	700.70
OP EXP	551.63	515.87	493.02	485.77	483.16	575.75	538.43	512.91	501.99	498.49	601.84	562.87	534.20	519.56	515.69	513.07
INT RATE	INTEREST EXPENSE. . .															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0	29.28	28.73	28.68	29.57	30.72	33.65	32.87	32.67	33.24	34.35	38.49	37.39	36.89	37.26	38.30	39.49
12.5	36.60	35.91	35.85	36.96	38.40	42.06	41.09	40.83	41.55	42.94	48.11	46.74	46.11	46.58	47.88	49.37
15.0	43.92	43.10	43.03	44.35	46.08	50.47	49.31	49.00	49.86	51.53	57.73	56.09	55.33	55.89	57.45	59.24
17.5	51.24	50.28	50.20	51.74	53.76	58.88	57.53	57.17	58.17	60.12	67.36	65.43	64.55	65.21	67.03	69.12
20.0	58.55	57.46	57.37	59.14	61.44	67.29	65.74	65.33	66.47	68.70	76.98	74.78	73.77	74.52	76.60	78.99
22.5	65.87	64.65	64.54	66.53	69.12	75.71	73.96	73.50	74.78	77.29	86.60	84.13	82.99	83.84	86.18	88.86
25.0	73.19	71.83	71.71	73.92	76.80	84.12	82.18	81.67	83.09	85.88	96.22	93.48	92.22	93.16	95.75	98.74
INT RATE	NET REVENUE. . .															
0	85.37	121.13	143.98	151.23	153.84	93.10	130.42	155.94	166.86	170.36	98.86	137.83	166.50	181.14	185.01	187.63
10.0	56.09	92.40	115.30	121.66	123.12	59.45	97.55	123.27	133.62	136.01	60.37	100.44	129.61	143.88	146.71	148.14
12.5	48.77	85.22	108.13	114.27	115.44	51.04	89.33	115.11	125.31	127.42	50.75	91.09	120.39	134.56	137.13	138.26
15.0	41.45	78.03	100.95	106.88	107.76	42.63	81.11	106.94	117.00	118.83	41.13	81.74	111.17	125.25	127.56	128.39
17.5	34.13	70.85	93.78	99.49	100.08	34.22	72.89	98.77	108.69	110.24	31.50	72.40	101.95	115.93	117.98	118.51
20.0	26.82	63.67	86.61	92.09	92.40	25.81	64.68	90.61	100.39	101.66	21.88	63.05	92.73	106.62	108.41	108.64
22.5	19.50	56.48	79.44	84.70	84.72	17.39	56.46	82.44	92.08	93.07	12.26	53.70	83.51	97.30	98.83	98.77
25.0	12.18	49.30	72.27	77.31	77.04	8.98	48.24	74.27	83.77	84.48	2.64	44.35	74.28	87.98	89.26	88.89
	QUANTITIES OF FEED PER HEAD--IN POUNDS. . .															
SILAGE	2741	5463	7655	9005	9975	3099	5916	8285	9776	10947	3396	6305	8739	10458	11738	12708
CORN	2084	1405	769	416	165	2348	1648	973	576	274	2631	1916	1258	776	448	197
DP	0	.04	2.38	3.16	3.83	0	0	1.60	3.16	3.35	0	0	.89	3.16	3.16	3.83
GL	29.40	17.35	8.33	4.64	1.54	33.08	20.60	10.59	6.16	2.96	37.20	24.27	13.79	7.67	4.64	1.54
SBM	592	316	198	175	184	665	375	234	182	189	753	447	259	197	193	206

FEED PRICES PER POUND: SILAGE=$.0096, CORN=$.0509

TABLE 2.6: NET RETURNS BY DAYS ON FEED AND MARKET WEIGHT AT VARIOUS ANNUAL INTEREST RATES--FEED PRICE SET 6.

WEIGHT	1000	1000	1000	1000	1000	1050	1050	1050	1050	1050	1100	1100	1100	1100	1100	1100
DAYS	200	210	220	230	240	220	230	240	250	260	240	250	260	270	280	290
REV $	637.00	637.00	637.00	637.00	637.00	668.85	668.85	668.85	668.85	668.85	700.70	700.70	700.70	700.70	700.70	700.70
OP EXP	555.74	524.07	504.50	499.28	498.12	580.40	547.31	525.33	516.66	514.91	606.94	572.33	547.31	535.25	533.30	532.13
INT RATE	INTEREST EXPENSE. . .															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0	29.50	29.20	29.37	30.42	31.70	33.93	33.43	33.48	34.24	35.52	38.82	38.04	37.82	38.42	39.65	41.00
12.5	36.88	36.50	36.72	38.02	39.62	42.41	41.79	41.85	42.80	44.40	48.53	47.54	47.27	48.02	49.56	51.25
15.0	44.25	43.80	44.06	45.62	47.55	50.89	50.14	50.22	51.36	53.28	58.24	57.05	56.72	57.63	59.47	61.51
17.5	51.63	51.10	51.40	53.23	55.47	59.37	58.50	58.59	59.92	62.16	67.94	66.56	66.18	67.23	69.38	71.76
20.0	59.00	58.40	58.74	60.83	63.40	67.85	66.86	66.96	68.48	71.04	77.65	76.07	75.63	76.84	79.29	82.01
22.5	66.38	65.70	66.09	68.44	71.32	76.33	75.22	75.33	77.04	79.91	87.35	85.58	85.09	86.44	89.20	92.26
25.0	73.75	73.00	73.43	76.04	79.25	84.82	83.57	83.70	85.60	88.79	97.06	95.09	94.54	96.05	99.12	102.51
INT RATE	NET REVENUE. . .															
0	81.26	112.93	132.50	137.72	138.88	88.45	121.54	143.52	152.19	153.94	93.76	128.37	153.39	165.45	167.40	168.57
10.0	51.76	83.73	103.13	107.30	107.18	54.52	88.11	110.04	117.95	118.42	54.94	90.33	115.57	127.03	127.75	127.57
12.5	44.38	76.43	95.78	99.70	99.26	46.04	79.75	101.67	109.39	109.54	45.23	80.83	106.12	117.43	117.84	117.32
15.0	37.01	69.13	88.44	92.10	91.33	37.56	71.40	93.30	100.83	100.66	35.52	71.32	96.67	107.82	107.93	107.06
17.5	29.63	61.83	81.10	84.49	83.41	29.08	63.04	84.93	92.27	91.78	25.82	61.81	87.21	98.22	98.02	96.81
20.0	22.26	54.53	73.76	76.89	75.48	20.60	54.68	76.56	83.71	82.90	16.11	52.30	77.76	88.61	88.11	86.56
22.5	14.88	47.23	66.41	69.28	67.56	12.12	46.32	68.19	75.15	74.03	6.41	42.79	68.30	79.01	78.20	76.31
25.0	7.51	39.93	59.07	61.68	59.63	3.63	37.97	59.82	66.59	65.15	-3.30	33.28	58.85	69.40	68.28	66.06
	QUANTITIES OF FEED PER HEAD--IN POUNDS. . .															
SILAGE	2741	5463	7655	9005	9975	3099	5916	8285	9776	10947	3396	6305	8739	10458	11738	12708
CORN	2084	1405	769	416	165	2348	1648	973	576	274	2631	1916	1258	776	448	197
DP	0	.04	2.38	3.16	3.83	0	0	1.60	3.16	3.35	0	0	.89	3.16	3.16	3.83
GL	29.40	17.35	8.33	4.64	1.54	33.08	20.60	10.59	6.16	2.96	37.20	24.27	13.79	7.67	4.64	1.54
SBM	592	316	198	175	184	665	375	234	182	189	753	447	259	197	193	206

FEED PRICES PER POUND: SILAGE=$.0111, CORN=$.0509

TABLE 2.7: NET RETURNS BY DAYS ON FEED AND MARKET WEIGHT AT VARIOUS ANNUAL INTEREST RATES--FEED PRICE SET 7.

WEIGHT	1000	1000	1000	1000	1000	1050	1050	1050	1050	1050	1100	1100	1100	1100	1100	1100
DAYS	200	210	220	230	240	220	230	240	250	260	240	250	260	270	280	290
REV $	637.00	637.00	637.00	637.00	637.00	668.85	668.85	668.85	668.85	668.85	700.70	700.70	700.70	700.70	700.70	700.70
OP EXP	574.76	532.96	503.55	492.93	487.91	601.80	557.85	525.80	511.09	504.71	631.01	585.26	550.28	531.00	524.00	518.99
INT RATE	INTEREST EXPENSE. . .															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0	30.54	29.71	29.32	30.02	31.03	35.21	34.09	33.51	33.86	34.79	40.40	38.92	38.03	38.11	38.94	39.96
12.5	38.17	37.14	36.64	37.52	38.79	44.01	42.61	41.89	42.32	43.49	50.50	48.65	47.53	47.63	48.67	49.95
15.0	45.81	44.57	43.97	45.03	46.54	52.82	51.14	50.27	50.79	52.19	60.60	58.38	57.04	57.16	58.40	59.94
17.5	53.44	51.99	51.30	52.53	54.30	61.62	59.66	58.64	59.25	60.89	70.70	68.11	66.55	66.68	68.14	69.94
20.0	61.08	59.42	58.63	60.03	62.06	70.42	68.18	67.02	67.72	69.59	80.80	77.84	76.05	76.21	77.87	79.93
22.5	68.71	66.85	65.96	67.54	69.82	79.22	76.70	75.40	76.18	78.29	90.90	87.57	85.56	85.74	87.60	89.92
25.0	76.35	74.28	73.29	75.04	77.57	88.03	85.23	83.78	84.65	86.98	101.00	97.29	95.07	95.26	97.34	99.91
INT RATE	NET REVENUE. . .															
0	62.24	104.04	133.45	144.07	149.09	67.05	111.00	143.05	157.76	164.14	69.69	115.44	150.42	169.70	176.70	181.71
10.0	31.70	74.33	104.13	114.05	118.06	31.84	76.91	109.54	123.90	129.35	29.29	76.52	112.39	131.59	137.76	141.75
12.5	24.07	66.90	96.81	106.55	110.30	23.04	68.39	101.16	115.44	120.65	19.19	66.79	102.89	122.07	128.03	131.76
15.0	16.43	59.47	89.48	99.04	102.55	14.23	59.86	92.78	106.97	111.95	9.09	57.06	93.38	112.54	118.30	121.77
17.5	8.80	52.05	82.15	91.54	94.79	5.43	51.34	84.41	98.51	103.25	-1.01	47.33	83.87	103.02	108.56	111.77
20.0	1.16	44.62	74.82	84.04	87.03	-3.37	42.82	76.03	90.04	94.55	-11.11	37.60	74.37	93.49	98.83	101.78
22.5	-6.47	37.19	67.49	76.53	79.27	-12.17	34.30	67.65	81.58	85.85	-21.21	27.87	64.86	83.96	89.10	91.79
25.0	-14.11	29.76	60.16	69.03	71.52	-20.98	25.77	59.27	73.11	77.16	-31.31	18.15	55.35	74.44	79.36	81.80
	QUANTITIES OF FEED PER HEAD--IN POUNDS. . .															
SILAGE	2741	5463	7655	9005	9975	3099	5916	8285	9776	10947	3396	6305	8739	10458	11738	12708
CORN	2084	1405	769	416	165	2348	1648	973	576	274	2631	1916	1258	776	448	197
DP	0	.04	2.38	3.16	3.83	0	0	1.60	3.16	3.35	0	0	.89	3.16	3.16	3.83
GL	29.40	17.35	8.33	4.64	1.54	33.08	20.60	10.59	6.16	2.96	37.20	24.27	13.79	7.67	4.64	1.54
SBM	592	316	198	175	184	665	375	234	182	189	753	447	259	197	193	206

FEED PRICES PER POUND: SILAGE=$.0099, CORN=$.0616

TABLE 2.8: NET RETURNS BY DAYS ON FEED AND MARKET WEIGHT AT VARIOUS ANNUAL INTEREST RATES--FEED PRICE SET 8.

WEIGHT	1000	1000	1000	1000	1000	1050	1050	1050	1050	1050	1100	1100	1100	1100	1100	1100
DAYS	200	210	220	230	240	220	230	240	250	260	240	250	260	270	280	290
REV $	637.00	637.00	637.00	637.00	637.00	668.85	668.85	668.85	668.85	668.85	700.70	700.70	700.70	700.70	700.70	700.70
OP EXP	578.87	540.75	515.03	506.43	502.88	606.45	566.72	538.23	525.76	521.13	636.10	594.72	563.39	546.68	541.61	538.05
INT RATE	INTEREST EXPENSE. . .															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0	30.76	30.16	30.00	30.86	32.01	35.49	34.65	34.32	34.86	35.96	40.73	39.56	38.96	39.26	40.28	41.47
12.5	38.45	37.70	37.51	38.58	40.01	44.36	43.31	42.91	43.57	44.95	50.92	49.45	48.70	49.08	50.35	51.84
15.0	46.14	45.23	45.01	46.30	48.01	53.23	51.97	51.49	52.29	53.94	61.10	59.34	58.44	58.89	60.42	62.21
17.5	53.83	52.77	52.51	54.01	56.02	62.11	60.63	60.07	61.00	62.93	71.28	69.24	68.18	68.71	70.49	72.58
20.0	61.53	60.31	60.01	61.73	64.02	70.98	69.29	68.65	69.72	71.92	81.47	79.13	77.92	78.52	80.56	82.94
22.5	69.22	67.85	67.51	69.44	72.02	79.85	77.96	77.23	78.43	80.91	91.65	89.02	87.65	88.34	90.63	93.31
25.0	76.91	75.39	75.01	77.16	80.02	88.72	86.62	85.81	87.15	89.90	101.83	98.91	97.39	98.15	100.70	103.68
INT RATE	NET REVENUE. . .															
0	58.13	96.25	121.97	130.57	134.12	62.40	102.13	130.62	143.09	147.72	64.60	105.98	137.31	154.02	159.09	162.65
10.0	27.37	66.09	91.97	99.71	102.11	26.91	67.48	96.30	108.23	111.76	23.87	66.42	98.35	114.76	118.81	121.18
12.5	19.68	58.55	84.46	91.99	94.11	18.04	58.82	87.71	99.52	102.77	13.68	56.53	88.61	104.94	108.74	110.81
15.0	11.99	51.02	76.96	84.27	86.11	9.17	50.16	79.13	90.80	93.78	3.50	46.64	78.87	95.13	98.67	100.44
17.5	4.30	43.48	69.46	76.56	78.10	.29	41.50	70.55	82.09	84.79	-6.68	36.74	69.13	85.31	88.60	90.07
20.0	-3.40	35.94	61.96	68.84	70.10	-8.58	32.84	61.97	73.37	75.80	-16.87	26.85	59.39	75.50	78.53	79.71
22.5	-11.09	28.40	54.46	61.13	62.10	-17.45	24.17	53.39	64.66	66.81	-27.05	16.96	49.66	65.68	68.46	69.34
25.0	-18.78	20.86	46.96	53.41	54.10	-26.32	15.51	44.81	55.94	57.82	-37.23	7.07	39.92	55.87	58.39	58.97
	QUANTITIES OF FEED PER HEAD--IN POUNDS. . .															
SILAGE	2741	5463	7655	9005	9975	3099	5916	8285	9776	10947	3396	6305	8739	10458	11738	12708
CORN	2084	1405	769	416	165	2348	1648	973	576	274	2631	1916	1258	776	448	197
DP	0	.04	2.38	3.16	3.83	0	0	1.60	3.16	3.35	0	0	.89	3.16	3.16	3.83
GL	29.40	17.35	8.33	4.64	1.54	33.08	20.60	10.59	6.16	2.96	37.20	24.27	13.79	7.67	4.64	1.54
SBM	592	316	198	175	184	665	375	234	182	189	753	447	259	197	193	206

FEED PRICES PER POUND: SILAGE=$.0114, CORN=$.0616

TABLE 2.9: NET RETURNS BY DAYS ON FEED AND MARKET WEIGHT AT VARIOUS ANNUAL INTEREST RATES--FEED PRICE SET 9.

WEIGHT	1000	1000	1000	1000	1000	1050	1050	1050	1050	1050	1100	1100	1100	1100	1100	1100
DAYS	200	210	220	230	240	220	230	240	250	260	240	250	260	270	280	290
REV $	637.00	637.00	637.00	637.00	637.00	668.85	668.85	668.85	668.85	668.85	700.70	700.70	700.70	700.70	700.70	700.70
OP EXP	582.99	548.95	526.51	519.93	517.84	611.10	575.60	550.66	540.42	537.55	641.20	604.17	576.50	562.37	559.21	557.11
INT RATE	INTEREST EXPENSE. . .															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0	30.99	30.63	30.69	31.71	32.99	35.77	35.20	35.14	35.86	37.12	41.07	40.21	39.89	40.42	41.63	42.98
12.5	38.73	38.28	38.37	39.64	41.24	44.71	44.00	43.92	44.82	46.41	51.33	50.26	49.86	50.52	52.03	53.73
15.0	46.48	45.94	46.04	47.57	49.48	53.65	52.81	52.71	53.79	55.69	61.60	60.31	59.83	60.63	62.44	64.47
17.5	54.23	53.60	53.71	55.49	57.73	62.59	61.61	61.49	62.75	64.97	71.87	70.36	69.80	70.73	72.85	75.22
20.0	61.97	61.25	61.39	63.42	65.98	71.54	70.41	70.28	71.72	74.25	82.13	80.42	79.78	80.83	83.25	85.96
22.5	69.72	68.91	69.06	71.35	74.23	80.48	79.21	79.06	80.68	83.53	92.40	90.47	89.75	90.94	93.66	96.71
25.0	77.47	76.56	76.73	79.28	82.47	89.42	88.01	87.85	89.65	92.81	102.67	100.52	99.72	101.04	104.07	107.45
INT RATE	NET REVENUE. . .															
0	54.01	88.05	110.49	117.07	119.16	57.75	93.25	118.19	128.43	131.30	59.50	96.53	124.20	138.33	141.49	143.59
10.0	23.02	57.42	79.80	85.36	86.17	21.98	58.05	83.05	92.57	94.18	18.43	56.32	84.31	97.91	99.86	100.61
12.5	15.28	49.77	72.12	77.43	77.92	13.04	49.25	74.27	83.61	84.89	8.17	46.27	74.34	87.81	89.46	89.86
15.0	7.53	42.11	64.45	69.50	69.68	4.10	40.44	65.48	74.64	75.61	-2.10	36.22	64.37	77.70	79.05	79.12
17.5	-.22	34.45	56.78	61.58	61.43	-4.84	31.64	56.70	65.68	66.33	-12.37	26.17	54.40	67.60	68.64	68.37
20.0	-7.96	26.80	49.10	53.65	53.18	-13.79	22.84	47.91	56.71	57.05	-22.63	16.11	44.42	57.50	58.24	57.63
22.5	-15.71	19.14	41.43	45.72	44.93	-22.73	14.04	39.13	47.75	47.77	-32.90	6.06	34.45	47.39	47.83	46.88
25.0	-23.46	11.49	33.76	37.79	36.69	-31.67	5.24	30.34	38.78	38.49	-43.17	-3.99	24.48	37.29	37.42	36.14
	QUANTITIES OF FEED PER HEAD--IN POUNDS. . .															
SILAGE	2741	5463	7655	8992	9975	3099	5916	8285	9765	10946	3396	6305	8739	10458	11738	12708
CORN	2084	1405	769	417	165	2348	1648	973	577	274	2631	1916	1258	776	448	197
DP	0	.04	2.38	3.16	3.83	0	0	1.60	3.16	3.35	0	0	.89	3.16	3.16	3.83
GL	29.40	17.35	8.33	4.35	1.54	33.08	20.60	10.59	5.91	2.96	37.20	24.27	13.79	7.67	4.64	1.54
SBM	592	316	198	177	184	665	375	234	183	189	753	447	259	190	197	205

FEED PRICES PER POUND: SILAGE=$.0129, CORN=$.0616

give total receipts (based upon a market price of $63.70/cwt), operating expenses and the optimal total feed use by market weight and days on feed. Interest cost on operating expenses and net returns per head are also shown, calculated at annual interest rates of 0.00%, 10.0%, 12.5%, 15.0%, 20.0%, 22.5% and 25.0%. Table 3 summarizes the results, showing the net return maximizing days on feed for each of the three market weights, each of the nine feed price sets and at each rate of interest.

Recall that feed price sets 1, 2 and 3 represent low, medium and high silage prices with a corn grain price of $2.25/bushel. Price sets 4, 5 and 6, and 7, 8 and 9 are for low, medium and high silage prices with corn grain priced at $2.85/bushel and $3.45/bushel, respectively. "Medium" silage prices (sets 2, 4 and 8) are "breakeven" prices -- six times the associated corn price plus $2.00 per ton. Low prices are $3.00 per ton less and high prices are $3.00 per ton more than the "breakeven" prices.

When the corn silage price was low relative to the corn grain price (price sets 1, 4 and 7), the optimal number of days on feed remained at 240, 260 and 290 for 1000, 1050 and 1100 lb. steers, respectively, at every interest rate considered. More corn is used in feed rations as the rate of gain is increased. The effect on feed costs of feeding the cattle more rapidly is most accute then, when corn is relatively expensive and this change in costs was not offset by interest expenses even when an annual rate of 25% was used.

At medium silage prices, no adjustment in days on feed occurred with the price of corn set at $3.45. The optimal number of days on feed decreased by 10 for 1000 and 1100 lb. steers when corn was priced at $2.85 as the interest rate reached higher levels than have been historically observed -- 25% for 1000 lb. and 22.5% for 1100 lb. steers. Optimal days on feed did not

Table 3: Optimal Number of Days on Feed for Each Market Weight and Feed Price Set.

Market Weight	Feed Price Set	Annual Interest Rate .000	.100	.125	.150	.175	.200	.225	.250
1000 lb.	1	240	—	—	—	—	—	—	240
	2	240	—	240	230	—	—	—	230
	3	240	230	—	—	—	—	—	230
	4	240	—	—	—	—	—	—	240
	5	240	—	—	—	—	—	240	240
	6	240	230	—	—	—	—	—	230
	7	240	—	—	—	—	—	—	240
	8	240	—	—	—	—	—	—	240
	9	240	—	—	240	230	—	—	230
1050 lb.	1	260	—	—	—	—	—	—	260
	2	260	—	—	—	—	260	250	250
	3	260	250	—	—	—	—	—	250
	4	260	—	—	—	—	—	—	260
	5	260	—	—	—	—	—	—	260
	6	260	—	260	250	—	—	—	250
	7	260	—	—	—	—	—	—	260
	8	260	—	—	—	—	—	—	260
	9	260	—	—	—	—	—	260	250
1100 lb.	1	290	—	—	—	—	—	—	290
	2	290	—	290	280	—	—	—	280
	3	290	280	—	—	—	—	—	280
	4	290	—	—	—	—	—	—	290
	5	290	—	—	—	—	290	280	280
	6	290	—	—	—	280	270	—	270
	7	290	—	—	—	—	—	—	290
	8	290	—	—	—	—	—	—	290
	9	290	—	—	290	280	—	—	280

change over the range of interest rates considered for 1050 lb. steers under the same feed price set (set 5). At the low corn price ($2.25/bu.) and the medium silage price ($15.50/t.), days on feed shifted from 240 to 230 as the rate of interest increased from 12.5% to 15.0% for 1000 lb. steers. Shifts from 260 to 250 and 290 to 280 occurred at 22.5% and 15.0% for market weights of 1050 and 1100 lb., respectively. When the medium silage prices were used, adjustment of the rate of gain associated with interest rate changes was sensitive to the absolute prices of the feeds. While in part attributable to the relative increases in feed costs as the rate of gain increased, this results stems also from the added interest expense on feed when maximum total days on feed was decreased.

Under relatively high silage prices (price sets 3, 6 and 9), optimal days on feed was most sensitive to changes in the interest rate. At the lowest positive interest rate considered (10.0%) and with corn priced at $2.25, optimal days on feed were 230, 250 and 280 for market weights of 1000, 1050 and 1100 lb., respectively -- 10 days less than when no interest was charged. Generally the shift in days on feed occurred at higher rates of interest as the price of corn was increased. However, with silage priced at the relatively high levels, increases in the optimal rate of gain occurred at interest rates within the range of rates faced by farmers in recent years.

The highest market weight, 1100 lb., generated the greatest net revenue under all combinations of feed prices and interest rates considered except one. With the feed prices at the highest levels (price set 9), the optimal market weight shifted from 1100 to 1050 lb. when the interest rate was increased to 25.0%. The increase in net revenue associated with feeding from 1050 to 1100 lb. ranged from $6.43 to $17.85 per head over all feed price sets when interest was changed at 10%. With an interest rate of 20% the range fell to between $0.06 and $13.42 -- $3.81 to $6.37 per head lower than the changes in net revenue with a 10.0% interest rate. Although the optimal market weight was not sensitive to interest rate changes within the historically observed range of rates, consideration of other time related costs along with costs considered here could imply an adjustment in market weight in response to interest rate increases.

Two categories of costs not considered in this analysis are worth noting. Labor use and thus labor costs are directly related to the number of days on feed. For farmer feedlots considered here, the value of labor in a given time period may vary widely, depending upon the availability of part-time labor and the implicit value of scarce full-time labor. While the focus of this study was on the impacts of interest rates on operating expenses, the impacts of interest rate changes on optimal days on feed and market weights would be exaggerated as implicit and/or explicit labor costs increase. A second time related cost is implied by the value of feeding facility services. For "turnover" feedlot operations, a group of feeder cattle is replaced after sale by another group. Thus the value per day of feeding facilities reflect the average return per day from the replacement herd. When operating at capacity, the implicit value of scarce feeding facilities may lead to the use of high cost, high rate of gain feed rations even at lower interest rates.

Conclusions

The research reported here focused on the impact of interest rates on optimal rates of gain and market weights for beef cattle. The emphasis was on operations which produce one group of slaughter cattle per year. The results suggest that for such operations, high grain rations with the associated higher rates of gain are optimal when the opportunity cost of operating capital approaches 15.0% to 25.0% per year. High grain rations were found to be optimal at interest rates around 15.0% when corn prices are low ($2.25/bu. was used here), and the corn grain-corn silage price ratio was around $5.3 (prices in pounds). Optimal days on feed were especially sensitive to interest rates when the corn grain-corn silage price ratio was around $4.5. Optimal days on feed then decreased, even at interest rates lower than current levels. The results suggest that a crucial consideration in determining optimal feeding strategies is the value of corn silage.

Optimal market weights were not as sensitive to interest rate changes as days on feed under price situations considered in the study. However, it was pointed out that other time-related costs, especially labor, when added to interest expenses may influence optimal feeding strategies.

The enterprise level model for estimating minimum cost feeding strategies was employed using least cost daily feed rations at rates of gain for which nutrient requirements were available. Specific data on nutrient requirements at other rates of gain would permit a more accurate capture of changes in feed costs associated with changes in overall rates of gain. With such information, adjustment within the model would be smoother and detailed analyses of the dynamics of the feeding process would be enhanced.

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