Animal Performance Changes Related to Time on Feed

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Summary

We are developing mathematical models to show how feed intake, rate of gain, and feed efficiency change during the finishing period. When finished, the models might be used to predict when to sell cattle to maximize profit or minimize loss, to plan feed inventories, or to predict when animals have reached a desired grade.

Introduction

Cattle feeders know that both rate of gain and feed efficiency deteriorate from the start of the finishing period to the end. Because information on deterioration is usually lacking, single values are given for animal performance that represent only averages from the beginning to the end of the finishing period. This experiment was designed to begin developing mathematical models to define how animal growth and efficiency change during the feeding period.

Experimental Procedure

Twenty Hereford steers were individually fed the ten rations (2 per ration) shown in table 29.1. The trial started when all animals had been adjusted to their final rations. Then, all animals were individually weighed once a week, before the morning feeding. Because a ruminant animal's weight can vary widely depending on how much feed and water is in the gut, individual weights contain considerable error that cannot be eliminated. To overcome that problem, a micro-computer was used to fit the best line through the points to remove most of the error. Animals were killed when a pound of gain required 3.41 therms of net energy for production (NEp).

Results and Discussion

Rate of Gain

The growth curve (weight related to days on feed) of a typical steer (ration 7) is shown in figure29.1a The slope of the growth curve at any point gives the rate of gain at that point. Figure29.1b shows how rate of gain was highest early in the feeding period and decreased to slaughter.

Feed Consumption

Figure29.2a shows the cumulative feed consumed related to time on feed.

Figure 29.2b shows how feed consumed per day changed during the feeding period. Feed per day varied through a rather small range as the example steer grew from 630 lbs. to 1052 lbs., which indicated that estimating an animal's feed consumption as a percentage of its body weight is extremely inexact.

Feed Efficiency

By deriving growth rate and feed consumption curves, we can find how feed efficiency changes during the feeding period (Figure 29.3). Gain is efficient early in the feeding period, and becomes quite poor later.

By multiplying feed cost by feed efficiency, we can estimate the feed cost per unit of gain at any point in the feeding period. From an economic standpoint, animals should continue on feed as long as a dollar's worth of inputs (including feed and fixed costs) yield more than a dollar's worth of products. Unfortunately, the value of the product varies with time and also depends on slaughter grade of the animal.

Table 29.2 shows weights, rates of gain, and feed consumptions for the experiment. The figures were calculated from curves like those in figures 29.1a through 3. Note that some animals continued to be efficient and had not been killed at 308 days. These apparently were extremely efficient at depositing fat. Most, however, became inefficient and were killed at light weights. The end-point used for slaughter produced cattle of mostly low choice grade, with a yield grade of less than 4, except in one case.

Although the system needs several refinements, it is perhaps the best available for finding the proper time to kill experimental cattle. A similar system might be used in the industry when curves could be based on three or four pen weights.

The experiment demonstrates (1) wide variability within a fairly uniform lot of cattle in regard to weights at choice grade, (2) decreases in rate of gain and efficiency as animals finish, and (3) relationships among animal size, roughage-to-concentrate ratio, and expected feed intake.

Table 29.1. Ration fed steers in study of performance changes related to time on feed.

Ration no.	% Dry Matter: Corn silage	Cracked corn	Supplement[1]	NEm Therms/100 lbs.	NEp Therms/100 lbs.
1	90.40	0.00	9.60	71.76	45.8
2	80.40	9.70	9.90	74.92	48.0
3	70.40	19.40	10.20	78.10	50.1
4	60.40	29.10	10.50	81.26	52.3
5	50.40	38.80	10.80	84.43	54.5
6	40.30	48.60	11.10	87.60	56.6
7	30.20	58.40	11.40	90.77	58.8
8	20.20	68.10	11.70	93.93	61.0
9	10.10	77.90	12.00	97.10	63.1
10	0.00	87.60	12.40	98.36	65.3

[1] Supplement composition was varied to assure adequate protein. Ingredients included soybean meal, ground limestone, dicalcium phosphate, salt, trace minerals and vitamins.

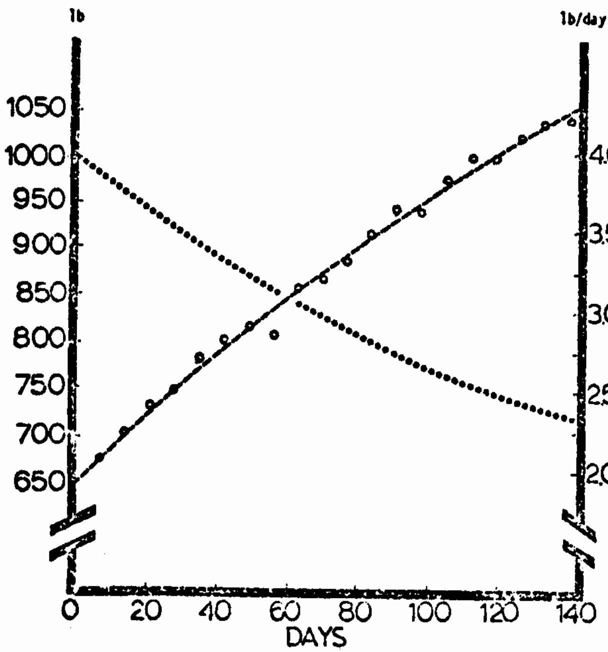
Table 29.2. Animal Performance Data Related to Time on Feed for Ten Concentrate Levels.

Ration No.	Animal No.		DAYS ON FEED 0	28	56	84	112	140	168	196	224	252	280	308	
1	1	WT[a]	676	727	776	823	869	913	956	999	1042	1086	1132	1179	
		ROG	1.90	1.80	1.71	1.64	1.59	1.56	1.54	1.54	1.56	1.59	1.65	1.72	
		FC	16.13	15.75	15.72	15.95	16.32	16.76	17.17	17.43	17.46	17.17	16.44	15.20	
		FE	8.49	8.76	9.19	9.70	10.25	10.76	11.13	11.30	11.19	10.77	9.99	8.86	
	2	WT	613	676	735	792	846	899	951	1002	1053	1106	1161	1217	
		ROG	2.32	2.18	2.07	1.97	1.90	1.86	1.84	1.84	1.86	1.91	1.98	2.07	
		FC	16.28	16.00	16.09	16.44	17.00	17.68	18.40	19.09	19.66	20.04	20.15	19.91	
		FE	7.02	7.33	7.79	8.33	8.93	9.51	10.02	10.39	10.56	10.50	10.18	9.61	
2	3	WT	617	699	760	830	881								
		ROG	3.12	2.71	2.33	1.99	1.69								Killed 119 Days
		FC	15.53	16.80	18.29	20.08	22.26								
		FE	4.97	6.20	7.83	10.06	13.13								C+[b], 2.75[c]
	4	WT	555	634	702	763	821	879	939	1101	1065	1131	1194	1253	
		ROG	3.08	2.58	2.27	2.11	2.07	2.10	2.10	2.26	2.32	2.31	2.21	1.97	
		FC	15.92	15.77	15.91	16.26	16.78	17.35	17.96	18.53	19.00	19.31	19.38	19.61	
		FE	5.17	6.11	7.00	7.70	8.11	8.26	8.25	8.20	8.19	8.34	8.77	9.72	
3	5	WT	649	744	822	883	926								
		ROG	3.71	3.10	1.48	1.85	1.25								Killed 119 Days
		FC	19.01	21.24	21.96	22.21	23.07								
		FE	5.11	6.26	8.86	11.91	18.45								C-, 2.15
	6	WT	618	720	807	879	940	991	1034						Killed 168 Days
		ROG	4.01	3.38	2.83	2.34	1.97	1.66	1.42						C-, 2.56
		FC	18.50	19.16	19.36	19.38	15.47	19.92	20.91						
		FE	4.61	5.66	6.84	8.22	9.90	12.00	14.66						
4	7	WT	595	692	778	853	918	977	1031	1083	1137	1193	1256	1327	
		ROG	3.88	3.32	2.86	2.48	2.19	2.00	1.89	1.80	1.95	2.12	2.38	2.73	
		FC	15.98	17.28	18.13	18.61	18.72	18.87	18.04	18.81	18.56	19.30	19.35	21.01	
		FE	4.12	5.20	6.35	7.51	8.59	9.45	9.96	10.04	9.71	9.10	8.39	7.70	
	8	WT	597	688	768	840	902	957	1005	1047	1083				Killed 226 Days
		ROG	3.41	3.05	2.70	2.39	2.10	1.84	1.60	1.29	1.20				
		FC	16.44	17.21	17.79	17.90	18.02	18.05	17.93	17.79	17.63				C + 3.30
		FE	4.82	5.65	6.54	7.53	8.62	9.84	11.22	12.62	14.66				
5	9	WT	741	849	940	1020	1093								Killed 119 Days
		ROG	4.21	3.52	3.02	2.70	2.56								
		FC	21.24	20.46	21.03	22.78	25.52								C-, 3.25
		FE	5.05	5.81	6.97	8.44	9.95								
	10	WT	614	709	830	894	956	1015	1057						Killed 168 Days
		ROG	3.40	3.33	3.13	2.81	2.36	1.83	1.30						
		FC	20.24	19.09	18.95	19.31	19.39	16.44	15.71						G + 2.86
		FE	5.94	5.70	6.04	6.87	8.20	10.27	14.23						
6	11	WT	676	769	877	963	1040								
		ROG	3.09	2.54	3.50	3.13	2.13								Killed 119 Days
		FC	18.83	19.92	20.56	21.89	25.56								C-, 3.37
		FE	6.29	5.63	5.74	7.00	11.53								
	12	WT	609	704	798	877	933								Killed 112 Days
		ROG	3.27	3.43	3.16	2.46	1.27								
		FC	14.05	17.60	17.79	17.50	19.60								C-, 3.00
		FE	4.30	5.12	5.63	7.18	15.43								
7	13	WT	655	767	873	965	1032								
		ROG	4.00	3.95	3.59	2.88	1.86								
		FC	18.86	18.71	20.69	22.48	21.70								Killed 119 Days
		FE	4.72	4.73	5.78	7.79	11.70								C-, 2.40
	14	WT	630	735	828	910	984	1051							
		ROG	3.98	3.52	3.13	2.79	2.52	2.20							Killed 140 Days
		FC	22.40	18.31	17.69	15.96	20.80	21.27							
		FE	5.68	5.20	5.66	5.83	8.27	9.24							C-, 3.6
8	15	WT	611	736	840	926	997	1057							
		ROG	4.85	4.06	3.37	2.80	2.33	1.97							Killed 140 Days
		FC	15.48	18.79	20.61	21.75	21.13	20.40							
		FE	3.19	4.63	6.11	7.61	9.07	10.39							C-, 3.80
	16	WT	618	740	847	941	1024	1058	1163	1224	1281	1335	1389	1443	
		ROG	4.62	4.07	3.58	3.15	2.79	2.49	2.25	2.06	1.97	1.92	1.93	2.01	
		FC	19.21	20.04	20.31	20.14	19.60	19.05	19.30	17.03	17.52	17.57	18.12	19.32	
		FE	4.16	4.93	5.67	6.36	7.05	7.05	8.17	8.59	8.91	9.16	9.38	9.61	
9	17	WT	650	705	823	909	951								Killed 112 Days
		ROG	2.19	3.05	3.08	2.63	.98								
		FC	11.22	14.95	17.97	17.70	15.18								C°, 3.40
		FE	5.13	4.90	5.32	6.73	15.48								
	18	WT	597	680	797	893	944								Killed 112 Days
		ROG	2.72	3.71	3.76	2.79	.64								
		FC	8.80	15.60	17.11	16.49	16.83								C-, 3.25
		FE	3.24	4.18	4.55	5.90	19.99								
10	19	WT	693	787	875	958	1034	1104	1167	1224	1273	1314			
		ROG	3.44	3.25	3.06	2.04	2.61	2.38	2.34	1.87	1.62	1.35			
		FC	10.04	13.84	16.05	16.66	17.03	16.50	15.74	15.09	14.83	15.00			
		FE	2.92	4.26	5.26	5.99	6.52	6.93	7.36	8.00	9.17	11.35			Killed 226 Days C+, 4.50
	20	WT	621	716	803	884	959	1031	1099	1164	1229	1293	1357	1423	
		ROG	3.52	3.24	3.00	2.79	2.62	2.48	2.38	2.32	2.28	2.29	2.33	2.41	
		FC	12.90	13.57	14.01	14.40	14.70	14.94	15.14	15.30	15.49	15.60	15.32	16.23	
		FE	3.67	4.19	4.60	5.16	5.62	6.02	6.36	6.61	6.65	6.85	6.13	6.74	

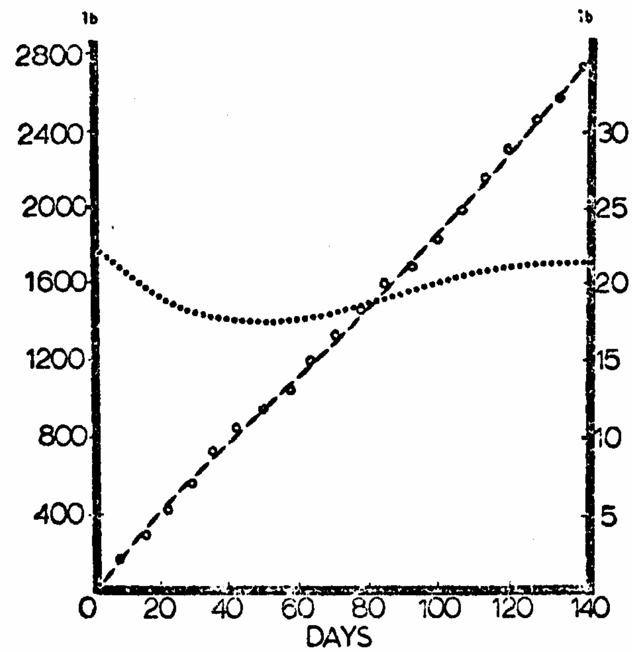
[a] WT. is animal weight in pounds
ROG is rate of gain in pounds per day
FC is feed consumption in pounds of dry matter per day
FE is feed efficiency: units of dry matter per unit of gain

[b] Quality grade to nearest third

[c] Yield grade



GROWTH CURVE-Figure 1a
DAILY GAIN-Figure 1 b



TOTAL FEED CONSUMED-Figure 2a
DAILY FEED CONSUMPTION -Figure 2b

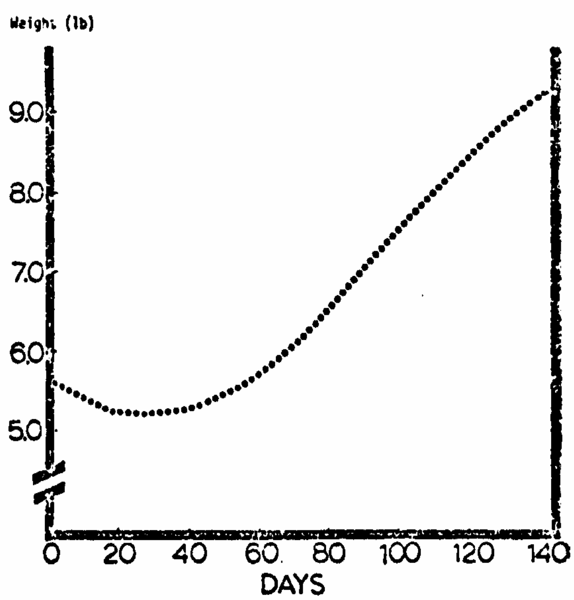


Figure 3. Lb Feed/lb Gain