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			NEm Therms/100 lbs.	NEp Therms/100 lbs.
	Corn silage	Cracked corn	Supplement[1]		
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	676	727	778	823	869	913	956	999	1042	1086	1132	1179
		ROG	1.90	1.00	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	8.75	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	1.85	1.84	1.84	1.86	1.91	1.98	2.07
		FC	15.28	16.00	15.09	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	10.35	10.56	10.50	10.18	9.61
2	3	WT	617	699	769	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	G+b, 2.25c						
	4	WT	555	634	702	763	821	879	939	1001	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	1.86	1.25	Killed 119 Days						
		FC	19.01	21.24	21.96	22.21	23.07							
		FE	5.11	6.86	8.86	11.91	18.45	C- 2.15						
	6	WT	618	720	807	879	940	991	1014	Killed 168 Days				
		ROG	4.01	3.38	2.83	2.34	1.97	1.66	1.42	C- 2.56				
		FC	18.39	19.16	19.36	19.38	19.47	19.94	20.91					
		FE	4.61	5.64	6.84	8.22	9.50	12.00	14.66					
4	7	WT	591	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	1.86	1.95	2.12	2.38	2.73
		FC	15.90	17.28	18.13	18.41	18.72	18.87	18.34	18.55	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	8.59	7.70
	8	WT	597	638	768	840	902	957	1005	1047	1083	Killed 236 Days		
		ROG	3.41	3.05	2.70	2.39	2.10	1.84	1.60	1.29	1.29			
		FC	16.44	17.21	17.79	17.88	18.07	10.05	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	960	1020	1093	Killed 119 Days						
		ROG	4.21	3.58	3.02	2.70	2.56							
		FC	21.24	20.46	21.03	22.78	25.52	C- 3.25						
		FE	5.05	6.81	6.97	8.44	9.95							
	10	WT	614	709	800	894	956	1015	1057	Killed 168 Days				
		ROG	3.43	3.33	3.13	2.81	2.36	1.83	1.10					
		FC	20.24	19.09	18.95	19.31	19.39	18.44	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	870	965	1040	Killed 119 Days						
		ROG	3.09	2.54	2.50	3.13	2.13							
		FC	15.83	19.92	20.56	21.89	25.56	C- 3.37						
		FE	8.29	5.63	5.74	7.60	11.53							
	12	WT	609	704	798	877	930	Killed 112 Days						
		ROG	3.27	3.43	3.16	2.46	1.27							
		FC	14.05	17.59	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	1.66							
		FC	18.86	18.71	20.69	22.29	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	Killed 140 Days					
		ROG	3.98	3.52	3.13	2.79	2.52	2.30						
		FC	22.60	18.31	17.69	19.05	20.89	21.27						
		FE	5.68	5.20	5.66	5.83	9.27	9.24	C-, 3.6					
8	15	WT	611	716	840	926	997	1057	Killed 140 Days					
		ROG	4.85	4.06	3.37	2.80	2.33	1.97						
		FC	15.48	18.79	20.61	21.70	21.13	20.69						
		FE	3.19	4.63	6.11	7.61	9.07	10.39	C-,3.80					
	16	WT	618	740	847	941	1024	1098	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	20.06	20.31	20.14	19.60	19.05	18.30	17.83	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	961	Killed 112 Days						
		ROG	2.19	1.95	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	630	797	891	944	Killed 112 Days						
		ROG	2.72	3.71	3.76	2.75	.64							
		FC	8.80	15.60	17.11	16.49	15.83	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	3.05	2.84	2.61	2.38	2.14	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	15.60		
		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	1009	1164	1229	1293	1357	1423
		ROG	3.52	3.24	3.00	2.79	2.62	2.48	2.38	2.32	2.28	2.79	2.53	2.41
		FC	12.90	11.52	14.01	14.40	14.70	14.94	15.14	15.30	15.45	15.68	15.92	16.23
		FE	3.67	4.15	4.66	5.16	5.62	6.02	6.36	6.61	6.65	6.85	6.33	6.74

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

Figure 1a. GROWTH CURVE

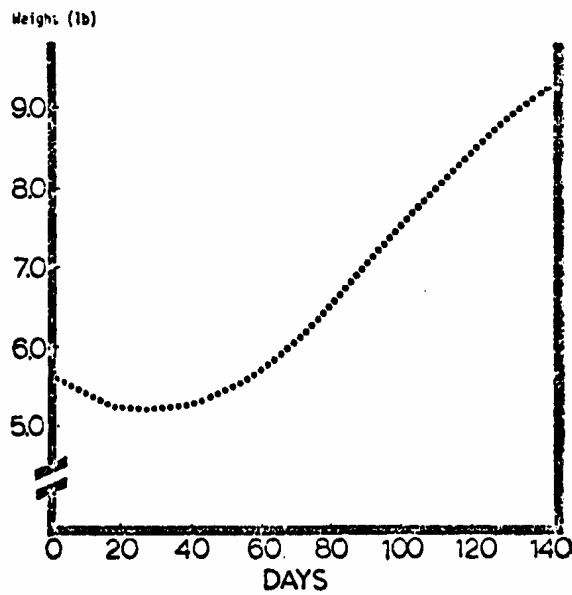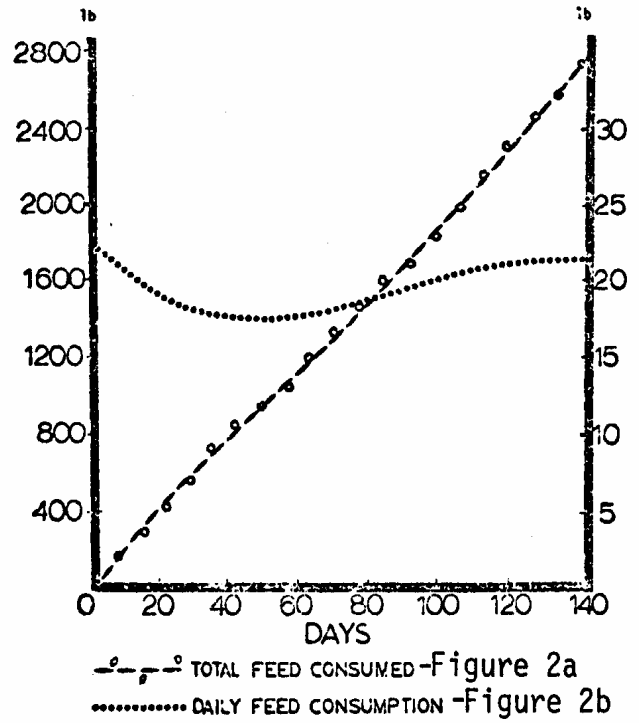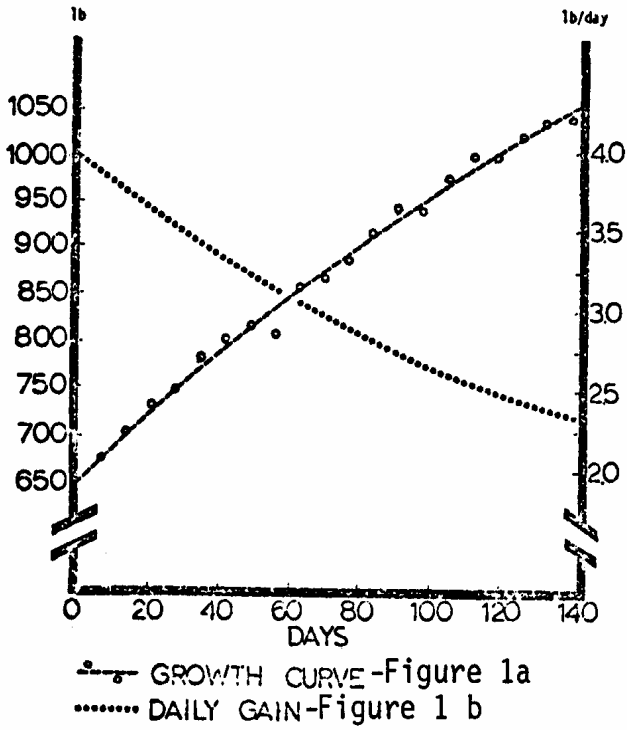Figure 1b. DAILY GAIN

Figure 2a. TOTAL FEED CONSUMED

Figure 2b. DAILY FEED CONSUMPTION

Figure 3. Lb Feed/lb Gain