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K**Animal Performance Changes Related to Time on Feed****S**

Allan Chestnut and B. E. Brent

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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 DiscussionRate of Gain

The growth curve (weight related to days on feed) of a typical steer (ration 7) is shown in figure 29.1a. The slope of the growth curve at any point gives the rate of gain at that point. Figure 29.1b shows how rate of gain was highest early in the feeding period and decreased to slaughter.

Feed Consumption

Figure 29.2a 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	NEp 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

¹Supplement 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	776	813	869	913	956	999	1042	1086	1132
		ROG	1.90	1.00	1.71	1.64	1.59	1.56	1.54	1.54	1.56	1.59	1.65
		FC	16.13	15.75	15.72	15.95	16.32	16.76	17.17	17.43	17.46	17.17	16.44
	2	WT	613	675	735	792	846	899	951	1002	1053	1106	1161
		ROG	2.32	2.18	2.07	1.97	1.90	1.85	1.84	1.84	1.86	1.91	1.98
		FC	15.25	16.50	15.09	16.44	17.00	17.68	18.40	19.09	19.66	20.04	20.15
	3	WT	702	733	779	833	893	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
		FC	15.25	16.50	15.09	16.44	17.00	17.68	18.40	19.09	19.66	20.04	20.15
	4	WT	617	699	760	830	881	Killed 119 Days					
		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	Killed 119 Days					
	5	WT	555	634	702	763	821	879	939	1001	1065	1131	1194
		ROG	3.04	2.58	2.27	2.11	2.07	2.10	2.18	2.26	2.32	2.31	2.21
		FC	15.92	15.77	15.91	16.26	16.78	17.35	17.96	18.53	19.00	19.31	19.38
	6	WT	649	744	822	893	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	Killed 119 Days					
	7	WT	618	720	807	879	940	991	1034	Killed 168 Days			
		ROG	4.01	3.38	2.63	2.14	1.97	1.66	1.42	Killed 168 Days			
		FC	18.20	19.16	19.34	19.30	19.47	19.90	20.91	Killed 168 Days			
	8	WT	591	642	778	853	918	977	1031	1083	1137	1193	1255
		ROG	3.88	3.32	2.96	2.48	2.19	2.00	1.83	1.80	1.95	2.12	2.38
		FC	15.98	17.23	18.13	18.81	19.72	19.87	18.04	18.24	18.55	19.30	19.35
	9	WT	597	638	768	810	902	957	1005	1047	1093	Killed 236 Days	
		ROG	3.41	3.05	2.70	2.39	2.10	1.84	1.68	1.79	1.70	Killed 236 Days	
		FC	16.46	17.21	17.79	18.10	18.07	18.05	17.91	17.76	17.63	Killed 236 Days	
	10	WT	741	849	940	1010	1093	Killed 119 Days					
		ROG	4.21	3.52	3.02	2.70	2.56	Killed 119 Days					
		FC	21.24	20.56	21.03	22.78	25.42	Killed 119 Days					
	11	WT	614	709	820	894	956	1015	1057	Killed 168 Days			
		ROG	1.43	3.13	3.13	2.81	2.36	1.87	1.10	Killed 168 Days			
		FC	20.24	18.60	18.95	19.31	19.39	18.44	15.71	Killed 168 Days			
	12	WT	676	759	877	955	1040						
		ROG	3.01	2.54	2.50	3.13	2.13	Killed 119 Days					
		FC	15.83	19.32	20.56	21.89	25.56	Killed 119 Days					
	13	WT	609	704	768	877	930	Killed 112 Days					
		ROG	3.27	3.43	3.16	2.44	1.37	Killed 112 Days					
		FC	14.05	17.91	17.79	17.50	19.60	Killed 112 Days					
	14	WT	655	767	873	965	1032						
		ROG	4.00	3.95	3.58	2.88	1.66	Killed 119 Days					
		FC	18.86	18.71	20.69	22.28	21.70	Killed 119 Days					
	15	WT	630	735	828	910	984	1061					
		ROG	3.58	3.52	3.13	2.79	2.52	2.30	Killed 140 Days				
		FC	22.40	18.31	17.69	19.56	20.89	21.27	Killed 140 Days				
	16	WT	611	716	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	21.70	21.12	20.40	Killed 140 Days				
	17	WT	618	740	847	941	1024	1058	1163	1224	1281	1355	1389
		ROG	4.62	4.07	3.58	3.15	2.79	2.49	2.25	2.06	1.97	1.92	1.93
		FC	19.21	20.04	20.31	20.14	19.65	19.05	18.30	17.03	17.52	18.12	19.32
	18	WT	650	705	823	909	961	Killed 112 Days					
		ROG	2.19	3.05	3.08	2.63	.98	Killed 112 Days					
		FC	11.22	14.95	17.97	17.70	15.18	Killed 112 Days					
	19	WT	597	630	797	891	944	Killed 112 Days					
		ROG	2.72	3.71	3.78	2.79	.64	Killed 112 Days					
		FC	8.80	15.60	17.11	16.47	15.83	Killed 112 Days					
	20	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	
	21	WT	621	716	803	884	959	1031	1099	1164	1229	1293	1357
		ROG	3.52	3.24	3.00	2.79	2.62	2.48	2.32	2.28	2.29	2.33	2.41
		FC	12.98	13.57	14.01	14.40	14.70	14.94	15.14	15.31	15.46	15.68	16.23

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

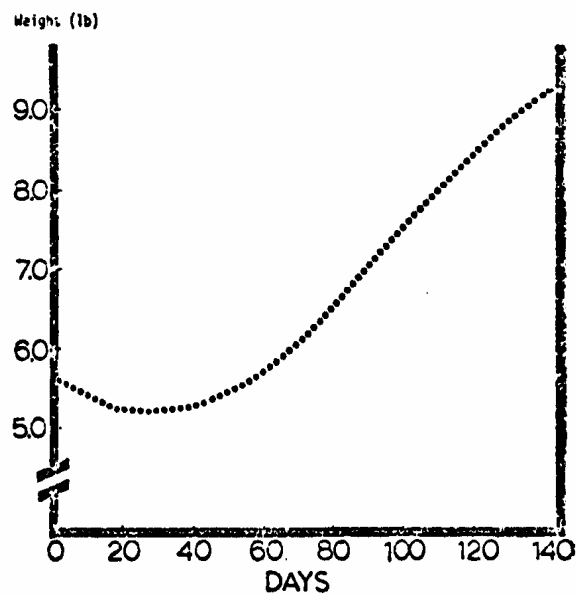
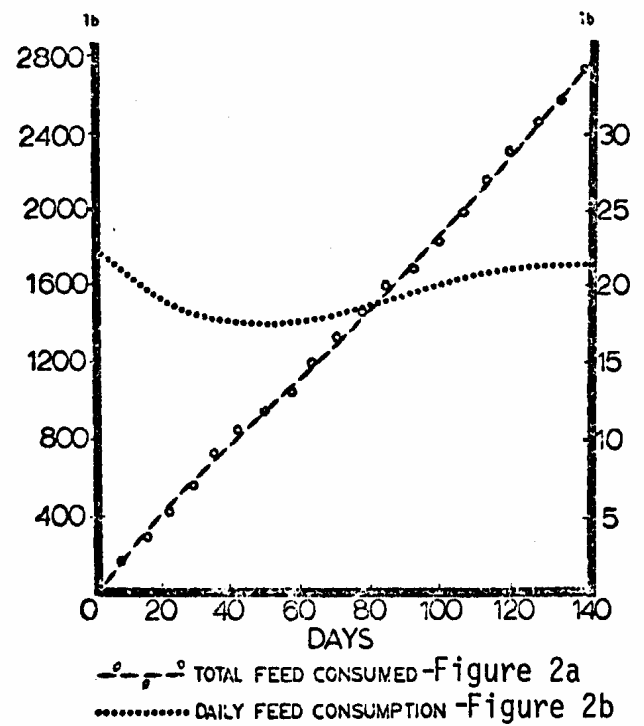
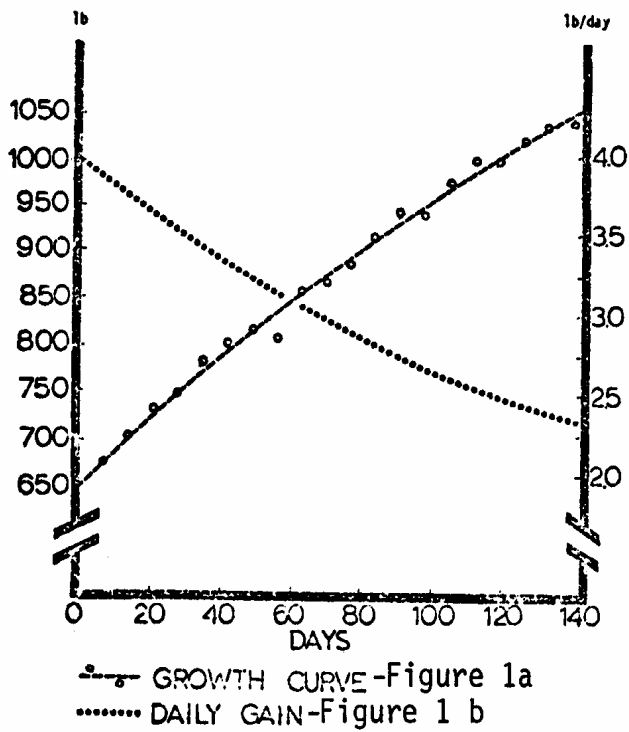


Figure 3. Lb Feed/lb Gain