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4.10.90

STAT 512
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The data (lbs. of milk/day) given below are from an experiment to characterize the lactation curves of breed cows of 3 different crosses. The cows were produced by crossing either Hereford (H), Jersey (J) or Simmental (S) bulls with Angus cows. Hereford is a beef breed while Jersey and Simmental represent high milk producing breeds that are either small or large for mature size, respectively. The major objectives were to see what the curves look like for each breed and to determine if there is significant variation in daily milk production due to breeds, days in lactation or their interaction.

Analyze and summarize this data.

Cross	Cow	Days in Lactation 28	84	140	196	Totals Cows	Breeds
H	381	19.0	17.3	12.1	8.7	57.1	
H	384	17.3	13.8	10.4	5.2	46.7	
H	386	20.7	19.0	13.8	5.2	58.7	
H	387	15.5	15.5	15.5	7.0	53.5	
H	389	15.5	13.8	10.4	7.0	46.7	
H	390	13.8	13.8	10.4	7.0	45.0	307.7
J	370	19.0	25.9	13.8	13.8	72.5	
J	372	17.3	15.5	15.5	7.0	55.3	
J	374	19.0	15.5	12.1	5.2	51.8	
J	375	19.0	19.0	13.8	10.4	62.2	
J	377	17.3	17.3	13.8	12.1	60.5	
J	380	19.0	17.3	13.8	12.1	62.2	364.5
S	328	19.0	19.0	17.3	13.8	69.1	
S	341	15.5	13.8	15.5	10.4	55.2	
S	344	22.4	19.0	17.3	8.7	67.4	
S	348	13.8	13.8	12.1	10.4	50.1	
S	351	19.0	13.8	17.3	12.1	62.2	
S	369	17.3	20.7	13.8	12.1	63.9	367.9
Day Totals		319.4	303.8	248.7	168.2		1040.1

Breed	Days in Lactation 28	84	140	196	Breeds
H	101.8	93.2	72.6	40.1	307.7
J	110.6	110.5	82.8	60.6	364.5
S	107.0	100.1	93.3	67.5	367.9
Day Totals	319.4	303.8	248.7	168.2	1040.1

$\sum\sum\sum_{ijk} Y^2_{ijk}$ = 16,305.07

Residual SS = 192.95541667

C = 15025.111

N = 72

JBMILK.512

CRD Split-plot

H_0: $M_S = M_J = M_H$ for all time periods.

Source	df	SS	MS	F	
Total	71	1279.96			
Cow (wholeplot)	17	269.22	15.836	1.36	
Breed (treat)	2	95.3	47.654	4.11	*
H vs J+S (B_1)	1	95.06	95.063	8.2	*
J vs S (B_2)	1	.24	.241	.02	
(Error a) Breed/cow	15	173.92	11.594		
Days	3	777.87	259.29	60.46	*
Linear	1	718.82	718.82	167.6	*
Quadratic	1	58.5	58.50	13.64	*
Cubic	1	.552	.552	.13	
Breed x days	6	39.9	6.652	1.55	
B_1 x Linear	1	16.32	16.32	3.81	
B_1 x Quad	1	.3211	.321	.07	
B_1 x cubic	1	.265	.265	.06	
B_2 x Linear	1	11.440	11.440	2.67	
B_2 x Quad	1	.213	.213	.05	
B_2 x cubic	1	11.353	11.353	2.67	
Error b	45	192.955	4.288		

$C = 15025.111$

$F_a = F_{.05,17,15} = 2.40$

$F_b = F_{.05,3,45} = 2.84$.

$SS(\text{Total}) = \sum y_{ijk}^2 - \frac{(y_{...})^2}{N} = 16,305.07 - \frac{(1040.1)^2}{72} = 1279.96$

$SS(\text{Breeds}) = \sum y_{i..}^2/bn - C = \frac{307^2 + 364.5^2 + 367.9^2}{24} - C = 95.3$

$SS(\text{cow})_{(\text{whole plot})} = \sum \frac{y_{ij.}^2}{n} - C = \frac{57.1^2 + \cdots + 63.9^2}{4} - C = 269.22$

Error a = SS(cow) − SS(cross) = 173.92

(B_1) H vs J+S $= (2)(307.7) + (-1)364.7 + (-1)367.9 = -117.2$

(B_2) J vs. S $= 0(307.7) + (1)364.7 + (-1)367.9 = -3.4$

$SS(Q)_{(B_1)} = \frac{Q^2}{\sum n_i c_i^2} = \frac{(117.2)^2}{144} = 95.06$

$SS(Q_2)_{(B_2)} = \frac{(-3.4)^2}{48} = .24$

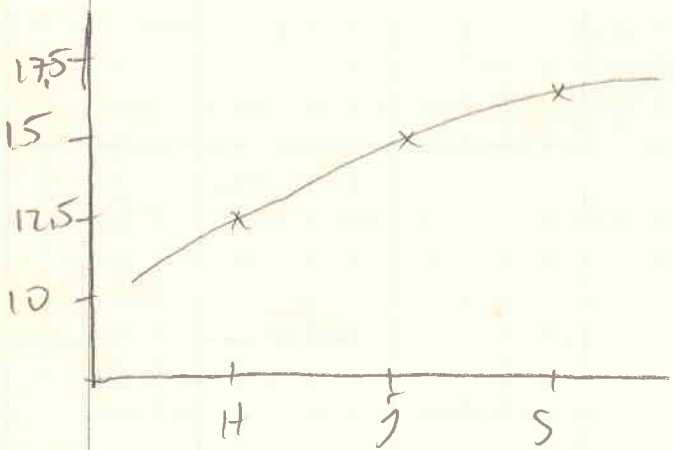
Day Effect	Q	$\sum c_i^2$	$\frac{Q^2}{\sum c_i^2}$
Linear $(-3)319.4+(-1)303.8+(1)248.7+(3)168.2$	$=-508.7$	360	718.8
Quad. $(1)319.4+(-1)303.8+(-1)248.7+(1)168.2$	$=-64.9$	72	58.5
Cubic $(-1)319.4+(3)303.8+(-3)248.7+(1)168.2$	$=14.1$	360	55

SS(breed x day)

$$\frac{\sum Y_{ij}^2}{n} - \frac{\sum Y_{i..}^2}{bn} - \frac{\sum Y_{.j.}^2}{an} + C$$

$$= 15938.202 - 15120.415 - 15802.985 + 15025.111 = 39.9$$

Breed x day)	Q	$\sum c_i^2$	SS(Q)
B_1 x Linear	-108.4	$6\times120=720$	16.32
B_1 x Quad.	-6.8	$6\times24=144$	.321
B_1 x Cub.	-13.8	$6\times120=720$	.265
B_2 x Lin.	-52.4	$6\times40=240$	11.441
B_2 x Quad	-3.2	$6\times8=48$	.213
B_2 x Cub	52.2	$6\times40=240$	11.353



Conclusion: Breed differences are significant. Orthogonal contrasts showed that Hereford compared to Jersey & Simmental was significant ($\alpha = .05$). There is a significant linear & quadratic effect of day of lactation on milk production. Milk production decreases at an increasing rate as days of lactation increases.

In summary, cross-bred animals (Jersey & Simmental) produced more milk than Hereford.