

# Ages at Calving and Calving Intervals for Dairy Cattle in the United States

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## ABSTRACT

Calving ages and intervals for cows first calving in 1966 to 1986 were examined for five dairy cattle breeds. For parities one through seven, mean age at each parity was lowest for Jerseys and highest for Ayrshires and Brown Swiss. Registered cows usually were older than grades for a specific parity. Notable exceptions were that registered Guernseys, Holsteins, and Jerseys were younger than grades at first parity. Trends in calving ages over time generally were positive for given parities; if parity was not considered, trends were negative except for Jerseys and significant except for Ayrshires and Holsteins. In later years, trend for Guernseys was no longer significant. Calving intervals were shortest for Jerseys and longest for Brown Swiss and Guernseys. Mean calving intervals decreased from first to second interval and then increased through sixth for all breeds. Calving intervals for Holsteins ranged from 393 d following second parity to 405 d following sixth. Registered cows had longer calving intervals than did grades. Trends for calving intervals generally were positive for given parities; trends for more recent data were less positive and significant only for Guernseys. No evidence of generally deteriorating reproductive performance across time was found.

## INTRODUCTION

Average herd life is an important economic factor (1, 3, 13, 14). Ages at calvings and survival rates largely determine average productive life of cows in a herd (2). Powell (11) reported average ages at first calving for different breeds by year for calvings in 1960 through 1982. Although trends were not significant, all breeds had an increasing trend until 1976 and afterwards a decreasing trend. Little has been reported about ages at later calvings. Andrus et al. (2) have shown distribution of cows over age classes but without accounting for parity. Knowledge of these ages combined with survival rates enables calculation of average age at calving of all cows, a parameter that is used routinely in many countries to monitor average herd life of dairy cows. Survival studies show differences in stayability between registered and grade cows (2, 4, 5, 8), a phenomenon that also could occur for age at calving for various parities.

A trait closely related with age at calving is calving interval. Although disagreement exists on optimum calving interval, this trait is economically important (6, 7, 10). Difference between average ages at successive calvings would equal average calving interval if the same cows were included in both average ages. In practice, however, cows are culled or die between calvings. If younger or older cows at the earlier calving are more likely to be culled, difference in average ages will overestimate or underestimate calving interval.

Objectives of this study were to determine average ages at calvings and calving intervals by breed, year of first calving, and registry status for US dairy cattle. Year of first calving was chosen rather than birth year or particular parity so that means for a given year would specify a particular base group of cows re-

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ardless of parity. Trends were investigated to assess changes over time.

### MATERIALS AND METHODS

Data were the same as those described by Nieuwhof et al. (8) and were records of sire-identified cows enrolled in official testing plans in the National Cooperative Dairy Herd Improvement Program and first calving between January 1, 1966, and April 30, 1986. To prevent overrepresentation of cows calving at younger ages due to date that herd testing was terminated or data were selected, cows were limited to those in herds on test long enough to provide the cow with an opportunity to have a next calf. Age at first reported calving was limited to 15 to 36 mo, and calving intervals were restricted to 270 to 650 d. Analysis was within breed for Ayrshires, Brown Swiss, Guernseys, Holsteins (representative sample of every 15th herd), and Jerseys. Data for first parity included information from 87,756 Ayrshires, 108,733 Brown Swiss, 331,497 Guernseys, 294,195 Holsteins, and 421,911 Jerseys. Numbers of cows with an opportunity to calve were reported by Nieuwhof et al. (8) by parity, registry status, and breed. Because of the large numbers of records, standard errors of means were small, most differences between means were significant, and that significance generally was not reported. Range of standard errors is in table footnotes if available and appropriate.

Mean age at calving ( $\bar{A}$ ), disregarding parity, was calculated by:

$$\bar{A} = \frac{\sum_{i=1}^7 S_i(\bar{A}_i)}{\sum_{i=1}^7 S_i}$$

where  $S_i$  = survival rate to parity  $i$  ( $i = 1, \dots, 7$ ) as reported by Nieuwhof et al. (8) and  $\bar{A}_i$  = mean age of cows surviving to parity  $i$ .

Trends were calculated by regression of annual average age at calving or calving interval on year of first calving. Trends in calving intervals were calculated without the last year with observations for each parity because of large fluctuations resulting from less data. Because regressions were computed on means rather than individual cow data, tests of significance were calculated and reported.

### RESULTS AND DISCUSSION

Ages at first calving (Figure 1) were highest in 1976, which agrees with peak ages in 1976 reported by Powell (11). No reason is known why cows of all breeds would have first calved at older ages in 1976. Overall mean age at first calving was highest for Ayrshires and lowest for Jerseys. Age in this study was computed in fractional months, whereas Powell (11) used truncated full months attained. After adjusting Powell's averages for truncation by adding .5 mo, average ages at first calving in this study were slightly higher than in his study. This may

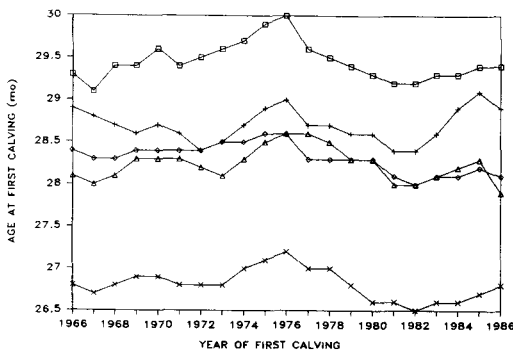


Figure 1. Mean age at first calving by breed and year of first calving ( $\square$  = Ayrshire,  $+$  = Brown Swiss,  $\diamond$  = Guernsey,  $\triangle$  = Holstein, and  $\times$  = Jersey).

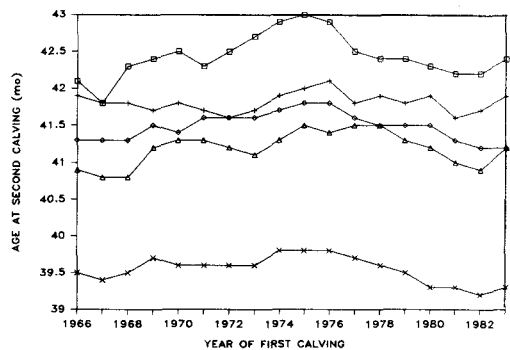


Figure 2. Mean age at second calving by breed and year of first calving ( $\square$  = Ayrshire,  $+$  = Brown Swiss,  $\diamond$  = Guernsey,  $\triangle$  = Holstein, and  $\times$  = Jersey).

TABLE 1. Mean ages at calvings<sup>1</sup> by breed and parity.

Parity	Ayrshire	Brown Swiss	Guernsey	Holstein	Jersey
	(mo)				
1	29.4	28.7	28.3	28.2	26.8
2	42.4	41.8	41.5	41.2	39.5
3	55.3	54.9	54.4	54.1	52.2
4	68.2	68.1	67.4	66.9	64.9
5	81.0	81.3	80.4	79.8	77.6
6	94.0	94.4	93.4	92.7	90.2
7	107.0	107.5	106.2	105.5	102.8
All <sup>2</sup>	51.8	52.2	49.1	50.4	49.8

<sup>1</sup> Standard errors ranged from .01 for Holsteins and Jerseys at first parity to .43 for Ayrshires at seventh parity.

<sup>2</sup> All cows regardless of parity.

be because of an editing difference for first lactations of cows between 35 and 36 mo of age. Powell required records of such cows to be coded as first lactations by the dairy records processing center, whereas no such check was performed in this study. In both studies, records accepted as first lactations were the first available in USDA master computer files.

Figures 2 and 3 show mean ages at second and third calvings. Number of years reported is fewer for later parities because of lack of opportunity for subsequent calvings for cows first calving in more recent years. Ages at second calving were highest for cows first

calving in 1975 and 1976. By third calving, this pattern had nearly disappeared, which suggests that higher ages at second calving result from some carryover effect from first calving.

Overall mean ages at calving are in Table 1 by breed and parity. For each parity, Jerseys were youngest and were significantly younger ( $P < .01$ ) than the next youngest breed, Holstein. Ayrshires and Brown Swiss had the oldest mean calving ages.

Mean ages at calving regardless of parity (Table 2) can be used to characterize a population at a given time and to compare across time. Overall mean age at calving without regard to parity was lowest for Guernseys and

TABLE 2. Mean ages at calvings regardless of parity by breed and year of first calving.

Year	Ayrshire	Brown Swiss	Guernsey	Holstein	Jersey
	(mo)				
1966	52.4	53.5	49.9	50.3	49.5
1967	51.5	53.1	49.4	50.5	49.6
1968	51.2	52.8	49.4	50.5	50.2
1969	52.8	51.9	49.4	50.5	48.8
1970	52.2	52.6	49.4	51.2	48.8
1971	52.0	53.0	49.0	50.7	48.8
1972	52.0	52.5	49.2	50.4	49.7
1973	51.2	51.6	48.8	50.4	50.0
1974	51.7	51.9	48.9	50.5	50.1
1975	51.5	51.3	49.0	50.1	50.1
1976	52.0	51.7	49.0	50.5	50.2
Overall	51.8	52.2	49.1	50.4	49.8

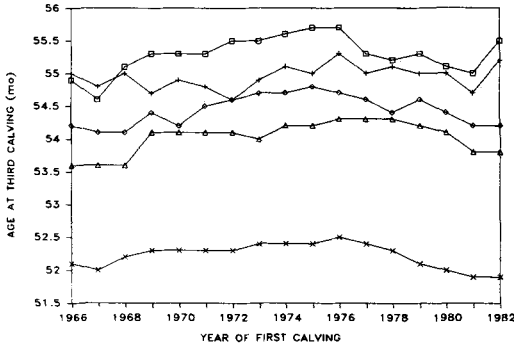


Figure 3. Mean age at third calving by breed and year of first calving (□ = Ayrshire, + = Brown Swiss, ◇ = Guernsey, △ = Holstein, and x = Jersey).

highest for Brown Swiss. Although Jerseys have the highest survival rates and longest productive life (8), their mean age at calving disregarding parity was second lowest as a result of their having the lowest age at first calving. Because of the way  $\bar{A}$  was computed, standard errors for testing significance among breeds were not available.

Mean ages at calving by registry status are in Table 3. Registered cows were younger for Guernseys, Holsteins, and Jerseys or the same age for Brown Swiss as grades at first calving. Ayrshire grades were younger than registered cows for each parity. Registered Jerseys were younger until sixth and later calvings. After first calving, registered cows tended to be older than grades. This can be caused both by longer calving intervals for registered cows and by more intense culling of older cows among grades. Such culling differences have been reported in previous studies (4, 8, 9, 12).

For all breeds, registered cows had a higher mean age at calving than did grades if parity was ignored (Table 3). Registered cows were older than grades by 1.1 mo for Holsteins to 3.7 mo for Brown Swiss. Because ages at calving at specific parities do not differ much between registered and grade cows, difference in calving age disregarding parity must be caused mainly by survival rates.

Trends for age at calving (Table 4) were mostly positive for given parities, and 8 of 35 regressions were significant ( $P < .05$ ) and positive. One of the six negative regressions was

TABLE 3. Mean ages at calvings<sup>1</sup> by breed, registry status, and parity.

Parity	Ayrshire		Brown Swiss		Guernsey		Holstein		Jersey	
	Registered	Grade	Registered	Grade	Registered	Grade	Registered	Grade	Registered	Grade
1	29.5	29.3	28.7	28.7	28.3	28.4	28.1	28.3	26.7	27.2
2	42.4	42.3	41.8	41.9	41.5	41.4	41.1	41.3	39.4	39.9
3	55.3	54.9	55.9	54.9	54.5	54.2	54.0	54.1	52.1	52.5
4	68.2	67.5	68.1	68.1	67.4	67.0	67.0	66.9	64.8	65.1
5	81.1	80.3	81.3	81.0	80.5	79.9	79.9	79.7	77.5	77.6
6	94.1	92.5	94.4	93.9	93.5	92.7	92.8	92.5	90.3	90.0
7	107.1	105.6	107.5	107.0	106.3	105.4	105.7	105.2	102.9	102.4
All <sup>2</sup>	52.0	49.7	52.8	49.4	49.4	47.7	50.9	49.9	50.2	48.3

<sup>1</sup> Standard errors ranged from .01 for registered or grade Holsteins or Jerseys to .56 for grade Ayrshires.

<sup>2</sup> All cows regardless of parity.

TABLE 4. Regressions and standard errors of age at calving on year of first calving by breed and parity.

Parity	Ayrshire		Brown Swiss		Guernsey		Holstein		Jersey	
	$\bar{X}$	SE	$\bar{X}$	SE	$\bar{X}$	SE	$\bar{X}$	SE	$\bar{X}$	SE
1	-.11	.26	.10	.21	-.51	.15*	.06	.22	.30	.18
2	.27	.41	.10	.20	-.12	.25	.36	.31	-.35	.26
3	.57	.42	.36	.35	.43	.35	.66	.36	-.28	.29
4	.83	.56	.30	.37	1.23	.42*	1.27	.36*	.01	.31
5	.32	.96	.77	.36	1.70	.45	1.17	.45*	.41	.31
6	2.10	1.18	0	.50	2.33	.62*	2.07	.59*	.58	.46
7	2.34	1.60	-.52	.92	3.22	.84*	2.74	.71*	1.16	.41*
All <sup>1</sup>	-1.09	1.45	-5.65	1.29*	-2.47	.56*	-.44	.80	1.60	.50*

<sup>1</sup> All cows regardless of parity.

\* $P < .05$ .

significant. The generally positive trends result largely from increases in ages in early data. If data from the first 5 yr were ignored, 24 of 35 regressions were negative, 9 significantly so.

Trends in age regardless of parity were negative except for Jerseys (Table 4). If the first 5 yr were ignored, trend for Guernseys no longer was significant. Although ages at specific parities generally were increasing, average cow age for breeds other than Jersey was decreasing because of a changing parity structure. Desirability of positive or negative trend for calving age regardless of parity is related to cause of trend. If genetic trend is accelerating and superiority of younger cows is recognized, trend would tend to be negative and favorable. However, if involuntary removals are reduced, a

positive trend would tend to be favorable as cows remain in herds longer. Both situations relate to culling rate and are desirable but affect average age in opposite directions. Congleton and King (3) simulated herd profitability under various culling policies and concluded that increased herd life would increase profitability under all conditions of feed and salvage prices and herd management. The assumed trend in sire merit was 30 kg/yr, which would affect results somewhat. Even if expressed as transmitting ability, this is not more than two-thirds of the current rate of improvement.

Mean calving intervals for the first three parities by year of first calving are in Figures 4 through 6. First calving intervals (Figure 4) generally were shorter for first calvings in 1976

TABLE 5. Mean calving intervals<sup>1</sup> by breed and parity.

Parity <sup>2</sup>	Ayrshire	Brown Swiss	Guernsey	Holstein	Jersey
	(d)				
1	393.6	400.8	399.6	394.2	387.7
2	388.6	399.3	395.7	392.8	385.4
3	389.5	400.9	398.7	394.6	386.2
4	391.6	404.2	402.3	398.1	388.5
5	395.0	408.1	405.8	400.4	390.6
6	397.8	411.1	407.2	404.7	393.6

<sup>1</sup> Standard errors ranged from .12 for Jersey first interval to 1.10 for Ayrshire sixth interval.

<sup>2</sup> Parity that initiates calving interval.

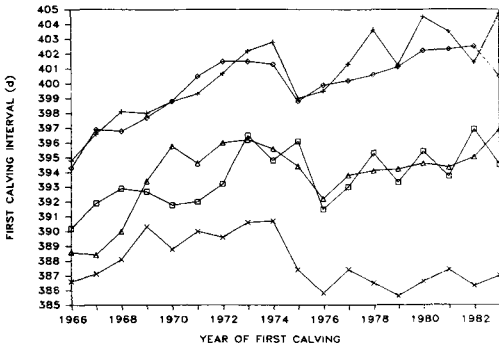


Figure 4. Mean calving interval between first and second calvings by breed and year of first calving (□ = Ayrshire, + = Brown Swiss, ◇ = Guernsey, △ = Holstein, and x = Jersey).

than for adjacent years. Thus, cows first calving in 1976 were older (Figure 1) but conceived sooner. Mean calving intervals by breed and parity are in Table 5. Jerseys had the shortest calving intervals and Brown Swiss and Guernseys the longest. Average calving intervals for all breeds decreased from first to second interval but increased thereafter through sixth.

In most cases, difference between mean ages at subsequent calvings was lower than for the corresponding mean calving interval. Underestimation of calving intervals by corresponding average ages at calvings increased with parity, likely because of increased culling among older

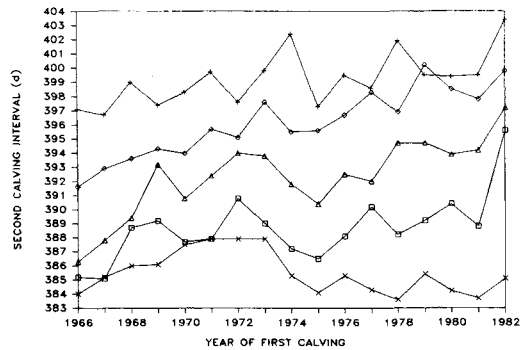


Figure 5. Mean calving interval between second and third calvings by breed and year of first calving (□ = Ayrshire, + = Brown Swiss, ◇ = Guernsey, △ = Holstein, and x = Jersey).

TABLE 6. Mean calving intervals<sup>1</sup> by breed, registry status, and parity.

Parity <sup>2</sup>	Ayrshire		Brown Swiss		Guernsey		Holstein		Jersey	
	Registered	Grade	Registered	Grade	Registered	Grade	Registered	Grade	Registered	Grade
1	393.6	394.0	401.0	399.5	400.1	396.5	394.9	393.6	388.0	386.5
2	388.8	385.0	399.6	396.3	396.5	391.2	394.6	391.1	386.0	382.6
3	389.8	385.6	401.2	397.5	399.6	393.6	396.7	392.5	386.8	383.3
4	391.8	388.1	405.0	395.9	403.2	397.1	400.8	395.3	389.0	385.6
5	395.7	384.2	408.2	406.8	406.7	400.4	403.5	396.8	391.2	387.4
6	397.8	399.0	411.4	407.5	407.8	402.8	407.2	401.5	394.6	388.0

<sup>1</sup> Standard errors ranged from .13 for registered Jersey first interval to 5.5 for grade Ayrshire sixth interval.

<sup>2</sup> Parity that initiates calving interval.

TABLE 7. Regressions and standard errors of calving intervals on year of first calving by breed and parity.

Parity <sup>1</sup>	Ayrshire		Brown Swiss		Guernsey		Holstein		Jersey	
	$\bar{X}$	SE	$\bar{X}$	SE	$\bar{X}$	SE	$\bar{X}$	SE	$\bar{X}$	SE
1	.24	.08*	.43	.08*	.38	.07*	.26	.10*	-.15	.08
2	.18	.08	.18	.08	.44	.06*	.39	.09*	-.14	.08
3	.10	.14	.10	.12	.64	.07*	.40	.10*	-.10	.06
4	.08	.12	.14	.13	.55	.12*	.29	.10*	-.05	.07
5	.15	.30	-.23	.21	.78	.14*	.50	.14*	.01	.11
6	-.09	.50	-.04	.37	.90	.22*	.35	.18	-.09	.22

<sup>1</sup> Parity that initiates calving interval.

\**P* < .05.

cows at a given parity. Thus, older cows were less likely to calve again and be included in averages for calving intervals.

Table 6 shows average calving intervals according to registry status. Registered cows tended to have longer first intervals by about 1.5 d for Brown Swiss, Holsteins, and Jerseys and 3.5 d for Guernseys. Registered Ayrshires had slightly shorter first intervals (.5 d) than did grades. Thereafter, interval differences for all breeds gradually increased until fourth interval, after which intervals for registered cows averaged about 5 d longer than for grades but with considerable variation within and across breeds.

Regressions calculated to determine trend in calving intervals (Table 7) were mostly positive

except for Jerseys but significant only for Guernseys and Holsteins. Ignoring the first 5 yr of data resulted in regressions that were less positive, and only Guernseys had significant positive regressions. Thus, little evidence was found of longer intervals in later years.

**CONCLUSIONS**

Within parity, Jerseys calved at the youngest ages and Ayrshires and Brown Swiss at the oldest. Ages at calving were relatively stable across time with significant increases only for Guernseys and Holsteins in later parities. Jerseys had the shortest calving intervals, whereas Brown Swiss and Guernseys had the longest. Although trends generally were for increasing calving ages and intervals, later years often showed decreases or nonsignificant increases. Registered cows generally were older than grades at calvings after first and had longer calving intervals. Differences between average calving ages from all data underestimated corresponding calving intervals, apparently because of culling; i.e., the same cows did not contribute to both averages. No indication of deteriorating reproductive performance across time was found in general in this study, but interpretations will vary with the time period examined.

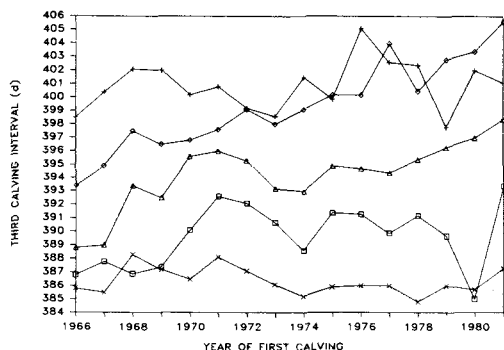


Figure 6. Mean calving interval between third and fourth calvings by breed and year of first calving (□ = Ayrshire, + = Brown Swiss, ◇ = Guernsey, △ = Holstein, and x = Jersey).

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