NATIONAL COOPERATIVE DAIRY HERD IMPROVEMENT PROGRAM

HANDBOOK

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• Dairy producers • Breed associations • AI organizations • Cooperative Extension • USDA—Extension Service — Agricultural Research Service

Procedures for Calculating Lactation Records

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Lactation records are the basic unit of information on a cow's production for management decisions and genetic evaluation. They are calculated from information collected on periodic sample days. The amount of information collected depends on the type of testing plan. The most common plans require weighing the milk at all milkings and collecting a composite sample during the approximate 24-hour period of the sample day. Variations include 1) AM-PM (AP) plans, for which only one milking is weighed and sampled each sample day for herds milked two times a day (2X) and only one or two milkings are weighed and one milking sampled each sample day for herds milked three times a day (3X); 2) AP Component Sampling (APCS) plans, for which all milkings are weighed each sample day, but only one milking is sampled; and 3) Milk-Only (MO) plans, for which no sampling is done. (See Fact Sheet H-11 for a complete list of testing plans and codes and Fact Sheet E-1 for definitions.)

In general, a lactation record is calculated by using three steps:

1. estimate the sample-day yield for milk and components;
2. estimate the yield from the previous sample day through the current sample day (credit for the test interval); and
3. add the test interval credits for the lactation to determine the lactation yield.

Factors used by the Northeast Dairy Records Processing Laboratory for estimating yields and adjusting credits differ from those presented here. Other dairy records processing centers (DRPC's) may not have adopted the latest equations or adjustments.

Estimating Sample-Day Yields (Step 1)

Sample-day yields and component percentages are estimated from yield weighed and sampled on sample day. The method for calculating sample-day yield depends on whether all milkings on sample day are weighed and sampled. If the measured milkings have abnormal yield or percentage values, this information must be estimated or the test interval merged with the following one.

All Milkings Weighed and Sampled (Most Common Testing Plans)

If all milkings are weighed and sampled on sample day, the recorded milk weights are added to obtain the sample-day milk yield. Component percentages from the composite sample are used as the sample-day component percentages. The sample-day milk yield is multiplied by the sample-day component percentages to estimate the sample-day component yields.

For example, Cow 29 gave 23.0 pounds of milk at the 6:30 a.m. milking and 17.0 pounds of milk at the 4:30 p.m. milking. Her composite sample was 4.0 percent fat and 3.5 percent protein. Cow 29's sample-day milk yield would be 40.0 pounds (the sum of the two milk weights). Her sample-day component percentages would be 4.0 percent for fat and 3.5 percent for protein (the test results from the composite sample). Her estimated sample-day component yields would be her sample-day milk yield multiplied by the appropriate sample-day component percentages (in decimal form):

40.0 pounds of milk × .040 = 1.60 pounds of fat

40.0 pounds of milk × .035 = 1.40 pounds of protein

If the herd had been milked 3X, the estimated sample-day yields and percentages would have been calculated the same way except that all three milk weights would have been summed to obtain the sample-day milk yield.

Not All Milkings Weighed and Sampled (AP Plans)

For AP plans, milking times for the measured milking and the milking preceding the measured milking must be recorded. This information is necessary because factors specific to milking time and interval are used with the measured milk

weight(s) and component percentages to estimate sample-day yields and percentages.

To determine the milking interval, the starting and ending times are averaged for the preceding milking and for the measured milking. The milking interval is the interval from the average time for the preceding milking until the average time for the measured milking. The results are expressed in hours using decimals.

For example, a herd had a measured milking that started at 6:30 a.m. and ended at 9 a.m. The preceding milking started at 4:30 p.m. and ended at 6:30 p.m. the previous afternoon. The average times would be 7:45 a.m. for the measured milking and 5:30 p.m. for the preceding milking. The milking interval would be 14.25 hours (expressed as a decimal).

Herds milked 2X. For 2X herds, sample-day yields and percentages are estimated from one measured milking using the factors in Table 1:

sample-day $yield_{2X}$ =

$factor_{2X\ milk}$ × milk yield for measured milking

+ covariate × (days in milk − 158)

sample-day fat $percentage_{2X}$ =

$factor_{2X \times fat}$ × fat percentage for the measured milking sample-day fat yield =

sample-day fat percentage × sample-day milk yield

sample-day protein or solids-not-fat (SNF) yield =

protein or SNF percentage for the measured milking × sample-day milk yield

Table 1. Factors[1] and covariates for estimating sample-day milk yield and fat percentage from one measured milking for herds milked two times a day.

Interval preceding measured milking (hours)	Milk yield				Fat percentage factor[3]
	a.m. milking[2]		p.m. milking[2]		
	Factor	Covariate	Factor	Covariate	
<9.00	2.465	.01566	2.594	.00834	.919
9.00-9.24	2.465	.01566	2.534	.01069	.927
9.25-9.49	2.465	.01566	2.477	.01071	.934
9.50-9.74	2.411	.01578	2.423	.01126	.941
9.75-9.99	2.359	.01600	2.370	.01043	.948
10.00-10.24	2.310	.01010	2.321	.00742	.955
10.25-10.49	2.262	.00879	2.273	.00471	.961
10.50-10.74	2.217	.00649	2.227	.00000	.968
10.75-10.79	2.173	.00492	2.183	.00000	.974
11.00-11.24	2.131	.00000	2.140	.00000	.980
11.25-11.49	2.091	.00000	2.099	.00000	.986
11.50-11.74	2.052	.00000	2.060	.00000	.992
11.75-11.99	2.014	.00000	2.022	.00000	.997
12.00-12.24	1.978	.00000	1.986	.00000	1.003
12.25-12.49	1.943	.00000	1.951	.00000	1.008
12.50-12.74	1.910	.00000	1.917	.00000	1.013
12.75-12.99	1.877	.00000	1.884	.00000	1.018
13.00-13.24	1.846	.00000	1.852	−.00418	1.023
13.25-13.49	1.815	.00000	1.822	−.00510	1.028
13.50-13.74	1.786	−.00369	1.792	−.00678	1.033
13.75-13.99	1.757	−.00569	1.763	−.00747	1.037
14.00-14.24	1.730	−.00766	1.736	−.01123	1.042
14.25-14.49	1.703	−.00801	1.709	−.01039	1.046
14.50-14.74	1.677	−.00733	1.683	−.01000	1.050
14.75-14.99	1.652	−.00696	1.683	−.01000	1.054
≥15.00	1.628	−.00518	1.683	−.01000	1.058

[1] Factors for milk and fat yields may be calculated by factor = 1/(intercept + slope × milking interval) where the intercepts and slopes are in the following table:

Yield trait	Intercept		Slope
	a.m.	p.m.	
Milk	.0654	.0634	.0363
Fat	.1965	.1939	.0254

Factors for fat percentage are the ratio of the fat yield factor to the milk yield factor.

[2] Time at start of measured milking determines whether a.m. or p.m. factors are used.

[3] Factors for fat percentage appropriate for both a.m. and p.m. milkings.

The formula for estimating sample-day milk yield is adjusted to account for differences in the time available to the cow for producing milk (the milking interval). A second adjustment is made through the covariate (which is set to 0 at 158 days, the midpoint for a 305-day record) because for unequal milking intervals, a cow's stage of lactation affects the influence that the length of the preceding interval has on milk production.

The formula for sample-day fat percentage also is adjusted to account for the effect of milking interval on fat percentage. Protein and SNF percentages are not affected by milking interval. Therefore, the percentage for the sampled milking is used as the sample-day percentage.

As an example, assume that Cow 29 now is in the herd with a measured milking at 6:30 a.m. and a milking interval of 14.25 hours. She has been in milk for 250 days. Her milk yield for the measured milking was 23.0 pounds, and her sample was 4.0 percent fat and 3.5 percent protein. From Table 1, the factor for estimating sample-day milk yield with a 14.25-hour milking interval preceding a measured a.m. milking is 1.703; the covariate is −.00801. The factor for estimating sample-day fat percentage is 1.046. Therefore,

sample-day milk yield =

$(1.703 \times 23.0) + (-.00801) \times (250 - 158) = 38.4$ pounds of milk

sample-day fat percentage =

$1.046 \times 4.0 = 4.2$ percent for fat

sample-day fat yield =

$.042 \times 38.4 = 1.61$ pounds of fat

sample-day protein yield =

$.035 \times 38.4 = 1.34$ pounds of protein

Herds milked 3X. For 3X herds, two consecutive milkings must be weighed with samples collected at one of these milkings. Sample-day milk yield and fat percentage are estimated by

sample-day milk yield $_{3X}$ =

$factor_{3X\ milk}$ × total milk yield from measured milkings

sample-day fat percentage$_{3X}$ =

$factor_{3X\ fat}$ × fat percentage from the measured milking

Formulas for calculating component yields for 3X herds are the same as those for 2X herds.

The 3X factors for estimating sample-day milk yield and fat percentage are calculated with the intercepts and slopes in Table 2:

$factor_{3X\ milk}$ =

1/(intercept for measured milking 1 + intercept for measured milking 2 + slope × total of the intervals preceding both measured milkings)

$factor_{3X\ fat\ percentage}$ =

(milk intercept for sampled milking + milk slope for sampled milking × interval preceding sampled milking)/(fat intercept for sampled milking + fat slope for sampled milking × interval preceding sampled milking)

The AP factors for 3X herds should not be confused with factors that adjust 3X records to a 2X basis. (See Fact Sheet G-2.)

Assume that Cow 29's herd now is milked 3X. She gave 16.0 pounds of milk at a 5 a.m. milking and 12.0 pounds of milk at a noon milking. Her sample at the 5 a.m. milking was 4.0 percent fat and 3.5 percent protein. The milking preceding the 5 a.m. milking started at 7 p.m. the evening before. The factors to estimate sample-day milk yield and fat percentage would be:

$factor_{milk}$ =

$1/\{.077 + .068 + [.0329 \times (10 + 7)]\}$

$= 1/.704 = 1.42$

$factor_{fat\ percentage}$ =

$[.077 + (.0329 \times 10)]/[.186 + (.0186 \times 10)]$

$= .406/.372 = 1.09$

Then,

sample-day milk yield$_{3X}$ $= 1.42 \times (16.0 + 12.0) = 39.8$ pounds of milk

sample-day fat percentage$_{3X}$ $= 1.09 \times 4.0 = 4.4$ percent for fat

sample-day fat yield$_{3X}$ $= .044 \times 39.8 = 1.75$ pounds of fat

sample-day protein$_{3X}$ $= .035 \times 39.8 = 1.39$ pounds of protein

Table 2. Intercepts and slopes for calculating factors to estimate sample-day milk yield from two consecutive milk weights and component percentages from samples collected at one milking for herds milked three times a day.

Yield trait	Intercept for milking times: Between 2 a.m. and 9:59 a.m.	Between 10 a.m. and 5:59 p.m.	Between 6 p.m. and 1:59 a.m.	Slope[1]
Milk	.077	.068	.066	.0329
Fat	.186	.186	.182	.0186

[1] Slope appropriate for all milkings regardless of milking time.

All Milkings Weighed But Only One Sampled (APCS Plans)

For both 2X and 3X herds, the sample-day milk yield is the sum of the recorded milk weights. The sample-day fat percentage is calculated with the formula for fat percentage for AP herds, 2X or 3X as appropriate.

Assume Cow 29 now is in a 2X herd on APCS test. She gave 23.0 pounds of milk at the 6:30 a.m. milking and 17.0 pounds of milk at the 4:30 p.m. milking. Her sample at the 6:30 a.m. milking was 4.0 percent fat and 3.5 percent protein. The milking interval preceding the sampled milking was 14.25 hours. Then,

sample-day milk yield = 23.0 + 17.0 = 40.0 pounds of milk

sample-day fat percentage = 1.046 × 4.0 = 4.2 percent for fat

sample-day fat yield = .042 × 40.0 = 1.68 pounds of fat

sample-day protein yield = .035 × 40.0 = 1.40 pounds of protein

Abnormal Sample-Day Yield

Abnormal values of yield or percentage for measured milkings require modifications of procedures for estimating sample-day yields.

Milk yield. Milk yield reported as abnormal and differing from yield from the adjacent sample day by more than a computed percentage (27.4 + .4 × days in test interval) is estimated from the preceding sample-day yield according to the method adopted by DRPC or spanned.

For example, Cow 29 had a sample-day yield of 20.0 pounds of milk at 85 days, which was reported as abnormal. Her previous sample-day yield had been 55.0 pounds at 50 days. Her sample-day yield differed from her preceding sample-day yield by 63.6 percent. For this cow's 35-day interval, a difference of greater than 41.4 percent is considered abnormal. Therefore, the sample-day yield of 20.0 pounds at 85 days is abnormal and either must be estimated or spanned.

The most accurate method of estimating sample-day milk yield for an abnormal sample day is to adjust the sample-day milk yield from the preceding sample day with the factors used for computing the credit for the last test interval (see Table 5):

sample-day milk yield =

$(2 \times \text{factor}_{\text{last}} - 1)$

× sample-day milk yield from preceding sample day

The factor appropriate for the preceding sample day rather than for the abnormal sample day should be used.

For first-lacation Cow 29, her estimated sample-day milk yield by this method would be

sample-day milk yield =

(2 × .97 − 1) × 55.0 = .94 × 55.0 = 51.7 pounds of milk

A less accurate method used by many DRPC's for estimating sample-day milk yield for abnormal sample days is

sample-day milk yield =

(1 − .0033 × days in test interval)

× sample-day milk yield from preceding sample day

The differences in estimated sample-day milk yield between the two methods are largest for first lactations.

First-lactation Cow 29's sample-day milk yield estimated by this method would have been

sample-day milk yield =

[1 − (.0033 × 35)] × 55.0 = 48.6 pounds of milk

For spanning, the abnormal sample-day yield is ignored, and the test interval is considered to be the interval from the sample day preceding the abnormal sample day to the sample day following the abnormal sample day.

Component percentage. If component analysis is not available because of loss or deterioration of the sample or because of impossible results, the component percentage from the preceding sample is used.

Estimating Test Interval Yield (Step 2)

For most test intervals, the interval yield (or credit) is calculated by multiplying the average daily yield between sample days by the number of days in the test interval. Average daily yield is estimated as the average of the yields for the preceding and current sample days. Therefore,

test interval credit =

[(yield on preceding sample day + yield on sample day)/2] × days in test interval

As an example, assume that Cow 29 had a sample-day yield of 40.0 pounds at 250 days in milk. Her preceding sample-day yield was 41.0 pounds at 220 days in milk. Therefore, her credit for milk yield for this test interval would be

test interval $\text{credit}_{\text{milk}}$ =

[(41.0 + 40.0)/2] × 30 = 1,215 pounds of milk

A theoretically more accurate method, although not currently in use in the National Cooperative Dairy Herd Improvement Program (NCDHIP), is to estimate the yield only for the days between sample days and then add the known yield on sample day. Test interval credits calculated by this method differ from those in NCDHIP by half the difference between sample-day yields.

Because of the shape of the lactation curve (Figure 1), some test interval yields must be adjusted so that production can be estimated accurately. First and last intervals have a sample day at only

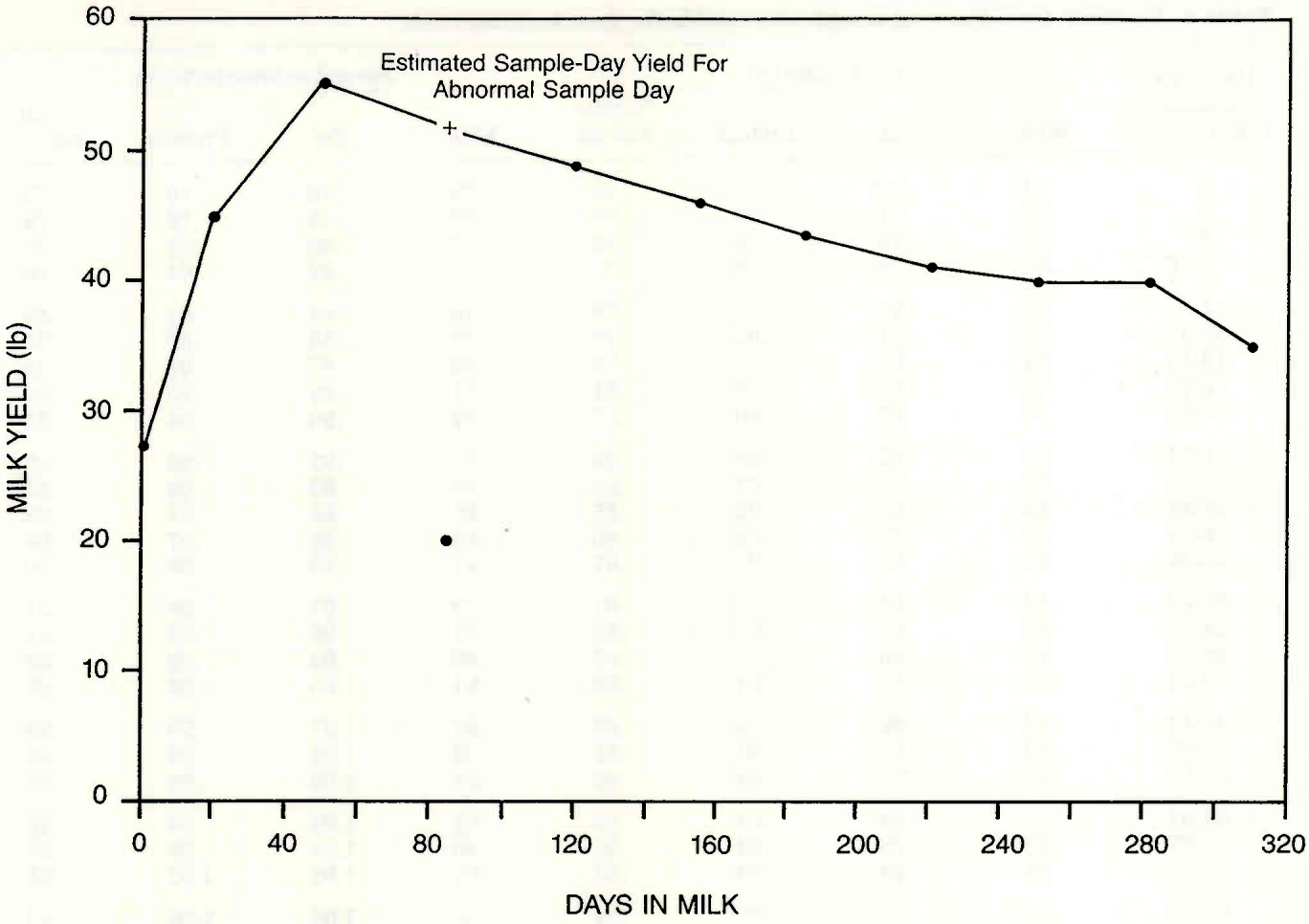

Figure 1. Lactation curve of first-lactation milk yield for example cow 29 in Table 6.

one end of the interval; therefore, the change in yield during the interval must be estimated. A test interval that spans the peak of lactation (at approximately 40 days in milk) must have the test interval yield adjusted to account for above-average yield on unrecorded days. In addition, if computing a 305-day record, the test interval that spans 305 days in milk must be adjusted to end on day 305.

First Test Interval

The credit for the first test interval can be calculated with the factors in Table 3:

test interval $\text{credit}_{\text{first}}$ =

factor × yield on sample day × days in milk

The number of days in milk includes both the calving day and the sample day.

For example, if first lactation Cow 29's first sample day was at 20 days in milk and her sample-day milk yield was 45.0 pounds, her test interval credit for first interval milk yield would be

test interval credit 1 =

$.80 \times 45.0 \times 20 = 720$ pounds of milk

Test Interval Spanning Lactation Peak

The test interval credit for an interval with a preceding sample day before 40 days in milk can be calculated with the factors in Table 4 by

test interval $\text{credit}_{\text{peak}}$ =

factor × (yield on preceding sample day + yield on sample day)/2

× days in test interval

To continue with Cow 29's first lactation as an example, her second sample day was at 50 days in milk. Her sample-day milk yield was 55.0

Table 3. Factors[1] for adjusting sample-day yields for first test intervals.

Day of first sample (days in milk)	First lactation				Second or later lactation			
	Milk	Fat	Protein	Solids-not-fat	Milk	Fat	Protein	Solids-not-fat
6	.71	.69	.70	.68	.74	.76	.76	.73
7	.72	.71	.73	.70	.75	.78	.79	.75
8	.73	.74	.76	.72	.76	.80	.81	.76
9-10	.74	.76	.79	.74	.77	.82	.84	.78
11	.75	.79	.81	.76	.78	.84	.87	.80
12-13	.76	.81	.83	.77	.79	.86	.89	.81
14-15	.77	.83	.86	.79	.80	.87	.91	.83
16-17	.78	.85	.88	.81	.81	.89	.93	.84
18-19	.79	.87	.89	.82	.82	.90	.94	.85
20-21	.80	.89	.90	.83	.83	.92	.95	.86
22-23	.81	.90	.91	.84	.84	.93	.96	.87
24-25	.82	.91	.92	.85	.85	.94	.97	.88
26-27	.83	.92	.92	.86	.86	.95	.97	.89
28-30	.84	.93	.93	.87	.87	.96	.98	.90
31-33	.85	.94	.93	.87	.88	.97	.98	.91
34-35	.86	.95	.93	.88	.87	.98	.99	.91
36-38	.87	.95	.94	.89	.90	.99	.99	.92
39-41	.88	.96	.94	.89	.91	1.00	.99	.93
42-44	.89	.96	.94	.90	.92	1.01	.99	.93
45-47	.90	.97	.94	.91	.93	1.02	.99	.94
48-50	.91	.97	.94	.92	.94	1.03	.99	.95
51-54	.92	.98	.94	.92	.95	1.03	.99	.96
55-57	.93	.98	.94	.93	.96	1.04	.99	.97
58-61	.94	.99	.94	.93	.97	1.05	1.00	.98
62-64	.95	.99	.95	.94	.98	1.06	1.00	.97
65-68	.96	1.00	.95	.95	.99	1.07	1.01	.99
69-72	.97	1.00	.96	.96	1.00	1.08	1.02	1.00
73-75	.98	1.01	.97	.97	1.01	1.09	1.03	1.02
>75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

[1] Factors are derived from the following regression coefficients:

Yield trait	Lactation	Regression coefficients[1] 1	2	3	4
Milk	First	.605	.0435	–	–
	Second or later	.635	.0435	–	–
Fat	First	.235	.239	−.0225	.000069
	Second or later	.476	.146	−.0115	.000038
Protein	First	.136	.316	−.0351	.000130
	Second or later	.177	.324	−.0366	.000141
Solids-not-fat	First	.342	.180	−.0173	.000066
	Second or later	.416	.167	−.0163	.000069

[1] The regression function is

$$\text{coefficient 1} + \text{coefficient 2} \times \sqrt{\text{day of first sample}} + \text{coefficient 3} \times \text{day of first sample} + \text{coefficient 4} \times (\text{day of first sample})^2$$

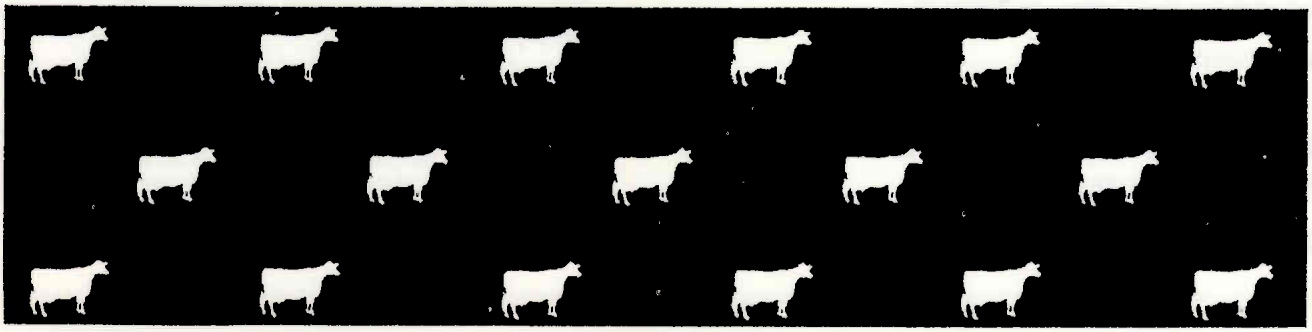

Table 4. Factors[1] for adjusting yields for test intervals at peak of lactation.

Day of preceding sample (days in milk)	Yield trait	Days in test interval 1-10	11-19	20-28	29-37	38-46	47-55	56-64	65-75
First lactation									
6-7	Milk	1.04	1.06	1.08	1.09	1.11	1.13	1.15	1.16
	Fat	1.02	1.03	1.03	1.04	1.05	1.06	1.05	1.05
	Protein	1.02	1.05	1.02	1.03	1.03	1.04	1.04	1.04
	Solids-not-fat	1.04	1.06	1.07	1.08	1.09	1.11	1.11	1.13
8-10	Milk	1.02	1.03	1.04	1.05	1.07	1.08	1.09	1.10
	Fat	1.02	1.02	1.03	1.03	1.03	1.04	1.03	1.03
	Protein	1.01	1.01	1.00	1.00	1.01	1.01	1.01	1.01
	Solids-not-fat	1.02	1.03	1.03	1.04	1.05	1.06	1.07	1.08
11-13	Milk	1.01	1.02	1.03	1.04	1.05	1.05	1.06	1.07
	Fat	1.01	1.01	1.01	1.01	1.02	1.02	1.01	1.01
	Protein	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01
	Solids-not-fat	1.01	1.01	1.01	1.03	1.03	1.04	1.05	1.05
14-22	Milk	1.01	1.01	1.02	1.02	1.03	1.03	1.04	1.05
	Fat	1.01	1.01	1.01	1.01	1.02	1.01	1.01	1.01
	Protein	1.00	1.00	1.00	1.01	1.01	1.01	1.01	1.02
	Solids-not-fat	1.00	1.00	1.01	1.02	1.02	1.03	1.03	1.04
23-31	Milk	1.00	1.01	1.01	1.01	1.02	1.02	1.02	1.03
	Fat	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
	Protein	1.01	1.01	1.02	1.02	1.02	1.02	1.03	1.03
	Solids-not-fat	1.00	1.01	1.01	1.02	1.02	1.02	1.03	1.03
32-39	Milk	1.00	1.00	1.01	1.01	1.01	1.01	1.02	1.02
	Fat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Protein	1.00	1.00	1.00	1.00	1.00	1.01	1.01	1.01
	Solids-not-fat	1.00	1.00	1.00	1.01	1.01	1.01	1.01	1.01
Second or later lactation									
6-7	Milk	1.02	1.04	1.05	1.07	1.08	1.10	1.12	1.13
	Fat	1.01	1.01	1.01	1.02	1.03	1.03	1.03	1.03
	Protein	1.02	1.01	1.00	1.00	1.00	1.00	1.00	1.01
	Solids-not-fat	1.02	1.04	1.04	1.06	1.07	1.08	1.08	1.09
8-10	Milk	1.01	1.03	1.04	1.05	1.06	1.07	1.08	1.09
	Fat	1.00	1.00	1.01	1.02	1.02	1.02	1.02	1.02
	Protein	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Solids-not-fat	1.01	1.02	1.02	1.03	1.04	1.05	1.05	1.06
11-13	Milk	1.01	1.02	1.03	1.04	1.04	1.05	1.06	1.07
	Fat	1.00	1.00	1.01	1.02	1.02	1.02	1.01	1.02
	Protein	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Solids-not-fat	1.01	1.01	1.01	1.02	1.03	1.03	1.04	1.05
14-22	Milk	1.01	1.01	1.02	1.02	1.03	1.03	1.04	1.05
	Fat	1.00	1.00	1.01	1.02	1.02	1.01	1.01	1.01
	Protein	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.01
	Solids-not-fat	1.00	1.00	1.01	1.02	1.02	1.02	1.03	1.03
23-31	Milk	1.00	1.01	1.01	1.01	1.02	1.02	1.02	1.03
	Fat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Protein	1.00	1.00	1.01	1.01	1.01	1.01	1.02	1.02
	Solids-not-fat	1.00	1.01	1.01	1.01	1.02	1.02	1.02	1.02
32-39	Milk	1.00	1.00	1.00	1.01	1.01	1.01	1.01	1.02
	Fat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Protein	1.00	1.00	1.00	1.00	1.01	1.01	1.01	1.01
	Solids-not-fat	1.00	1.00	1.00	1.00	1.01	1.01	1.01	1.01

[1] Milk factors also can be calculated by

$.998 + 1.23/(\text{day of preceding sample})^2$
$+ .0113 \times (\text{days in interval} + 1)/\text{day of preceding sample}$

for first lactations and by

$1.001 - .00042 \times \text{day of preceding sample}$
$+ .0109 \times (\text{days in interval} + 1)/\text{day of preceding sample}$

for second and later lactations. Component factors are available only from the table.

pounds. Therefore, Cow 29's test interval credit for second interval milk yield would be

test interval credit 2 =

1.02 × [(45.0 + 55.0)/2] × 30 = 1,530 pounds of milk

Interval to 305 days with subsequent sample day

If a cow has a sample day after 305 days in milk, the credit for the test interval up to 305 days is calculated for a 305-day lactation record by

test interval credit$_{305}$ =

[yield on preceding sample day

+ (daily change/2) × (days to 305 days + 1)]

× days to 305 days

where

daily change =

(yield on sample day − yield on preceding sample day)/ days in test interval

Assume that Cow 29 had a sample day at 310 days in milk with a sample-day yield of 35.0 pounds of milk and her preceding sample-day yield had been 40.0 pounds of milk at 280 days. Average daily change in milk yield for the test interval would be

daily change = (35.0 − 40.0)/30 = −.17

The test interval credit for milk yield up to 305 days would be

test interval credit$_{305}$ =

[40.0 + (−.17/2) × 26] × 25 =

(40.0 − 2.21) × 25 = 945 pounds of milk

Last Interval

If a cow terminates her lactation before 305 days in milk or if a complete rather than 305-day record is to be calculated, the credit for the last interval is calculated with the factors in Table 5 by

test interval credit$_{last}$ = factor × yield on last sample day × days to termination

If a cow is milked past 305 days without a subsequent sample day, the credit for the last interval is calculated for a 305-day record with the same formula except that the number of days to 305 days is substituted for the number of days to termination.

If Cow 29 had been dried off at 290 days rather than having a sample day at 310 days, the credit for her last test interval milk yield would have been

test interval credit $_{last}$ =

.99 × 40.0 × 10 = 396 pounds of milk

If Cow 29 had been dried off at 310 days but with no sample day after 305 days, her credit for the last test interval for a 305-day record would have been

test interval credit $_{\text{last to 305 days}}$ =

.96 × 40.0 × 25 = 960 pounds of milk

Summing the Test Interval Credits To Determine Lactation Yield (Step 3)

The lactation yield is calculated by summing the credits for all the test intervals. A 305-day lactation record includes only test intervals through 305 days in milk. Table 6 shows sample-day information on milk yield for Cow 29's complete first lactation and calculation of her 305-day lactation yield for milk.

Calculating Days Milked 3X

The days that a cow is milked 3X also are calculated as part of the lactation record to provide information for management decisions and genetic evaluation. The days milked 3X reflect the portion of the lactation record calculated from 3X sample days. The procedures for calculating days 3X are determined by the days in milk.

Test Interval Not Spanning 305 Days in Milk

If the cow is milked 2X on one sample day and 3X on the other, the days 3X for the test interval is one-half the number of days in the test interval.

For example, if Cow 29 had a 3X sample day at 280 days in milk and her preceding sample day was 2X at 250 days in milk, her days 3X for the test interval would be 15 days.

Test Interval Spanning 305 Days in Milk

If the sample day preceding 305 days is 3X and the sample day after 305 days is 2X, the days 3X for the last interval of the 305-day record is calculated by

days 3X =

(305 − days in milk at 3X sample day)

× {1 − (306 − days in milk at 3X sample day)/[2

× (days in milk at 2X sample day − days in milk at 3X sample day)]}

If Cow 29 had a 3X sample day at 280 days in milk and a 2X sample day at 310 days, her days 3X for the test interval would be

days 3X =

(305 − 280) × {1 − (306 − 280)/[2 × (310 − 280)]} =

25 × (1 − .43) = 14.25 days

If the sample day preceding 305 days is 2X and the sample day after 305 days is 3X, then

days 3X =

(305 − days in milk at 2X sample day)

× (306 − days in milk at 2X sample day)/[2 × (days in milk at 3X sample day − days in milk at 2X sample day)]

If Cow 29 had a 2X sample day at 280 days in milk and a 3X sample day at 310 days, her days 3X for the test interval would be

days 3X =

(305 − 280) × (306 − 280)/[2 × (310 − 280)] =

25 × .43 = 10.75 days

Table 5. Factors[1] for adjusting yields for test interval after last sample day.

Day of last sample (days in milk)	Yield trait	Days in test interval 5-14	15-24	25-34	35-44	45-54	55-64	65-75
First lactation								
40-159	Milk	.99	.98	.97	.97	.96	.95	.94
	Fat	.99	.99	.98	.97	.97	.96	.95
	Protein	.99	.99	.98	.98	.97	.96	.96
	Solids-not-fat	.99	.99	.98	.97	.96	.96	.95
160-249	Milk	.99	.98	.97	.96	.95	.94	.93
	Fat	.99	.98	.98	.97	.96	.95	.94
	Protein	.99	.99	.98	.97	.96	.96	.95
	Solids-not-fat	.99	.98	.97	.96	.95	.95	.94
250-305	Milk	.99	.97	.96	.95	.94	.92	.91
	Fat	.99	.98	.97	.96	.95	.94	.93
	Protein	.99	.98	.98	.97	.96	.95	.94
	Solids-not-fat	.99	.98	.97	.96	.95	.94	.93
Second or later lactation								
40-129	Milk	.99	.97	.96	.95	.94	.92	.91
	Fat	.99	.98	.97	.95	.94	.93	.92
	Protein	.99	.98	.97	.95	.94	.93	.92
	Solids-not-fat	.99	.98	.96	.95	.94	.93	.91
130-184	Milk	.99	.97	.96	.94	.93	.91	.90
	Fat	.99	.97	.96	.95	.93	.92	.91
	Protein	.99	.97	.96	.95	.93	.92	.91
	Solids-not-fat	.99	.97	.96	.94	.93	.91	.90
185-224	Milk	.98	.96	.95	.93	.91	.89	.88
	Fat	.98	.97	.95	.94	.92	.91	.89
	Protein	.98	.97	.95	.94	.92	.91	.89
	Solids-not-fat	.98	.97	.95	.93	.91	.90	.88
225-254	Milk	.98	.96	.94	.92	.90	.88	.86
	Fat	.98	.97	.95	.93	.91	.90	.88
	Protein	.98	.97	.95	.93	.91	.90	.88
	Solids-not-fat	.98	.96	.94	.92	.90	.88	.86
255-279	Milk	.98	.96	.93	.91	.89	.87	.84
	Fat	.98	.96	.94	.92	.91	.89	.87
	Protein	.98	.96	.94	.92	.90	.89	.87
	Solids-not-fat	.98	.96	.94	.91	.89	.87	.85
280-305	Milk	.97	.95	.92	.90	.87	.85	.82
	Fat	.98	.96	.94	.92	.90	.87	.85
	Protein	.98	.96	.94	.92	.89	.87	.85
	Solids-not-fat	.98	.95	.93	.90	.88	.86	.83

[1] Factor = 1 − .5 × slope × days in interval/(intercept − slope × day of preceding sample):

Yield trait	First lactation Intercept (pounds)	First lactation Slope (pounds/day)	Second or later lactation Intercept (pounds)	Second or later lactation Slope (pounds/day)
Milk	48.3	.071	71.0	.144
Fat	2.03	.0025	2.78	.0052
Protein	1.67	.0019	2.39	.0045
Solids-not-fat	4.35	.0057	6.54	.0130

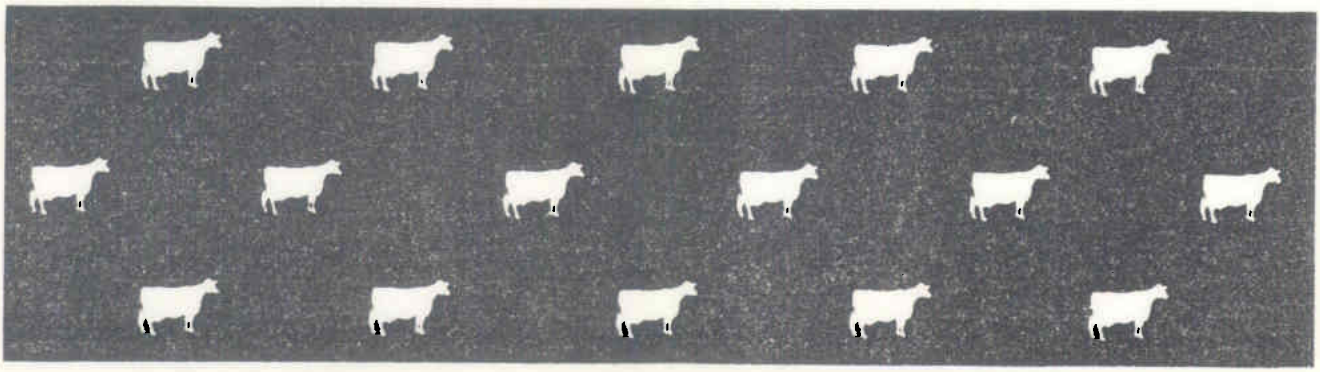

Table 6. Sample-day information on milk yield for the first lactation of example Cow 29 and computation of her 305-day lactation record.

Test interval	Day of sample (days in milk)	Sample-day yield (pounds)	Days in test interval	Test-interval credit (pounds)
1	20	45.0	20	720
2	50	55.0	30	1,530
3	85	20.0 (51.7)[1]	35	1,867
4	120	48.5	35	1,754
5	155	46.0	35	1,653
6	185	43.5	30	1,342
7	220	41.0	35	1,479
8	250	40.0	30	1,215
9	280	40.0	30	1,215
10	310	35.0	30	945
Lactation	–	–	305	12,293

[1] Abnormal sample day. Test-interval credit calculated with estimated sample-day yield in parentheses.

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