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The Relative Accuracy of Estimating the Production of Dairy Cows as Affected by Length of Testing Interval and Method of Estimating Production

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THE RELATIVE ACCURACY OF ESTIMATING THE PRODUCTION OF DAIRY COWS AS AFFECTED BY LENGTH OF TESTING INTERVAL AND METHOD OF ESTIMATING PRODUCTION

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INTRODUCTION

Production records for dairy cows were first based on the yield of butter for a seven day period any time during the lactation. Later, 365-day records based on production for one day in each calendar month came into general use. The records preferred at present are 305-day records based on monthly test day production, but calculated using the centering date method. The centering date estimate is based on milk and butterfat production from two consecutive milkings per month. The sampling day is centered as nearly as possible in the test month period which need not coincide with the calendar month.

The reason for the general acceptance of the 305-day records is the desire of the dairyman to freshen the dairy cow annually, which means milking for ten months and dry for two months. Records calculated by the centering date method more nearly represent actual production than records calculated by other methods that have been used.

It is generally accepted that if the present testing program is used properly it can be of great value to the dairy farmer from the standpoint of herd improvement and for selecting animals for a breeding program. However, only a small percentage of the dairymen take advantage of a testing program. One of the limiting factors has been the cost of testing and record keeping. It has been suggested that bimonthly or trimonthly test periods might provide as much information as the monthly testing interval and at the same time reduce the cost to the individual dairymen. It is reasonable to speculate that with reduced costs there would be an increased number of herds tested. This would help compensate the testing supervisor and data processing center for lost income resulting from less frequent testing, and at the same time provide more information for national sire proving programs.

However, bimonthly or trimonthly testing have not been accepted because of the possibility of larger error being involved in individual records. This larger error occurs because the curvelinear shape of the lactation is not taken into account and a cow is given credit for the same production over the entire testing period, resulting in either under or over estimation of the record.

The objective of this study is to measure the relative accuracy of estimating 305-day production of dairy cows by using different testing intervals and different methods to estimate production. Monthly, bimonthly, and trimonthly intervals are studied. Methods include the centering date method and three methods using factors designed to extend production from each test day to a 305-day estimate with the test day estimate averaged to determine the final estimate of production for 305 days.

REVIEW OF LITERATURE

Dairymen have used various methods of estimating the production of milk and butterfat of dairy cows so that they might have some measure to compare cows within their herd and with cows in other herds. The records have also played an important part in sire selection and proving.

In times past daily production of milk could be measured quite inexpensively by using a scale, but a measure of butterfat production require additional equipment and greater expense. Automation has brought in the pipeline milker which requires additional equipment to obtain milk weights and butterfat samples. Because of the expense involved in daily testing, various methods of estimating production have been used or suggested. The most common methods used to estimate production have been the seven-day test, yearly tests based on daily milk weights and a one day butterfat sample per month, and 305- or 365-day records based on production of milk and butterfat recorded one day per month. Both the calendar month method and the centering date method have been used to estimate lactation records from monthly test day production. Bimonthly and trimonthly testing intervals have been suggested and used limitedly to reduce the cost of testing.

Yapp (1919) defined the seven-day test as an official test which covers a period of seven consecutive days and may be begun as early as the seventh day after the cow's last calving. The calendar month method of determining monthly production disregards date of test within the month and uses the calendar month as the testing period. Production on test day is multiplied by the number of days in the month to obtain monthly production. The centering date method uses a specified number of days centered on a day near the usual test date. This period may or may not coincide with the calendar month.

Testing methods used

Yapp (1919) reported a correlation of 0.702 between the seven-day test and the calendar month test for milk production and 0.703 for butterfat production. Gaines (1927) reported that the objections to the seven-day test were (i) the fat percentage was not representative and (ii) the record was not dependent on persistency of production. Gaines (1927) suggested that fat percentage would be more representative by deferring testing until sixty days from freshening and the record would have greater indication of persistency by deferring testing until the fifth month of production.

Gowen (1927) indicated that the seven-day test was about two and one-half times as good as indicator of the cows ability to produce as were any of the physical points of conformation.

Yapp (1919) reported that the seven-day test was accepted as an official test by the Holstein-Friesian breed, but later it was reported in Holstein-Friesian History (1960, p.61) that in 1923 the seven-day test died a natural death from lack of patronage and was formally discontinued as a separate testing division.

McKellip and Seath (1941) reported the calendar month method to have a correlation of 0.991, 0.991, 0.993 and 0.987 when tests taken on the fourth, eleventh, eighteenth and twenty-fifth day of the month, respectively, were compared to butterfat production determined from actual milk weights.

McKellip and Seath (1941) found little difference in the accuracy of the centering date and calendar month method. Erb et al. (1953) found the centering date method to be a little more than twice as accurate as the calendar month method. They reported the calendar month system as having an error exceeding 1.9 percent one time in four. This was reduced to 0.7 percent when the centering date system was used.

Length of testing interval

Erb et al. (1953) cited a report by McCandlish and McVicar (1925) that a 1-day test per month yielded results within 2 percent of actual milk yield. Dick (1950) observed an average error of 2.32 percent from actual yield when cows were tested at 28 day intervals. Houston (1932) reported that to keep error less than 10 percent the testing interval should not exceed one month.

Tyler and Chapman (1944) suggested a simplified method of estimating 305-day records. This method used a straight 30.5 days for each test period regardless of time first tested or last tested. The purpose of this method was to eliminate error due to "back-credit" and save time in research when the records were used. They reported a correlation of 0.990 between actual production and the simplified method and 0.995 between simplified and monthly centering date method.

Bayley et al. (1952) reported a 5 percent variation for bimonthly records for milk and a 7 percent variation for butterfat when compared to records computed from daily measure. Also, they indicated that the percent error was smaller when test was begun in the first month of lactation. However, Gifford (1930) reported a correlation of 0.986 when test was begun in first month and 0.997 when test was begun in second month of lactation. Van Vleck and Henderson (1961a) reported a 0.98 correlation when month of first test was not considered.

Castle and Searle (1961) reported that the within herd ranking of cows using the bimonthly centering date method was almost identical to the ranking using the monthly centering date method. Also, repeatability of records was only 0.04 lower than that of the monthly centering date records and sire proofs calculated from the two sets of records ranked bulls similarly. Alexander and Yapp (1949) reported that testing every other month was slightly less accurate than testing once a month, but was sufficiently accurate for practical application.

Erb et al. (1953), using the actual yield of nine cows as a standard, found bimonthly centering date records to be in error less than 3.4 percent for milk and less than 5.4 percent for butterfat for three records out of four. They found monthly centering date records to be in error less than 3.4 percent for milk and less than 5.4 percent for butterfat for three records out of four. They found monthly centering date records to be in error less than 2.4 percent for milk and less than 3.7 percent for butterfat for three records out of four. The difference in error between monthly and bimonthly testing was only 1 percent for milk and 1.7 percent for butterfat yield for 75 percent of the records.

Alexander and Yapp (1949) reported that testing three times during the lactation, when the tests were taken on the second, sixth and tenth months was a sufficiently accurate method to merit a consideration of its adoption as a means toward lowering the cost of testing.

Erb _et al._ (1953) reported the monthly centering date method to be twice as accurate as the trimonthly testing interval. When tests were taken on four consecutive days in an effort to improve accuracy of the extended testing interval over half of the improvement was gained on a 2-day test, but the increase in accuracy by testing more than 1 day at each test interval was not great enough to justify the added expense.

Van Vleck and Henderson (1961a) reported correlations between monthly and trimonthly estimates of 305-day production of 0.94 when first test occurred in first month of production. The correlation increased to 0.96 when first tested in the second or third month of production.

Van Vleck and Henderson (1961c) concluded that the trimonthly test results were nearly as accurate in predicting a sire's breeding value as were complete records. They further concluded that the correlation was sufficiently high to merit use of trimonthly testing if reducing the cost of records was desired.

Suggested methods

Erb et al. (1953) suggested that testing at longer intervals was undesirable if the centering date method was used because of the typical lactation curve. Yields of cows tested first after the second month in lactation were always underestimated. Use of factors describing the lactation curve were suggested to remove this source of variation.

Ratio factors for extending part records and estimating production from a single test day have been reported by Cannon et al. (1942), Erb et al. (1953), Lamb (1960, 1962) and Van Vleck and Henderson (1961a). These factors take the shape of the lactation curve into account in estimating production for the lactation.

Cannon et al. (1942) published extension factors that disregard any enviromental variables. Later Erb et al. (1953) presented factors based on age with different factors for milk and fat. Different factors were presented for cows freshening before thirty-one months, thirty-one to forty-two months, and over forty-two months of age. Lamb (1962) reported factors grouped on basis of breed, age and season of calving with different factors for milk and fat. The factors for milk were for cows calving before thirty-six months, and for thirty-six months of age or older. Factors for cows calving from March through June, were in separate groups within age from those cows calving from July through February. The factors for butterfat were for cows calving before thirty-six months, from thirty-six to forty-seven months, and over forty-seven months in age. Factors for cows calving from April through July, and from August through March were in separate groups within age. Van Vleck and Henderson (1961a) did not report what variables they studied, but indicated they agreed with Lamb (1960) that separate factors were needed for different breeds, ages and seasons of freshening. Patterson (1955) noted a difference in shape of lactation curve between cows freshening in spring and summer compared to fall and winter.

Each 305-day estimate will vary in accuracy according to month of production from which estimates are made. Gaines (1927) reported that a single test in the fourth month had the highest correlation with actual production; Searle (1961) agreed with Gaines. Cannon (1942) reported the fifth month as the most accurate for predicting total production followed in turn by the sixth, seventh and fourth months. Madden et al. (1959) agreed that the fifth month was most accurate but followed in turn by the fourth, sixth and seventh months. Van Vleck and Henderson (1961c) reported that the correlation between the complete 305-day record and the record predicted from the fourth, fifth and sixth months to be 0.85. They further stated that the tenth month was the poorest indicator of total production followed closely by the first and ninth months.

PROCEDURE

Records of milk and butterfat production from the Holstein dairy herd at the Utah State University Dairy Experimental Farm were utilized in this study. A total of 688 records completed from January 1, 1948 up to and including January 15, 1963 were used. Only completed 305-day production records were included.

Data for each lactation were placed on punched cards. The data included: cow identification, age in months at time of freshening, fresh date, lactation number, and production information for 10 test days. Production information included milk weights, butterfat percent, date of test and the number of days in testing period.

Records determined from daily milk weights with semi-monthly butterfat tests taken near the first and fifteenth of each month were used as a standard for basis of comparison. These data plus cow identification and lactation number were also placed on punched cards. Butterfat percent from the middle of the month test and milk production from the two milkings represented by butterfat percent were used in making all estimates.

Twelve estimates of 305-day production were made and compared to the standard or actual 305-day production. Four methods were used: (i) centering date, (ii) month factor, (iii) day factor and (iv) regression factor. Within each method 305-day production was estimated using a monthly, bimonthly and trimonthly testing interval.

The same basic data were used in all four methods for estimating 305-day production. The centering date method multiplied test day production times the number of days in the test period to get production for the period. The final 305-day estimate was the sum of production for all test periods in the lactation.

The three factor methods each used a different type of factor to extend test day production to a 305-day estimate. The final 305-day estimate was the average of all extended estimates for a lactation. Thus, with a monthly interval the final 305-day estimate was the average of ten test day estimates, bimonthly was the average of five, and trimonthly was the average of three or four test day estimates, depending upon the month in the lactation in which the cow was first tested.

Centering date method

The centering date method centers the days of the test interval on or near the usual test date. The test interval need not coincide with calendar month. The fifteenth of the month was used as the centering date for this study. The bimonthly interval was centered on the fifteenth day of the odd months January, March, etc. The trimonthly interval was centered on the fifteenth of every third month beginning with January.

The study was designed to simulate actual farm practices where all cows in milk in the herd are tested regardless of month of lactation. Under an actual supervised testing program a supervisor would test as many cows in one month as another on the average. Month of test should make little difference according to Van Vleck and Henderson (1961a) who found little or no difference in month of first test when extended testing interval was used.

The intervals in the bimonthly centering date method all have sixty-one days except the period from February 15 to April 15 which has sixty days. February was divided evenly between the interval centered around January 15 and the interval centered around March 15 making the first interval have sixty-one days and the latter interval sixty days instead of fifty-nine days, thus allowing a greater uniformity in length of testing intervals (see Table 1).

Table 1. Intervals covered by bimonthly centering date method

Beginning of interval	Centering date	End of interval	Days in interval
December 16	January 15	February 14	61
February 15	March 15	April 15	60
April 16	May 15	June 15	61
June 16	July 15	August 15	61
August 16	September 15	October 15	61
October 16	November 15	December 15	61

The bimonthly estimations were determined from production recorded on the odd months; January, March, May, July, September, and November (see Table 1). The trimonthly estimations were determined from production recorded in January, April, July and October (see Table 2). With the trimonthly interval cows were tested either three or four times. Four tests resulted from cows being tested during the first month of lactation which would result in tests in the first, fourth, seven and tenth months of lactation.

Table 2. Intervals covered by the trimonthly centering date method

Beginning of interval	Centering date	End of interval	Days in interval
December 1	January 15	February 28	90
March 1	April 15	May 31	92
June 1	July 15	August 31	92
September 1	October 15	November 30	91

Month factor method

This method of estimating production used factors developed by Lamb (1962) from Michigan DHIA data. These factors were the ratio of total production on ten test days to production on each test day. To use these factors, production on test was multiplied by 30.5 (the average number of days in a month) to get monthly production, which was multiplied by the ratio factor for that particular month in the lactation to obtain estimated 305-day production.

Lamb (1962) reported a significant difference between production for different breeds, ages and seasons of freshening and between milk and butterfat, warranting a different set of ratio factors for each.

The age groupings for milk factors were for cows calving under thirty-six months and thirty-six months and over. Age groupings for butterfat factors were under thirty-six months, thirty-six to forty-seven months and forty-eight months or over. The season of freshening groupings for milk factors were March to June in one group and July to February in another. Groupings for butterfat factors were for cows calving between April and July in one group and August to March in another.

The production data were grouped according to age and season of freshening for milk and butterfat. Milk and butterfat production for each cow on each test day were multiplied by 30.5 times the appropriate factor. The estimated production for each lactation was determined by averaging the estimates derived from each test day. In the case of the monthly interval there were ten estimates, bimonthly interval had five estimates and trimonthly interval either three or four estimates depending on month of first test.

Day factor method

The day factors were developed from the month factors by McGilliard (1962) using an interpolation method suggested by Lamb (1959). Interpolation of each set of month factors resulted in 305-ratio factors, one for each day in the lactation.

These factors take into account the curvilinearity of production for the lactation in extending test day production to a 305-day estimate. This follows the reasoning of Erb *et al.* (1953), who suggested that if the lactation curve was considered in developing factors for extending records, it should reduce the error common to the extended testing interval. The month factors do not take the full curvilinearity into account since they extend monthly production which has been determined by assigning the same level of production to all days in a monthly test period.

The day factors have the same grouping requirements for breed, age and season of freshening as the month factors. Separate factors are required for extending milk and butterfat records. Production of milk and butterfat on test day was multiplied by the appropriate ratio factor for number of days since freshening, age and season of freshening to estimate 305-day production. The final 305-day estimate for each lactation was determined as in the month factor method by averaging the estimates derived from test day production. Thus, the 305-day estimate resulted from an average of ten estimates for the monthly interval, from an average of five estimates for bimonthly interval, and from an average of three or four estimates for trimonthly intervals, depending on month of first test.

Regression factor method

The use of day factors for both milk and butterfat required more storage space than was available in the electronic computer used to process data in this study. This required the estimate for milk and butterfat to be processed separately. This large storage requirement could create a cost problem if this method proved worthwhile and were used routinely. In an attempt to overcome this storage problem, the electronic computer was used to derive a regression formula for each group of day factors. Both second and third degree polynomials were derived. The polynomial covering the largest amount of variation was used.

Production of milk and butterfat on test day was multiplied by the appropriate regression formula to estimate 305-day production. The final 305-day estimate for each lactation was determined as in the month factor method by averaging the estimates derived from test day production. Thus, the final estimate resulted from an average of ten estimates for the monthly interval, from an average of five estimates for bimonthly interval, and from an average of three or four estimates for trimonthly interval, depending on month of first test.

RESULTS AND DISCUSSION

The results of this study (see Tables 3 and 4) indicate all methods and all intervals within methods have correlations sufficiently high to recommend their use in estimating production.

Table 3. Correlations between standard and estimated records for different testing intervals

Methods Correlated	Monthly		Bimonthly		Trimonthly	
	Milk	Butter-fat	Milk	Butter-fat	Milk	Butter-fat
Standard - Centering Date	0.977	0.975	0.963	0.954	0.947	0.926
Standard - Month Factors	0.959	0.963	0.941	0.944	0.926	0.917
Standard - Day Factors	0.963	0.964	0.946	0.947	0.925	0.922
Standard - Regression Factors	0.965	0.967	0.949	0.944	0.930	0.924

Table 4. Within method correlations between monthly and extended testing intervals

Method	Intervals Correlated			
	Monthly-Bimonthly		Monthly-Trimonthly	
	Milk	Butter-fat	Milk	Butter-fat
Centering Date	0.987	0.975	0.966	0.947
Month Factor	0.978	0.972	0.961	0.950
Day Factor	0.978	0.962	0.958	0.945
Regression Factor	0.979	0.958	0.964	0.951

Centering date method

The correlations between the standard method and the centering date method for monthly, bimonthly and trimonthly testing intervals were 0.977, 0.963 and 0.947, respectively, for milk production, and 0.975, 0.954 and 0.926, respectively, for butterfat production. The within method correlations between monthly and bimonthly testing intervals were 0.987 and 0.975 for milk and butterfat, respectively (see Table 4). These compare favorably with McKellip and Seath (1941) who reported a correlation for butterfat of 0.974 between monthly and bimonthly interval when first tested in first month of production, and 0.984 when first tested in the second month of production. Gifford (1930) reported similar results; however, Van Vleck and Henderson (1961c) reported a higher correlation when first tested in first month of lactation. No attempt was made here to study the effect of month of first test. Van Vleck and Henderson (1961b, 1961c) also reported that trimonthly tests were nearly as accurate as bimonthly tests, which is in agreement with the results of this study.

Month factor method

The factors used for this study were developed by Lamb (1959) from Michigan DHIA data. The factors were designed to extend test day yield times 30.5 (average number of days in month) to production for 305 days. The correlations between this method and standard records for the monthly, bimonthly and trimonthly testing intervals were 0.959, 0.941 and 0.925, respectively, for milk production, and 0.963, 0.944 and 0.917, respectively, for butterfat production. These correlations are sufficiently high to merit further study of the month factor method for use in comparing cows.

There is a fairly consistent decrease in the correlations as the length of the interval increases for both milk and butterfat production. This decrease is significant ($P<.05$) (Snedecor, 1961, p.178). There is also a significant difference between the month factor method and the centering date method. The variability of production for the first, ninth, and tenth months as cited by Cannon _et al._ (1942) and Madden _et al._ (1955) could account for the decrease in correlation.

The difference might be overcome if the estimates from different months were not weighted equally but a smaller weight given the months that have greater variability and a greater weight given the months with less variability. No attempt was made in this study to determine the optimum weight for production from each month, so each month was weighted equally.

Day factor method

Factors for extending production from one test day to 305 days were used in this method. The factors were developed by McGilliard (1962) by interpolating the month factors as discussed by Lamb (1959). The day factors differ from the month factors in that they estimate 305-day production from production for a single day. The final estimate was determined by averaging the test day estimates.

The correlations between this method and the standard were 0.963, 0.946 and 0.925 for milk and 0.964, 0.946 and 0.922 for fat for monthly, bimonthly and trimonthly testing intervals, respectively. The results are slightly higher than the month factor method, but the differences are not statistically significant ($P<.05$) within testing intervals. There is a significant difference between intervals within this method.

One of the limiting factors of this method from a practical standpoint is the large computer storage needed to store the table of values used in computation of the estimations for the various intervals. In order to compute milk and butterfat at the same time the computer would have to exceed 40,000 core storage.

Regression factor method

The day factors were used to derive a regression formula. The regression formula are expressed in second and third degree polynomial depending on the percent of variation accounted for.

The second degree formula is expressed as:

$$Y = b_1 + b_2X + b_3X^2,$$

and the third degree formula is expressed as:

$$Y = b_1 + b_2X + b_3X^2 + b_4X^3,$$

where Y equals the regression factor, b_i represents coefficients in the regression equation and X equals the number of days from beginning of record to test date.

The resulting formula for the various ages and seasons for milk production are:

under 36 months freshening between April and July,

$$Y = 228.9258 + 0.29830686X + 0.0013798249X^2$$

under 36 months freshening between August and March,

$$Y = 234.86815 + 0.9299713X - 0.0065883208X^2 + 0.00001983701X^3$$

over 36 months freshening between April and July,

$Y = 180.24365 + 1.4344797X - 0.009302503X^2 + 0.000032453805X^3$

over 36 months freshening between August and March,

$Y = 184.6958 + 2.1652553X - 0.018542427X^2 + 0.000055375805X^3$

The factors for butterfat are:

under 36 months freshening between March and June,

$Y = 233.25905 + 0.35596245X + 0.00086108521X^2$

under 36 months freshening between July and February,

$Y = 225.60902 + 1.2188618X - 0.0077346741X^2 + 0.000019668441X^3$

between 36 and 47 months freshening between March and June,

$Y = 176.63304 + 1.7843625X - 0.010899282 + 0.000030678853X^3$

between 36 and 47 months freshening between July and February,

$Y = 185.62727 + 1.9882574X - 0.014138399X^2 + 0.000038430172X^3$

over 47 months freshening between March and June,

$Y = 166.01393 + 1.9679846X - 0.013733883X^2 + 0.000042135332X^3$

over 47 months freshening between July and February,

$Y = 165.88981 + 2.458666X - 0.018689782X^2 + 0.000052370157X^3$

This method resulted in slightly higher correlations in most cases than the day factor method (see Table 3). The differences were not significant ($P < .05$), but there were significant differences between intervals within both methods. The correlations between the regression factor method and the standard were 0.965, 0.949 and 0.930 for milk and 0.967, 0.949 and 0.924 for butterfat for monthly, bimonthly and trimonthly testing intervals, respectively. Although the results for the regression factor method were essentially the same as for the day factor method, the regression factor method has advantages when using a high speed electronic computer. The day factor method is simpler to use when calculations are made on a hand calculator.

Application

The monthly testing interval using the centering day method is the most commonly accepted method of testing at the present time, but it is costly. The rapid progress in automation of the dairy industry has increased the need for complete records. If the cost of records could be reduced by using one of the suggested methods with an extended testing interval, more dairymen might use a testing program.

The results of this study indicated that bimonthly and trimonthly testing intervals are sufficiently accurate to yield relatively the same information as is gained with the monthly testing interval. The bimonthly or the trimonthly intervals would serve to reduce the cost of testing. Often a small isolated area doesn't have a testing program because of insufficient cow numbers, but by use of an extended testing interval an outside supervisor could make regular but less frequent visits to the area to provide the service needed.

The use of the extension factors could be applied to both our present monthly testing method or any of the extended testing intervals with the following result:

(i) Furnish to the dairymen an early indication of the production expected from an individual cow.

(ii) Furnish an excellent means to utilize incomplete records. This would benefit bull proving programs from the standpoint of earlier and more complete proofs.

CONCLUSIONS

Correlations between the centering date estimates and the standard records were the highest. There was a significant difference between intervals within the centering date method and also a significant difference between the centering date method and all other methods. There was not a significant difference between the three factor methods, but there was significant difference between intervals within each method. All correlations were sufficiently high to indicate usefulness of any of the methods for estimating production, for ranking cows within herds, and for use in bull proofs.

The results of this study supports Alexander and Yapp (1949), Bayley *et al.* (1952), Erb *et al.* (1953), McKellip and Seathe (1941), and Van Vleck and Henderson (1961b, 1961c) who agreed that either monthly, bimonthly or trimonthly testing intervals would be satisfactory for comparing cows.

The factor methods have sufficiently high correlations to merit additional research. Further study might include (i) correlation between monthly estimates and the standard record, (ii) determination of proper weight based on correlation for each month to more accurately extend records,

(iii) using a larger cow population from a wider area and

(iv) economics of extended test intervals if applied to present testing programs.

SUMMARY

Production records for 688 Holstein cows completed from January 1, 1948 through January 15, 1963 at Utah State University Dairy Experimental Farm were used in this study. Daily milk weights and twice monthly butterfat tests were used as a standard. Estimated records using various testing methods and lengths of testing intervals were compared to the standard records. The methods used to estimate total production of milk and butterfat were centering date, month factor, day factor and regression factor methods. Monthly, bimonthly and trimonthly testing intervals were used with each method.

The centering date method had the highest correlation with standard records for all intervals. There was a significant difference between the factor methods and the differences between these factor methods were not significant (P<05) within intervals.

The monthly testing interval had the highest correlation within all methods. The correlations decreased at a very consistent rate as the length of testing interval increased. The difference between testing intervals was significant.

The correlations were sufficiently high in all methods and testing intervals to suggest their use in a cow testing program if cost is a factor or if early indication of production for a lactation is desired.

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