USDA-DHIA FACTORS FOR STANDARDIZING 305-DAY LACTATION RECORDS FOR AGE AND MONTH OF CALVING

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USDA-DHIA FACTORS FOR STANDARDIZING 305-DAY LACTATION RECORDS FOR AGE AND MONTH OF CALVING 1/

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Many environmental influences have a marked effect on a cow's performance during a lactation; therefore, adjustments are made to put lactation yield on a standardized basis. In the United States, lactation records have been standardized for (1) the number of days milked in the lactation, (2) the number of times the cow was milked per day, and (3) her age at calving. A fourth variable, calendar month of calving, will be accounted for with the implementation of these new factors. These four adjustments are important for comparing milk and fat of cows in different environmental conditions.

LENGTH OF LACTATION

The accepted standard length of the lactation record is 305 days. When a cow is milked longer than 305 days, her yield for the first 305 days is used as the lactation yield. Partial lactations (those terminated in less than 305 days because of environmental influences having no relation to the cow's genetic ability to complete normal length lactations) are considered legitimate measures of the cow's performance up to the time they were terminated and are projected to 305 days.

NUMBER OF MILKINGS PER DAY

Records are standardized to a twice-daily milking basis, usually referred to as "2X." For most lactations no adjustment is required because the majority of cows are milked twice daily. Factors are available for converting 3X or 4X records to a 2X basis.

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AGE AND MONTH OF CALVING

New adjustment factors were computed through the cooperative efforts of USDA and Cornell University to standardize 305-day lactation records to a mature equivalent basis and to minimize environmental variation in the standardized records that is due to month of the year in which the record began. These new factors are more appropriate than any others available for milk and fat, because they more accurately remove recent environmental effects from age and month of calving in individual breeds and regions.

The purpose of new factors is to remove some of the nongenetic variation arising from differences in age and season of calving among cows in the same herd. Reviews of research show that age factors differ between breeds, seasons of calving, geographical areas, and traits (milk and fat) 3/. Independent sets of factors were developed for the Ayrshire, Guernsey, Holstein, Jersey, Brown Swiss, and Milking Shorthorn breeds. Because of the small number of records available for the remaining breeds, factors for them were selected from those of some of the breeds named above. Age effects for Red Dane cows most closely resembled those for Holsteins, and age effects for Red Polls resembled those for Brown Swiss. The Brown Swiss factors will be used for the Red Polls, and the Holstein factors will be used for cows coded as Red Danes, Red and Whites, and Mixed Breeds. Different feeding and other management practices are probably the primary reason that a single set of factors is not satisfactory for each breed for the entire United States. Feeding practices readily affect the 305-day yield of cows calving in the various months, and differing practices by States likely affect the relative yield of cows of varying ages.

Factors for fat yields were computed as the product of individual factors for milk yields and fat percent. Generally, the age corrections required for fat yields were slightly less than those for milk yields, although results varied by breed and seasons of calving.

DATA

The new age and month-of-calving factors were based on a total of 4,452,332 Official DHI and DHIR lactations initiated between January 1, 1964, and December 31, 1968. Restrictions ascertained that the lactations used were made by progeny of registered sires and a registered or grade dam of the same breed. The main reason for restrictions on parental identification was an attempt to screen out lactations where the birth dates reported were most likely to be estimated. Lactations of 15 days or more were used after pro-

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3/ Freeman, A. E. Age adjustment of production records: History and basic problems. J. Dairy Sci. 56:941. 1973.

McDaniel, B. T., Miller, R. H., Corley, E. L., and Plowman, R. D. DHIA age adjustment factors for standardizing lactations to a mature basis. Dairy Herd Improvement Letter 43, No. 1. U.S. Dept. Agr. ARS 44-188, 32 pp. 1967.

jecting 4/ to a 305-day basis if the cow was denied an opportunity to milk 305 days. To avoid biases, the following lactations were excluded in addition to those designated unusable from USDA edits: 5/

1. Those in which the cow was milked three or four times per day for any part of the lactation.
2. Those initiated at ages less than 18 months or more than 200 months.
3. Those where the breeds of sire and dam were different.
4. Those where the breed of dam was unknown.
5. Those with either grade or unknown sires.
6. Those coded as complete (termination code = 0) but less than 180 days in length.
7. Those less than 15 days in length (regardless of termination code).

Age at calving was computed in days, converting to months, and rounded to the nearest month. The factors have since been adjusted so they can be used correctly with age calculated by truncation to month, as adopted by the Coordinating Group for the National Cooperative Dairy Herd Improvement Program (November 1973 meeting). This method of calculating age was adopted to promote uniformity in age adjustment throughout all segments of the dairy industry.

COMPUTING AVERAGE YIELD FOR AGE-MONTH OF CALVING GROUPS

Miller and coworkers in 1970 6/ published a method for computing means for age and month of calving free of effects due to herd, year of calving, and biases due to culling of cows based on milk yield. Differences among lactations of the same cow and differences among cows of varying ages were used in developing the means. A similar statistical model was used for calculating the age and month-of-calving factors presented herein and is explained by Miller. 7/

Mean yields of milk and fat percent were obtained for the 23 age classes shown separately by breeds in tables 1 through 6 across all calendar months of calving.

4/ McDaniel, B. T., Miller, R. H., and Corley, E. L. DHIA factors for projecting incomplete records to 305 days. Dairy Herd Improvement Letter 41, No. 6. U.S. Dept. Agr. ARS 44-164, 21 pp. 1965.

5/ Dairy Herd Improvement Investigations, ARS. Editing of lactation records used in USDA-DHIA genetic evaluations of sires and cows. Dairy Herd Improvement Letter 46, No. 6. U.S. Dept. Agr. ARS 44-222, 32 pp. 1970.

6/ Miller, P. D., Lentz, W. E., and Henderson, C. R. Joint influence of month and age of calving on milk yield of Holstein cows in the Northeastern United States. J. Dairy Sci. 53:351. 1970.

7/ Miller, P. D. A recent study of age adjustment. J. Dairy Sci. 56:952. 1973.

Mean yields for each calendar month of calving are shown in table 7 across all ages. Mean yields for 72 groupings, based on age of the cow and calendar month in which she calved, are presented in tables 8 and 9. The standardization factors given herein were calculated from similar sets of age means.

PRELIMINARY STUDIES

A number of preliminary analyses were done using the Holstein data, this being possible because of the large number of records. Data for each State were stratified into three groups of approximately equal size, based on average yield of the herd in which the cow calved. Age constants and adjustment factors were computed for each of the State-herd level groups. Results indicate that the effect of herd level on ratio age factors was very small and could be ignored. Details on these results were published by Miller. 8/

The preliminary analyses revealed that there were large, important differences among States in the yield ratio of young to old cows. These differences were influenced by the calendar month in which the cow calved. In addition, the effects of month of calving itself varied considerably among States. It seemed impractical, nevertheless, to have different sets of factors for every State. The small number of lactations available in some States resulted in large sampling errors. Thus, the States were grouped into regions for the various breeds considering the following criteria:

1. Similarities of age factors among geographically adjacent States.

2. Apparent sampling errors in averages for individual States based on the number of records.

It was decided that 11 regions were justified for Holsteins, 6 each for Guernseys and Jerseys, 4 each for Ayrshires and Brown Swiss, and 1 for Milking Shorthorns. The States used in the final regional stratification for each breed are shown in table 10.

BASE FOR THE NEW AGE AND MONTH-OF-CALVING ADJUSTMENT FACTORS

Bases for season and age are required to standardize milk and fat records. No specific month seemed acceptable as the season base because of different seasonal effects on yield by breeds and regions within breeds. Thus, the unweighted average of the 12 calendar months was used as the season base because it better represented all calvings than did any individual month.

The age base was the age with the highest average season yield in each breed and region, as shown in table 11.

8/ See footnote 7.

SMOOTHING THE AGE FACTORS

The standardization factors in this publication were smoothed across ages and seasons to eliminate minor fluctuations in yield that result from small numbers of lactations available in some age-month groups. Details of these smoothing procedures are available in mimeograph form. 9/

The milk and fat factors for the regions designated are presented in tables 12 through 85.

INTERPRETATION OF THE AGE AND MONTH-OF-CALVING FACTOR

Records traditionally have been standardized to a mature equivalent (ME) basis. The interpretation given to an ME record has been: The amount of milk or fat that the same cow would have produced under the same environmental condition had she been of mature age. A mature equivalent record was not to predict what a cow would produce in the future. Obviously, such a prediction could not be made with much accuracy since many things may happen to a cow before she reaches mature age, and environmental conditions affecting her future records may be quite different. Neither should ME factors be interpreted to simply mean that heifers mature faster in some regions of the country than in others, or that cows are genetically superior in some regions than in others. Breed and regional differences in ME factors are caused by a multitude of genetic and environmental effects that influence the yield of cows of different ages.

A new dimension is added to the interpretation of standardized yield with these new factors. Standardized yield is the amount of milk or fat that the cow would have produced with calving in an average environmental month had she been of mature age.

The standardized yield is obtained by multiplying yield for the first 305 days of lactation by the factor corresponding to the age at calving for the appropriate breed, region of the country, season of the year, and trait.

ACKNOWLEDGMENT

These age adjustment factors are the result of a cooperative research project between the United States Department of Agriculture and the Animal Science Department of Cornell University in which several individuals made important contributions.

9/ McDaniel, B. T., Norman, H. D., and Dickinson, F. N. Procedure to get unbiased, smoothed estimates of points on an age curve. 1973. (Mimeograph) Animal Physiology and Genetics Institute, Northeastern Region, ARS, U.S. Dept. Agr., Beltsville, Md. 20705.

All basic summaries, such as average yields by age and numbers of records, were computed by Paul D. Miller with data obtained from USDA files and edited by Ben T. McDaniel with the technical assistance of Lewis G. Waite. The basic age averages and unsmoothed adjustment factors were computed by Paul D. Miller with a statistical model and computing procedures he developed. Modifications to Miller and coworkers' model 10/ that were used were suggested by H. Duane Norman, Ben T. McDaniel, Frank N. Dickinson, and Charles R. Henderson. The regional groupings used in these factors and the choice of the base age and season were made by Dickinson, Norman, and McDaniel. Smoothing procedures were developed and conducted by McDaniel, Norman, and Dickinson with the technical assistance of Michael French, and Charles R. Lynch. Ivan L. Mao and Glen R. Ufford provided some technical assistance to Paul D. Miller at Cornell. Additional assistance in final preparation of the factors was received from Maureen K. Dixon, Jeffrey F. Keown, Anna H. Kienast, Gerald J. King, James A. Knox, Rex L. Powell, and Linda F. Randall.

Tables 1 to 85 (pages 7 to 91) are not shown.

10/ See footnote 6.