Converting single sample herd test production to 24-hour equivalent production

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Let y_{24} refer to 24-hour yield and y_{am} and y_{pm} denote the corresponding AM and PM yields. Given a single sample AM yield, we estimate the 24-hour yield using an expansion factor, F_{am}, such that

$$\hat{y}_{24} = F_{am} y_{am} \tag{1}$$

or for a PM yield

$$\hat{y}_{24} = F_{pm} y_{pm} \tag{2}$$

We use the following relationship between expansion factors

$$F_{pm}^{-1} = 1 - F_{am}^{-1} \tag{3}$$

the inverses of the expansion factors can be regarded as portions of 24-hour yield.

Table 1 gives parameter estimates which are used to build the expected portions of AM yield based on information such as age of cow, stage of lactation and milking interval. Days-in-milk (DIM) is the number of days between parturition date and test date (parturition date is day 0) and milking interval (INT) is the number of hours between the previous milking and the current test milking.

The same parameters are used to build F_{am} or F_{pm} except that the milking interval variable is $INT_{am} - 14$ for AM testing or $10 - INT_{pm}$ for PM testing. DIM should not exceed 305 so just use 305 for herd tests beyond this point.

Example - AM. Single sample AM test, milking interval of 14.5 hours, 2-yr-old cow 100 days in milk. Then

$$(DIM - 120)/100 = (100 - 120)/100 = -0.2$$

$$INT_{am} - 14 = 14.5 - 14 = 0.5$$

and taking values in Table 1 for milk volume we calculate the expected portion of AM milk

$$p = 0.5844 + 0.00368 * (-0.2) - 0.00148 * (-0.2)^2 + 0.02385 * (0.5) = 0.5955$$

and so the expansion factor for milk volume to be applied in equation 1 is

$$F_{am} = \frac{1}{p} = \frac{1}{0.5955} = 1.68$$

The expansion factors for fat and protein are 1.77 and 1.69 respectively. Suppose the test results are 6.6, 4.64% and 3.41% for AM volume, fat and protein. Then the 24-hour estimates are

- volume $1.68 \times 6.6 = 11.1$
- fat yield $1.77 \times (6.6 \times 0.0464) = 0.542$
- protein yield $1.69 \times (6.6 \times 0.0341) = 0.380$
- fat% $\frac{0.542}{11.1} \times 100 = 4.88$
- protein% $\frac{0.380}{11.1} \times 100 = 3.42$

Example - PM. Single sample PM test, milking interval of 11 hours, 4-yr-old cow 150 days in milk. Then

$$(DIM - 120)/100 = (150 - 120)/100 = 0.3$$

$$10 - INT_{pm} = 10 - 11 = -1$$

and taking values in Table 1 for milk volume we calculate the expected portion of AM milk

$$p = 0.5782 + 0.00368 * (0.3) - 0.00148 * (0.3)^2 + 0.02385 * (-1) = 0.5553$$

and using relationship 3 the expansion factor for milk volume to be applied in equation 2 is

$$F_{pm} = \frac{1}{1-p} = \frac{1}{1 - 0.5553} = 2.25$$

The expansion factors for fat and protein are 2.15 and 2.24 respectively. Suppose the test results are 7.3, 4.38% and 2.96% for PM volume, fat and protein. Then the 24-hour estimates are

- volume $2.25 \times 7.3 = 16.4$
- fat yield $2.15 \times (7.3 \times 0.0438) = 0.687$
- protein yield $2.24 \times (7.3 \times 0.0296) = 0.484$
- fat% $\frac{0.687}{16.4} \times 100 = 4.19$
- protein% $\frac{0.484}{16.4} \times 100 = 2.95$

Table 1: Parameter estimates to build AM portion of total yield

Effect	milk	fat	protein
2-yr old	0.5844	0.5612	0.5814
3-yr old	0.5811	0.5542	0.5800
4-yr old	0.5782	0.5441	0.5782
5 to 9-yr old	0.5768	0.5367	0.5778
>9-yr old	0.5750	0.5322	0.5770
$(DIM - 120)/100$	0.00368	0.01936	0.00253
$(DIM - 120)^2/10000$	-0.00148	-0.01162	-0.00235
$(INT_{am} - 14)$ or $(10 - INT_{pm})$	0.02385	0.01469	0.02496