Converting single-sample herd test SCC measurement to a 24-hour equivalent SCC measurement

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Analyses

Let y_{24} be the 24-hour SCC measurement and SCC_{am} and SCC_{pm} the corresponding AM and PM measurements, respectively. $\hat{y}_{24}$ is the 24-hour SCC measurement predicted from either the AM or PM measurement. y_{24} was modelled using a linear regression model. The dependent variable, y_{24}, as well as the SCC_{am} and SCC_{pm} predictors were transformed using the logarithm (base 2). Separate analyses were done for the SCC_{am} and SCC_{pm} predictors. The predictors in the models were the interaction between age of the cow (in years) and SCC_{am} or SCC_{pm}, the linear and quadratic effects of days in milk (DIM) and the milking interval (INT_{am} or INT_{pm}) in hours. DIM is the number of days between parturition date and test date (parturition date is day 0). INT is the number of hours between the previous milking and the current test milking. Age of cow was grouped as 2, 3, 4, 5 to 9, and greater than 9 years. The variables for each of the predictors need to be transformed or adjusted, as shown in Table 1. Note that the adjustments of INT_{am} and INT_{pm} made the two measurements equivalent.

Table 1: Transformations and adjustments of predictors.

Variable	Abbreviation	Transformation
am milking interval	INT_{am}	INT_{am} - 14
pm milking interval	INT_{pm}	10- INT_{pm}
days in milk	DIM	(DIM-120)/100
AM SCC measurement	SCC_{am}	$log_2(SCC_{am})$
PM SCC measurement	SCC_{pm}	$log_2(SCC_{pm})$

Solutions and Examples

The parameter estimates for the linear models are shown in Table 2. The first column of solutions is used to convert the SCC_{am} to an equivalent 24-hour yield. The second column is used to convert the SCC_{pm} to an equivalent 24-hour yield.

AM Example

Consider a cow of age 10 that is 63 DIM with an SCC_{am} measurement of 90 and a milking interval (INT_{am}) of 13.

Using the transformations/adjustments in Table 1 we have:

$$log_2(90) = 6.49185$$

$$(DIM - 120)/100 = -0.57$$

$$INT_{am} - 14 = -1$$

The first column of solutions in Table 2 is used to calculate $\hat{y}_{24}$ as shown below. The hat, for example, $\hat{age}$, is used to denote the regression estimates.

$$\widehat{intercept} + \hat{age} * log_2(90) + \widehat{DIM} * (DIM - 120)/100 + \widehat{DIM^2} * ((DIM - 120)/100)^2 + \widehat{INT}_{am} * (INT_{am} - 14)$$

$$= 0.399717 + 0.978532 * 6.49185 + (-0.57) * -0.04383 + (-0.57)^2 * -0.01223 + (-1) * 0.04143$$
$$= 6.7318$$

Note that since the dependent variable was transformed using log_2, the result must be antilogged. That is, $2^{6.7318} = 106.3$. The value 106.3 is the predicted 24-hour SCC measurement.

PM Example

Consider a cow of age 10 that is 111 DIM with an SCC_{pm} measurement of 242 and a milking interval (INT_{pm}) of 10.

Using the transformations/adjustments in Table 1 we have:

$$log_2(242) = 7.918863$$

$$(DIM - 120)/100 = -0.09$$

$$10 - INT_{pm} = 0$$

Using the second column of solutions in Table 2, $\hat{y}_{24}$ is calculated as:

$$\widehat{intercept} + \hat{age} * log_2(242) + \widehat{DIM} * (DIM - 120)/100 + \widehat{DIM^2} * ((DIM - 120)/100)^2 + \widehat{INT}_{pm} * (10 - INT_{pm})$$

$$= -0.083258 + 0.977624 * 7.918863 + (-0.09) * 0.062052 + (-0.09)^2 * 0.026183 + (0) * -0.060262$$
$$= 7.6530$$

As above, since the dependent variable was transformed using log_2, the result must be antilogged. That is, $2^{7.6530} = 201.3$.

Table 2: Parameter estimates from the linear regression model.

Effect	level	am sol	pm sol
intercept	1	0.399717	-0.083258
DIM	1	-0.04383	0.062052
DIM^2	1	-0.01223	0.026183
INT_{am} or INT_{pm}	1	0.04143	-0.060262
age of cow	2	0.978043	0.965405
age of cow	3	0.974441	0.970058
age of cow	4	0.973704	0.972889
age of cow	5 to 9	0.975587	0.975411
age of cow	> 9	0.978532	0.977624