**Supplementary Material**

**Toward better estimates of the real-time individual amino acid requirements of growing-finishing pigs showing deviations from their typical feeding patterns**

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Animal Journal

**S1 – Posterior and prior distribution – Kalman Filter**

The mean and variance-covariance matrix of the posterior distribution are represented as **m*t*** and **C*t***, respectively, such that (θ*t*|D*t*) ~ *N*(m*t*, C*t*). In order to initialize the model, prior information is required (**D0**; before any observations are made, *t* = 0) on the initial distribution of the parameter vector: (θ0|D0) ~ *N*(m0, C0). The observation and evolution error sequences *vt* and *wt* are assumed to be internally and mutually independent and are independent of (θ0|D0).

The recursively obtained prior distribution for θ*t* at time *t* − 1 for the Kalman filter is described as follow:

[S1]

where **a*t*** = G*t*m*t*−1 and **R*t***= G*t*C*t*−1G′*t* + W*t*. The one-step forecast for Y*t* at time *t* is as follows:

[S2]

where **f*t*** = F′*t*a*t* and **Q*t***= F′*t*R*t*F*t* + V*t*. Finally, the posterior distribution for θ*t* at time *t* is as follows:

[S3]

where m*t* = a*t* + A*t*e*t* and C*t* = R*t* − A*t*Q*t*A*t*′, with the adoptive matrix (**A*t***) specified as A*t* = R*t*F*t*Q*t*−1. The vector of one-step forecast errors (**e*t***) is calculated as e*t* = Y*t* − f*t*. The vector m*t* and the matrix C*t* are referred to as the filtered mean and variance-covariance matrix of the parameter vector at time *t*, respectively.

Sequential forecast for k steps ahead is calculated as follows for *j* = 1, …, *k*:

[S4]

where a*t*(*j*) = G*t+j*a*t*(*j* − 1) and R*t*(*j*) = G*t+1*R*t*(*j* − 1)G*t+1* + W*t+j*, with the initial values a*t*(0) = m*t* and R*t*(0) = C*t*. Based on this parameter vector distribution, the following forecast distribution is obtained:

[S5]

where f*t*(*j*) = F′*t+j*a*t*(*j*) and Q*t*(*j*) = F′*t+j*R*t*(*j*)F*t+j* + V*t+j*.

The proposed model works with one-step-ahead forecast (*j* = 1).

Based on retrospective analysis, moments for θ*t−j* given all observations D*t* are specified as follows:

[S6]

where a*t*(−*j*) = m*t−j* + B*t−j*[a*t*(*−j* + 1) − a*t−j*+1] and R*t*(*−j*) = C*t−j* + B*t−j*[R*t*(−*j* + 1) − R*t−j*+1]B*t−j*, with B*t−j* = C*t−j*G′*t−j+1*R−1*t−j+1* and given initial values for a*t*(0) = m*t* and R*t*(0) = C*t*. The vector a*t*(−*j*) and the matrix R*t*(−*j*) are also denoted as m̃*t−j* and C̃*t−j*, respectively, and are referred to as the smoothened mean and variance-covariance matrix at time *t* − 1, respectively.

**S2 - Cumulative tabular sum**

This method accumulates deviations from **T0** (target value) that are above the target with one statistic, **C+**, and those that are below the target with another statistic, **C−**. The C+ and C− for a given day (*t*) were as follows:

[S7]

[S8]

where T0 = 0, and **K** is the reference value expressed as K = (1 \* )/2. Alarms are activated if or exceed a threshold **H** (expressed in terms of the SD) in a given day *t*. The Cumulative tabular sum (CUMSUM) parameters (the reference value [K] and the decision interval [H]) were selected in order to provide good average run length performance. The K is relevant to the size of a shift that we want to detect, while the H determines in-control and out-of-control performance. If K = 1, we aim to detect a two-SD shift. The choice of which value of K and which value of H should be applied depends on how sensitive the farm manager thinks that the system should be. The starting values of or are set to zero. As we are interested only in identifying reductions in feed intake, only the alarms generated when exceeds the threshold H are considered.