THÜRINGER TIERSEUCHENKASSE
Tiergesundheitsdienste

TGD THÜRINGEN Kompetent.

An algorithm for the identification of disease introduction dates using daily milk yields

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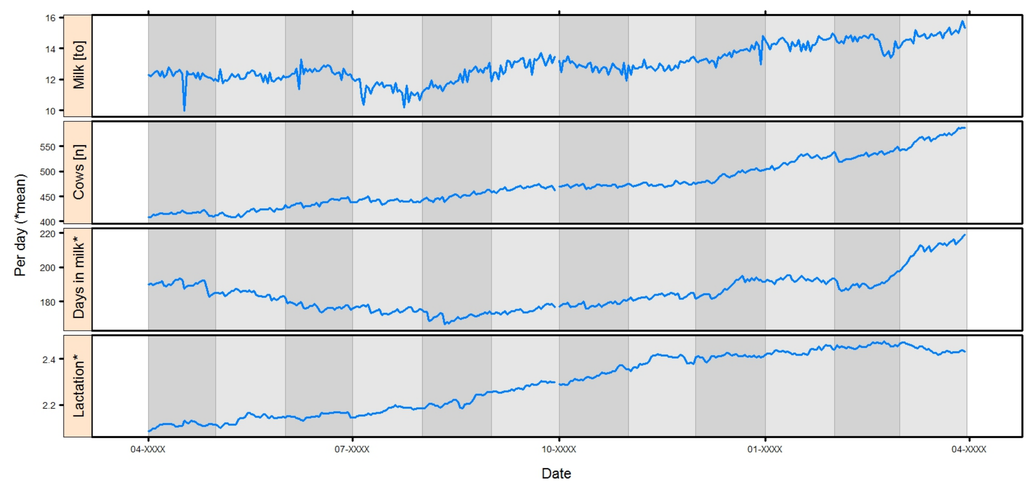
Background

When investigating an outbreak of a transmissive disease, it is necessary to narrow down the time period when the disease was first introduced into the animal population. Therefore, dates when the disease was most probably introduced have to be identified retrospectively. For dairy cow herds, the daily milk yields documented in the herd management software can be a valuable source of information.

Task of the data analyst

In a time series of milking performance data, find patterns that are representative for the introduction of a specific disease.

Data available from the herd management software

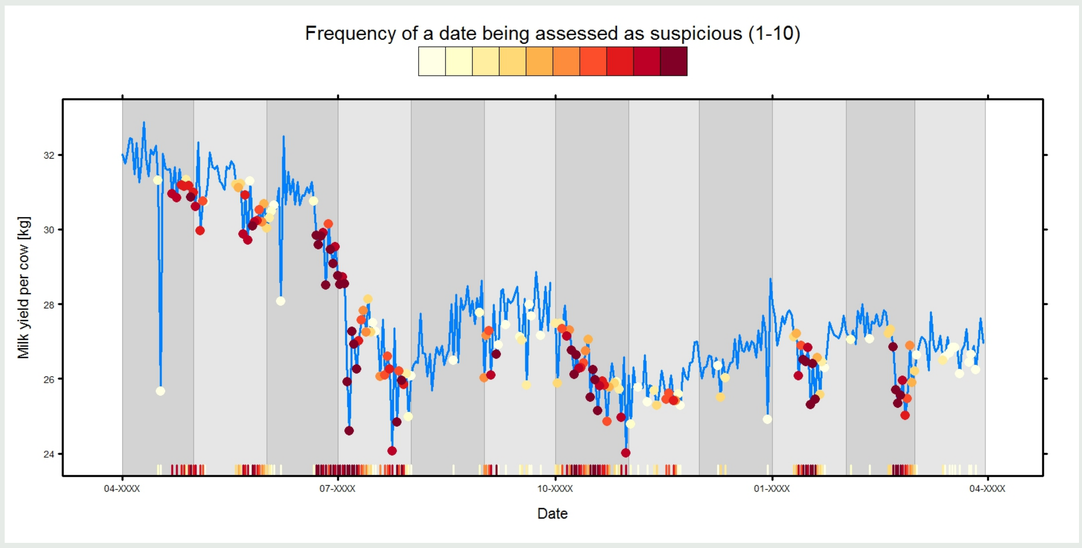


Methods

Option 1

Look for dates with decreased milk yield

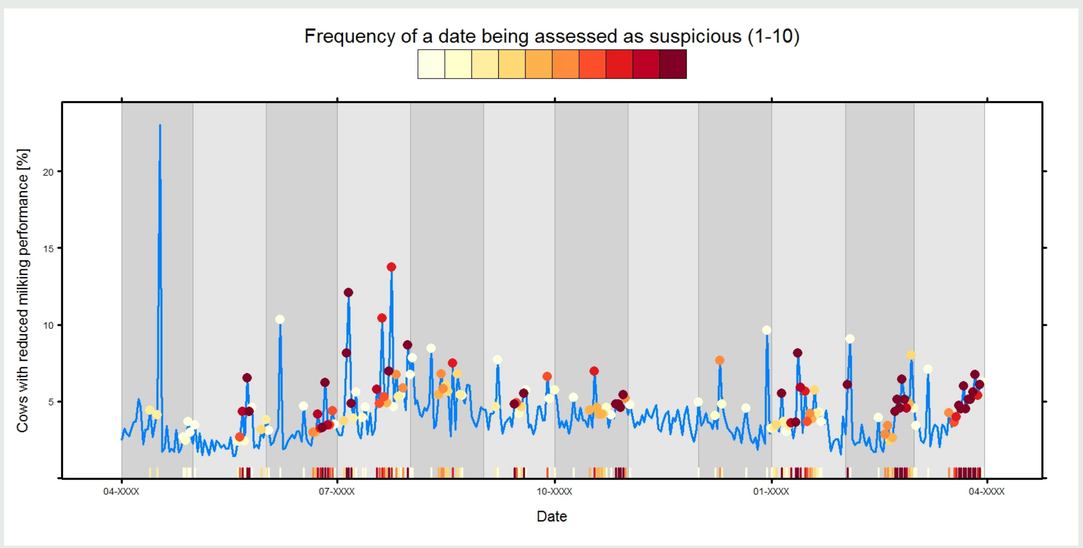
- Adjust daily milk yields for the number of cows, the lactation, the time in milk
- Estimate the date effect on the milk yield
- Identify suspicious dates in the resulting time series of mean milk yields per cow using e.g. a window-based evaluation method



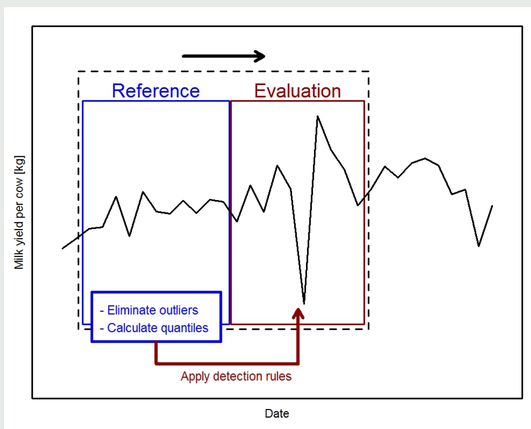
Option 2

Look for dates with an increased percentage of cows with reduced milking performance

- Estimate lactation curves for all individual cows
- Predict milk yields for all dates and cows including uncertainty limits
- Calculate the percentages of cows with reduced milking performance per date
- Identify suspicious dates in the resulting time series of percentages of cows using e.g. a window-based evaluation method



Window-based evaluation method



The **detection rules** depend on the expected effect pattern of the specific disease on the time series (e.g. the milk yield per cow and day).
Example:

- The evaluated value and at least 1 of the 2 subsequent values are below the 2% quantile.
  and/or
- The evaluated value and at least 3 of the 4 subsequent values are below the 80% quantile.

Both windows (reference and evaluation) **move** together at defined steps (e.g. 1 day).
This results in $\frac{\text{length of the evaluation window}}{\text{length of a step}}$ evaluations per date.

Discussion

- The algorithm contributed to the investigation of an BHV1 outbreak. Although the disease patterns depended only on expert opinions, the identified dates were concordant with probable introduction dates that resulted from the analyses of other data sources.
- Window-based methods are easily implemented and adapted to different disease patterns. They allow to ignore slow shifts (e.g. seasonal fluctuations) in the evalution of the dates by using suitable window lengths and detection rules.
- The algorithm is very hard to validate because data of similar disease outbreaks with verified introduction dates are very rare.
- Looking for dates with an increased percentage of cows with reduced milking performance seemed to be less sensitive to other influences on the milk yield (e.g. nutritional changes).

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