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THE USE OF FIELD DATA FOR BUILDING AN EXPERT SYSTEM FOR THE CONTROL OF RESPIRATORY DISEASES IN PIGS

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Three examples of empirical methods for deriving decision rules for expert system development in the field of respiratory disease management in pigs are presented: multinominal logistic regression modelling, tree diagram analysis and neural network simulation. A data set with information on management factors and prevalence of respiratory diseases from 89 New Zealand pig farms was used to compare the performance of the three techniques. The farms were to be classified in either of three prevalence categories (low, medium, and high). The example shows that empirical methods are valuable alternatives to domain expert interviews for knowledge acquisition.

INTRODUCTION

Despite intensive research and the introduction of rigid control programs over the last decades, respiratory diseases have remained among the most prevalent and costly health problems in swine production world-wide. The large number of risk factors involved in respiratory diseases in pigs and their complex interaction make it difficult to intuitively assess the situation on a farm. The development of an expert system incorporating domain knowledge on respiratory disease risk factors could help identifying high-risk farms and problem areas within a farm immediately as well as provide advice for appropriate interventions. This article explores three methods, how decision rules for risk factor-based farm classification can be derived from field data.

MATERIAL AND METHODS

A data set from a survey on respiratory diseases in pigs in New Zealand containing information on 89 farms was used. For each farm, the prevalence of respiratory lesions was available from two abattoir checks. Risk factor information was collected using a mailed questionnaire (for a more detailed description of the data set refer to Stärk and Morris, 1996). In this article, decision rules for farm classification with respect to pleuropneumonia/pleurisy (PLPN) are derived as an example, but the same techniques are applicable to enzootic pneumonia as well. Farms were grouped into three categories according to their PLPN prevalence: low (<4%), medium (4-20%) and high (>20%). A total of 15, 45 and 29 farms were in these respective categories. Three techniques were used to derive classification rules for farms:

1. Statistical analysis: After the univariate analysis, variables with a $p<0.20$ were used to build a multinominal logistic regression model based on a stepwise selection procedure with $p\leq0.05$ (Proc CATMOD, SAS v.6.12, SAS Institute Inc. Cary, USA).

2. Tree diagram: CHAID™ (Chi-squared Automatic Interaction Detector) was used to divide the observations into mutually exclusive segments using statistically significant predictor variables (CHAID™ for SPSS v.6.0, SPSS Inc., Chicago, USA). Again, variables with a $p<0.20$ at the univariate level were used as predictors.

3. Neural network simulation: A two layer network with one hidden layer and the three PLPN categories as outcome units was built and trained with the example data set (NeuroSolutions v.3.0, NeuroDimension Inc., Gainesville, USA). The same input variables were used as with the other techniques.

RESULTS AND DISCUSSION

In terms of classification performance, the statistical model slightly outperformed the neural network and both the neural network and the statistical model provided clearly more reliable classification than the tree diagram.

Traditionally, knowledge acquisition for an expert system was performed by interviewing one or several domain experts (for an example in the field of pig health see Enting et al., 1995). Problems related to this approach include the difficulty to define expertise and the need to interpret and structure verbal information. The techniques described in this paper are examples of a number of possible empirical alternatives. However, they require the availability of high-quality field data. Once the decision rules have been derived, additional data is needed to test the system.

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