Improving hatchability and chick quality – the power of data to unlock performance

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A great deal of data is collected in hatcheries all over the world, as batches of eggs, originating from many different sources, are set. Hatcheries hold information about the history of the eggs: which flock they originate from, flock age, the number of egg storage days and many other factors, as well as hatchability percentages, fertility percentages, and very often the results of detailed break out analyses.

This data is extremely valuable, as it can be used not only to gain insights into the incubation process, but also to improve hatchery performance. However, in day-to-day hatchery practice, the expertise and/or time available to extract practical information out of such complex datasets is often missing.

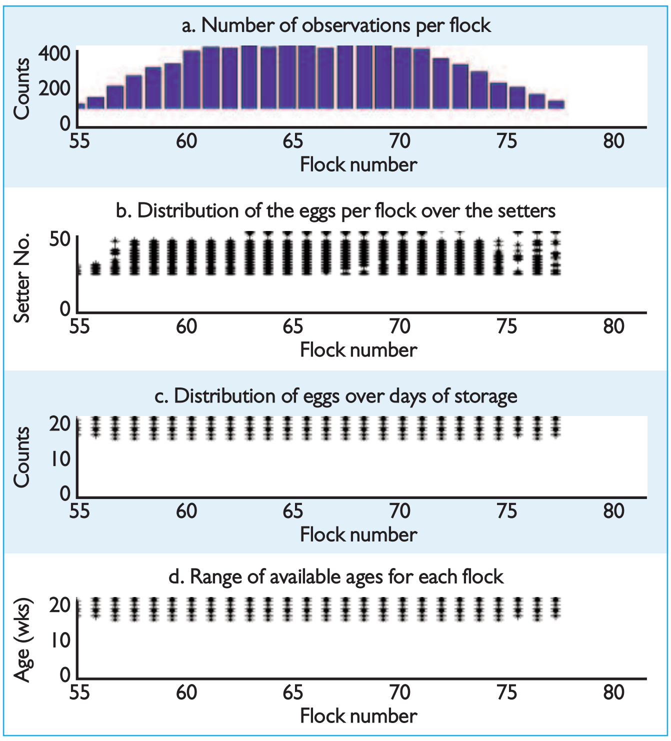
During the season 2011/2012, Pas Reform gathered data from 6,800 batches of eggs set in Latin America. To fully exploit this data, the Dutch hatchery technology company initiated a collaboration with Porphyrio. The expertise of Porphyrio was used to convert the available raw data into reliable information.

The report of this study, summarised in this article, demonstrates the value of a profound statistical analysis of observational datasets gathered in hatcheries. After a detailed evaluation of the quality of the dataset, analysis can provide fact-based information for improved hatchery management and decision making.

First, the importance of data quality evaluation was discussed in terms of the great care that should be taken when interpreting complex data, to avoid reaching the wrong conclusions and consequently making incorrect management decisions. Secondly, those parameters that have an important influence on hatchability rate were investigated. Finally, the performance of the SmartSetPro setter (Pas Reform) was compared to that of a conventional incubation system.

In collaboration with Porphyrio, Pas Reform Academy can now perform such advanced statistical analyses for customers worldwide, to unlock the information held in the available data as a real asset to day-to-day operations in the modern hatchery.

Fig. 1. Overview of the data distribution for the different flocks.



Data quality evaluation

An important first step in data analysis is to gain insight into the available data. Fig. 1 shows the experimental structure of the dataset gathered in Latin America.

Fig. 1a provides an overview of the number of observations per flock. Fig. 1b shows in which setter the eggs from the different flocks were placed. Additionally, Fig. 1c displays the storage duration of eggs from the different flocks. Finally, Fig. 1d shows the age range of the different flocks during the period of data collection.

For example, in the case of flock 61 (Fig. 1a), there are 227 observations; the eggs were set in setter numbers 1 to 24 (Fig. 1b) (excluding Setter 8), they were stored from 1-8 days (Fig. 1c) and flock age ranged from 40-70 weeks during the period of data collection (Fig. 1d).

From Fig. 1, it can be seen that many combinations of parameters are not present, e.g. for some flocks, observations for a limited range of flock age were available and the eggs were not placed in all setters.

This is a common observation for data collected at a hatchery. For such an observational dataset, it is difficult to extract causal relations.

We illustrate this with an example. Fig. 2 shows the observed hatchability rates for two different flocks without taking relevant information such as age of the flock and storage duration into account. The conclusion from this data is that flock 57 performs significantly worse than flock 82 (Fig. 2).

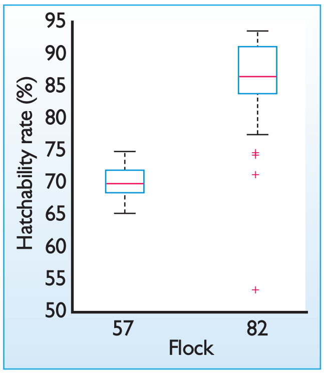


Fig. 2. Boxplot of the hatchability rates for flock 57 and 82.

As can be seen from Fig. 1d, observations for flock 57 originate from old hens, while the observations for flock 82 originate from young hens. However for old hens, the hatchability rate decreases significantly as can be seen in Fig. 3.

To conclude: comparing hatchability rates between flocks without taking this relevant information into account will lead to the wrong conclusions. The hatchability rates observed in Fig. 2 result, among other factors, from differences between the flocks and differences in the age of the flocks during data collection. Based on the available data, it is impossible to separate these effects. Therefore in this example, a conclusion about the origin of the observed differences in hatchability rate cannot be made.

Results

Which parameters influence hatchability rate? From Fig. 1, it could be seen that the experimental design is incomplete, i.e. many combinations of parameters are not present. To minimise the problem of correlated parameters, a subset is created for which the experimental design is as complete as possible.

The observations from flocks 66 to 74 are the most complete with respect to setter (Fig. 1b), storage duration (Fig. 1c) and age of the flocks (Fig. 1d) and are used to create the subset on which the final analysis was performed.

Continued on page 15

Continued from page 13

This subset consists of approximately 3,500 observations.

Next, an initial selection of the most important parameters with respect to hatchability rate was made based on existing literature to include the following during this investigation;

- Age of the flock (FlockAge).
- Storage duration (EggStorage).
- Flock.
- SmartSetPro setter vs conventional setter (SetterType).
- Season.

A statistical logistic model selection procedure was applied to determine the most informative statistical model for a given number of parameters. For a straightforward interpretation, only the parameters that have the largest impact on hatchability rate are included. This allows rapid assimilation into the management decision making process.

It was concluded that variables FlockAge and EggStorage have the largest influence on hatchability rate.

Compared to FlockAge and EggStorage, the other variables and their interactive effects have a less pronounced effect.

Performance analysis

An analysis was performed to compare the performance of the SmartSetPro setter with a conventional incubation system. A powerful way to investigate the effect of SetterType (conventional vs SmartSetPro setter) is to use the information from batches of eggs for which one part was incubated in a conventional setter and the other part of the batch in a SmartSetPro setter. Eggs from one batch originate from the same flock, with the same flock age and storage duration.

Therefore, any variability due to Flock, FlockAge and EggStorage is excluded. Based on these observations, the average hatchability rate for the SmartSetPro setters and conventional setters was 78.6 and 76.6% respectively.

A student t-test was performed to analyse whether the effect of SetterType on hatchability rate is significant. The calculated t-statistic corresponds to a p-value of 0.013, leading to the following conclusion:

- At a significance level of 0.05, it can be stated that the new SmartSetPro setters perform significantly better in terms of hatchability rate compared with conventional setters. Comparing average hatchability data per machine type could easily lead to the formation of incorrect conclusions. Fig. 4 shows the distribution of the number of observations per FlockAge for the different SetterType. This indicates that the batches of eggs incubated in the SmartSetPro setters originate from older flocks than those set in the conventional setter.

As shown in Fig. 3, hatchability rate decreases considerably with FlockAge. Therefore to make a fair comparison, flock age should be considered and kept equal.

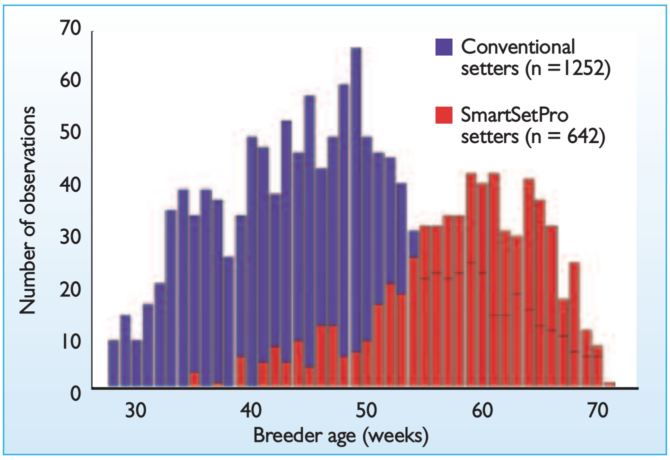


Fig. 4. Distribution of the number of observations per FlockAge for each SetterType.

Summary

Statistical analyses were performed on a relational dataset gathered in Latin America during 2011/2012.

It was concluded that the age of flock and the duration of storage have the largest influence on hatchability rate. Other variables and their interactive effects have a less pronounced effect.

Analysis revealed that the SmartSetPro setters perform significantly better in terms of hatchability rate compared with conventional setters.

A difference of hatchability of 2% was observed (76.8% for conventional vs 78.6 % for SmartSetPro Setters).

It was also observed that comparing hatchability rate between different SetterType without correcting for FlockAge will produce incorrect conclusions. Since the distribution of FlockAge of eggs set in different SetterType was very different, the actual effect of SetterType was masked by the FlockAge effect.

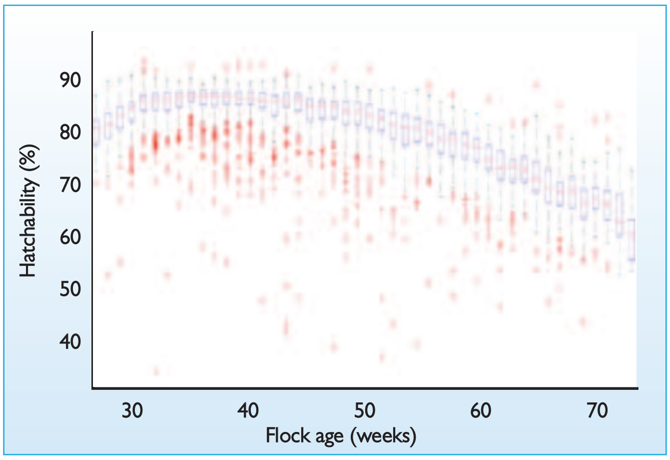


Fig. 3. Boxplot of the hatchability rates at different flock age.

Conclusion

To conclude, Pas Reform sees great potential in the new collaboration between its Academy and Porphyrio, to obtain and provide deeper insights into the dynamics of modern incubation for the benefit of clients worldwide.

Such collaboration enables the profound and well substantiated analysis of numerous large and complex hatchery data sets. This report shows that such levels of analysis can support day-to-day operational decision making in hatchery critical processes, such as the optimisation of incubation time and the performance of individual incubators.

On a more strategic level, reliable data analysis forms the basis for decision making in poultry integration, for example regarding investment proposals.

This sort of analysis has the potential to become a powerful management tool for hatcheries and integrations focused on performance, results and growth. ■