A Statistical Approach to Predict and Classify the Commercial Hatchability of Chickens Using Extrinsic Parameters of Breeders and Eggs

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Abstract : Hatchery performance is critical for the profitability of poultry breeder operations. Some extrinsic parameters of eggs and breeders cause to increase or decrease the hatchability. This study aims to identify the affecting extrinsic parameters on the commercial hatchability of local chicken's eggs and determine the most efficient classification model with a hatchability rate greater than 90%. In this study, seven extrinsic parameters were considered: egg weight, moisture loss, breeders age, number of fertilised eggs, shell width, shell length, and shell thickness. Multiple linear regression was performed to determine the most influencing variable on hatchability. First, the correlation between each parameter and hatchability were checked. Then a multiple regression model was developed, and the accuracy of the fitted model was evaluated. Linear Discriminant Analysis (LDA), Classification and Regression Trees (CART), k-Nearest Neighbors (kNN), Support Vector Machines (SVM) with a linear kernel, and Random Forest (RF) algorithms were applied to classify the hatchability. This grouping process was conducted using binary classification techniques. Hatchability was negatively correlated with egg weight, breeders' age, shell width, shell length, and positive correlations were identified with moisture loss, number of fertilised eggs, and shell thickness. Multiple linear regression models were more accurate than single linear models regarding the highest coefficient of determination (R^2) with 94% and minimum AIC and BIC values. According to the classification results, RF, CART, and kNN had performed the highest accuracy values 0.99, 0.975, and 0.972, respectively, for the commercial hatchery process. Therefore, the RF is the most appropriate machine learning algorithm for classifying the breeder outcomes, which are economically profitable or not, in a commercial hatchery.

Keywords : classification models, egg weight, fertilised eggs, multiple linear regression