

The Effect of Diseases on Optimal Replacement Policy of Dairy Cows

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Introduction

- The average culling age of Finnish dairy cows is 4.9 years, while their herd life is only 2.7 years.
- The high replacement rate (36%) causes high replacement costs but, on the other hand, a rapid cycle of generations.
- The purpose of our study was, first, to investigate the reasons of culling, especially the ratio of voluntary vs. involuntary cullings and, second, to find an optimal replacement policy if there is room for intentional disposals.

Model

- We developed a stochastic dynamic optimisation model and utilised the CompEcon Toolbox of MATLAB in solving the optimisation problem.
- The optimal decision of 'keeping' or 'replacing' a cow was determined periodically, a lactation being the period.
- The condition of a cow was determined with three state variables: parity (1-10), production level (85, 100, 115) and state of health (no diseases, treatable diseases, diseases which cause involuntary culling).
- The stochastic elements of the model were linked to the production level and the state of health.



Photo: Aino Pietilä

Data

- The production of the Ayrshires and the Holstein-Friesians was calculated with the solutions of a test day model used for evaluating the breeding value of Finnish dairy cattle.
- The feed consumption was calculated according to feeding standards.
- The probability of veterinary treatment (Fig.1) and the probability of involuntary culling (Fig.2) were estimated using the SAS/Univariate and SAS/Logistic procedures from the Finnish health recording system (61,477 cows in 2003-2004).
- The estimates of yield losses caused by diseases were based on previous studies.
- Market prices of inputs and outputs were collected from price statistics.

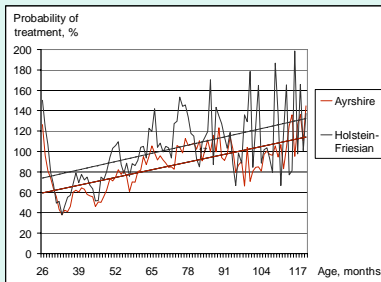


Fig.1. Probability of veterinary treatment by breed and age.

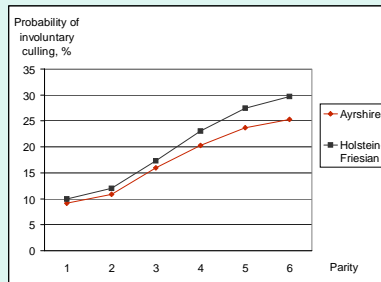


Fig. 2. Probability of involuntary culling by breed and parity.

Results

- The portion of involuntary cullings is about 50% of present cullings.
- In the optimal solution, the steady-state parity was 3.8 and 3.6 for Ayrshire and Holstein-Friesian cows, respectively.
- The replacement rate was 21% for the Ayrshires and 22% for the Holstein-Friesians with the estimated probabilities of different production levels.
- Regardless of the state of health, it is profitable to intentionally dispose only cows with a low production level.
- The expected net present value of current and replacement cows over the decision horizon was higher for the Ayrshires than for the Holstein-Friesians.

Conclusions

- Increasing the herd life of Finnish dairy cows is possible and profitable.
- Preventing premature culling of dairy cows is important in order to improve the possibilities of breeding selection and the economic performance of milk production.
- Investing in the veterinary treatment of dairy cows with an average or high production level is profitable.
- The Holstein-Friesians lose the benefit of their high production level because of high treatment costs and high probability of involuntary culling.

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