DYNAMIC PROGRAMMING APPROACH TO COW REPLACEMENT

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A farmer's decision whether to keep or replace a particular dairy cow is subjective. Dynamic programming has been used in an attempt to remove some of the subjectivity of this decision by assessing the future value of a cow compared with the future value of a heifer which may replace her.

Each cow is assigned a state according to her breed, age and fat yield in her last lactation. In this study three hundred states were considered, representing two breeds (corresponding to Friesian and Jersey), ten age groups (2-11 years), and fifteen production levels.

Three functions were used to assess the future value over ten years of a cow of a particular state. Function 1 attempted to predict future fat yield of a cow of a particular state, given its probability of death or failure due to disease or infertility, compared with the future yield of a replacement cow. Functions 2 and 3 attempted to assess the future economic value of a cow of a particular state by taking into account the probability of death or failure, future production, the price received for fat, costs of feeding a cow of that state, slaughter value, and cost of purchasing a replacement cow. Function 2 used figures derived from Cochrane (1975) for assessing feed requirements, while function 3 used figures derived from the Ministry of Agriculture, Fisheries and Food (1975). A range of economic values was used.

With all three functions, state representing cows of age 11 were replaced irrespective of value. States of replacement cows were assigned as being those of 2 year old heifers of the same breed as the cow being replaced with production level determined by drawing at random from a normal distribution of 2 year old fat yields.

Over the ten year evaluation period, the states marked for replacement varied from year to year with states representing the higher age groups (7-10 years) showing greatest variation. At the end of ten years a decision could be made for each state. Variations in economic values resulted in minor changes to the production level below which all states were to be replaced, particularly in the Jersey breed.

The systems developed were applied to records of approximately 2,000 cows in 19 herds from the South Australian herd recording scheme. The proportion of the herd marked for replacement each year varied between 30% and 60% using the results of functions 1 and 2, and between 15% and 40% using the results of function 3.

Where more than one lactation of a cow was recorded, an indication of the accuracy of a decision at the end of each lactation was given by results from later lactations. With all functions 10%-20% of cows marked for replacement at the end of one of their lactations were subsequently marked for retention.

Functions 1 and 2 select an impractically high proportion of cows for replacement. However, it appears as if manipulation of economic values and other parameters of function 3 could improve its use as a selection aid for dairy cow replacement.

REFERENCES

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