Projecting Dairy Herd Size and Make-Up Using the Herd Structure Simulation (HSS) Model

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Spreadsheet Application (PC Compatible) Available at DairyMGT.info: Tools: Replacement (HSSModel)

Introduction

The HSS model simulates on a monthly basis the dynamics of a dairy herd population, including the future make-up of the herd. The HHS model takes the following information into consideration:

1- Time to first calving (TFC) in months.
2- Heifer calves born per year (%).
3- Stillbirth rate (%)
4- Calves and heifers culled before entering 1st lactation (%)
5- Cow replacement rate per year (%)
6- Calving interval (CI) in months
7- The size of the current adult herd size

Using these 7 inputs, the HSS model projects the size and make-up of a dairy herd at any future point in time.

Input Data Required

TFC: Average time in months at which heifers calve for first time. *For example 24 months* implies that heifers become pregnant on average at 15 months.

Heifer calf born *(%/year)*: If non-sexed semen is used, the percentage heifers born could be considered to be 47%. If sexed semen is used, this percentage would increase. However, the use of sexed semen on heifers would likely increase TFC. Also, the CI would also be extended if sexed semen is used on adult cows. It is imperative that realistic figures are used. Discuss your input values with your advisor.

Stillbirth rate (%/year): This figure takes into account all stillborns as well as those heifers that die within 48h. A realistic figure could be a stillbirth rate of 7%.

Calves and heifers culled: This figure represents all the heifers that do not make it to 1st lactation for any reason, including those that die of dystocia or any other calving related complication. This is different from stillbirth. It is imperative that accurate figures are

used for these inputs otherwise the growth of the herd could be vastly over-estimated. A realistic value could be 15.5%.

Cow replacement rate (%/year): Average percentage of adult cows leaving the herd in a year. *For example 30%* means that approximately 2.5% of cows leave the herd every month.

Cow calving interval (months): Average time in months from one calving to the next in the adult herd population. *For example 13 months* means that cows on average get pregnant between months 4 and 5 after calving and then calve again at 13 months from previous calving.

Number of adult cows (count): Average number of milking and dry cows that have had at least one calving.

Running the Model

Once the 7 parameters discussed above are defined, the model can be run by hitting the button "Go!" located on cell G11 of the spreadsheet.

The model runs in 2 steps. The first step runs as long as needed to reach a "*steady state*" or equilibrium of the adult herd population and it is independent of the input running time value entered. Steady state is the condition of the nature on which the proportion of cows in each cow state remains constant over time. Assuming that a herd normally remains constant in size, all the animals leaving the herd are immediately replaced and over time this causes a baseline herd structure in steady state that represents the dairy herd being studied. *Having for example the herd projected at 0 (zero) months in the model* will give a herd structure expected when the herd is in steady state.

The second step runs assuming that all the heifers calving enter the adult cow population regardless of the balance of the cows leaving the herd and the need for replacements. This runs for as many months as requested by the user. *For example using 120 months* as the time of projection means that the model will calculate the number of animals in each state at the end of the month 120 (10 years) in the future. Depending on the input data, the herd size could either expand, contract or remain the same.

Results

Two tables and a graph summarize the main results at the end of the projection time. The first table refers to the number of heifers in each major category as well as the total number of heifers. The second table summarizes the population of cows in the various categories as well as the total number of cows. The graph shows the number of heifers at different ages and the number of cows (1st, 2nd, and 3rd lactation animals) at different months after calving.

Example: Using the following inputs:

1. *24 months for TFC,*
2. *47% heifer calves born,*
3. *7% Stillbirth,*
4. *15.5% calves and heifers culled,*
5. *30% cow replacement rate,*
6. *13 months of calving interval,*
7. *1,000 cows as the number of adult cows,*

   Will yield the following results:

At 0 months of projection *(steady state of the herd population) there would be: 296 cows in first lactation, 213 in second, 153 in third, and the rest, 338, in fourth and later lactations. The HSS model predicts that 657 cows are pregnant, 343 are non-pregnant, and 867 cows are producing milk. There are 133 dry cows.*

The HSS model also predicts the farm counts with 1,010 heifers of all ages. Of these, 90 are 2 months and younger, 177 are between 3 and 6 months of age, 382 are 7 months and older and non-pregnant, and 361 are pregnant.

At 120 months *the HSS model predicts: 1,938 adult cows and 1,677 heifers. For the adult cows, 647 are in first lactation, 437 in second, 295 in third, and 560 in fourth or later lactations. The HSS predicts that 1,256 cows are pregnant, 682 are non-pregnant, and 1,688 cows are producing milk.*

For the heifers, 158 are 2 months or younger, 308 between 3 and 6 months, 635 are 7 months and older but not pregnant, and 575 are pregnant.