The effect of reproductive performance on the herd value assessed by integrating a daily dynamic programming with a daily Markov chain model

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Outline

- Introduction
  - Background
  - Objectives

- Material & Methods
  - Daily Dynamic Programming model
  - Daily Markov Chain
  - 5 different Reproductive programs characteristics

- Results

- Conclusion
Introduction

- Reproductive Performance
  - Milk yields
  - Available replacement heifers
  - Culling rates

- Replacement Policy
  - High cost of maintaining a dairy herd

Dairy Herd’s Profitability
Objective

- Determining the effect of reproductive performance on dairy cattle herd value
  - DP: Developing a daily DP model
  - MC: Combining with a Daily Markov chain model
  - Herd value: Compare different reproductive programs’ herd values
Daily DP model

• A technique that uses divide and conquer algorithm

• In this study value iteration method was used to find optimal replacement decisions with daily stage length
• DP model  Retention Pay-Off (RPO)
• RPO = Expected profit from keeping the cow compared with immediate replacement
Daily Markov chain model

- Is a simulation method
- After optimizing with DP daily Markov chain was used to simulate the herd demographics
- This model find the structure or proportion of cows at steady state for cow states
Herd Value

- was defined as the herd’s weighted average RPO

\[
\text{Herd Value} = \sum_{l=1}^{9} \sum_{d=1}^{750} \sum_{p=0}^{282} \left( p \downarrow l, d, p \times RPO \downarrow l, d, p \right)
\]
# Reproductive programs chars

<table>
<thead>
<tr>
<th>Repro Program</th>
<th>First AI</th>
<th></th>
<th></th>
<th>Second and subsequent AI</th>
<th></th>
<th></th>
<th>21dPR(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E</td>
<td>D</td>
<td>CR ED before 1st TAI</td>
<td>CR TAI</td>
<td>E</td>
<td>D</td>
<td>CR ED before TAI</td>
</tr>
<tr>
<td>RP1</td>
<td>-</td>
<td>-</td>
<td>42</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30</td>
</tr>
<tr>
<td>RP2</td>
<td>70</td>
<td>25</td>
<td>32</td>
<td>70</td>
<td>25</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>RP3</td>
<td>50</td>
<td>30</td>
<td>36</td>
<td>50</td>
<td>30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>RP4</td>
<td>30</td>
<td>35</td>
<td>40</td>
<td>30</td>
<td>35</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>RP5</td>
<td>80</td>
<td>35</td>
<td>30</td>
<td>80</td>
<td>35</td>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>

* A subset of reproductive programs studied in Giordano et al. (2012)
## Results

- Herd values (US$) for five repro programs across five milk classes

<table>
<thead>
<tr>
<th>Repro Program</th>
<th>21 d PR (%)</th>
<th>76</th>
<th>88</th>
<th>100</th>
<th>112</th>
<th>124</th>
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</thead>
<tbody>
<tr>
<td>RP1</td>
<td>17</td>
<td>156</td>
<td>374</td>
<td>769</td>
<td>1,224</td>
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<td>14</td>
<td>376</td>
<td>729</td>
<td>1,129</td>
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<tr>
<td>RP3</td>
<td>16</td>
<td>385</td>
<td>77</td>
<td>1,190</td>
<td>1,693</td>
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<tr>
<td>RP4</td>
<td>18</td>
<td>395</td>
<td>1,234</td>
<td>1,248</td>
<td>1,753</td>
<td></td>
</tr>
<tr>
<td>RP5</td>
<td>20</td>
<td>410</td>
<td>806</td>
<td>1,248</td>
<td>1,753</td>
<td></td>
</tr>
</tbody>
</table>
Ranking changes of 5 repro programs across 5 milk classes
Source of difference btw repro programs

[Graph showing the comparison of RPO×% cows($/cow per d) over days after 1st calving for RP1, RP5, and RP2.]
Conclusion

• Positive relationship between Reproductive performance and herd value

• There could be an opportunity to adjust the reproductive programs according to milk class

• daily decisions of assigning cows to different reproductive management groups based on their RPO Improving a herd value
Conclusion...

Daily reproductive decisions

Relative milk Yield

Herd Value

Reproductive programs
Thank you!
RPO for different DIM at pregnancy
Changes in RPO for pregnancy at 120 DIM

- No Pregnancy Loss
- Pregnancy loss at 220 DIM & rebred at 250 DIM
- Pregnancy loss at 170 DIM & rebred at 200 DIM