Economic Analysis Tools for Dairy Reproduction Programs

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Rationale

• Herd profitability depends on reproductive efficiency, but relationship is highly complex.

• Reproductive performance can be measured (e.g., 21-d pregnancy rate).

• Costs of reproductive programs can be calculated (e.g., cost per pregnancy).

• **But**, it is difficult to measure its full economic impact (e.g., profitability).
Profitability of reproduction

- Simulate herd structure in response to a reproductive program
- Calculate the expected net return under different reproductive performances (De Vries et al., 2010; Fricke et al., 2010; Cabrera, 2011)
Evaluation of repro programs

- Analyze specific reproductive programs
- Impact of reproductive management strategies on a farm-by-farm specific basis (Giordano et al., 2011; 2012; 2013; Kalantari and Cabrera, 2012)
Individual cow management

- Not all cows have the same reproductive value within a herd.

- Opportunities for individual cow decision-making exist. (Cabrera, 2012)
Profit of improving pregnancy rate

• Improving reproductive efficiency improves returns (Fricke et al., 2010)

• Reproductive efficiency improves overall profit (De Vries, 2010; Giordano et al., 2012; Kalantari and Cabrera, 2012)

• Law of diminishing marginal net returns

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Profit of improving pregnancy rate

• Higher gains are due to improved milk income over feed cost

• Other important factors: savings in reproductive costs, return for additional calves, and savings in replacement costs (Cabrera, 2011)

<table>
<thead>
<tr>
<th>21-d Pregnancy Rate, %</th>
<th>Income over feed cost</th>
<th>Replacement cost</th>
<th>Reproductive cost</th>
<th>Calf return</th>
<th>Overall Net Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 to 11</td>
<td>19.42</td>
<td>1.14</td>
<td>6.10</td>
<td>5.25</td>
<td>32</td>
</tr>
<tr>
<td>11 to 12</td>
<td>18.28</td>
<td>1.28</td>
<td>5.60</td>
<td>4.84</td>
<td>30</td>
</tr>
<tr>
<td>12 to 13</td>
<td>17.18</td>
<td>1.36</td>
<td>5.17</td>
<td>4.48</td>
<td>28</td>
</tr>
<tr>
<td>13 to 14</td>
<td>16.13</td>
<td>1.42</td>
<td>4.79</td>
<td>4.16</td>
<td>26</td>
</tr>
<tr>
<td>14 to 15</td>
<td>15.12</td>
<td>1.44</td>
<td>4.45</td>
<td>3.87</td>
<td>25</td>
</tr>
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<td>15 to 16</td>
<td>14.17</td>
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<td>3.60</td>
<td>23</td>
</tr>
<tr>
<td>16 to 17</td>
<td>13.26</td>
<td>1.43</td>
<td>3.88</td>
<td>3.36</td>
<td>22</td>
</tr>
<tr>
<td>17 to 18</td>
<td>12.41</td>
<td>1.41</td>
<td>3.64</td>
<td>3.15</td>
<td>21</td>
</tr>
<tr>
<td>18 to 19</td>
<td>11.62</td>
<td>1.37</td>
<td>3.42</td>
<td>2.95</td>
<td>19</td>
</tr>
<tr>
<td>19 to 20</td>
<td>10.87</td>
<td>1.33</td>
<td>3.23</td>
<td>2.77</td>
<td>18</td>
</tr>
<tr>
<td>20 to 21</td>
<td>10.17</td>
<td>1.28</td>
<td>3.05</td>
<td>2.60</td>
<td>17</td>
</tr>
<tr>
<td>21 to 22</td>
<td>9.52</td>
<td>1.23</td>
<td>2.88</td>
<td>2.44</td>
<td>16</td>
</tr>
<tr>
<td>22 to 23</td>
<td>8.91</td>
<td>1.17</td>
<td>2.73</td>
<td>2.30</td>
<td>15</td>
</tr>
<tr>
<td>23 to 24</td>
<td>8.34</td>
<td>1.12</td>
<td>2.59</td>
<td>2.17</td>
<td>14</td>
</tr>
<tr>
<td>24 to 25</td>
<td>7.82</td>
<td>1.06</td>
<td>2.46</td>
<td>2.05</td>
<td>13</td>
</tr>
<tr>
<td>25 to 26</td>
<td>7.33</td>
<td>1.01</td>
<td>2.34</td>
<td>1.94</td>
<td>12</td>
</tr>
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<td>26 to 27</td>
<td>6.87</td>
<td>0.96</td>
<td>2.23</td>
<td>1.84</td>
<td>12</td>
</tr>
<tr>
<td>27 to 28</td>
<td>6.45</td>
<td>0.90</td>
<td>2.13</td>
<td>1.74</td>
<td>11</td>
</tr>
<tr>
<td>28 to 29</td>
<td>6.06</td>
<td>0.85</td>
<td>2.03</td>
<td>1.65</td>
<td>11</td>
</tr>
<tr>
<td>29 to 30</td>
<td>5.70</td>
<td>0.80</td>
<td>1.94</td>
<td>1.57</td>
<td>10</td>
</tr>
</tbody>
</table>

Expected additional net return ($/cow per yr) response to increased 21-d pregnancy rate.

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Make your own analyses

“Dairy Reproductive Economic Analysis” online tool

- Enter farm-specific information:
  - Milk production
  - Culling rates
  - Abortion rates
  - Prices and costs
- Run model
- Compare scenarios

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Farm specific analyses

- Value of a reproductive program assessed by:
  - Simulating reproductive performance along with
  - Estimating net returns

(Giordano et al., 2011; 2012; 2013; Kalantari and Cabrera, 2012)
Farm specific analyses

• Different herds with different repro programs can have **same** performance

• Same repro program in different herds can have **different** outcomes
Farm specific decision-making

- Include, exclude, or change level of **TAI or HD** (Giordano et al., 2011)

- Manipulate **IBI** for TAI programs (Giordano et al., 2012)

- **Start** re-synchronization before pregnancy diagnosis

- Introduce the use of chemical pregnancy test (Giordano et al., 2013)

- Assessing the cost benefit of introducing **HD devices**
Introducing heat detection devices

- Increasing the percentage of cows bred in estrus from 50 to 80% increased the 21-d PR by 2%, and

- Would translate in $22,000/year of additional profit in a 1,000-cow herd

DairyMGT.info: Tools: UW-DairyRepro$Plus
Heat detection between syncs

- Adding 30% CR of 50% ED improves profit?
- No gain / No loss
- Only before first TAI: Loss
- Only after first TAI: Gain

DairyMGT.info: Tools: UW-DairyRepro$Plus
Earlier chemical pregnancy test

- Between $40 and $60 additional profit to 1-week shorter interbreeding interval (between 9 and 4 weeks)

- However, earlier pregnancy tests has inaccuracies and is affected by early pregnancy losses

Effect of shorter interbreeding intervals (IBI) when conception rate was 35%

Giordano et al., 2013

DairyMGT.info: Tools: UW-DairyRepro$Plus
Earlier chemical pregnancy test

Value of using chemical test (CT) for earlier pregnancy diagnosis

<table>
<thead>
<tr>
<th></th>
<th>Base</th>
<th>Range</th>
<th>CT31 vs RP39</th>
<th>CT24 vs TU32</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Sensitivity</td>
<td>98/97</td>
<td>94-99</td>
<td>+5.3</td>
<td>+4.5</td>
</tr>
<tr>
<td>% Specificity</td>
<td>98/97</td>
<td>94-99</td>
<td>+3.1</td>
<td>+2.5</td>
</tr>
<tr>
<td>% Pregnancy loss</td>
<td>6/6.6</td>
<td>0-10</td>
<td>-3.1</td>
<td>-2.5</td>
</tr>
<tr>
<td>% Questionable</td>
<td>3.3/8.5</td>
<td>0-10</td>
<td>-0.4</td>
<td>-0.3</td>
</tr>
<tr>
<td>% Estrous detection</td>
<td>50</td>
<td>30-80</td>
<td>0.097</td>
<td>-0.220</td>
</tr>
<tr>
<td>$ CT cost</td>
<td>2.4</td>
<td>0.5-5</td>
<td>-0.0175</td>
<td>-0.0192</td>
</tr>
</tbody>
</table>

Break even

<table>
<thead>
<tr>
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<td>% Sensitivity</td>
<td>96.4</td>
<td>94.9</td>
</tr>
<tr>
<td>% Specificity</td>
<td>95.1</td>
<td>93.2</td>
</tr>
<tr>
<td>% Pregnancy loss</td>
<td>8.9</td>
<td>10.5</td>
</tr>
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Giordano et al., 2013

DairyMGT.info: Tools: UW-DairyRepro$Plus
Make your own analyses

DairyMGT.info: Tools: UW-DairyRepro$Plus
Individual cow decision-making

• Every cow has a **different** contribution

• After best repro program: **individual cow management**

• **Fine-tune** individual cow reproductive management

• **Critical concepts:**
  – Economic value of a dairy cow (Eicker and Fetrow, 2003; Groenendaal et al., 2004)
  – Retention payoff (De Vries, 2004; Kalantari et al., 2010)
  – Value ranking of cows

• **Crucial** reproductive decisions:
  – Breeding, VWP, DNB, …
Determining the value of a cow

Value of cow = $328

$/cow per mo

Months in the future

Meaning of value of a cow

• **Positive:**
  – Cow provides more profit than potential replacement
  – Relative cow value to be used for:
    • Ranking
    • Treating
    • Better reproductive management

• **Negative:**
  – Herd will have higher profit with a replacement
Value of a cow illustration

• **Open cow**
  – Decreases
  – Becomes negative

• **Pregnant cow**
  – Higher than open
  – U-shaped
  – Similar value at calving

[Graph showing 2nd lactation average production cow value over months after calving.]

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MIM = month in milk.
The impact of milk productivity

2\textsuperscript{nd} lactation open

$\begin{align*}
$1,800 & \quad 2 \text{ mo pregnant, 10 mo lactating} \\
$1,340 & \\
$980 & \\
$420 & \\
-40 & \\
-500 & \\
\end{align*}$

DairyMGT.info/tools/cow_replacement/
Illustration of possible cow value repro management decisions

<table>
<thead>
<tr>
<th>Cow Value</th>
<th>MIM</th>
<th>MIP</th>
<th>Manager Possible Reproductive Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>1</td>
<td>0</td>
<td>Consider enlarging voluntary waiting period</td>
</tr>
<tr>
<td>Low</td>
<td>1</td>
<td>0</td>
<td>Consider shorten voluntary waiting period</td>
</tr>
<tr>
<td>High</td>
<td>9</td>
<td>0</td>
<td>Keep breeding for at least 3 more services</td>
</tr>
<tr>
<td>Low</td>
<td>9</td>
<td>0</td>
<td>Label do-not-breed and replace next month</td>
</tr>
<tr>
<td>Very High</td>
<td>3</td>
<td>0</td>
<td>Use better quality semen or female sexed semen</td>
</tr>
<tr>
<td>Very Low</td>
<td>3</td>
<td>0</td>
<td>Consider embryo transfer or using male sexed semen</td>
</tr>
<tr>
<td>Very High</td>
<td>4</td>
<td>1</td>
<td>Consider sooner pregnancy diagnosis confirmation</td>
</tr>
<tr>
<td>Very Low</td>
<td>4</td>
<td>1</td>
<td>Consider replacement if negative cow value</td>
</tr>
<tr>
<td>Very High</td>
<td>10</td>
<td>5</td>
<td>Consider sooner pregnancy diagnosis re-confirmation</td>
</tr>
<tr>
<td>Very Low</td>
<td>10</td>
<td>5</td>
<td>Consider replacement after calving</td>
</tr>
</tbody>
</table>

MIM = month in milk. MIP = month in pregnancy.
Make your own analyses

- **Critical variables:**
  - Evaluated cow
  - Replacement

- **Important variables**
  - Herd production
  - Herd reproduction
  - Prices and costs

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