Benefit-Cost Analysis of NIRS Feeding Initiative for the Alberta Livestock Industry

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Near-Infrared Reflectance Spectroscopy (NIRS) is a technology used to quickly analyze feed nutrients.

- For livestock producers (beef, dairy, hogs, and poultry)
- For crop producers
- For feed mills

Commercial introduction of NIRS is currently being investigated in Alberta.
Main Objective

To conduct a Benefit-Cost Analysis (BCA) of NIRS in the dairy and beef cattle sector in Alberta

Key Assumptions

- Benefit from NIRS is through an improvement in feed cost savings
- NIRS technology is fully adopted by each sector of interest
Methodological Approach

NIRS Scenario

Nutrient Content

Nutrient Requirements

Expected Feed Prices

Least-Cost Ration Model

Optimal Ration

Ration Cost

Stochastic Feed Prices

Note: Green boxes are stochastic elements
Stochastic Price Model

- Collect historical data
  - Quarterly Prices (99Q1-12Q3) of Barley, Corn, Oats, Wheat, Alfalfa Hay, Canola Meal, Barley Silage, and Straw are collected from AARD and AFSC

- Adjust for inflation

- Test for stationarity

- Use Seemingly Unrelated Regression (SUR) for price forecasts
  - Each feed grain price equation is built as a function of lagged prices
    \[ P_t = a_0 + a_1 P_{t-1} + \cdots + a_n P_{t-n} + e_t \]

- Validation Tests
Least-cost ration (LCR) model:

- **Objectives:**
  - Minimize the total cost of the ration
  - Satisfy the nutrition constraints

- **Constraints:**
  - Nutrition requirements from National Research Council (NRC)
    - e.g., net energy, crude protein, fiber, moisture, dry matter intake, etc.
  - Feed grain constraints from expert opinion
    - e.g., alfalfa hay limit, wheat limit, etc.
Construct triangle distributions for all the nutrient contents in the baseline model

NRC (2001) used to calculate the most likely, maximum and minimum values for triangle distributions
How do we measure the effect of NIRS?

NIRS: lower quality feed grains are rejected

NIRS is modeled as a truncated triangle distribution of nutrient content.
Average Daily Feed Cost Savings per head for the Dairy Industry

Preliminary Results – Feed Cost Savings (Dairy)
Average Daily Feed Cost Savings per head for Backgrounding Cattle

Preliminary Results – Feed Cost Savings (Backgrounding Cattle)

- Average Daily Feed Cost Savings per head for Backgrounding Cattle
- ADG=0.80kg
- ADG=1.22kg

Truncation Level

- 5%
- 15%
- 25%
- 35%
- 50%
Average Daily Feed Cost Savings per head for Finishing Cattle

- Truncation Level:
  - 5%
  - 15%
  - 25%
  - 35%
  - 50%

- ADG:
  - ADG=1.53kg
  - ADG=1.91kg

- Average Daily Feed Cost Savings per head:
  - $0.000
  - $0.030
  - $0.060
  - $0.090
  - $0.120
  - $0.150
  - $0.180
  - $0.210
Net Present Value

• Present day value of the sum of the net benefits

\[ NPV = \sum_{t=0}^{n} \frac{NB_t}{(1 + i)^t} \]

• 8% private discount rate (PDR)
  • Adopted from Canadian Cost-Benefit Analysis Guide issued by Treasury Board of Canada (2007)
20-yr NPV per head for Alberta Dairy Industry at different truncation levels

Net Present Value Per Head (Dairy)
20-yr NPV per head for backgrounding cattle at different truncation levels

**Truncation Level**
- 5%
- 15%
- 25%
- 35%
- 50%

**ADG=0.80kg**
- 5%
- 20%
- 40%
- 60%
- 80%

**ADG=1.22kg**
- 100%
- 120%
- 140%
- 160%

Net Present Value Per Head (Backgrounding Cattle)
20-yr NPV per head for finishing cattle at different truncation levels

![Graph showing 20-yr NPV per head for finishing cattle at different truncation levels. ADG=1.53kg and ADG=1.91kg are represented by different colors.](image)

Net Present Value Per Head (Finishing Cattle)
20-year NPV for the Alberta dairy industry\(^a\)

<table>
<thead>
<tr>
<th>Mean NPV</th>
<th>Standard Deviation NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 59,121,815</td>
<td>$ 537,624</td>
</tr>
</tbody>
</table>

Note: \(^a\) 25% rejection level, 8% private discount rate
As of January 1\(^{st}\), 2013, there were 80,400 milking dairy cows in Alberta
20-year NPV for the Alberta backgrounding cattle farms\(^a\)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Mean NPV</th>
<th>Standard Deviation NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG=0.80 kg</td>
<td>$59,407,486</td>
<td>$4,419,629</td>
</tr>
<tr>
<td>ADG=1.22 kg</td>
<td>$87,489,690</td>
<td>$2,441,372</td>
</tr>
</tbody>
</table>

Note: a 25% rejection level, 8% private discount rate
As of January 1\(^{st}\), 2013, there were 1,116,400 backgrounding cattle in Alberta
### 20-year NPV for the Alberta finishing cattle feedlots

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Mean NPV</th>
<th>Standard Deviation NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG=1.53 kg</td>
<td>$51,220,334</td>
<td>$288,582</td>
</tr>
<tr>
<td>ADG=1.91 kg</td>
<td>$98,412,541</td>
<td>$6,628,116</td>
</tr>
</tbody>
</table>

Note: a 25% rejection level, 8% private discount rate
As of January 1\(^{st}\), 2013, there were 897,500 finishing cattle in Alberta
Marginal cost of NIRS test is $8.26 per sample

Commercial introduction of NIRS in Alberta is viable, especially for dairy industry

For beef cattle industry, the benefit of NIRS is more significant in the finishing cattle sector
Future Research

- for dairy/cattle sectors:
  - Extend the BCA analysis to a regional level for Western Canada
  - Incorporate government subsidy for NIRS commercial introduction

- for whole project:
  - Conduct BCA for swine and poultry industry
  - Measure the social welfare of NIRS feed evaluation programs
Thank You for Your Time

Questions?

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