Breeding Objectives

Lecture 17
Introduction to Breeding and Genetics
GENE 251/351
School of Environment and Rural Science (Genetics)
Breeding Objectives

2 components

- traits affecting profit
- economic values of traits
Breeding Objectives

- traits affecting profit
- economic values of traits

Objective = $a_1 BV_1 + a_2 BV_2 + \ldots + a_m BV_m$
Breeding Objectives

- traits affecting profit
- economic values of traits

Objective = $a_1 BV_1 + a_2 BV_2 + \ldots + a_m BV_m$
Breeding Objectives

- traits affecting profit
- economic values of traits

Objective = \( a_1 \cdot BV_1 + a_2 \cdot BV_2 + \ldots + a_m \cdot BV_m \)
Breeding Objectives

Multi-trait selection
  – how to implement?

• Need to combine:
  – the (relative) economic weights
  – genetic parameters
    (heritabilities, correlations)
Issues with MT selection

• We have to spread our selection efforts over several traits, each of them weighted economically.

• Selection for one trait gives also a correlated response for other traits.

• Can use optimal weight in multiple trait selection
  – Correlations can be favourable or unfavourable.
Where do we want to end up?

 Depends on what is possible (=ellipse)....
*genetic parameters*

...and on what is most profitable (= iso-economic line)
*Economic parameters*
How to select for multiple traits – in practice

Index = $a_1 EBV_1 + a_2 EBV_2 + \ldots + a_m EBV_m$

Note that EBVs have more variation if they are more accurate. Therefore, effectively less emphasis on low accurate EBVs.

Need to measure if you want response (unless favourably correlated).

Index selection is more efficient than single trait selection!
How do we derive economic values?

**Definition:**
- Economic value of a trait is the change in profit after changing the mean for that trait by one unit

- Use profit functions

Profit per ewe = FleeceWght * price/kg – cost per ewe

\[
= 4 \times 10 - 10 = $30
\]

Now increase FW by one unit:

\[
= 5 \times 10 - 10 = $40
\]

Hence the economic value of 1 kg increase in FW is $10

More challenging to account for change in Fibre Diameter!
Spreadsheets are good tools to work this out!

<table>
<thead>
<tr>
<th>Trait</th>
<th>Mean</th>
<th>Income per ewe</th>
<th>Economic Value after 1 unit increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaning Rate</td>
<td>1.2</td>
<td>33.5</td>
<td>15</td>
</tr>
<tr>
<td>Days to Slaughter</td>
<td>100</td>
<td>18.2</td>
<td>-0.3</td>
</tr>
<tr>
<td>Fleece Weight</td>
<td>3.5</td>
<td>21.5</td>
<td>3</td>
</tr>
</tbody>
</table>

**Constants**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale Weight</td>
<td>40</td>
</tr>
<tr>
<td>Weaning Weight</td>
<td>20</td>
</tr>
</tbody>
</table>

**Prices**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lamb Value per kg</td>
<td>$1.00</td>
</tr>
<tr>
<td>Lamb Cost per day</td>
<td>$0.25</td>
</tr>
<tr>
<td>Fleece Value per Kg</td>
<td>$3.00</td>
</tr>
<tr>
<td>Annual Cost per ewe</td>
<td>$10.00</td>
</tr>
</tbody>
</table>

**Calculation of Net income**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Income per ewe</td>
<td>$0.50</td>
</tr>
<tr>
<td>Income per lamb</td>
<td>$15.00</td>
</tr>
<tr>
<td>Net income per ewe</td>
<td>$18.50</td>
</tr>
</tbody>
</table>
Economic values do not guarantee a ‘desired’ response for a single trait!

\[ \text{Index} = 1 \times EBV_W - 0.5EBV_{FI} \]

\[ R_W = 6.93 \text{ kg} \]
\[ R_{FI} = 0.39 \text{ kg} \]

Weight

1 $/g

Feed Intake

-0.5 $/g

Negative economic weight

Yet, a positive response
Changing economic values can give a “desired” response for single traits!

\[
\text{Index} = 1. \ EBV_W - 10 \ EBV_{FI}
\]

\[
\begin{align*}
\text{Weight} & : 1 \ $/g \\
\text{Feed Intake} & : -10 \ $/g
\end{align*}
\]

Desired gains: change economic value until desired outcome

\[R_W = 4.29 \ \text{kg}\]
\[R_{FI} = -0.05 \ \text{kg}\]

A larger weight...... gives a negative response

\text{good idea?}
Selection index with ‘desired gains’

• Rather than
  – determine econ. values >>>> response
  – We desire a response >>>> economic values (implicit)

When useful?
Breeding objectives are subject to debate!

- Are selection indices always linear?
  - nonlinear profit function
  - optimal traits
  - threshold values for profit

- Are the same indices (= econ. wghts) valid for all?
  - what could be reasons for differences?
Breeding objectives are subject to debate!

- Who’s perspective for profit?
  
  - Breeder: selling bulls Producer: buying bulls
  
  - Maximize profit per head….more lambs/ewe is good
    .................or per ha..... more lambs/ewe only good if lambs are more profitable than ewes
  
  - Profit of who? producer; whole sector; consumer
Example reference point
(going for bigger is not necessarily better)

<table>
<thead>
<tr>
<th>Breed</th>
<th>Value of weight at slaughter</th>
<th>Value of food consumed</th>
<th>Profit per head</th>
<th>Dollar efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>$200</td>
<td>$100</td>
<td>$100</td>
<td>2:1</td>
</tr>
<tr>
<td>Large</td>
<td>$350</td>
<td>$200</td>
<td>$150</td>
<td>1.75:1</td>
</tr>
</tbody>
</table>
Traits in BREEDPLAN

**growth**
- birth weight
- weaning weight
  - direct and maternal
- yearling weight
- final weight
- mature cow weight

**carcase**
- carcase weight
- eye muscle area
- rib fat
- rump fat
- retail beef yield %
- % IMF

**reproduction**
- gestation length
- calving ease
  - direct and daughter
- scrotal size
- days to calving
Basis of $Indexes

Market-production system (context)

Value of trait improvements to the beef enterprise

commercial

BREEDPLAN EBVs

seedstock

$Index Jap B3

$Index Domestic

$Index Northern

Breeding objective
BreedObject on the web

The genetic selection aid for breeders, buyers, and sellers of beef seedstock.
BreedObject™ uses BREEDPLAN EBVs

Bull-buyers, Semen-buyers

Check the catalogues for upcoming stud sales, private sales, multivendor sales, semen listings.
See which cattle best suit your needs.

Angus 3 sales  (sire summary)
Brahman 5 sales  (sire summary)
Charolais 2 sales  (sire summary)
Hereford 1 sale, 1 semen sale  (sire summary)
Murray Grey 2 sales, 1 semen sale  (sire summary)
Poll Hereford 1 sale, 1 semen sale  (sire summary)
Simmental  (sire summary)

See past listings

Breeders, Semen distributors

Listing facility for sale cattle & semen

Latest News

Herefords now available
Choose one or more catalogue.

Bull Sales

- Bongongo Angus 2002 Bull Sale
- Raff Angus Bull Sale
- Lawsons Angus Female Production Sale

Next - See Results >>

Raff Angus Bull Sale

30-Sep-2002

Mundibulanga, Drillham, Qld.

raffbeef@bigpond.com
Choose EBV range
Download Data
View Sire Summary

Choose another index, or derive an index for your production purpose

300x22
300kg carcase by 22months; pasture finished

Brian
Jap Production, tough country

CAAB Index
CAAB: Pasture grown, 150d fed steers, 595kg at 18 months, for the 'Certified Australian Angus Beef' market (Role:'Self-Replacing', Env:'Temperate')

North.Terminal
TERMINAL NORTH: Pasture grown, 120d fed steers and heifers, steers 650kg at 21m, from joinings with adapted cows in northern Australia (Role:'Terminal Sire', Env:'Temperate or Sub-Tropical')

Supermarket
SUPERMARKET: Pasture grown & finished steers, 420kg at 17m, for Supermarket trade (Role:'Self-Replacing', Env:'Temperate')

<table>
<thead>
<tr>
<th>Lot</th>
<th>Details, Pedigree, Accuracies click on the animal name</th>
<th>Animal ID</th>
<th>300x22</th>
<th>Brian</th>
<th>CAAB Index</th>
<th>North.Terminal Index</th>
<th>Supermarket Index</th>
<th>Calving Ease</th>
<th>Birth</th>
<th>200 Day Wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>CAWDOR GARDINER W135 (APR)</td>
<td>QRCW135</td>
<td>+76</td>
<td>+118</td>
<td>+84</td>
<td>+54</td>
<td>+57</td>
<td>###</td>
<td>###</td>
<td>+4.2</td>
</tr>
<tr>
<td>28</td>
<td>CAWDOR GARDINER W91 (APR)</td>
<td>QRCW091</td>
<td>+73</td>
<td>+113</td>
<td>+80</td>
<td>+52</td>
<td>+57</td>
<td>###</td>
<td>###</td>
<td>+6.0</td>
</tr>
<tr>
<td>43</td>
<td>RAFF ULTIMATE W137 (APR)</td>
<td>QRFW137</td>
<td>+73</td>
<td>+111</td>
<td>+78</td>
<td>+49</td>
<td>+61</td>
<td>###</td>
<td>###</td>
<td>+6.9</td>
</tr>
<tr>
<td>3</td>
<td>BONGONGO W61 (A1)</td>
<td>NGXW61</td>
<td>+66</td>
<td>+108</td>
<td>+73</td>
<td>+67</td>
<td>+45</td>
<td>-0.9</td>
<td>-0.3</td>
<td>-1.7</td>
</tr>
<tr>
<td>10</td>
<td>RAFF GARDINER W41 (APR)</td>
<td>QRFW41</td>
<td>+72</td>
<td>+107</td>
<td>+77</td>
<td>+67</td>
<td>+57</td>
<td>###</td>
<td>###</td>
<td>+6.9</td>
</tr>
<tr>
<td>7</td>
<td>RAFF GARDINER W15 (APR)</td>
<td>QRFW15</td>
<td>+68</td>
<td>+106</td>
<td>+73</td>
<td>+65</td>
<td>+54</td>
<td>###</td>
<td>###</td>
<td>+6.6</td>
</tr>
</tbody>
</table>
Bull/Ram Breeders

Set breeding goal according to the needs of commercial clients

- Identify target clients, their markets and their production environments
- Align breeding objectives with clients’ needs
- According to which index
Bull/Ram Buyers

Focus on profitability of own production system

- A bull can do more than just produce offspring
- Breed more profitable calves
- Which index suits them best?
Wool price between 1974 and 2000

Prices from Wool International Market Report

Wool price (cents/kg clean)

Year

19 um
20 um
21 um
22 um
23 um
24 um
Optimal selection response can be sensitive to economic values

Fibre Diameter

Fleece Weight
Wool price determinants (2003-04) (% contribution to price)

<table>
<thead>
<tr>
<th></th>
<th>17 to 18.5 micron</th>
<th>18.6 to 24 micron</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibre diameter</td>
<td>25</td>
<td>49</td>
</tr>
<tr>
<td>Staple strength</td>
<td>38</td>
<td>15</td>
</tr>
<tr>
<td>% mid breaks</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Staple length</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Vegetable matter</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Colour</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Style</td>
<td>10</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: http://www.pricemaker.info
Effect of ignoring staple strength in the breeding objective

<table>
<thead>
<tr>
<th>Micron premium</th>
<th>Strength premium</th>
<th>CFW (Kg)</th>
<th>MFD (micron)</th>
<th>SS (N/Ktex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3%</td>
<td>-</td>
<td>0.3</td>
<td>-1.4</td>
<td>-7</td>
</tr>
<tr>
<td>15%</td>
<td>-</td>
<td>0.1</td>
<td>-3.6</td>
<td>-9</td>
</tr>
<tr>
<td>30%</td>
<td>-</td>
<td>0.0</td>
<td>-3.9</td>
<td>-8</td>
</tr>
</tbody>
</table>

(Results from CSIRO Fine Wool Project flock – responses after 10 years selection)
Including strength in the objective, CVFD as a selection criterion

<table>
<thead>
<tr>
<th>Micron premium</th>
<th>Strength premium</th>
<th>CFW (Kg)</th>
<th>MFD (micron)</th>
<th>SS (N/Ktex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3%</td>
<td>1%</td>
<td>0.3</td>
<td>-0.6</td>
<td>-1</td>
</tr>
<tr>
<td>15%</td>
<td>3%</td>
<td>0.0</td>
<td>-2.9</td>
<td>0</td>
</tr>
<tr>
<td>30%</td>
<td>5%</td>
<td>-0.1</td>
<td>-3.3</td>
<td>0</td>
</tr>
</tbody>
</table>

(Results from CSIRO Fine Wool Project flock – responses after 10 years selection)
Summary

Need to set breeding objectives by

- defining the traits
- and their economic value

Economic value is change in profit if individuals perform one unit more for that characteristic

Index are used for multiple trait selection

Sometimes the optimal response is sensitive to economic values (esp with unfavourable correlations)