

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

$$\text{Objective} = a_1 BV_1 + a_2 BV_2 + \dots + a_m BV_m$$

Breeding Objectives

- traits affecting profit
- economic values of traits

The diagram illustrates the components of a breeding objective. A box labeled "Breeding values" has three red arrows pointing to the BV_1 , BV_2 , and BV_m terms in the equation below.

$$\text{Objective} = a_1 BV_1 + a_2 BV_2 + \dots + a_m BV_m$$

Breeding Objectives

- traits affecting profit
- economic values of traits

$$\text{Objective} = a_1 BV_1 + a_2 BV_2 + \dots + a_m BV_m$$



Economic values

Breeding Objectives

Multi-trait selection

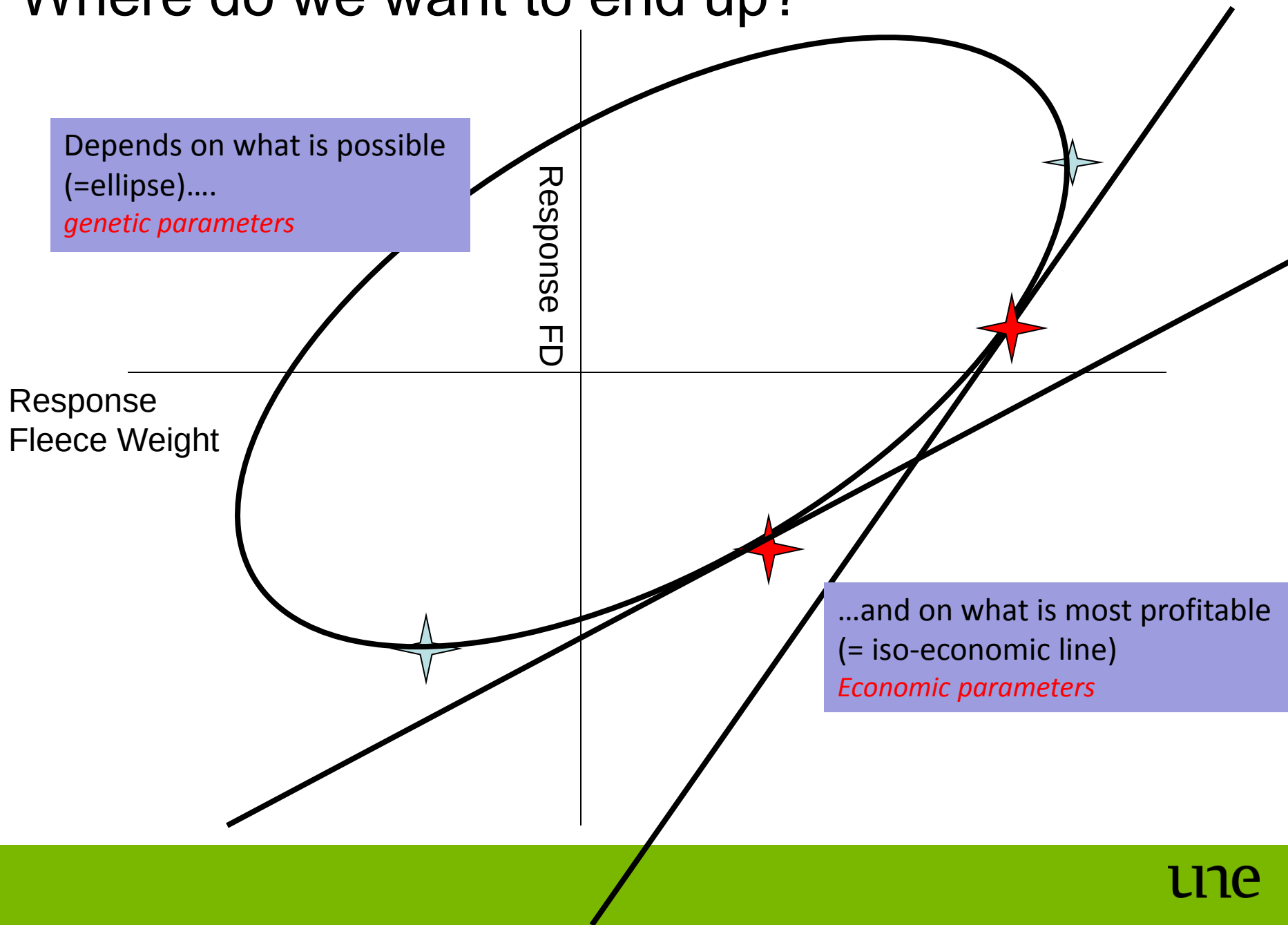
– how to implement?

- Need to combine:
 - the (relative) economic weights
 - genetic parameters
(heritabilities, correlations)

Issues with MT selection

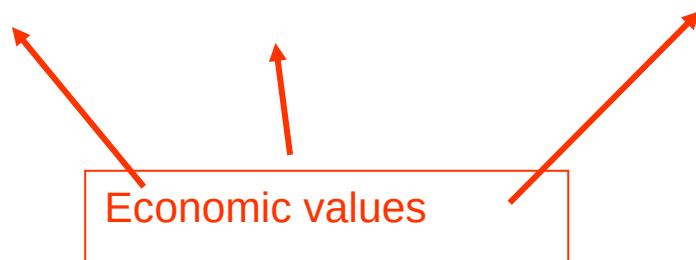
- We have to spread our selection efforts over several traits, each of them weighted economically
- Selection for one trait gives also a correlated response for other traits
- Can use optimal weight in multiple trait selection
 - *Correlations can be favourable or unfavourable*

Where do we want to end up?



How to select for multiple traits – in practice

$$\text{Index} = a_1 \text{EBV}_1 + a_2 \text{EBV}_2 + \dots + a_m \text{EBV}_m$$



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

$$= 4 * 10 - 10 = \$ 30$$

Now increase FW by one unit:

$$= 5 * 10 - 10 = \$ 40$$

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!

LECTURE 14 GENE422/522

Trait	Mean
-------	------

Weaning Rate	1.2
Days to Slaughter	100
Fleece Weight	3.5

Income per ewe after 1 unit increase	Economic Value
---	----------------

33.5	15
18.2	-0.3
21.5	3

Constants

Sale Weight	40
Weaning Weight	20

Prices

Lamb Value per kg	\$1.00
Lamb Cost per day	\$0.25
Fleece Value per Kg	\$3.00
Annual Cost per ewe	\$10.00

Calculation of Net income

Income per ewe	\$0.50
Income per lamb	\$15.00
Net income per ewe	\$18.50

Economic values do not guarantee a “desired” response for a single trait !

Weight	1 \$/g
Feed Intake	-0.5 \$/g

Economic Weights

$$\text{Index} = 1. \text{EBV}_W - 0.5\text{EBV}_{FI}$$

Negative economic weight

$$R_W = \mathbf{6.93 \text{ kg}}$$

$$R_{FI} = \mathbf{0.39 \text{ kg}}$$

Yet, a positive response

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

Weight	1 \$/g
Feed Intake	-10 \$/g

Economic Weights

Desired gains: change economic value until desired outcome

good idea?

$$\text{Index} = 1. \text{EBV}_W - 10 \text{EBV}_{FI}$$

↑
A larger weight.....

$$R_W = 4.29 \text{ kg}$$

$$R_{FI} = -0.05 \text{ kg}$$

↑
..gives a negative response

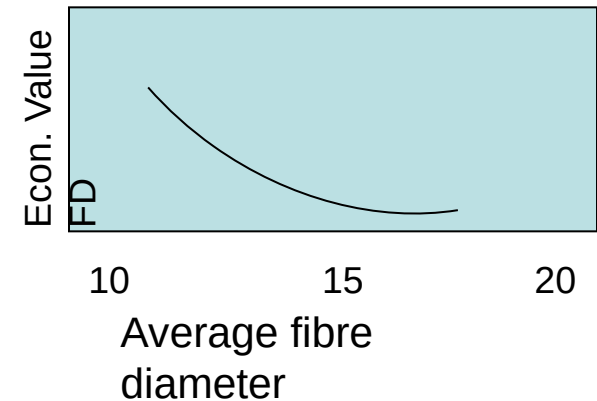
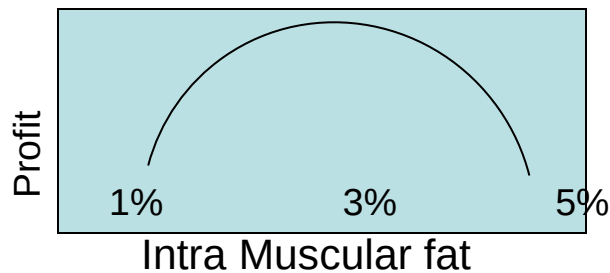
Selection index with 'desired gains'

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

When useful?

Breeding objectives are subject to debate!

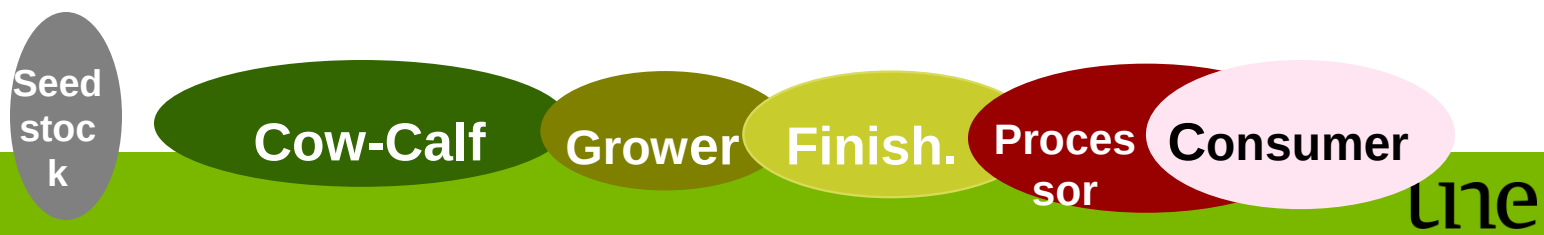
- Are selection indices always linear?
 - nonlinear profit function
 - optimal traits
 - threshold values for profit



- 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)

Breed	Value of weight at slaughter	Value of food consumed	Profit per head	Dollar efficiency
Small	\$200	\$100	\$100	2:1
Large	\$350	\$200	\$150	1.75:1

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)



commercial

Value of trait improvements to the beef enterprise

Breeding objective
←

seedstock

BREEDPLAN EBVs



\$Index

Jap B3

\$Index

Domestic

\$Index

Northern

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](#)

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Raff Angus Bull Sale

30-Sep-2002

Mundibulanga, Drillham, Qld.

raffbeef@bigpond.com

 Welcome to Liqu

BreedObject

sales catalogue

ongoo, Coolac

ibulanga, Drillham, Qld.

nbrae' Yea VIC

Suggestions? Comments? Send email to sbarwick@metz.une.edu.au

BREEDOBJECT.COM, Contact: Stephen Barwick Ph: +61 2 6773 3481, Wayne Upton Ph: +61 2 6773 3141
Fax: +61 2 6773 3266 Animal Genetics and Breeding Unit, University of New England, Armidale NSW, Australia

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

Lot	Details, Pedigree, Accuracies click on the animal name	Animal ID	Hide EBVs					Calving Ease		Birth		200 Day Wt.
			300x22	Brian	CAAB Index	North.Terminal Index	Supermarket Index	Calv. Ease Direct	Calv. Ease Dtrs	Gest. Len	Birth Wt.	
41	CAWDOR GARDINER W135 (APR)	QRCW135	+76	+118	+84	+54	+57	###	###	###	+4.2	+34
28	CAWDOR GARDINER W91 (APR)	QRCW091	+73	+113	+80	+52	+57	###	###	###	+6.0	+37
43	RAFF ULTIMATE W137 (APR)	QRFW137	+73	+111	+78	+49	+61	###	###	###	+6.9	+41
3	BONGONGO W61 (AI)	NGXW61	+66	+108	+73	+67	+45	-0.9	-0.3	-1.7	+3.7	+35
10	RAFF GARDINER W41 (APR)	QRFW41	+72	+107	+77	+67	+57	###	###	###	+6.9	+45
7	RAFF GARDINER W15 (APR)	QRFW15	+68	+106	+73	+65	+54	###	###	###	+6.6	+43

Bull/Ram Breeders

Set breeding goal according to the needs of commercial clients

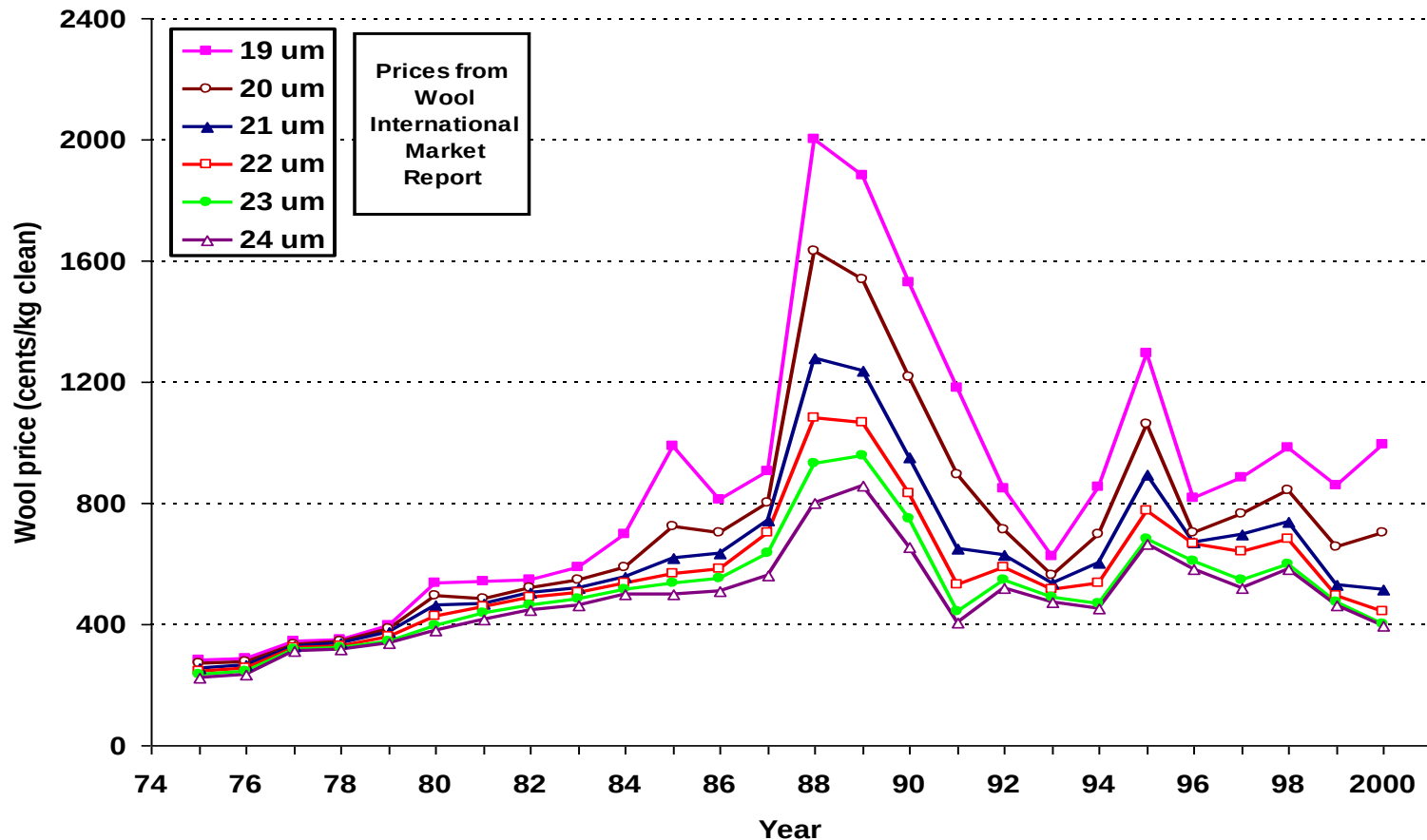
- Identify target clients, their markets and their production environments
- Align breeding objectives with clients' needs
- According to which index

Bull/Ram Buyers

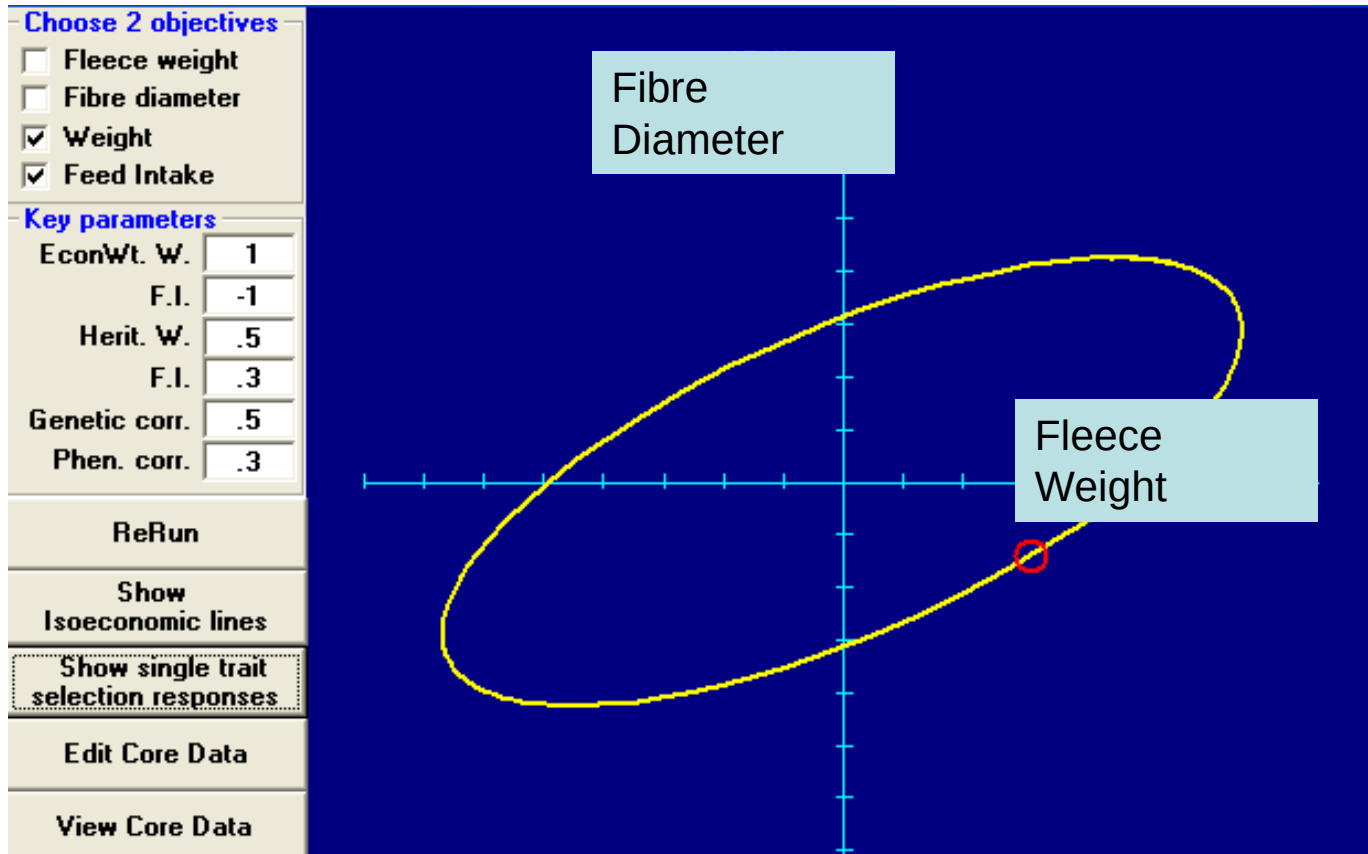
Focus on profitability of own production system

- A bull can do more than just produce offspring
- Breed more profitable calves
- Which index suits them best?

Wool price between 1974 and 2000



Optimal selection response can be sensitive to economic values



Wool price determinants (2003-04)

(% contribution to price)

	17 to 18.5 micron	18.6 to 24 micron
Fibre diameter	25	49
Staple strength	38	15
% mid breaks	6	3
Staple length	7	8
Vegetable matter	4	10
Colour	1	3
Style	10	1

Source: <http://www.pricemaker.info>

Effect of ignoring staple strength in the breeding objective

Micron premium	Strength premium	CFW (Kg)	MFD (micron)	SS (N/Ktex)
3%	-	0.3	-1.4	-7
15%	-	0.1	-3.6	-9
30%	-	0.0	-3.9	-8

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

Including strength in the objective, CVFD as a selection criterion

Micron premium	Strength premium	CFW (Kg)	MFD (micron)	SS (N/Ktex)
3%	1%	0.3	-0.6	-1
15%	3%	0.0	-2.9	0
30%	5%	-0.1	-3.3	0

(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)