AN APPRAISAL OF SELECTION OBJECTIVES AND CRITERIA FOR NEW ZEALAND ROMNEY SHEEP WITH PARTICULAR REFERENCE TO WOOL TRAITS

A THESIS PRESENTED IN PARTIAL FULFILMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF AGRICULTURAL SCIENCE

IN

ANIMAL SCIENCE

AT

MASSEY UNIVERSITY

ALLAN WAYNE MCPHERSON

1982

ABSTRACT

Selection objectives and criteria were defined and appraised for a simple production system involving a New Zealand Romney breeding flock under North Island hill country conditions, in which all surplus offspring are sold as lambs.

Through the availability of New Zealand Wool Board auction data for the seasons 1976/77 to 1980/81, the influence of wool quality traits on price was analysed by regression techniques. Traits examined included mean fibre diameter (MFD), style(S), mean length (ML) and yield (Y). For the 1980/81 season only, further data from the Coded Sales Assistance Report (C.S.A.R.) was available for scouring indicator (SI), colour indicator (CI), felted (F), pen stain (P), cotted (Co), tender (T), mixed length (LV) and mixed quality (QV). In addition, the effects on price of three non-fleece variables, lot weight (LW), mode of offering (MO) and New Zealand Wool Board market intervention policies (Int), were considered.

Y was shown to have a major influence over greasy price. The relationship between price and ML was confirmed as being non-linear, with ML having a greater effect on the price of shorter wools. S and MFD were less influential. The control these four traits jointly exerted over greasy price ranged up to 74.0%, which was further enhanced by the introduction of quadratic terms. ML^2 was the most important quadratic term. The inclusion of the C.S.A.R. and non-fleece related traits, failed to provide any further control over price. CI proved to be an effective substitute for S.

Selection objectives were defined for greasy and clean wool, combined with short, long and mixed length categories. Economic weights for wool quality traits were directly calculated from the regression of auction price on the level of the traits. Economic weights for number of lambs weaned (NLW), weaning weight (WW), ewe body weight (EBW),

greasy fleece weight (GFW) and clean fleece weight (CFW) were calculated using the marginal profit method. The relativities between the calculated economic weights were generally in good agreement with those of previously published estimates.

For the selection objectives defined, various selection criteria were appraised. These included the traits in the selection objective, or their respective criteria, as well as hogget body weight (HBW), quality number (QN) and fleece character grade (CHG). NLW (dam), HBW and HGFW were of major importance in the selection index. The remaining traits were of only minimal value. On the basis of cost of measurement and value within the index, the full index was converted to a reduced index of NLW (dam), HBW and HGFW. In terms of accuracy of prediction and economy, this index was considered suitable for most commercial conditions. Further reduced indices were computed which generated less overall genetic gain, but which individual breeders may consider more appropriate to their particular requirements.

Sensitivity analyses for HBW, NLW, GFW (CFW) and SC generally produced few changes of any consequence to the selection indices. Restriction of all genetic change in EBW significantly reduced the expected overall genetic gain.

DEDICATED TO THE MEMORY OF

IVAN DOUGLAS McPHERSON

(1912 - 1979)

ACKNOWLEDGEMENTS

It is with considerable pleasure that I now thank the many people who have provided assistance during the preparation of this thesis.

Sincere gratitude naturally belongs to my supervisor Dr. G.A. Wickham whose willingness to provide assistance whenever it was required was greatly appreciated.

I also wish to acknowledge the guidance received throughout my studies from Professor A.L. Rae.

Grateful acknowledgement is made to the New Zealand Wool Board for allowing the release of their auction data for the purposes of this thesis and the general assistance obtained from its staff.

Thanks are also due to Mr A.R. Gilmour (NSW Department of Agric.) for the availability of the REG computer package and his assistance during the period of computer familiarisation; Professor E.P. Cunningham (Agric. Inst., Dublin) and Dr. D.L. Johnson (Ruakura Anim. Res. Centre, Hamilton) for their respective versions of the SELIND computer package; the staff of the Massey University Computer Centre and the Massey University Library; colleagues and friends within the Sheep Husbandry Department.

Special thanks are extended to Mrs V. Fieldsend for her skillful typing of this thesis.

My wife, Jennifer, provided the necessary impetus when it was most required. Her support and encouragement were of vital significance in the completion of this thesis.

The financial assistance received from the New Zealand Wool Board Scholarship, the Leonard Condell Scholarship and the Kitchener Memorial Scholarship is gratefully acknowledged.

TABLE OF CONTENTS

Chapter		Page
	ABSTRACT	ii
	ACKNOWLEDGEMENTS	v
	LIST OF TABLES	ix
	LIST OF FIGURES	xvi
One	INTRODUCTION	1
Two	REVIEW OF LITERATURE	2
	2.1 Definition of selection objectives and criteria	2
	2.1.1 The goals of livestock production	2
	2.1.2 Methods of coping with multi-trait objectives	7
	2.1.3 Selection objectives vs. selection criteria	8
	2.1.4 Changing Romney objectives and criteria	11
	2.2 The estimation of the economic weights of wool traits	14
	2.2.1 Subjective assessment	14
	2.2.2 Genetic progress required	15
	2.2.3 Processing trials	16
	2.2.4 Marginal profit	33
	2.2.5 Regression of selling price on level of wool traits	34
	2.2.6 New Zealand Wool Board relatives	38
	2.2.7 Regression of profit on the selection objective	43
	2.2.8 Production systems analysis	44
	2.3 Published economic weights for the Romney	45
	2.4 General problems associated with the use of economic weights	47

Chapter		Page
	2.5 Effect of errors in economic weights on selection index efficiency	50
Three	THE INFLUENCE OF WOOL QUALITY TRAITS ON PRICE	53
	3.1 Introduction	53
	3.2 Materials and methods	54
	3.3 Results	57
	3.3.1 Greasy analyses	57
	3.3.2 Clean analyses	67
	3.3.3 Coded Sales Assistance Report analyses	76
	3.3.4 Short and long length analyses	82
	3.3.5 Scoured colour for style	90
	3.4 Discussion	90
Four	DEFINITION OF SELECTION OBJECTIVES	97
	4.1 Introduction	97
	4.2 Materials and methods	97
	4.3 Results	98
	4.3.1 Calculation of economic weights for wool quality traits	98
	4.3.2 Calculation of economic weights for other than wool quality traits	102
	4.3.3 Summary of selection objectives	105
	4.4 Discussion	106
Five	APPRAISAL OF SELECTION INDICES AND SENSITIVITY ANALYSES	110
	5.1 Introduction	110
	5.2 Materials and methods	110
	5.3 Results	111

Chapter			Page
	5.3.1	Full and reduced selection indices	111
	5.3.2	Further reduced selection indices	126
	5.3.3	EBW sensitivity analysis	139
	5.3.4	NLW, GFW (CFW) and SC sensitivity analysis	152
	5.3.5	Cotting and tenderness	166
	5.3.6	Sheeplan comparison	171
	5.4 Discussion		173
Six	GENERAL DISCUSSION		178
	APPENDICES		184
	REFERENCES		210

LIST OF TABLES

Table		Page
2.1	Published economic weights for the Romney expressed as ratios	46
3.1	General statistics of greasy analyses	58
3.2	Simple correlations with greasy price	57
3.3	Wool trait regression coefficients for greasy price	60
3.4	The effect of quadratic terms for Y, ML, S and MFD on explaining variation in greasy price for the 1976/77 season	61
3.5	The effect of quadratic terms for Y, ML, S and MFD on explaining variation in greasy price for the 1977/78 season	62
3.6	The effect of quadratic terms for Y, ML, S and MFD on explaining variation in greasy price for the 1978/79 season	63
3.7	The effect of quadratic terms for Y, ML, S and MFD on explaining variation in greasy price for the 1979/80 season	64
3.8	The effect of quadratic terms for Y, ML, S and MFD on explaining variation in greasy price for the 1980/81 season	65
3.9	The effect of quadratic terms for Y, ML, S and MFD on explaining variation in greasy price for all seasons	66

Table		Page
3.10	Additional statistics of clean analyses	67
3.11	Simple correlations with clean price	68
3.12	Wool trait regression coefficients for clean price	69
3.13	The effect of quadratic terms for Y, ML, S and MFD on explaining variation in clean price for the 1976/77 season	70
3.14	The effect of quadratic terms for Y, ML. S and MFD on explaining variation in clean price for the 1977/78 season	71
3.15	The effect of quadratic terms for Y, ML, S and MFD on explaining variation in clean price for the 1978/79 season	72
3.16	The effect of quadratic terms for Y, ML, S and MFD on explaining variation in clean price for the 1979/80 season	73
3.17	The effect of quadratic terms for Y, ML, S and MFD on explaining variation in clean price for the 1980/81 season	74
3.18	The effect of quadratic terms for Y, ML, S and MFD on explaining variation in clean price for all seasons	75
3.19	General statistics of Coded Sales Assistance Report analyses for the 1980/81 season	77
3.20	Simple correlations between price and the Coded Sales Assistance Report traits for the 1980/81 season	78

Table		Page
3.21	Partial regression coefficients on greasy price of the Coded Sales Assitance Report analyses for the 1980/81 season	79
3.22	Partial regression coefficients on clean price of the Coded Sales Assistance Report analyses for the 1980/81 season	80
3.23	Regression on S for short and long length categories for the 1980/81 season	81
3.24	General statistics of short and long length categories (all seasons)	85
3.25	Simple correlations with greasy price for short and long length categories (all seasons)	86
3.26	Simple correlations with clean price for short and long length categories (all seasons)	86
3.27	Wool trait regression coefficients for greasy price for short and long length categories (all seasons)	87
3.28	Wool trait regression coefficients for clean price for short and long length categories (all seasons)	88
3.29	Partial regression coefficients with SC substituted for S (all seasons)	89
4.1	Lifetime economic weights of wool quality traits	99

Table		Page
4.2	Lifetime economic weights of other than wool quality traits	103
4.3	Lifetime economic weights using government supplementary minimum prices	104
4.4	Comparison of economic weights before and after government supplementary minimum prices taken into consideration	104
4.5	Summary of selection objectives	105
4.6	Comparison of economic weight estimates	108
5.1	Full and reduced selection indices for the greasy short objective	112
5.2	Full and reduced selection indices for the greasy long objective	114
5.3	Full and reduced selection indices for the greasy objective	116
5.4	Full and reduced selection indices for the clean short objective	118
5.5	Full and reduced selection indices for the clean long objective	120
5.6	Full and reduced selection indices for the clean objective	122
5.7	Further reduced selection indices for the greasy short objective	127

Table		Page
5.8	Further reduced selection indices for the greasy long objective	129
5.9	Further reduced selection indices for the greasy objective	131
5.10	Further reduced selection indices for the clean short objective	133
5.11	Further reduced selection indices for the clean long objective	135
5.12	Further reduced selection indices for the clean objective	137
5.13	EBW sensitivity analysis for the greasy short objective full index	140
5.14	EBW sensitivity analysis for the greasy long objective full index	141
5.15	EBW sensitivity analysis for the greasy objective full index	142
5.16	EBW sensitivity analysis for the clean short objective full index	143
5.17	EBW sensitivity analysis for the clean long objective full index	144
5.18	EBW sensitivity analysis for the clean objective full index	145
5.19	EBW sensitivity analysis for the greasy short objective reduced index	146

Table		Page
5.20	EBW sensitivity analysis for the greasy long objective reduced index	147
5.21	EBW sensitivity analysis for the greasy objective reduced index	148
5.22	EBW sensitivity analysis for the clean short objective reduced index	149
5.23	EBW sensitivity analysis for the clean long objective reduced index	150
5.24	EBW sensitivity analysis for the clean objective reduced index	151
5.25	NLW, GFW and SC sensitivity analysis for the greasy short objective full index	153
5.26	NLW, GFW and SC sensitivity analysis for the greasy long objective full index	154
5.27	NLW, GFW and SC sensitivity analysis for the greasy objective full index	155
5.28	NLW, CFW and SC sensitivity analysis for the clean short objective full index	156
5.29	NLW, CFW and SC sensitivity analysis for the clean long objective full index	157
5.30	NLW, CFW and SC sensitivity analysis for the clean objective full index	158
5.31	NLW and GFW sensitivity analysis for the greasy short objective reduced index	160

Table		Page
5.32	NLW and GFW sensitivity analysis for the greasy long objective reduced index	161
5.33	NLW and GFW sensitivity analysis for the greasy objective reduced index	162
5.34	NLW and CFW sensitivity analysis for the clean short objective reduced index	163
5.35	NLW and CFW sensitivity analysis for the clean long objective reduced index	164
5.36	NLW and CFW sensitivity analysis for the clean objective reduced index	165
5.37	The effects on the full index of the inclusion of Co and T in the greasy long objective	167
5.38	The effects on the full index of the inclusion of Co and T in the clean long objective	168
5.39	The effects on the reduced index of the inclusion of Co and T in the greasy long objective	169
5.40	The effects on the reduced index of the inclusion of Co and T in the clean long objective	170
5.41	Sheeplan comparison	172

LIST OF FIGURES

Figure		Page
2.1	Mean fibre diameter vs. price. 1978/79	39
2.2	Mean length vs. price. 1978/79	41
2.3	Style vs. price. 1978/79	42
3.1	The relationship between greasy price and ML	83
3.2	The relationship between clean price and ML	84
4.1	The relationship between greasy price and Co	101