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Relative economic values of wool processing parameters

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ABSTRACT

The wool described by the New Zealand Wool Board's auction data may be considered to be a vector space defined by axes which are the wool processing parameters. Analysis of this wool vector space gives indications of the relative economic values of the wool properties.

Data from 1984 to 1990 has been analysed to give relative economic values and, although short term values vary considerably, there appear to be some longer term trends. Wool bulk as predicted from NZWB type shows a general increase in premium, and wool colour, described by objectively measured yellowness and brightness, has shown increased importance for determining wool price, with brightness taking over from yellowness as the more important of the two.

The correlation between parameters in the range of wools offered at New Zealand auctions not only makes it difficult to determine the relative economic importance of the wool properties but limits the range of blend specifications a wool processor can work with. Hence, although premiums are not always obvious, it is important to the processor that extremes of wool properties are available to allow the maximum flexibility when making up parcels of wool for processing.

Keywords Wool, supply, auctions, properties, prices, relative economic values, vector space, farm management, breeding, processing.

INTRODUCTION

The wool properties or processing parameters (Table 1) important for the production of products made from New Zealand wool, have only relatively recently been identified by research scientists (Carnaby *et al.*, 1985) and thus it has only recently been possible to determine their relative economic values (REVs) for farm management and breeding purposes. Suitable laboratory test methods for objectively measuring most of these parameters are now available, but while the measurement of diameter is generally known some or all of the other parameters are unfamilar to many involved with wool.

If the wool parameters are considered to be co-ordinates then they describe position vectors which locate wool parcels in a vector space (Carnaby *et al.*, 1988). Since wool processors would like to manipulate all ten processing parameters separately, the vector space is fully ten-dimensional. For the New Zealand wool clip some parameters are related, thus this supply of wool is not fully ten-dimensional (Maddever, 1989). Over 100,000 lots of wool are sold at auction every year in New Zealand and each one is potentially a separate point in the vector space. However considerable simplification of the data can be achieved by clustering wool types with similar properties. Each cluster has been termed an INVERT wool type (Carnaby *et al.*, 1988). This INVERT type structure can be thought of as representing the view a wool processor would have of the supply of wool. This aggregation of auction lots brought about by the clustering helps to smooth price variability created by factors other than the variation in wool processing parameters.

Overall movement in wool prices is continuously described by a market indicator, MI (Wiggins and Beggs, 1980). This is a weighted average price calculated as if the full season's clip were to be sold all at the one time. The market indicator and the measured yield can be used to determine a relative clean price for different lots of wool, thus eliminating the overall average market trends. Wool prices are highly variable between lots and sales, but with the aggregation of wool types that are similar as previously described, the relative clean prices averaged over several lots are more stable.

Two studies of the NZWB auction data (Stanley-Boden, 1985; Maddever, 1989) have analysed the relative clean price received for wool. Multiple linear regression was used to predict relative clean price from the ten wool parameters of Table 1. Both these studies give regression coefficients for each of the wool parameters which when multiplied by the market indicator give REV's. However clean price relativities may be changing with time and this paper endeavours to address that by examining the six seasons of NZWB's auction data from 1984/85 to 1989/90.

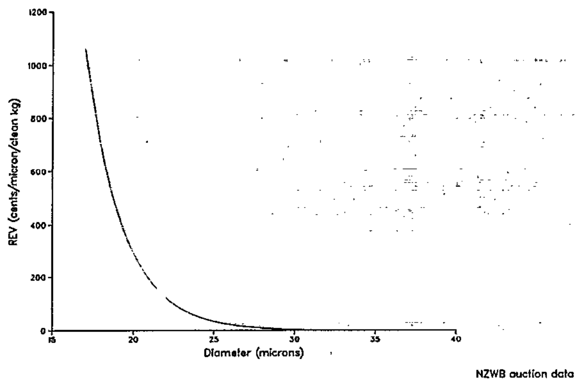

FIG 1 Average relative economic value of diameter based on an average price of 450 cents/clean kg.

REGRESSION ANALYSIS

The method of analysis used is based on that of the earlier work (Maddever, 1989) although many of the routines were simplified. First every auction lot is assigned an INVERT type code, determined from the parameters, measured pre-sale or predicted by the computer routines (Carnaby *et al.*, 1985). The identical INVERT types are aggregated to form the points in the vector space. Then the average diameter value for each point is transformed to create a new parameter which has a better linear correlation with relative price. Finally weighted multiple linear regression (the GENSTAT statistical package was used) predicts the relative price from the wool processing properties. The results of this analysis are similar to the earlier work except that the number of INVERT types in each season has nearly doubled. This increase in separate wool processing types can be attributed to the fact that the prediction of length has been significantly altered by extensive testing at WRONZ (Ford *et al.*, 1990). In earlier work (Maddever, 1989) the 'fitcurve' directive of GENSTAT was used to determine the form of the diameter transformation. From a processing point of view it is the square of the diameter that is important in determining the limiting count of yarn that can be made. However an exponential transformation was found to be the optimum in maximising the price variation explained and this was not altered by the introduction of other parameters (some of which are correlated with diameter). Also the form of the most suitable transformation alters little from one season to the next.

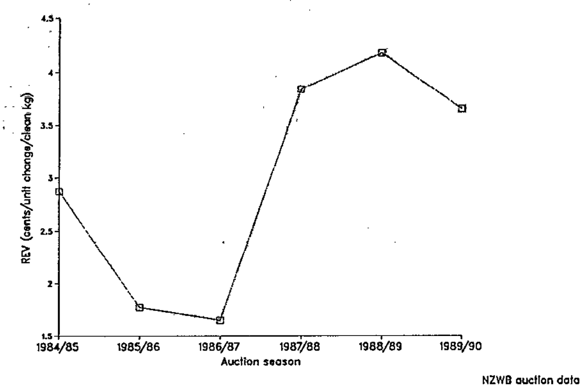

FIG 2 Relative economic value of the transformed diameter based on an average price of 450 cents/clean kg.

The exponential transformation for the diameter parameter was:

$$\text{transformed diameter} = 10^6 * 0.65^{\text{diameter}}$$

where the scale factor 10^6 is used to give it more manageable values and the diameter used is the measured or predicted value of the mean fibre diameter. About 60% of the variation in clean wool price can be explained by a weighted multiple linear regression on the ten wool processing parameters but by transforming the diameter parameter the variation in clean wool price explained is increased to about 90%. It was also found in the earlier work (Maddever, 1989) that none of the other parameters could have a significantly improved correlation with price using any of the transformations available in GENSTAT.

The regression coefficients for the six seasons

TABLE 1 Average REVs of wool parameters important in processing based on an average price of 450 cents/clean kg.

Parameter	Units	Test method	cents/unit change/clean kg
Yellowness	tristimulus Y-Z	NZS 8707:1984	-6.5
Diameter	micron	IWTO-6-86(E)	3.0#
Vegetable matter	% by mass	IWTO-19-85	-24.3
Medullated fibre	% by number	IWTO-12-64(E)	-0.7
Mean carded length	mm (barbe)	NZS DZ_8719*	0.3
Bulk	cm^3/g	NZS DZ_8716*	6.4
Brightness	tristimulus Y	NZS 8707:1984	4.3
Kemp fibre	% by number	IWTO-12-64(E)	-0.8
Short fibre	% <40mm barbe	NZS DZ_8719*	-2.2
Black fibre	(% by mass)	subjective	-0.8

* test methods were developed at WRONZ and are currently draft NZ standards
# this is the premium per unit change of the transformed variable.

are listed in Table 2 and to calculate the REV's for the wool processing parameters for all but diameter these coefficients must be multiplied by the present market indicator. If the current market indicator is assumed to be 450 cents/clean kg then the average REV's are listed in Table 1. A negative REV for a parameter indicates that a reduction of the numerical value of that parameter will increase the value of the wool.

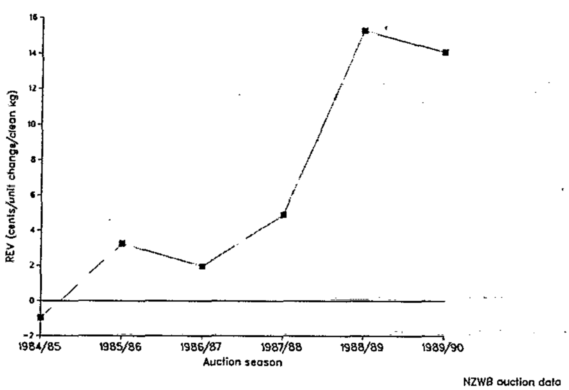

FIG 3 Relative economic value of the bulk parameter based on an average price of 450 cents/clean kg.

The transformed diameter parameter has an average 3.0 cents/unit change/clean kg which must be transformed to get a REV for diameter. At 34 and 35 micron the transformed diameter parameter has values of 0.44 and 0.28 respectively. The difference of 0.16 represents the change in the transformed diameter when going from 35 to 34 micron and this value when multiplied by the 3.0 cents/unit change/clean kg of the transformed diameter gives a REV for diameter of 0.48cents/unit change/clean kg in this region. If a similar calculation is done at 20 micron the REV for diameter is 293 cents/unit change/clean kg. The REVs for different diameters are plotted in Fig. 1. Fig. 2 shows the change in the level of the transformed diameter parameter and indicates that the diameter premium is up a little in the last 3 years. On the other hand there appear to be some more definite trends in the bulk and colour parameters (Figs. 3 and 4). In the two most recent seasons there has been a considerable increase in the REV for bulk. The REV for yellowness was high in 1984/85 possibly due to the introduction of displaying colour measurements on auction sample test certificates but since then it has been rather varied, while the REV for brightness has shown a steady increase over the period of study.

TABLE 2 Weighted multiple linear regression coefficients for predicting relative clean price of New Zealand auction wool.

Season	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	average
Constant	0.89	0.45	0.31	0.054	-0.24	-0.48	0.16
Yellowness	-0.036	-0.016	-0.010	-0.0052	-0.011	-0.0086	-0.014
Trans. diam	0.0064	0.0039	0.0037	0.0085	0.0093	0.0081	0.0067
Vege.matter	-0.041	-0.052	-0.038	-0.044	-0.058	-0.092	-0.054
Medulla	0.0071	-0.0043	-0.00060	-0.0019	-0.0057	-0.0037	-0.0015
Barbe	0.000028	0.00077	0.0012	0.0012	0.00019	0.00067	0.00067
Bulk	-0.0022	0.0072	0.0044	0.011	0.034	0.031	0.014
Brightness	0.0057	0.0079	0.0093	0.011	0.0099	0.013	0.0095
Kemp fibre	-0.0083	0.00021	-0.0034	-0.00093	-0.00070	0.0030	-0.0017
Short fibre	-0.0039	-0.0041	-0.0021	-0.0037	-0.0079	-0.0081	-0.0050
Black fibre	0.0035	-0.0013	-0.0010	-0.0020	-0.0060	-0.0042	-0.0018
Degrees of freedom	9725	13601	15519	16272	16643	14285	
R^2 value	82.2	87.1	89.4	94.0	91.4	91.6	

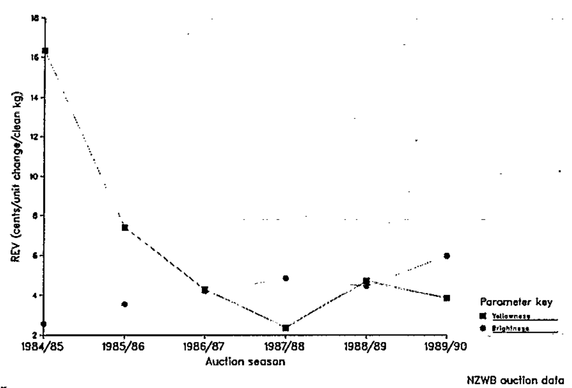

FIG 4 Relative economic value of the colour parameters based on an average price of 450 cents/clean kg.

RELATIVE RANKING OF PARAMETERS

Comparing REVs does not give a clear understanding of the economic importance of the fibre parameters. Stanley-Boden (1985) ranked parameters for economic importance according to a 10% change in the variable range but this is not realistic in terms of farming practice. What could be achieved in terms of a shift in properties by altering breeding or management procedures is important. Within breed parameter correlations adds further complications but the ranking of parameters in terms of economic importance is dependent on conditions such as breeds used for ewes and rams, type of farm and scope of farm management practices. In fine wool clips the high value of the REV for diameter makes the economics of diameter changes far more important than any other parameter changes. On the other hand in coarser wool clips where the REV for diameter is very low the recent high premiums for bulk may give that parameter more economic importance than any other in terms of an achievable shift.

DISCUSSION

The results presented in this paper are based on regression analysis of full sets of auction records throughout New Zealand and for a whole season and thus can be used as broad guidelines. For more specific data the reader is refered to the NZWB fortnightly market review or even the more specific sale data itself: after all the best short term predictor of future wool prices is the price of wool today (Mahandru and Leaf, 1977).

The use of the computer routines to predict objective measurements for wool types earlier than 1984 would be suspect, since the NZWB classing system has evolved and improved considerably over this period. Consequently this analysis was restricted to the six seasons since that time. While the first five seasons showed healthy positive markets there was a downturn in the wool market during the 1989/90 season caused by reduced demand from China, a depressed Australian wool market and a general easing of economic activity in the major world economies. The effect of this downturn on relative clean price paid for wool is believed by many in the trade to have little effect on the premiums paid for quality. This is confirmed by this study.

CONCLUSIONS

This paper provides some indications of the REVs for the wool parameters important in processing. The study shows that the auction system has however generally provided relatively stable and consistent premiums for quality. When the auction data is smoothed and analysed using an appropriate mathematical framework, these signals for the price relativity for the different wool characteristics are clear and unconfused by centre, time of year, shipping demands or the overall total demand situation. They are sufficiently stable to be useful as the basis for wool breeding decisions which impact over a five-year time scale or longer. It shows that the REVs of bulk and brightness have been slowly increasing, while those of the other parameters have fluctuated slightly. However it seems reasonable to assume, providing there is a demand for wool fibre, that premiums will be paid for excellence in the parameters that are important for processing and product performance.

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