Factors influencing the price of greasy fleece wool in South Africa

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A sample of the 1984/85 wool clip was analysed to determine the physical properties affecting price. Clean yield percentage and fibre diameter were found to be by far the most important. The importance of the other properties varied between ports. The effect of staple length on price was found to be almost negligible. Breed had a small but highly significant influence on auction price. Quality and crimp frequency are apparently no longer important. The effects of various factors on price are in broad agreement with their effects on wool-processing performance.

'n Monster van die 1984/85 wolskeersel is ontleed om vas te stel watter fisiese eienskappe die prys van wol bepaal. Daar is bevind dat skoonopbrengspersentasie en veseldikte by verre die belangrikste is. Die belangrikheid van die ander eienskappe het gevarieer tussen hawens. Die effek van stapellengte op prys is byna onbeduidend. Ras het 'n klein maar hoogs betekenisvolle invloed op veilingsprys gehad. Kwaliteit en kartelfrekwensie is skynbaar nie meer belangrik nie. Die invloed van verskeie faktore op prys is in breë ooreenstemming met hul invloed op wolverwerking.

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Introduction

The South African wool marketing system was revolutionized in the early 1970s with the introduction of sale-by-sample, pre-sale objective measurement and the pool system which features the payment of an advance price before the wool is auctioned and a final payment based on the earnings of the specific pool. The aim of this study was to ascertain which properties are important in determining both the advance and auction price in this very modern and sophisticated marketing set-up. Numerous studies have been made to determine the relative contribution of different physical properties to price, especially in Australia (Dunlop & Young, 1960; Skinner, 1962; Whan & Richardson, 1969; Mc Kinnon, 1971; Pattinson, 1981). For the South African situation, similar work was done by Retief (1970). All the results obtained in these studies, with the exception of Pattinson (1981), have become outdated and largely irrelevant as they were carried out before the advent of pre-sale objective measurement and sale-by-sample. Pattinson (1981) found fibre diameter to be of overwhelming importance in determining price of clean wool. Several trials have also been conducted to determine which physical properties are important in wool processing. In a comprehensive survey, Hunter (1980) came to the conclusion that fibre diameter and, to a lesser extent, staple length are by far the most important.

Hunter, Turpie & Gee (1984) have also investigated the effect of breed on processing performance and found that breed differences could be explained by other physical properties.

Knowledge about the relative importance of the different physical properties on price (short term) and on processing performance (long term) is essential in formulating breeding aims, planning management strategies, wool classing and in production research.

Procedures

A total of 1 017 grab samples, representing 8 078 bales of fleece wool, were drawn at the four ports, *viz.* Port Elizabeth, East London, Durban and Cape Town, during the 1984/85 wool marketing season. All types of fleece wool received at a specific port were included.

Each of the samples was subjectively scored by the brokers' appraisers for the following traits and divided into classes as follows :

Style

1.Spinners	5. Floating kemp
2. Good topmaking	6. Carbonizing *aristida* spp. ('steekgras')
3. Average topmaking	7. Carbonizing black jack
4. Inferior topmaking	8. Carbonizing burr

Quality (defined according to NWGA classing standards)

1. Poor; 2. Average; 3. Good; 4. Very good

Tensile strength

1. Tender; 2. Slightly tender; 3. Sound

Appearance

1. Poor; 2. Average; 3. Good

Standard of classing

1. Poor; 2. Average; 3. Good; 4. Very good

Thirty staples were drawn at random from each sample to determine mean staple length (mm) and mean crimp frequency (number of crimps per 25 mm) as well as the coefficients of variation (CV%) of staple length and crimp frequency. The calculated coefficients of variation of staple length and crimp frequency were then used as additional variables as uniformity in these traits is generally regarded as being desirable. The clean yield percentage, fibre diameter and vegetable matter content of the core sample of the lot from which the grab sample was taken were noted, as well as the advance and auction price of the lot. In a preliminary analysis (Erasmus & Delport 1976 — unpublished), a highly significant similarity ($P \leq 0{,}01$) was found between fibre diameter of the grab sample and that of the core sample, while the clean yield percentage of the grab sample was significantly higher ($P \leq 0{,}05$) than that of the core sample, attributable to the fact that the grab sample had shed much of its impurities after much handling by buyers and appraisers. It was, therefore, decided to use the measurements on the core samples for analysis because the core sample represents the average of the complete lot and must be regarded as correct.

Each sample was traced back to the farm on which it was produced to determine the breed of sheep from which it was derived and numbered as follows: 1. Merino; 2. Plain bodied Merino ('Geelbek'); 3. Dohne Merino; 4. Fine wool Merino strain; 5. SA Mutton Merino.

The data set, therefore, included two dependent variables (for which two independent analyses were done), five subjectively evaluated variables, seven objectively measured variables (see Table 1) and 'breed' which was included as a 'dummy' variable with the largest breed, Merino = 0. A stepwise-regression on principal components was carried out to select the independent variables to be included in the multiple regression.

Plotting the residuals against the expected Y values yielded a pattern indicating not only the possibility of inconsistent variances of the error terms in the model, but also the possibility of non-linearity of one or more of the independent variables. These deficiencies in the original model indicated the desirability of transformation of the dependent variable and also possibly one or more of the independent variables. Using the procedure suggested by Box & Cox (1964), a suitable transformation of Y was found, being Y^{-1}. Fibre diameter was transformed in the same way as the pattern obtained by plotting the residuals against fibre diameter suggested that the variances of the residuals decreased with increasing fibre diameter. This unfortunately only inverted the pattern when tested on a sample set of data and was therefore most probably not warranted. Variables with relatively low or high values were scaled up or down to eliminate large order differences.

All auction prices were adjusted for overall market trends through multiplication by the market indicator, as calculated by the SA Wool Board, of the specific catalogue.

A separate analysis was done on the data for each port and then pooled over ports with port as a 'dummy' variable taking Port Elizabeth as 0, Cape Town as 1, East London as 2 and Durban as 3.

Results

The means, standard deviations and coefficients of variation of the different variables are given in Table 1.

The rather large correlation matrix is not very helpful in explaining the results and is therefore not given in full. The partial correlation coefficients between style and the other independent variables (untransformed) are however reasonably enlightening and are supplied in Table 2, together with the partial correlation coefficients of each independent variable with advance and auction price.

The multiple regression equations eventually fitted for the data of each port and for both advance price and auction price as well as their multiple R^2 values are given in Table 3. For a variable to be included, a significance level of 5% ($P \leq 0{,}05$) was considered acceptable, but it

Table 1 Means, standard deviations (*SD*) and coefficients of variation (*CV*) of the dependent and independent variables (untransformed)

Variable	Mean	*SD*	*CV* (%)
Advance price (c/kg)	341,26	43,33	12,70
Auction price (c/kg)	540,27	118,31	21,90
Clean yield (%)	64,23	5,31	8,26
Fibre diameter (μm)	22,21	1,45	6,54
Style (score)	2,43	0,86	35,27
Veg. matter cont. (score)	0,46	0,37	79,02
Quality (score)	3,21	0,76	24,50
Tensile strength (score)	1,09	0,29	26,63
Appearance (score)	2,60	0,57	21,89
Standard of classing (score)	3,25	0,54	16,69
Staple length (mm)	83,16	10,97	13,19
CV Staple length (%)	9,99	3,21	32,12
Crimp frequency (n/25mm)	9,67	2,40	24,83
CV Crimp frequency (%)	13,13	4,32	32,93

Table 2 Partial correlation coefficients between independent variables and style, advance price and auction price

Variable	Partial correlation		
	Style	Advance price	Auction price
Clean yield (%)	-0,59[a]	0,70[a]	0,37[a]
Fibre diameter (μm)	-0,21[a]	-0,43[a]	-0,64[a]
Veg. matter cont. (%)	0,38[a]	-0,20[a]	-0,06[c]
Quality (score)	-0,44[a]	0,31[a]	0,16[a]
Tensile strength (score)	0,49[a]	-0,39[a]	-0,21[a]
Appearance (score)	-0,74[a]	0,51[a]	0,24[a]
Standard of classing (score)	-0,31[a]	0,34[a]	0,21[a]
Staple length (mm)	-0,24[a]	0,13[a]	-0,01[c]
CV Staple length (%)	0,15	-0,13[a]	-0,08[b]
Crimp frequency (no/25mm)	0,27[a]	-0,14[a]	0,02[c]
CV Crimp frequency (%)	0,11[a]	-0,13[a]	-0,09[b]
Style (score)	1	-0,53[a]	-0,27[a]

[a] $P \leq 0{,}01$; [b] $P \leq 0{,}05$; [c] non-significant

Table 3 Multiple regression equations fitted to predict advance price (Y_1) and auction price (Y_2)

Equation													n	R^2
Port Elizabeth														
Y_1 = 10,4802	$-05,5294X_1$	$-0,8357X_2$	$+0,1521X_3$	$-0,2366X_4$					$+0,0633X_9$	$+0,0673X_{10}$			n = 362	R^2=0,8295
Y_2 = 8,3533	$-0,3932X_1$	$-0,8504X_2$	$+0,0788X_3$	$-0,0906X_4$									n=335	R^2=0,8907
East London														
Y_1 = 10,7270	$-0,5772X_1$	$-0,8477X_2$			$+0,2948X_5$	$-0,0642X_6$					$+0,1378X_{11}$		n=185	R^2=0,9163
Y_2 = 9,0230	$-0,4087X_1$	$-1,0234X_2$			$+0,1345X_5$						$+0,1002X_{11}$		n=162	R^2=0,9257
Durban														
Y_1 = 9,0712	$-0,5210X_1$	$-0,7006X_2$	$+0,1160X_3$		$+0,0849X_5$						$+0,2272X_{11}$		n=336	R^2=0,9072
Y_2 = 9,3976	$-0,4166X_1$	$-1,0432X_2$			$+0,0866X_5$	$-0,0019X_6$					$+0,0855X_{11}$		n=262	R^2=0,8827
Cape Town														
Y_1 = 10,3457	$-0,3434X_1$	$-0,9970X_2$	$+0,0857X_3$				$-0,3009X_7$	$-0,0115X_8$			$+0,2503X_{11}$		n=134	R^2=0,7745
Y_2 = 6,5860	$-0,1852X_1$	$-0,6829X_2$					$-0,1647X_7$				$+0,1703X_{11}$		n=102	R^2=0,8272
Pooled over ports														
Y_1 = 10,1951	$-0,5400X_1$	$-0,8346X_2$	$+0,1222X_3$			$-0,0328X_6$					$+0,2069X_{11}$		n=1017	R^2=0,8543
Y_2 = 8,4978	$-0,3884X_1$	$-0,9438X_2$	$+0,0461X_3$		$+0,0573X_5$				$+0,0715X_9$	$+0,0459X_{10}$	$+0,1133X_{11}$	$-0,0667X_{12}$	n=861	R^2=0,8769

Some lots were not sold hence the discrepancy between n for Y_1 and Y_2

Y_1 and Y_2, X_1 — X_{12} as in text

turned out that all the variables eventually entered in each case were highly significant ($P \leq 0,01$). The two dependent variables and a total of 12 independent variables (of which four are class divisions of 'dummy' variables) qualifying for inclusion in one or more specific cases are denoted as follows:

Y_1 = (1/Advance price) 1 000
Y_2 = (1/Auction price) 1000
X_1 = Clean yield percentage/10
X_2 = (1/Fibre diameter) 100
X_3 = Style
X_4 = Standard of classing
X_5 = Tensile strength
X_6 = Staple length
X_7 = Appearance
X_8 = Vegetable matter content
X_9 = Plain-bodied Merino (breed)
X_{10} = Dohne Merino (breed)
X_{11} = SA Mutton Merino (breed)
X_{12} = Cape Town (port)

Variables and divisions not qualifying for inclusion are not listed.

The relative importance of the different physical properties and categorized divisions in determining either advance or auction price was of paramount importance in this study. The transformations used make direct interpretations rather awkward. The regression equations were, therefore, used to calculate what the effect of one standard deviation improvement from the mean in respect of each of the relevant properties would be on price (advance and auction) as an indication of their relative economic importance. In the case of the 'dummy' variables, the effect of each significant categorized change was calculated. The results are presented in Tables 4 and 5.

Discussion

From these results it is clear that fibre diameter and clean yield percentage are by far the most important physical properties determining the price of wool. In fact, the role of clean yield percentage is so obvious that it could be argued that, strictly speaking, it should not be included as a variable, but that instead price should be determined on a clean wool basis. This was not done simply because wool is sold on a greasy basis.

The emphasis placed on fibre diameter in determining price is in accordance with its relative importance in processing trials as, for instance, reported by Hunter (1980). An interesting result is the almost negligible effect of staple length. This could possibly be due to the relatively high values in the range covered.

There is no doubt that, although small, some of the subjectively assessed properties, of which the much-embracing 'style' (Table 2) is probably the most important, do affect the price of wool. Their effect could of course increase if they were to deteriorate seriously. The fact that tensile strength and vegetable matter content

Table 4 The effect on price (c/kg) of one standard deviation improvement from the mean in respect of each property which makes a significant contribution ($P \leq 0{,}05$) at a port

	Clean yield	Fibre diam.	Style	Standard of classing	Tensile strength	Staple length	Appear- ance	Veg. mat. cont.
Port Elizabeth								
Advance price	32,40	26,73	14,64	7,40				
Auction price	67,61	74,66	21,06	7,95				
East London								
Advance price	41,22	28,27			9,81	7,95		
Auction price	81,89	100,95			12,92			
Durban								
Advance price	40,31	13,533	11,27		2,72			
Auction price	76,98	109,40			7,09	5,38		
Cape Town								
Advance price	5,18	10,24	2,50				4,35	1,87
Auction price	9,32	21,31					8,47	
All ports								
Advance price	35,73	30,63	11,41			4,10		
Auction price	66,40	90,78	11,20		4,99			

Table 5 Effect of breed and port on price

	Breed			Port
	Plain bodied	Dohne Merino	SA Mutton	Cape Town
Port Elizabeth				
Advance Price (c/kg)	0	0	−2,00	–
Auction Price (c/kg)	−18,47	−19,70	0	–
East London				
Advance Price (c/kg)	0	0	−14,51	–
Auction Price (c/kg)	0	0	−28,04	–
Durban				
Advance Price (c/kg)	0	0	−25,31	–
Auction Price (c/kg)	0	0	−22,86	–
Cape Town				
Advance Price (c/kg)	0	0	−10,36	–
Auction Price (c/kg)	0	0	−22,09	–
All ports				
Advance Price (c/kg)	0	0	−21,81	0
Auction Price (c/kg)	−19,39	−12,61	−27,59	19,46

Only breeds and ports which deviated significantly ($P \leq 0{,}05$) from 'Merino' and 'Port Elizabeth' are included.

(objectively measured) did not really feature was probably because in most cases they influenced style and were thus included as a component of style. The same can be said for appearance and standard of classing. This is obviously a problem with subjectively assessed properties, *viz.*, that precise definitions are difficult, especially in their application and they are inclined to overlap, especially when a property like style is encountered, because its definition includes most of the others to varying degrees. Inconsistency in assessing subjective properties possibly contributed to the significant breed effects, as breed is probably a more precise definition and its effect could not be totally explained by other subjective properties.

The significant breed effects could be seen as contradictory to the results obtained by Hunter, Turpie & Gee (1984) in processing trials. They stressed, however, that breed differences do exist, but that these differences could be explained by other properties, which is obviously not entirely the case in this study.

There are some conspicuous omissions in the final equations, noticeably quality, crimp frequency, *CV* of crimp frequency and *CV* of staple length. It can be argued that the effect of quality is explained by breed but plain-bodied Merino ('Geelbek') was found to have a positive relationship with quality while Dohne Merino and SA Mutton Merino had a negative relationship with quality. Another explanation for the lower auction price (Table 5) could be that the wool of these breeds is more weathered, their fleeces being drier and less dense. As the present tendency is to breed a plainer Merino, the exact cause needs further investigation, perhaps with the inclusion of resistance to compression as variable.

The role of crimp frequency in price determination has obviously been replaced by fibre diameter, but it should be noted that it could still be important in processing, the less crimped wools generally giving better results (Hunter, 1980).

Wool received at Cape Town realized a significantly higher ($P \leq 0{,}01$) auction price than wool at the other three ports. The sample was, however, relatively small (n = 102) and deviated from normality. The results obtained for Cape Town should, therefore, not be taken too seriously when assessed in isolation.

Conclusions

This study necessitated the inclusion of variables which were doubtful starters from the onset but which had to be additionally measured or assessed for the sake of completeness. Stepwise-regression on principal components provided a means of identifying variables which in no combination with any other would influence price. A fortunate result was that clean yield percentage, fibre diameter and style, which were identified as the most important, are measured or assessed as a matter of routine. Continuous monitoring of market trends is of course a prerequisite for long and short-term planning.

Results are in broad agreement with those obtained in processing trials (Hunter, 1980), which means there is unanimity between appraisers, buyers, manufacturers and textile scientists. Producers should take cognizance of this fact and not lay too much emphasis on properties which have become largely irrelevant.

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