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Prepared by: **JS Richards and KD Atkins**

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Simultaneous Assortment of Merinos to meat and wool production

SHEEPCRC

Abstract

A simultaneous phenotypic assortment strategy was developed to increase the meat value of one group of animals as well as increasing the value of animals retained in the flock for wool production. At it simplest, the selection strategy involves ranking animals using fibre diameter and body weight and allocating them to either a wool or meat production group according to their merit for each trait. The method can be used as a tactical response to high meat and low wool markets to increase money made through higher weight meat animals, whilst still maintaining the wool quality of the breeding ewe flock. This method is also a flexible management approach as it allows the groups to be re-allocated in other years. It is not recommended as a long-term selection option, unless other additional ram buying strategies are put in place to mitigate the long-term effect of reduced body weight in the wool breeding ewes.

Executive Summary

Drought and low wool prices have resulted in a decline in Merino sheep numbers, increasing pressure on the Merino as a dual meat and wool animal. A simultaneous phenotypic assortment strategy for dual products was developed to increase the size of animals (for meat sale) as well as reducing the fibre diameter of retained animals (for wool production). The selection strategy outlined in this report involves ranking the animals using fibre diameter and body weight and allocating them to a wool or meat production group according to their merit for each trait. This assortment can be used in yearlings to identify sale or retained animals or among breeding ewes for mating allocation to improve progeny performance through appropriate mating to either meat or wool sires.

Initially, empirical studies were carried out on four sets of data from two sites in NSW. The results from this study showed that we could achieve maximum selection advantage in either of the meat or wool groups through single trait selection. The difference in fibre diameter was 2 micron when using fibre diameter measurements to separate animals into two groups and a difference of 7 kg was achieved when separating by body weight. Since correlations between fibre diameter and body weight were low, the impact of selection in the second group had no particular advantage for the other product in a dual production system. The dual selection scenario may lose a small amount of the maximum selection advantage in each trait, but rather than one selected (as in single trait selection) there are two groups containing animals selected either for their meat or wool production. Most importantly, the concept of cull animals has disappeared. In the dual selection scenario a difference in fibre diameter of 1.5 micron and 5kg body weight was achieved between the wool and meat groups. This should maximise the productive advantages of the two selected groups and result in a better consumer focused product.

These initial findings were examined using previously recorded data. A modelling program was then used to calculate predicted changes over time. The model allowed predictions of future progeny to be examined and also possible economic results from the suggested allocation strategies under various market conditions. The results from this model showed that using fibre diameter measurements was an important process in improving economic gain from the animals, irrespective of whether it was used as the sole selection criteria or combined with other trait measurements, especially in low meat value markets. The value of body weight as a selection criterion (to identify meat animals) increased as meat value increased but never exceeded the value of joint selection on body weight and diameter. The value of simultaneous selection only exceeded the value of diameter selection at higher meat values and where the proportion of animals sold for meat was relatively low, that is, high selection intensities for meat. Using the model to predict future outcomes, at finer diameters, fibre diameter selection would be relatively more attractive while at broader diameters, body weight and especially dual selection become more advantageous. Clearly, a global recommendation is not appropriate, but selection using information will always be beneficial and, in most situations, the benefits will be substantially greater than the cost of measurement.

In the second case, we examined the short-term and long-term impact of using alternative selection policies to sort the ewe flock into a wool group (to be mated to Merino sires) and a meat group (to be mated to terminal lamb sires). In finer diameter flocks, the principal economic advantage flowed from wool selection for the Merino-mated group. Dual selection was generally less efficient in the wool flock with relatively small (additional) benefits to the meat flock. Selecting on body weight alone (larger animals to the meat flock) was little better than random allocation (no selection). In broader wool flocks, the advantage of diameter selection lessened substantially. Long-term effects on body weight in the Merino wool flock are expected to influence carrying capacity (DSE ratings are

included in the model) and will influence appropriate ram-buying policies if such selection is followed strategically rather than as a tactical response to current markets.

The next step within this project was to implement these findings on a property and examine the effects of the dual selection strategy as a case study over three years.

The trial commenced on a property in Ladysmith, NSW (near Wagga Wagga). 2000 breeding Merino ewes were split into two groups of equal size using the Simultaneous Assortment program developed as part of this project. The software sorted the animals into two groups depending on fibre diameter, fleece weight and body weight to achieve fitness for purpose in both wool and meat production groups. These animals were run on the same property over the three years, with the wool groups mated to Merino sires and the meat group mated to terminal sires. The immediate and progressive production differences between the ewes were tabulated and the progeny of the Merino ewes had fleece information recorded at hogget age.

Industry will be able to examine how this trial was run and what results were achieved from this assortment process via the case study that is currently being compiled. The software to calculate the selection lists for single or dual trait selection is freely available to be downloaded on the Sheep Industry CRC website or via the Precision Sheep Production Toolkit CD.

This selection method can be used as a tactical response to high meat and low wool markets to increase money made through higher weight meat animals, whilst still maintaining the wool quality of the breeding ewe flock. This method is also a flexible management approach as it allows the groups to be re-allocated in other years. It is not recommended as a long-term selection option, unless other additional ram buying strategies are put in place to mitigate the long-term effect of reduced body weight in the wool breeding ewes.

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1 Background

There is enormous pressure on the Merino sheep population to supply wool to the world market and as a precursor in the production of meat to satisfy increasing demand for sheep meat. Long-term decline in the Merino sheep population over the last decade in response to relatively low wool prices and the short-term effects of drought over the past 5 years has exacerbated this pressure (Barrett *et al.* 2003). In order to deal with this situation Merino producers often use the following options to produce both meat and wool from their Merino breeding ewes:

- Animals surplus to the wool flock needs are "finished" as meat animals. These commonly include complete drops of wethers or cull ewes.
- A proportion of ewes are mated to meat sires to produce crossbred lambs. These meat enterprise dams are usually aged Merino ewes that are surplus to the requirements of the purebred Merino flock.

The options are sensible but the selection decisions are commonly not based on their optimal suitability for a certain purpose. We propose refined selection options for integrated wool and meat production from a base Merino flock where the choice of animal for each enterprise is optimised for both wool and meat products and therefore profit. Selection decisions are based on animals' ranking on a single objective and result in a selected (more valuable) group and a cull (low value). Where the flock is producing dual products, this is not necessarily an optimal approach for commercial flocks. An alternative approach is to segment the flock on dual objectives (meat and wool) and identify groups of animals of merit for each product.

For example, primary profit drivers for meat and wool production per head are growth (body weight) and fibre diameter respectively. There are other profit drivers, although these are the only two included in the initial investigation for simplicity of the assortment process. Fleece weight and reproduction have been included in later studies which are also included in this report and subsequent analyses will test whether these additional traits will deliver any further benefits to the assortment process. A single on-farm measure of body weight or fibre diameter could be used in several ways to separate a flock of animals into two groups. Body weight could be used to identify the superior and inferior animals for meat production, or fibre diameter could be used to identify the superior and inferior animals for wool producing sheep. Alternatively, animals could be simultaneously assorted on both traits, still forming two groups.

This selection can be used for two different applications: The assortment of lambs to a meat group for short-term advantage and a wool group for lifetime wool production and also the assortment of adult ewes into meat or wool mating groups. This report discusses a number of studies that examine these possibilities. These studies include;

- An empirical study that demonstrates the potential benefits of simultaneous assortment within unselected Merino ewe flocks, including a model that predicts future results and shows the economic impact of selection options;
- Software that was developed to allocate animals into these "meat" and "wool" selection groups and show a summary of the production statistics for each of the groups;
- A case study where animals were split according to the results from the allocation process delivered from the program, where progeny were also monitored for two years after this allocation process.

2 Project Objectives

- Provide proof of the production and economic benefits of simultaneous selection for wool and meat traits as a means of segmenting a dual-purpose Merino flock, using data from research and commercial flocks;
- Develop a simple algorithm for achieving simultaneous selection that can be applied on farm (in real-time) and off-farm (post-measurement). Provide the algorithm in a form that could be incorporated into providers' software; and
- Identify potential on-farm implementation sites from Sheep CRC resources where the process and benefits of the method can be demonstrated.

3 Methodology

3.1 Proof of production and economic benefits – Empirical study

An empirical study was carried out to demonstrate the potential benefits of simultaneous assortment within unselected Merino ewe flocks.

3.1.1 Data

Data were obtained from two sources for the empirical study:

(i) QPlu$, Trangie. Ewes born in 1993 and 1994 from the medium – Peppin flock of QPlu$ had their fibre diameter and body weight recorded at shearing at 15 months of age. A description of these animals was given by Taylor and Atkins (1997). Briefly, about 1200 ewes were mated to 40 sires that had been sourced from a single industry flock. Random allocation of ewes to sires produced two unselected drops of animals that were then measured at 15 months of age. All ewes had been shorn previously as lambs at about 3-4 months of age.

(ii) Centre Plus, Tullamore. A second set of data was sourced from a stud flock on all ewes born in 1997 and 1998 at Centre Plus. Again, body weight and fibre diameter were available on all unselected animals at first test shearing at approximately 15 months of age. All ewes had been shorn previously as lambs at about 5 months of age.

3.1.2 Phenotypic Assortment – The selection Process

The initial step was to examine the effect of subdividing a population into "meat" animals that would be sold as lamb or mutton and "wool" animals that could be retained in the flock to produce wool for sale. The first approach could use body weights to select the animals to be sold ("superior meat") and the retained animals would then become the "meat culls". Alternatively, a second approach could use fibre diameter to select the animals to be retained in the wool flock ("superior wool") while the sale animals would be the "wool culls". The new (or third) approach will use both body weight and fibre diameter simultaneously, producing two groups of animals; ("better meat" and "better wool"). This terminology will be used later on in the tables that show the results.

A process of selection was implemented in Excel®. For single trait selection the animals were ranked for the trait of interest and (when wanting 50% of the animals for meat production and 50% for wool) the top half was allocated to the "select" group and the bottom half to the "cull" group. For the dual selection scenario standardised values (calculation below) for FD and BW were calculated separately:

$$\frac{\textit{(Actual trait measurement)} - \textit{(mean of trait for the flock)}}{\textit{(SD of trait for the flock)}}$$

Standardised values are necessary to remove the units of fibre diameter and body weight and to place them on the same variance scale to allow ranking to occur. For the animals selected on dual trait objective these two standardised values were added together for each animal and ranked. The highly ranked animals were chosen for the "better meat" group (as they had the higher BW and higher FD) and the lower ranked animals were selected for the "better wool" group. An addition was also made to the spreadsheet to allow for selection of a percentage of culls. This was achieved through subtracting the standardised BW from the standardised FD and ranking the animals accordingly, resulting in the highest ranked animals being removed for culling (having low BW and high FD). These processes have been generalised to allow variable proportions of animals to be chosen for each group. This phenotypic assortment process was initially carried out on the QPlu$ data to determine its success. The process was then repeated on the Centre Plus data to ensure that the results were repeatable in different environments under different management circumstances.

3.2 Simple algorithm for achieving simultaneous selection

The data allocation process has been simplified through the development of software that carries out the steps mentioned in the process above, so that data can easily be entered and allocation results achieved quickly. The software produces a selection list for "wool" and "meat" animals (and a "cull" list if requested) based on current measurements, such as fibre diameter and body weight. A summary table compares the fibre diameter (FD) and body weight (BW) (and fleece weight (FW) if data available) of the animals according to no selection, meat or wool single trait selection or the dual selection scenario. Some screen shots and further descriptions of the software can be found in Appendix 1

3.3 On-farm implementation site

A property situated in Ladysmith (near Wagga Wagga), NSW, was selected as the proposed trial site for this research. Prior to the trial the main focus for the property was wool production and they were currently discussing options for including a meat enterprise in their wool system. This was an opportunity to test these theories in practice. The main difference for this site compared to the earlier studies was that the property owner/manager (David Strong) wanted to use a fleece value (that included a fleece weight) instead of just a fibre diameter measurement when selecting for his wool ewe flock. Fleece value is a difficult unit because this means valuing a fleece under a specific market at a certain time or over an average of markets over a longer period of time. For the case of this trial this was accommodated by using David's own calculation for fleece value.

This property had individual records written via hand written notes for the lifetime of each animal. These were written up into computer files and were used as the base information on which to allocate the animals into each flock. From the flock of 2000 ewes, 1000 were to be mated to terminal sires and the other 1000 to Merino ewes. Animals were allocated using a modified version (to include fleece weights) of the Phenotypic Assortment model produced as part of an earlier stage of this project. All fleece records were taken at first shearing as hoggets and to reduce the effect of year differences (including environmental or ram differences, etc) each year drop was allocated in a separate assortment process.

The flocks were managed in an attempt to achieve highest productivity according to best practice and suitability for this particular property. Regular weights and fat scores were measured as well as shearing results and pregnancy scanning. Some of this information will be used to illustrate the difference between the various production groups, but mainly this information was used to determine how the animals were run to achieve optimal production. Best practice management was carried out under David's own management guidelines with assistance from the local District Livestock Officer, Geoff Casburn.

The first allocation process took place in February 2005. Animals were allocated into two groups according to David's calculation of fleece value (containing both fibre diameter and fleece weight) and body weight (BW). These groups were allocated via the Simultaneous Assortment software that uses an index to sort the animals into "better wool" (higher fleece value) and "better meat" (higher body weight) groups. These two groups were then split again into high and low fleece values (FV), resulting in four groups in total.

4 Results and Discussion

4.1 Proof of production and economic benefits – Empirical Study

4.1.1 Production outcomes

Detailed results of selection into two equal groups by the various selection strategies are shown in Table 1 ("no culls" column) for the two drops of QPlu$ (Trangie) animals. It shows that selecting separately for wool or meat produced a group of culls that were of limited merit for the alternative product. Selecting animals to be retained in the flock for wool production on fibre diameter produced sale animals (wool culls) that were broader but still average in body weight. Alternatively, selecting animals for sale on body weight results in retained animals (meat culls) that were only average in diameter. When selecting for meat (body wt) and wool (FD) jointly there were two groups of potentially valuable animals retaining 70-85% of the maximum selection advantage available from separate single trait selection.

The outcomes of the selection process are illustrated in Figure 1 for the 1993 drop QPlu$ animals. Wool and meat selection (on single traits) is a one dimensional selection effect and, since the two traits are poorly correlated, there was little benefit to the alternative trait. The dual selection (Figure 1c) allocates animals more appropriately to a group depending on their relative advantages on fibre diameter versus body weight.

The information from two separate drops in two separate flocks is presented in Figure 2. This information comes from the data sources mentioned in the methodology in section 3.1.1 of this report (Qplu$ and Centre Plus). The responses to selection in each flock and year were very similar.

When removing 10% of the lowest value animals as culls there was little benefit on the other groups (Table 1). There was only very small improvement in the amount of meat produced and the fineness of the wool produced. Table 1 also shows the very low quality of the animals that were removed as culls (high fibre diameter and low body weight).

Table 1: Resulting mean FD and BW of different selection groups with and without a 10% "cull" group included

Groups 50%meat 50% wool	1993 drop				1994 drop			
	Fibre diameter (µm)		Body weight (kg)		Fibre diameter (µm)		Body weight (kg)	
	no culls	10% culls	no culls	10% culls	no culls	10% culls	no culls	10% culls
Average (all)	**20.4**	**20.4**	**51.7**	**51.7**	**21.4**	**21.4**	**47.5**	**47.5**
Superior meat[*a]	**20.5**	**20.5**	**55.3**	**55.7**	**21.6**	**21.5**	**50.9**	**51.3**
Meat culls	**20.3**	**20.3**	**48.0**	**49.6**	**21.3**	**21.4**	**44.1**	**45.4**
10% culls [*d]		**20.4**		**43.1**		**21.0**		**40.1**
Superior wool[*b]	**19.5**	**19.4**	**51.3**	**51.2**	**20.3**	**20.2**	**47.0**	**47.2**
Wool culls	**21.3**	**21.0**	**52.1**	**52.1**	**22.5**	**22.1**	**47.9**	**47.5**
10% culls [*d]		**22.5**		**51.9**		**24.1**		**48.4**
Better meat[*c]	**21.1**	**20.9**	**54.3**	**55.0**	**22.2**	**22.1**	**50.3**	**50.7**
Better wool	**19.7**	**19.5**	**49.1**	**49.6**	**20.6**	**20.4**	**44.7**	**45.3**
10% culls [*d]		**21.9**		**46.3**		**23.0**		**42.9**

[*a] using body weight only to rank and select superior and cull group, [*b] using only fibre diameter, [*c] using both FD and BW [*d] 10% culls are the lowest ranked animals for **BOTH** FD and BW (not just low in one trait or the other)

Apart from these direct effects on traits, there were other traits affected by the selection process, such as fleece weight and reproductive traits. These have been investigated and shown in Tables 2 and 3.

Table 2: Resulting mean FW of different selection groups with no "cull" group

	1993 drop	1994 drop
	Fleece weight (kg)	Fleece weight (kg)
Average (all)	6.62	6.75
Superior meat	6.82	6.75
Meat culls	6.41	6.74
Superior wool	6.59	6.74
Wool culls	6.66	6.75
Better meat	6.73	6.79
Better wool	6.52	6.70

When using any of the three selection options there was very little, if any, difference in fleece weights between the two groups (Table 2). There was a small difference in one year group when selecting on just BW with the superior meat group having a little higher FW than the meat culls. There was very little effect on reproduction as well. The "better meat" group has a slightly higher number of lambs born per lambing, but the higher number of lambs weaned per lambing varies between both groups (Table 3). This suggests that the selection process will not impact significantly on reproduction in the retained flock, but requires further investigation.

Table 3 a: Average number of lambs born per lambing

	HR93				HR94			
	Age 2	Age 3	Age 4	Age 5	Age 2	Age 3	Age 4	Age 5
Average (all)	1.35	1.46	1.52	1.56	1.51	1.54	1.58	1.58
Superior meat	1.43	1.53	1.58	1.60	1.59	1.63	1.66	1.65
Meat culls	1.26	1.38	1.46	1.51	1.41	1.44	1.47	1.48

Superior wool	1.39	1.46	1.55	1.57	1.50	1.54	1.60	1.60
Wool culls	1.30	1.45	1.49	1.53	1.52	1.54	1.54	1.55
Better meat	1.35	1.51	1.54	1.56	1.56	1.58	1.57	1.58
Better wool	1.34	1.41	1.50	1.55	1.45	1.49	1.58	1.58

b: Average number of lambs weaned per lambing

	HR93				HR94			
	Age 2	Age 3	Age 4	Age 5	Age 2	Age 3	Age 4	Age 5
Average (all)	1.01	1.12	1.18	1.14	1.08	1.09	1.12	1.11
Superior meat	1.06	1.17	1.25	1.21	1.13	1.11	1.17	1.14
Meat culls	0.95	1.06	1.12	1.06	1.03	1.07	1.06	1.06
Superior wool	1.03	1.09	1.15	1.14	1.10	1.15	1.14	1.16
Wool culls	0.99	1.15	1.22	1.13	1.06	1.03	1.09	1.02
Better meat	1.02	1.16	1.25	1.21	1.07	1.07	1.12	1.08
Better wool	1.00	1.07	1.11	1.07	1.10	1.12	1.13	1.13

The maximum selection advantage in either of the meat or wool groups is achieved through single trait selection (Table 1). This results in the second group having no particular advantage for the other product in a dual production system. The dual selection scenario may lose a small amount of the maximum selection advantage in each trait, but rather than one selected group (as in single trait selection) there are two groups containing animals selected either for their meat or wool production. Most importantly, the concept of cull animals has disappeared. This should maximise the productive advantages of the two selected groups and result in a better consumer focused product. Figure 2 shows that these results are highly repeatable across different years in different locations, so this could be a powerful tool for many producers. Such a process could be implemented for ewes and/or wethers to identify animals according to their fitness for purpose.

The focus so far has been on the benefits of phenotypic assortment of Merino lambs to meat or wool products. An equivalent approach might also be applied to the question of which ewes to mate to which rams within a dual production system. The common practice of mating surplus age groups of animals to meat sires is no more than random allocation and leads to a net zero contribution of improved genes from commercial ewe selection to progeny from either of the dual production systems. Selecting ewes to remain in the wool flock (mated to Merino rams) on fibre diameter and those for the meat flock (mated to terminal sires) on body weight could be an effective mating allocation strategy resulting in superior performance of the resultant progeny.

The appropriate suite of traits to be included in the selection process is another issue to be investigated. There is the possibility that repeat measures of body weight will make the selection more accurate or perhaps a wider range of traits (including fleece weight) in the selection process would increase selection accuracy. The selection process itself should be considered with the application of appropriate economic weights. There is also the issue of the optimal age for selection.

4.1.2 Economic impact

In order to provide a profitable selection process for commercial producers, the economic returns from using simultaneous selection of meat and wool animals within a Merino flock needs to be compared to other selection options. Both the production effects from lifetime production and mating allocation effects need to be included. Other traits had to be considered that may be influenced by the selection process and have an economic effect, such as fleece weight and reproduction rate. In addition to the direct economic effects, the flock structure implications and interactions need to be also considered.

A model was developed (Assortment Model) as a means of generalising the process and predicting the potential future impacts. The model allows other questions to be examined that cannot be achieved through the two data sets examined. A summary of the model is in Appendix 2. Another model (Wether Calculator), an extension of the general approach, examines just the impact of wether selection within a flock. It is based on this same initial model, but removes all sire and ewe selection. It also includes a wether proportion section that allows the optimal proportion of wethers to be calculated according to the gross margins per DSE. A summary of this software is included in Appendix 3.

The first comparison was to examine the impact of alternative selection policies in sorting a group of animals into a wool (retain as adult wool growers) and a meat (sell as hoggets) group. Figure 3 shows the economic impact in a medium wool flock (1993 Qplu$ data) for a 50%:50% (1:1) assortment and for a 25% (1:3) and a 75% (3:1) retention of animals as adult wool growers. The 25% retention rate would model wether selection while the 75% retention is more akin to selection among ewes. Using information on measured diameter is economically beneficial for all scenarios, but especially at low meat values. The value of body weight as a selection criterion (to identify meat animals) increased as meat value increased but never exceeded the value of joint selection on body weight and diameter. The value of simultaneous selection only exceeded the value of diameter selection at higher meat values and where the proportion of animals sold for meat was relatively low, that is, high selection intensities for meat. Using the model to predict future outcomes, at finer average diameters, fibre diameter selection would be relatively more attractive while at broader average diameters, body weight and especially dual selection become more advantageous. Clearly, a global recommendation is not appropriate, but selection using information will always be beneficial and, in most situations, the benefits will be substantially greater than the cost of measurement. This finding has generated the program to find the optimum proportion of wethers for retention in specialist wool flocks (see below).

In the second case, we examined the short-term and long-term impact of using alternative selection policies in sorting the ewe flock into a wool group (to be mated to Merino sires) and a meat group (to be mated to terminal lamb sires). In finer diameter flocks, the principal economic advantage flowed from wool selection for the Merino-mated group. Dual selection was generally less efficient in the wool flock with relatively small (additional) benefits to the meat flock. Selecting on body weight alone (larger animals to the meat flock) was little better than random allocation (no selection). In broader wool flocks, the advantage of diameter selection lessened substantially. Long-term effects on body weight in the Merino wool flock are expected to influence carrying capacity (DSE ratings are included in the model) and will influence appropriate ram-buying policies if such selection is followed strategically rather than as a tactical response to current markets.

4.2 Software

Decision support software for on farm use is required to aid in the selection decisions for the producer. A program was developed that produces a selection list for “wool” and “meat” animals based on current measurements, such as fibre diameter and body weight. A summary table enables a comparison to be made between the two single trait selection options and the dual selection option for the immediate production differences. The other option for using this tool is for identifying which ewes to mate to which rams within a dual production system. The common practice of mating surplus age groups of animals to meat sires is no more than random allocation and leads to a net zero contribution of improved genes from commercial ewe selection to progeny from either of the dual production systems. Selecting ewes to remain in the wool flock (mated to Merino rams) on fibre diameter and those for the meat flock (mated to terminal sires) on body weight could be an effective mating allocation strategy resulting in superior performance of the resultant progeny. The selection process here is the same as that described above.

This software is summarised in Appendix 1. There is also the possibility for real time selection (James 2002, Atkins and Semple 2003), reducing labour and time to make these selection decisions. Real time selection allows the animals to be allocated to their production group at the time the measurements are taken. This reduces the need to collect the data, decide on group allocation and then bring the animals around again to be drafted into the appropriate group. The simple system of using fibre diameter and body weight demonstrated here has been implemented in real time where selections can be made at the time of measurement of either or both of the traits in question. Real time selection relies on calculating the expected index and ranking of the animal in the whole mob based on the information collected (this is updated after each measurement is taken). There is very little error in using real-time selection (2-3%) (Atkins and Semple 2003) and most of these errors occur early in the measurements process when cumulative information on mean and standard deviation is less precise. On farm implementation and demonstration of this process needs to be carried out to enhance adoption of these practices in real time.

The software is available on the Precision Sheep Production Toolkit CD or on the Sheep CRC website for downloading. The summary and instruction sheet for the software is included in Appendix 4.

4.3 On-farm implementation site

The differences between the four groups that were allocated for joining in 2005 are shown in Table 4. These values were created from hogget fleece records (fibre diameter and fleece weight) and body weights collected at joining. The difference in fleece weight could not be calculated because there were no fleece weight records known for the 1998 drop. Table 5 shows the same information but does not include 1998 drop animals so all production traits (including fleece weight) can be compared. From Table 4 it is clear that the wool group was 0.4 micron finer than the average flock micron (the base flock with no selection) and was 0.8 micron finer than the meat group. It is also shown that the meat animals were 2.4kg heavier than the flock average and 4.9kg heavier than the wool group. This difference is similar but slightly less than was achieved in the empirical study, although this allocation process included fleece weight in the wool index not just fibre diameter. When the groups were split into four in total, there was a difference of 2 microns and 7.5kg between the highest and lowest groups for fibre diameter and body weight respectively, remembering that both the wool and meat groups were split according to fleece value. If the meat group was split according to BW there would be a larger range in weights between the groups. There was also a large variation in fleece values. The animals in the wool group were producing on average $10 more per animal than the meat group. The variation in fleece values was also evident when splitting the wool animals into two groups, with a difference of $16 between the high and the low FV wool groups.

Table 4: Four groups split according to meat and wool simultaneous assortment and each split again on Fleece Value (combination of fibre diameter and fleece weight) (2005)

	hFD (µm)	hFV ($)	BW (kg)
Average	16.9	36.5	45.0
wool	16.5	41.3	42.5
meat	17.3	31.7	47.4
wool highFV	15.9	48.3	44.2
wool lowFV	17.2	31.8	40.8
MeathighFV	16.7	38.2	48.3
meatlowFV	17.9	25.9	46.5

As expected, Table 5 shows a similar trend as table 4, because it contains the same data excluding the first drop of animals born in 1998. Table 5 shows that there is no large difference in fleece weight between the different groups when selecting on fleece value. There was only 100g difference between the meat and wool groups and 400g difference when looking at the highest and lowest groups for fleece weight.

Table 5: Same as table 4 but with 1998 drop animals removed to allow fleece weight comparisons (1998 fleece weight data was unavailable)

	hFD (µm)	hFW (kg)	hFV ($)	BW (kg)
Average	16.7	3.35	37.9	44.8
wool	16.3	3.29	43.2	42.3
meat	17.1	3.41	33.2	47.2
wool highFV	15.7	3.40	50.6	43.9
wool lowFV	17.0	3.16	33.0	40.9
MeathighFV	16.5	3.57	40.4	48.3
meatlowFV	17.7	3.22	26.4	46.2

The reproductive differences between the meat and wool groups (Table 6) show that there were slightly more singles and fewer twins in the wool group compared to the meat group. There was no significant difference between the meat and wool groups for the proportion of dry ewes, although the difference between singles and twins in both groups was significant. This suggests, as expected, that the larger body weight animals produce a larger number of twins than the lighter body weight animals.

Table 6: 2005 scanning results of ewes joined in respective mating groups in early 2005

	Single	Twin	Dry**
total	0.50	0.47	0.03
meat	0.43	0.54	0.04
wool	0.57	0.40	0.02
wool(highFV)	0.51	0.47	0.02
wool(lowFV)	0.64	0.33	0.02
meat(highFV)	0.44	0.54	0.02
meat(lowFV)	0.42	0.54	0.05

The other interesting information from the scanning results is between the high and low fleece value (FV) groups within the meat and wool group animals. The higher FV animals in the wool group have less singles and more twins than the lower FV group. This, similarly to the meat and wool group difference, is probably due to the larger size of the higher FV ewes. It is shown in Tables 4 and 5 that the higher FV group also has a higher body weight due to the positive correlation between FW and BW. This suggests that if this technique was used as a longer term strategic approach rather than a short-term tactical response, the reproductive rate of the breeding ewe flock could be compromised.

The growth of the ewes in both groups over time is shown in Figure 4. The weights were taken at joining (24/2/05), scanning (1/6/05), pre-lambing (1/7/05), weaning (22/11/05) and again at joining in the following year (9/2/06). The wool and meat groups follow a similar trend for most of this period with the meat group remaining heavier than the wool group for the whole trial. The wool group had a greater increase in weight between pre-lambing and weaning and a greater loss after this period up until the next joining, where shearing took place in between.

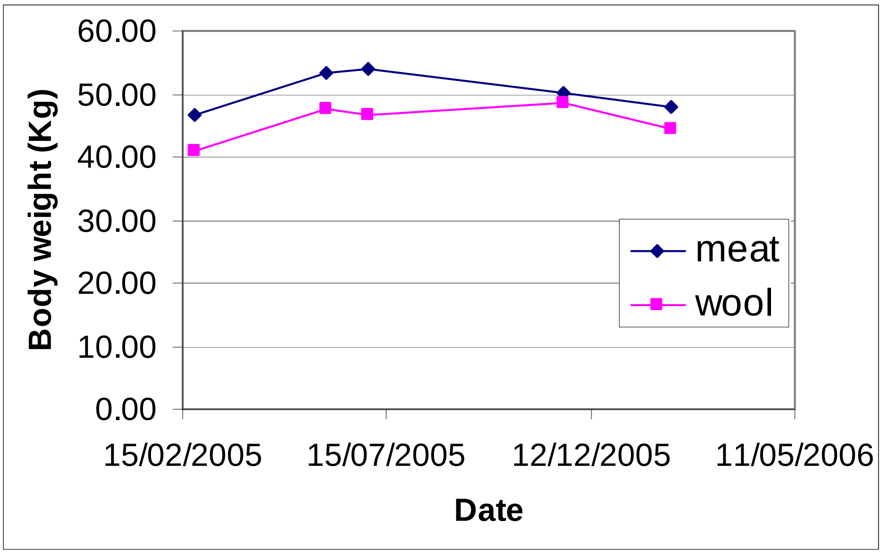


Figure 4: weights (and growth) of the ewes that were allocated into their mating groups in 2005

The fleece information for the progeny of the wool ewes was collected and the average fibre diameter was 14.5 micron and the fleece weight was 2.7kg. Unfortunately the progeny are not able to be split according to the high and low fleece values so no comparison can be made between the different groups. Also no comparison can be made with the progeny from the meat flock because they were mated to terminal sires. The progeny from the meat flock grew as shown in figure 5. Once again, these weights cannot be broken down into the high and low FV groups, nor can they be compared to the progeny from the wool group.

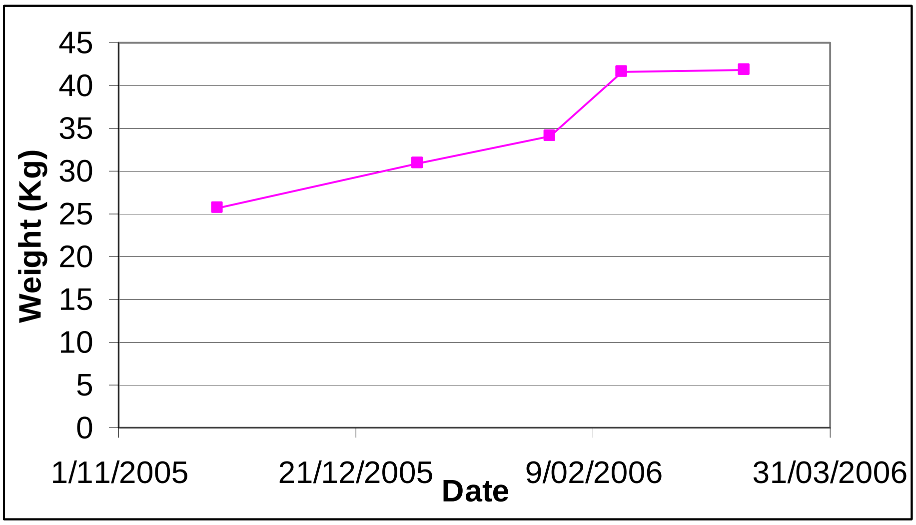


Figure 5: Weights of the lambs that were the progeny of ewes allocated to the meat group in 2005

5 Success in Achieving Objectives

All objectives were successfully completed as shown below;

5.1 Proof of production and economic benefits

- Data was successfully divided up into "meat" and "wool" groups according to different selection options.
- The data was taken from two different drops from each of two locations and the resulting production figures were shown after group allocation. These were then analysed to show the economics for each of the groups under the various selection options
- Software was developed to examine potential flock changes over time and estimate economic results from these selection strategies.
- Results from this preliminary analysis of the data showing the difference in production statistics between the groups and selection options were presented at the "Towards Individual Animal Management" conference in Perth (October 2004) and also at the Kangaroo Island Sheep Production Group Field day on Kangaroo Island (December 2004). These early results have also been published in WTSB journal.

Richards JS, Atkins KD (2004) Integrating meat and wool production in Merino flocks. *Towards Individual Animal Management,* Sheep CRC Program 2 Conference, Broadwater Conference Centre, Perth, October 2004

Richards JS, Atkins KD (2004) Simultaneous assortment of animals for meat and wool production in Merino flocks. *Wool Technology and Sheep Breeding Journal,* **52 (3),** 193-201. (September)

5.2 Software

- Decision support software was developed to simplify the allocation process, producing a list of "wool", "meat" and "cull" animals. Individual fibre diameter, body weight and possibly fleece weight needs to be entered and the draft list is given according to single and dual trait selection options.

- Another piece of software was developed as a branch off the modelling software that was designed to predict future production and economic results from various selection strategies and flock structures. The Wether Calculator uses this information to examine the economic responses to different proportions of wethers within a flock.
- The Simultaneous Assortment software as well as the Wether Calculator have been made available as part of the Precision Sheep Production Toolkit CD and also as a separate CD which was submitted with Milestone 2 as part of this project. These CDs also contain some extension material for raising awareness of ways of optimising selection options within Merino flocks producing dual products.

- The Milestone CD contains two programs both with instructions as well as a corresponding powerpoint presentation that shows the usefulness of the programs and models and how they can be used. The two programs are listed below;

    - Simultaneous Selection
    - Wether Calculator

The summary document describing the contents of the CD as well as the summary/instructions for these two programs are attached in the appendix.

- An article on the wether calculator was published in the wool feature in AgToday

Richards JS (2005) "Is there still a role for Merino wethers as wool growers?" Agriculture Today, *The Land Newspaper* 26th May 2005.

- The software was also included in a paper that was presented at the 2006 ASAP conference;

Atkins KD, Richards JS & Rowe JB (2006) The Wool-Meat Balance – Getting it right. *Australian Society of Animal Production 26th Biennial Conference 2006* Short Communication number 30, Perth, July.

- Both programs were demonstrated at the Sheep Industry CRC conference in Orange, February 2006 ("Wool meets Meat – Tools for a modern sheep enterprise") and a brief description included in the proceedings. They were also included briefly in two papers and presentations included in the conference.

Atkins, KD, Richards, J.S, Swan A.A. and Kelly M. (2006) Measurement and selection options for wool and meat production in commercial sheep flocks. In: PB Cronje and D Maxwell (eds.) Wool Meets Meat – Tools for a modern sheep enterprise. *Proceedings of the 2006 Australian Sheep Industry CRC Conference*, Orange, Australia pp. 80-84.

Atkins, KD, Richards, J.S, Swan A.A. and Kelly M. (2006) Measurement and selection options for wool and meat production in commercial sheep flocks. *International Journal of Sheep and Wool Science* **54** (1), 56-60.

Kelly M, Swan A.A., Richards, J.S, Atkins, KD (2006) Implementing selection and optimising flock structures in Merino flocks. *International Journal of Sheep and Wool Science* **54** (1), 61-65.

Kelly M, Swan A.A., Richards, J.S, Atkins, KD (2006) Implementing selection and optimising flock structures in Merino flocks. In: PB Cronje and D Maxwell (eds.) Wool Meets Meat – Tools for a modern sheep enterprise. *Proceedings of the 2006 Australian Sheep Industry CRC Conference*, Orange, Australia pp. 86-90.

- The software was included in a presentation at the QPLU$ Open Day in Trangie

Richards JS & Atkins KD (2006) Making the most from selection in your Merino Business: Optimising flock structure to improve profit from current and future generations. *Proceedings of the Trangie QPLU$ Open Day,* May p. 60-67.

- The role of selected wether flocks was presented to both the AAABG conference as well as the NSW DPI Sheep Conference

Richards JS, Atkins KD (2005) The role of selected wether flocks in Merino wool enterprises. *Proceedings of the Association for the Advancement of Animal Breeding and Genetics* **16:** 223-226. (September)

Richards JS, Atkins KD (2005) The role of selected wether flocks in Merino wool enterprises. *Proceedings NSW DPI Sheep Conference*, NSW Department of Primary Industries, Dubbo, April p. 169-175.

- The software has also been included in the individual animal management learner guide that has been developed as part of the Sheep CRC for TAFE and school teachers.

5.3 On-farm implementation site

- The trial was carried out on “Coolbaroo” of Ladysmith, NSW (near Wagga Wagga). The initial allocation occurred in February 2005 and the progeny from those ewes completed their first shearing in 2006. The project has been completed and the report on the outcomes has been included in this final milestone report.
- The major outputs included the immediate production differences between the ewes after allocations in early 2005, their growth after allocation, pregnancy scanning results as well as fleece and body weight information on their progeny of the wool and meat flock respectively.
- An article on the activities and results on the trial site was published in Agriculture Today;

Casburn G, Richards J (2006) Wool and meat profit together. *Agriculture Today* August p17.

6 Impact on Meat and Livestock Industry – now & in five years time

This trial has shown the benefits of using a combined meat and wool selection technique as a tactical response to high meat and low wool prices. Software is now available for producers wanting to use this technique to easily identify the most appropriate ewes for wool production and the most appropriate for meat production. The on-farm trial showed the process and management of the allocation to be successful. It also showed actual results of what could be achieved when using this technique to confirm the initial suggestions that were made in the empirical study and the initial modelling of the data. An economic comparison from the trial site could not be made as there was no base flock to compare to, but the modelling suggested that benefits could be made in the short-term. Over the longer term it may be more beneficial to continue only selecting animals on their wool value for entering the wool flock with a medium to fine wool flock. There may be some benefits of including a body weight measurement in the selection index in the broader micron flocks. The trial site results also suggested that there could be a small reduction in reproduction rate when using this selection technique, but would not have a very large impact if only used as a short-term tactical response. The use of this assortment process would allow some better consumer-focused products and therefore higher returns for farmers over the shorter term, but would not have any major influence to a change in the industry over the longer term.

7 Conclusions and Recommendations

A simultaneous phenotypic assortment strategy was developed to increase the meat value of one group of animals as well as increasing the value of animals retained in the flock for wool production. At it simplest, the selection strategy involves ranking animals using fibre diameter and body weight and allocating them to either a wool or meat production group according to their merit for each trait. The method can be used as a tactical response to high meat and low wool markets to increase money made through higher weight meat animals, whilst still maintaining the wool quality of the breeding ewe flock. This method is also a flexible management approach as it allows the groups to be re-allocated in other years. It is not recommended as a long-term selection option, unless other additional ram buying strategies are put in place to mitigate the long-term effect of reduced body weight in the wool breeding ewes.

The project also delivered two other important conclusions.

1. There is a clear message to industry that dual purpose enterprises need not be a compromise. Meat animals produced from Merinos are not necessarily the culls from the wool enterprise or vice versa. Appropriately selected products can be delivered from such enterprises by applying simultaneous attention to both wool and meat.

2. The general issue of using some basic measured information for selection in commercial flocks has identified many more specific questions on improving productivity on farm. For example,

    - Optimal flock structure (age classes, wether flock size or terminal sire crossing flock size) will alter with the application of effective within flock selection.
    - Where effective selection intensity exists (determined by age classes and reproduction rate) across age selection of ewes can contribute further gains for important additional traits such as reproduction rate.
    - Within flock selection in commercial flocks can be both of similar magnitude but additive with sire selection from studs. The key difference is that ram selection contributes genetic improvement while ewe (and wether) selection contributes largely to current generation

improvement. The additivity of current generation and genetic improvement offers scope for even more rapid gains in on farm productivity of sheep production systems.

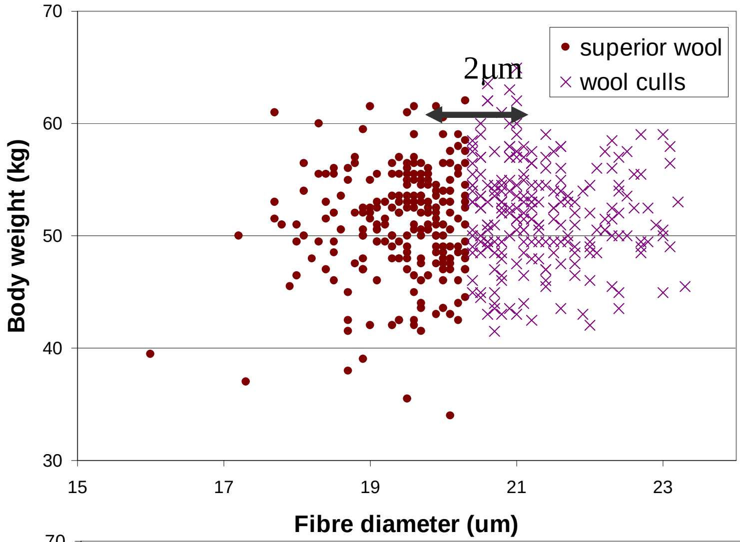
8 References

Atkins,K.D. and Semple,S.J.(2003). Real time selection. ***Proceedings of the Association for the Advancement of Animal Breeding and Genetics***, **15:** 147-150.

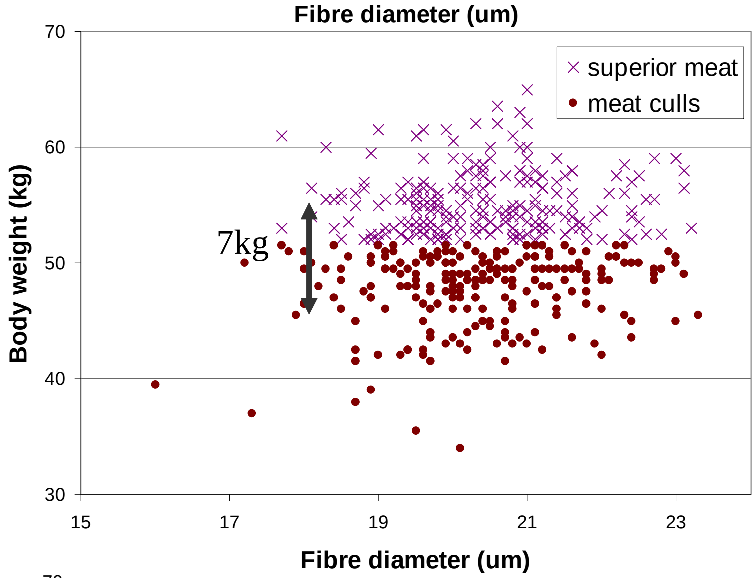
Barrett,D., Ashton,D. and Shafron,W. (2003). Australian Wool Industry 2003, Report on the Australian Agricultural and Grazing Industries Survey of Wool Producers, ***ABARE Research Report 03.5,*** Canberra.

James,J.W. (2002). Real time selection for measured performance. ***Proc. 7^{th} Wld. Congr. Genet. Appl. Livest. Prod., Montpellier, France*** **Vol 33**: 175-178.

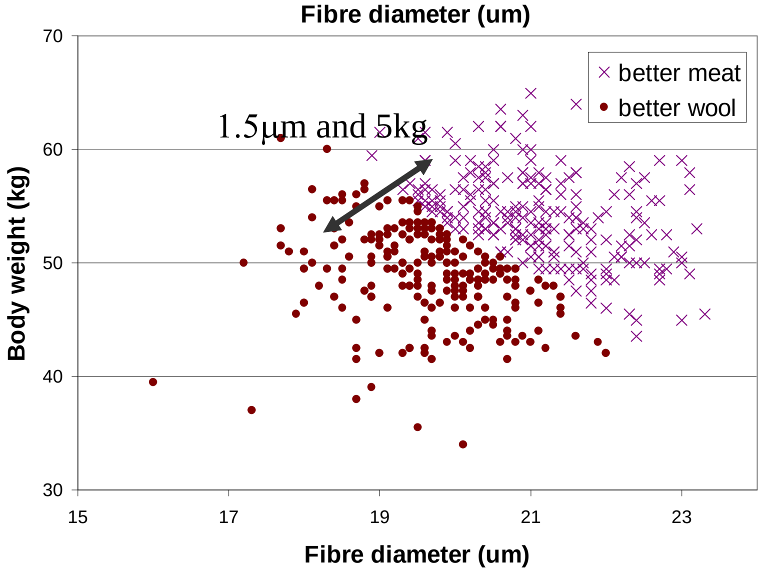
Taylor,P.J. and Atkins,K.D.(1997). Genetically improving fleece weight and fibre diameter of the Australian Merino - The Trangie QPLU$ Project. ***Wool Technology and Sheep Breeding*** **45**: 92-107.



1. a) Wool Selection on 1993 drop QPlu$
2μm represents the difference between the average FD of the superior wool and wool cull group when using only FD in the selection process.



1. b) Meat Selection on 1993 drop QPlu$
7kg represents the difference between the average BW of the superior meat and meat cull groups when using only BW in the selection process



1. c) Dual Selection on 1993 drop QPlu$
1.5μm and 5kg represent the differences between the average FD and BW respectively of the better meat and better wool groups when using both FD and BW in the selection process

Figure 1: Group allocation according to different selection strategies

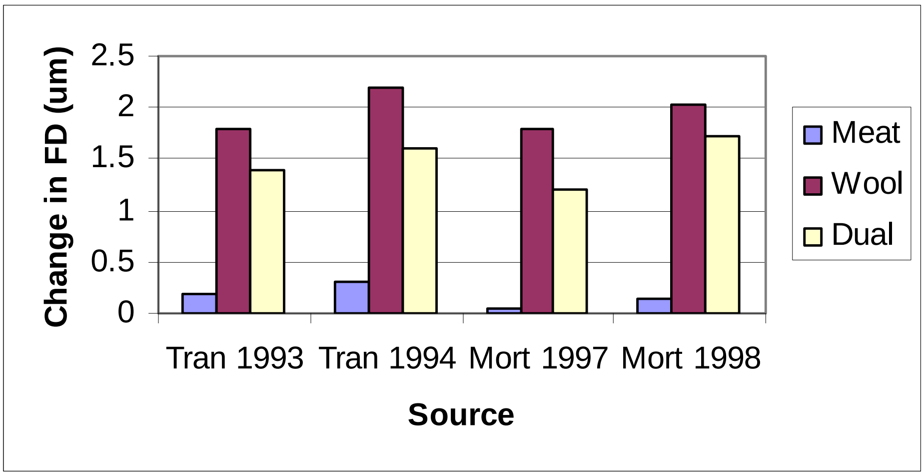
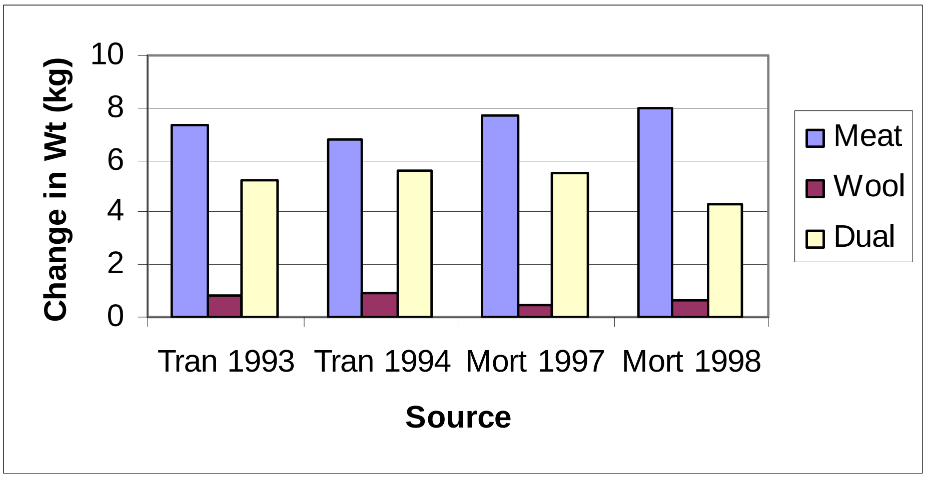
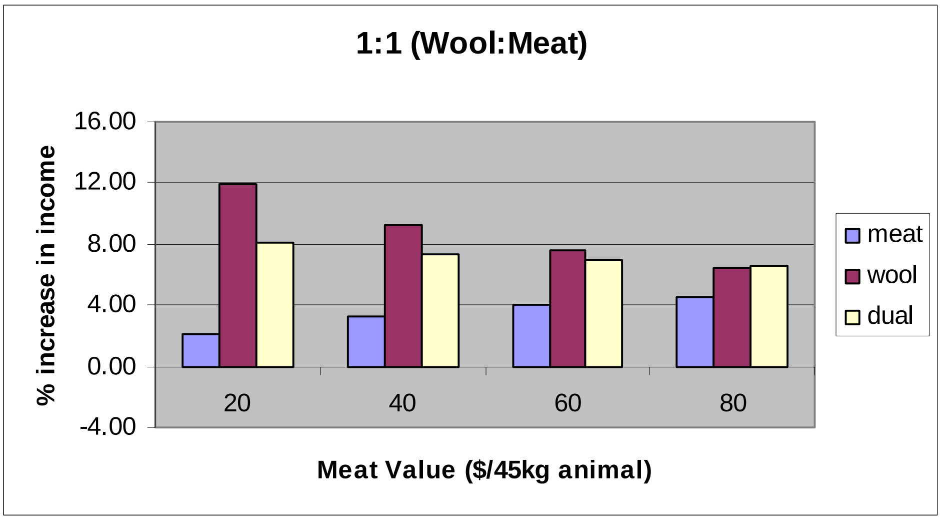
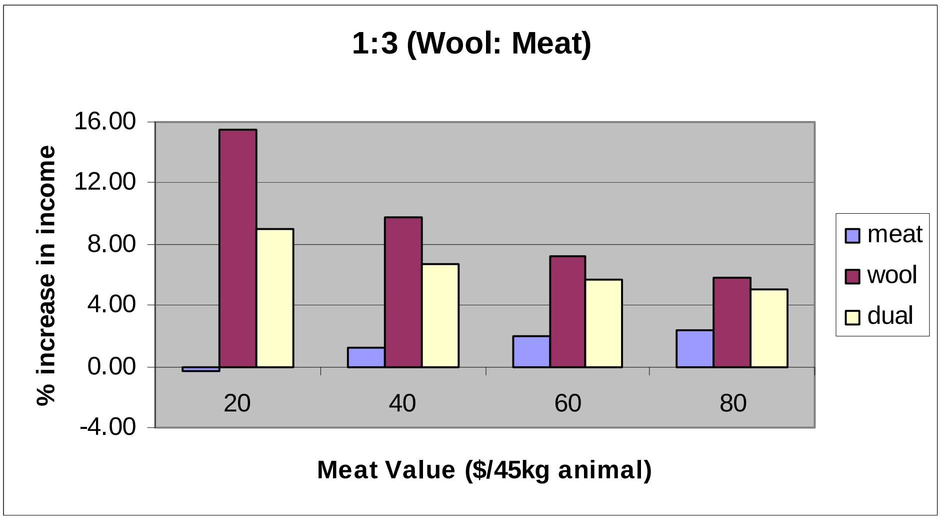


Figure 2: Response to different selection strategies in each flock
*Tran = Location 1 (QPlu$, Trangie)
*Mort = Location 2 (Centre Plus, Tullamore)




1:1 (Wool:Meat)
% increase in income
16.00
12.00
8.00
4.00
0.00
-4.00
20
40
60
80
Meat Value ($/45kg animal)
meat
wool
dual


1:3 (Wool: Meat)
% increase in income
16.00
12.00
8.00
4.00
0.00
-4.00
20
40
60
80
Meat Value ($/45kg animal)
meat
wool
dual

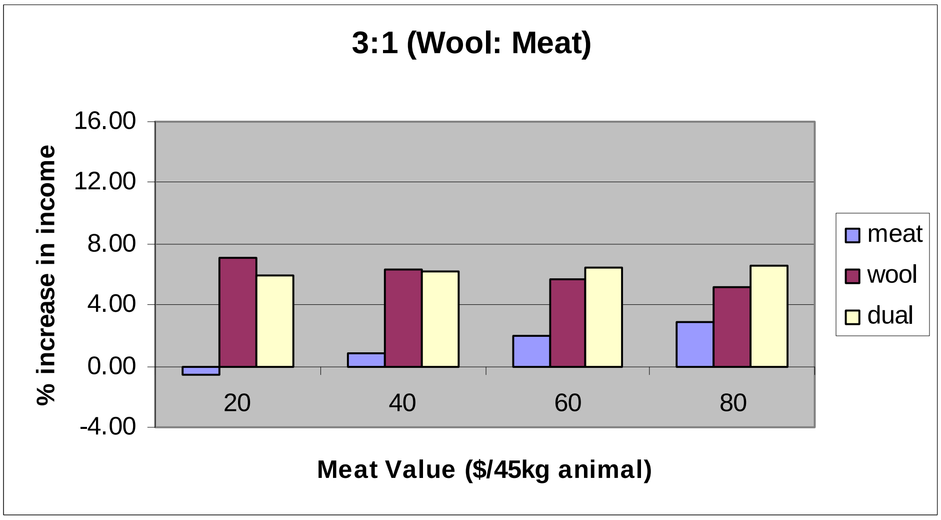

3:1 (Wool: Meat)
% increase in income
16.00
12.00
8.00
4.00
0.00
-4.00
20
40
60
80
Meat Value ($/45kg animal)
meat
wool
dual

Figure 3: Increase in income from no selection to wool, meat or dual selection options

9 Appendices

9.1 Appendix 1 – Simultaneous Assortment

Phenotypic assortment of sheep into meat and wool groups according to body weight and fibre diameter

This software was developed to allocate animals into their most appropriate “meat” or “wool” groups according to individual information on the animals (eg. fibre diameter (FD) and/or body weight (BW)).

The first step is to paste in the animals tag numbers and their corresponding data (body weight, fibre diameter and fleece weight if known) under the appropriate headings in the “Data Entry” sheet (Figure 1). Note: the program calculates up to 5000 records. Once this data is entered select the “summary” sheet (Figure 2). The first decision is whether any animals are to be removed as culls. These culls are removed before the animals are divided into the meat and wool groups. This percentage of culls can be entered in the yellow box at the top of the worksheet (“%culls”). Note: these are the lowest value animals in both fibre diameter AND body weight (eg high FD and low BW). It does not remove the worst “wool” animals or the worst “meat” animals. The percentage of the remaining animals to be placed in the wool flock needs to be selected and entered in the other yellow box (“%wool”). The percentage of meat animals is calculated as being the remainder of the animals (as shown in Figure 2). This means that if 10% were entered for culls and the remainder of the animals were to be split in half, the wool animals (“%wool”) would need to be entered as 50%, ie. meat% + wool% = 100% irrespective of the proportion of culls removed first.

The main purpose of this software is to allocate the animals using both FD and BW to produce two flocks chosen for their meat or wool value. For comparison there are also two single trait selection options to show what the results may have been if using ONLY FD or BW to allocate the animals. The actual count of animals for all three selection options for each of the meat/wool/cull assortments will now be displayed. The percentage of the animals in these flocks is also calculated. This is slightly different to the selected percentage entered into the “summary” sheet due to a number of animals having equal FD or BW in the single trait selection options. Underneath this table is another that gives the average fibre diameter, body weight and fleece weights for each flock if information has been entered for all of these traits. Note: Fleece weight (FW) is included to show the resultant changes from the FD and/or BW selection process but is not itself included in the selection process.

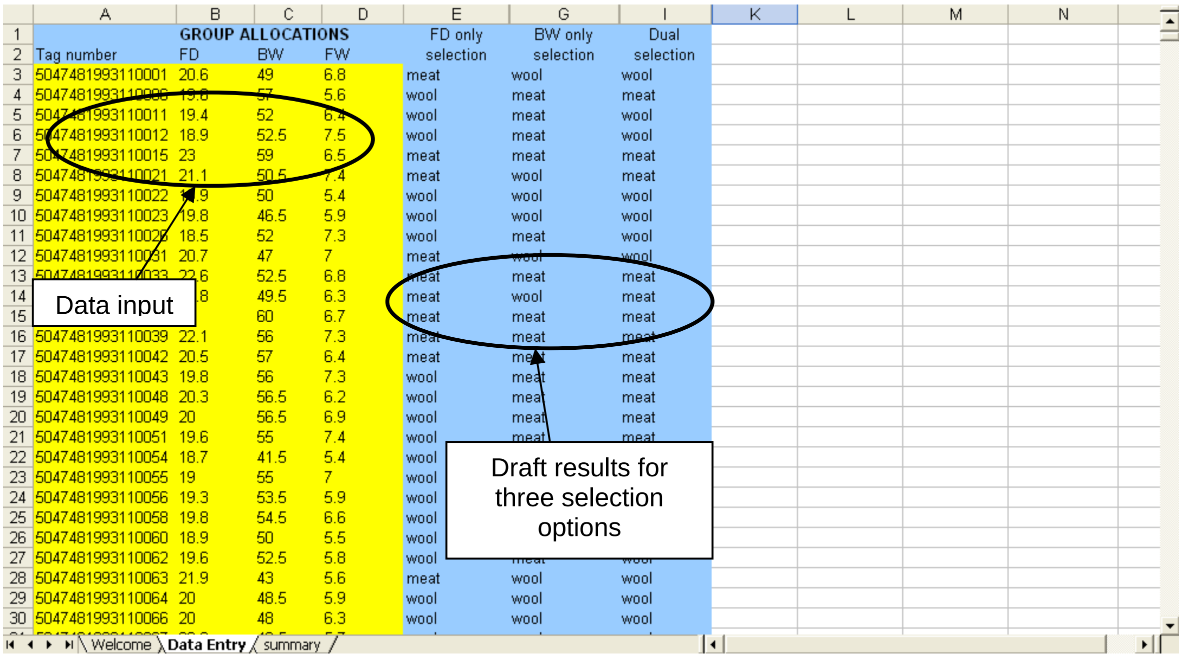


Figure 1: Screen shot of "Data Entry" screen

To view which individual animals would be selected into which flock (meat, wool or cull) according to the 3 selection options return to the "Data Entry" sheet. For "FD only selection" the animals are ranked according to their FD with the lowest FD animals allocated to the wool flock, the highest FD are removed as culls and the remainder of animals are allocated to the meat flock. The percentage allocated to each of these flocks is determined by what was entered on the "summary" sheet. The "BW only selection" is calculated in a similar way. The animals are ranked according to body weight. The heaviest animals are used as the meat flock, the lightest as culls and the remainder for the wool flock. The process for dual-selection is more complicated, but uses an index that combines both BW and FD to allocate animals into the meat, wool and cull groups. In combination the wool animals will have a lower average micron and the meat group a higher average body weight, rather than just a "select" group and an alternative group.

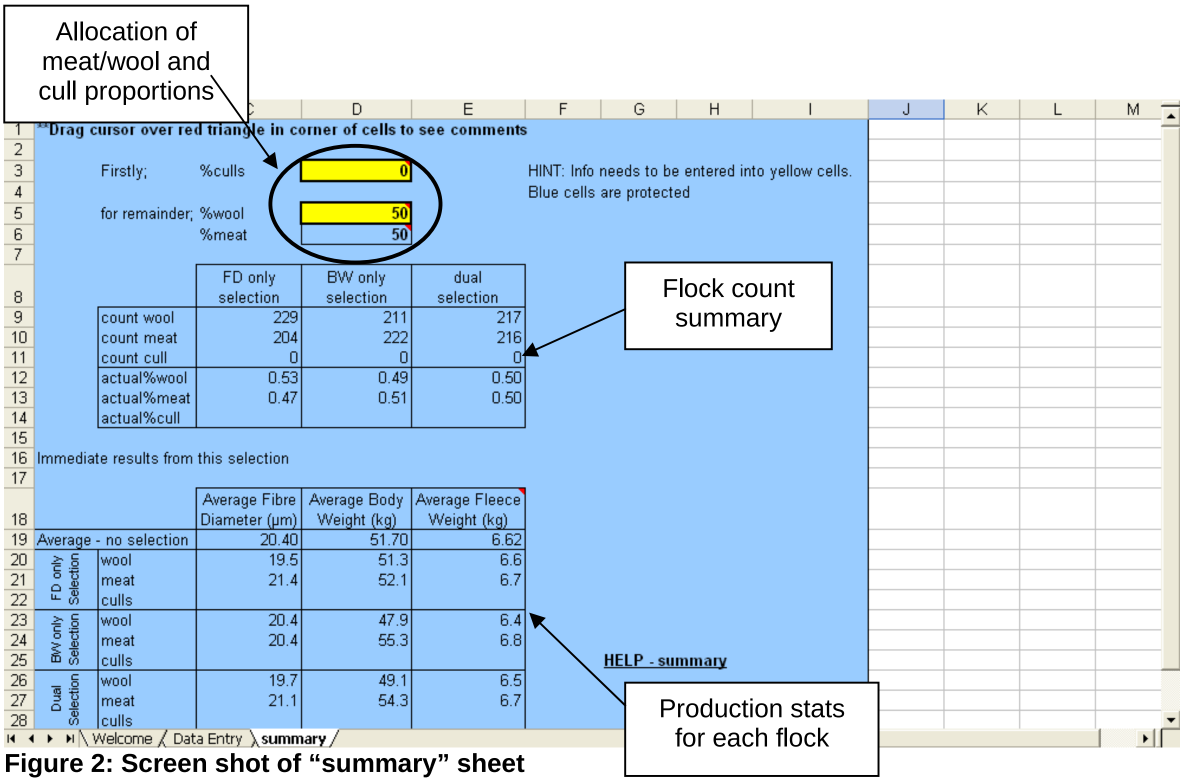


Figure 2: Screen shot of "summary" sheet

9.2 Appendix 2 – Phenotypic Assortment model

Phenotypic Assortment Model Summary

The deterministic model traces the flow of genes in a commercial Merino flock for fleece weight (FW), fibre diameter (FD) and body weight (BW) arising from various selection scenarios. The model uses base flock information and makes predictions using this information and phenotypic and genetic parameters on future FW, FD and BW.

The first thing to be established is the flock structure in the 'Data Entry' sheet. Information is needed, such as the number of breeding ewes and adult wethers as well as the corresponding number of age groups and the reproduction rate for the flock. There is a set mortality rate of 5% built into the model that cannot be changed. The average fibre diameter (FD) of the flock also needs to be allocated at this stage. The fleece weight (FW) and body weight (BW) values are optional. If no values are allocated then default values will be used based on predictions calculated from the given FD. There is also an option of additional sire input in both wool and meat flocks. After the base flock information has been decided, the selection index for both the ewes and wethers needs to be allocated. There could be many successful options for selection, this model currently offers twelve different selection techniques (and one "no selection" option). Below is a snapshot of the 'Data Entry' screen of the model where this information is entered.

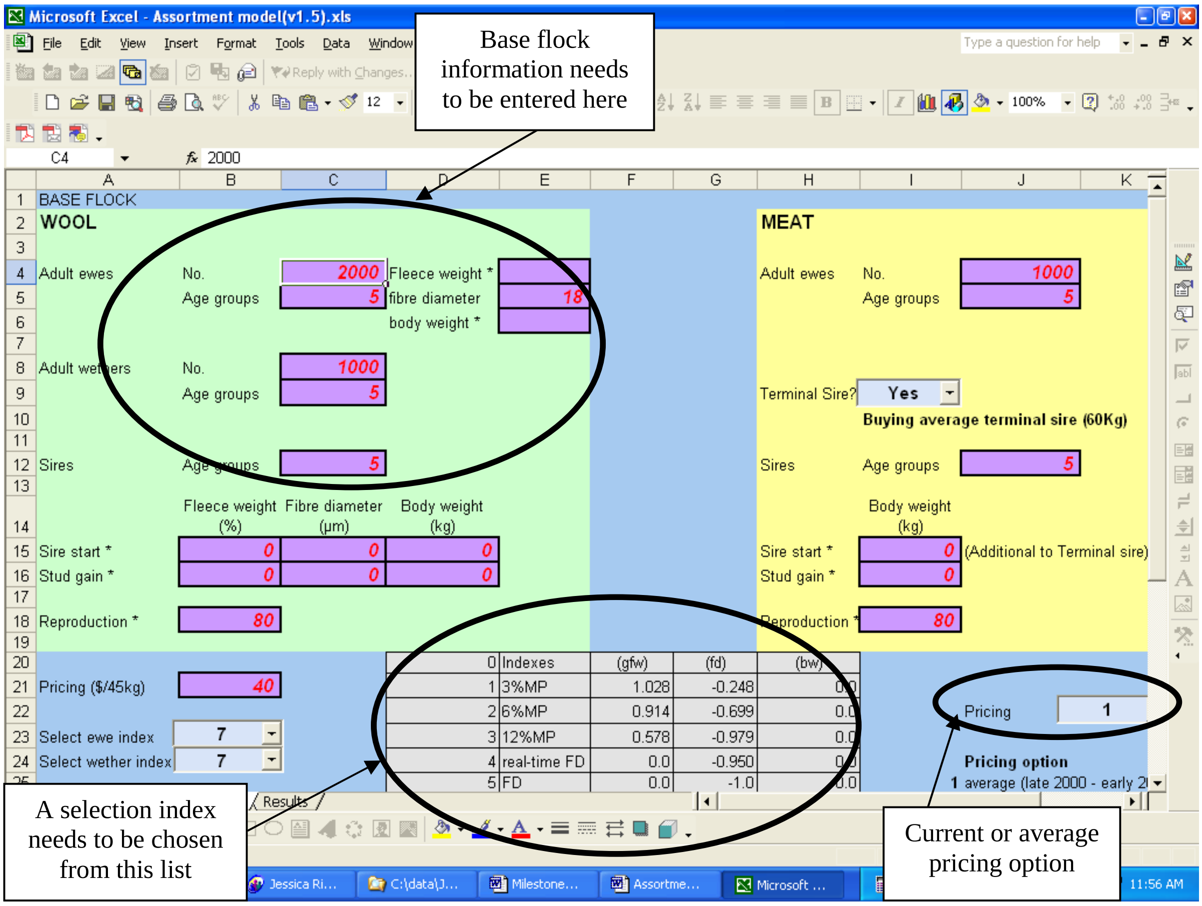


Figure 1: Snapshot of 'Data Entry' sheet in Phenotypic Assortment Model

From this information the BW, FW, FD and DSEs are shown on the 'Results' sheet for ewes and wethers over the next twenty years after the first selection. It also separates the body weights of animals into retained (wool or meat group) and sale animals to compare the difference in BWs between the groups. The gross margins are then calculated according to these production results based on average wool pricing (over the last 5 years) or the latest price period and a range of meat pricing values. The meat pricing values can range between $20-$40/45kg animal, depending on what is selected. This value represents a $10 skin value and the remainder of this figure is used as the carcase value per 45kg body weight. These gross margin calculations allow comparisons to be made between the different selection options as well as different flock structures and meat values.

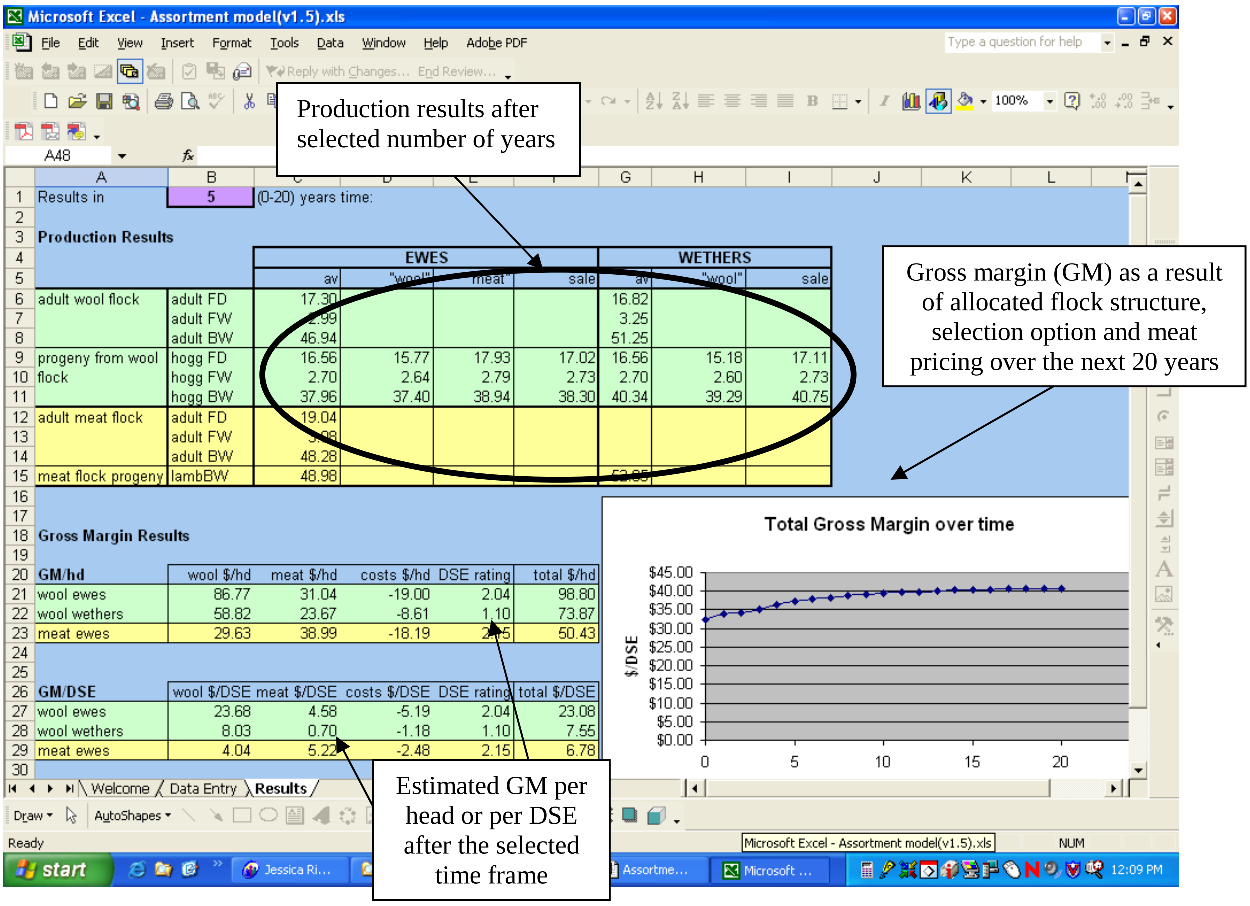


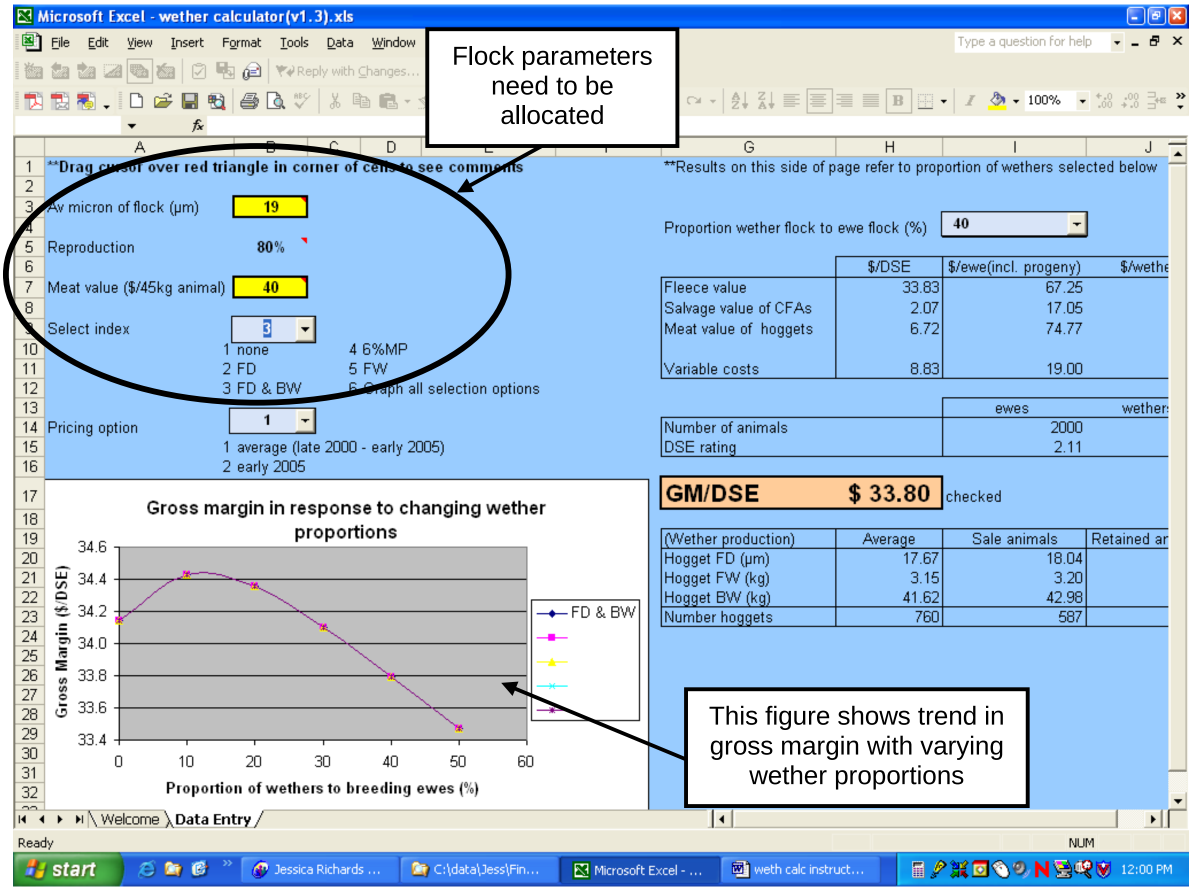
Figure 2: Snapshot of 'Results' sheet in Phenotypic Assortment Model

9.3 Appendix 3 – Wether Calculator

CALCULATOR FOR PREDICTING GROSS MARGIN CHANGES ACCORDING TO WETHER PROPORTIONS IN A MERINO FLOCK

This calculator was developed as decision support software. It shows the economic consequences of varying the proportion of wethers within flocks of varying fibre diameter over a range of meat values for surplus stock. A range of selection options are also available for consideration. It relies on base flock information to be entered and uses these to make predictions on future fibre diameter (FD), fleece weight (FW) and body weight (BW) and uses these to calculate meat and wool values. These are then used to determine the gross margins per DSE and shows the optimal proportion of wethers within their flock economically (the decision for including wethers or not is determined on more factors than just economics).

The first section of the program is where the flock parameters are set. The average micron of the adult flock can range anywhere between 17 and 22 micron. Reproduction is fixed at 80%. The meat value for the sale animals can range between $20-$80/45kg animal. This value represents a $10 skin value and the remainder of this figure is used as the carcase value per 45kg body weight (BW). The selection index needs to be determined as well. This sets how the wethers were selected to be retained versus sold (there is no selection in the ewes or sires). The “none” option refers to just random allocation of the wethers to be retained or sold for meat. The “FD” option refers to ranking the animals according to their FD and retaining the animals with the lowest FD and selling those with the higher FD. The “FW” option retains animals with high fleece weights. The “6%MP” option combines these first two by using a 6% micron premium, ie. they are ranked according to an index. The “FD & BW” option refers to ranking the wethers on both FD and BW and using standardised values to determine which groups they are more suited to, according to their relative ranking (ie. low FD for the wool group and high BW for the meat group). The final option allows all scenarios to be graphed simultaneously so comparisons can be made. The figure on the bottom left allows estimations to be made for a range of wether proportions. The figure also allows an estimation of what the optimal wether proportion is within the flock at those parameters.



The other section of results refers to a specific proportion of wethers. The percentage of wethers within the Merino flock can range in 10% intervals from 0 – 50%. All the fleece values and meat values of the ewes and wethers are shown in their respective columns. The overall variable costs are also shown as well as the DSE rating of the ewes and wethers. Under all of this is the over all gross margin per DSE. The table on the bottom right shows the predicted BW, FW and FD of the flock in five years time according to the parameters set.

9.4 Appendix 4 – Summary document on CD

SIMULTANEOUS ASSORTMENT OF MERINOS INTO “MEAT” AND “WOOL” PRODUCTION AND MATING GROUPS

Drought and low wool prices have resulted in a decline in Merino sheep numbers, increasing pressure on the Merino as a dual meat and wool animal. A simultaneous phenotypic assortment strategy for dual products was developed to increase the size of animals (for meat sale) as well as reducing the fibre diameter of retained animals (for wool production). The selection strategy involves ranking the animals using fibre diameter and body weight and allocating them to a wool or meat production group according to their merit for each trait. This assortment can be used in yearlings to identify sale or retained animals or among breeding ewes for mating allocation to improve progeny performance through appropriate mating to either meat or wool sires.

A program was developed (**Simultaneous Assortment**) that produces a selection list for “wool” and “meat” animals based on current measurements, such as fibre diameter and body weight. A summary table compares the fibre diameter (FD) and body weight (BW) (and fleece weight (FW) if data available) of the animals according to no selection, meat or wool single trait selection or the dual selection scenario. This easily shows the benefits achieved through the selection options. So this is a useful tool for allocating animals into production groups and a summary of the production result is shown immediately.

The other way this program can be used is for identifying which ewes to mate to which rams within a dual production system. The common practice of mating surplus age groups of animals to meat sires is no more than random allocation and leads to a net zero contribution of improved genes from commercial ewe selection to progeny from either of the dual production systems. Selecting ewes to remain in the wool flock (mated to Merino rams) on fibre diameter and those for the meat flock (mated to terminal sires) on body weight could be an effective mating allocation strategy resulting in superior performance of the resultant progeny. The selection process here is the same as that described above.

In order to provide a profitable selection process for commercial producers, the economic returns from using simultaneous selection of meat and wool animals within a Merino flock were examined in comparison to other selection options. Both the production effects from lifetime production and mating allocation effects were included. Other traits were considered that may be influenced by the selection process and have an economic effect, such as fleece weight and reproduction rate. In addition to the direct economic effects, the flock structure implications and interactions also need to be considered.

A model was developed (**Assortment Model**) as a means of generalising the process and predicting potential future impacts. The model allows questions to be examined that cannot be achieved through analysing actual data without mating animals and studying their progeny. The model traces the flow of genes in a commercial Merino flock for FW, FD and BW arising from various selection scenarios. The model uses base flock information and makes predictions using this information and phenotypic and genetic parameters on future FW, FD and BW. These predictions were then used to make estimations on the dollar value of the wool and meat production from these animals. There is an option in the model to enter various meat values to cover the changing meat market. This model is quite complex and not suitable for distribution. The main output from this model is smaller subsets of the total output available. These subsets can be used to demonstrate specific examples, such as the Wether Calculator.

Another model (**Wether Calculator**), an extension of the general approach, examines just the impact of wether selection within a flock. It is based on this same initial model, but removes all sire and ewe selection. It also includes a wether proportion section that allows the optimal proportion of wethers to be calculated according to the gross margin per DSE.

CONTENTS ON CD

Included on this CD is a copy of these two programs as well as a brief description of both. Sample data is included for the Simultaneous Selection program as no data is saved in the actual model. PowerPoint presentations that could potentially be used for highlighting the usefulness of these programs are also attached. There is also one other PowerPoint presentation that combines both of the programs into one presentation. The presentations contain numerous slides so they can be cut down according to the level of description needed or time constraints accordingly. The CD is divided into three sections as listed below;

1. Summary

This Opening document
Overall presentation

2. Simultaneous Assortment

Simultaneous Selection program
Simultaneous Selection instructions
Sample data for Simultaneous selection
Simultaneous Selection PowerPoint presentation

4. Wether Calculator

Wether Calculator Model
Wether Calculator instructions
Wether Calculator PowerPoint presentation

9.5 Appendix 5 – Case study of David Strong

PROFILE 1

David Strong
'Coolbaroo'
Wagga Wagga, NSW

AT A GLANCE

- 950 hectares
- 1150 ewes joined to Merino rams, 1150 ewes joined to terminal sires
- Marketing 1000 crossbred lambs per year

KEY POINTS:

- **Large volumes of performance data are easily handled, and can be re-used in multiple facets of livestock management.**
- **Data collected on individual animals enables accurate culling decisions – individual measurements revealed fleece values varied from $15 to $90 per head.**
- **Auto-drafting before shearing, based on current and/or historical records, means wool can be baled according to specific target markets.**

David Strong uses PSM in both his Merino and crossbred lamb flocks.

Performance data on the pulse

There was a time at 'Coolbaroo' when sheep classing was a long and drawn out process that involved pots of paint and sometimes pots of frustration at the race.

Not any more thanks to the use of precision sheep management (PSM) and particularly the advent of RFID tags.

'Coolbaroo' manager, David Strong, says his 'old' classing system involved being at the race with a lot of books, tins of paint – and a lot of people.

"My finger is right on the pulse. In a drought for example, we will know very quickly where to start culling."

"Some one would call out a tag number, some one would retrieve the hard copy of the information and then the sheep would be marked accordingly. We always had errors with that system," David says.

"That's all in the past now with the advent of the RFID tag and we can readily access the data on the computer in the yards or at the race."

David's first experience with RFID tags was in 2003 but the family had been recording individual animal performance for many years prior to that.

"We had the book work on fleece weights and micron for pretty much the entire ewe flock so it was great to be able to combine the data."

"It means we can easily re-use the information and importantly, the data can be accessed at the race and used in our classing decisions."

David has been involved in RFID tag trials and 2005 was the first time that all the Merino ewes were RFID tagged.

'Coolbaroo' is a family property located at Ladysmith, near Wagga Wagga in southern NSW, which has been in the Strong name since the 1950s.

Apart from the livestock, crops of wheat, canola and oats are grown. The sheep flock comprises 2300 Merino breeders, 500 wethers and 900 hoggets. Of the ewe flock, 1300 are joined to Merino rams while 1000 are joined to terminal sires such as White Suffolks or composite breeds.

The aim is to turn off around 900 first-cross prime lambs per year as well as 450 Merino wether hoggets. The target specification of the prime lambs is a trade carcase weight of 18 kilograms or 40-45kg liveweight.

4 **Precision Pays.** Producer profiles on how precision sheep management is achieving accuracy, confidence and on-farm profitability.

Lambing is in August. Lambs are sold through the saleyards and some over-the-hooks direct to the abattoir. The average lambing rate (at marking) is 93 percent (but 85pc during the 2006 drought).

Lambs get their RFID tags at marking.

"So from lamb marking onwards, the computer and we know which mob that lamb was born into. Lambs are then weighed at various stages throughout the year to generate growth rate information that is used for genetic comparison and selection."

The crossbred sheep are sold at certain target weights, as are the Merino hoggets. An auto-drafter is used to ensure slaughter sheep are at their target weight prior to selling.

At crutching in October a mid-side sample is taken and, at the same time, the RFID tag number is read, and a barcode printer prints a label.

The label goes on the bag with the mid-side sample that is sent off-farm for wool testing. The wool testers can read the barcode and then all the matched data is e-mailed back to David.

David can then run the hoggets, for example, through an auto-drafter (which he has on loan from the NSW Department of Primary Industries) prior to shearing according to micron to achieve specified bales of wool.

"This means we can very accurately target a specific market," David says.

The RFID tags are also utilised at shearing. Typically the hogget's tag is scanned as the sheep comes onto the board. A label is

"Our notional fleece values range from $15 – $90 a head ... this huge variation is largely hidden unless we capture and access the data."

printed off and placed above the shearer. When the fleece is picked up, the label goes to the electronic scales with the fleece. The number is scanned and the fleece weight is recorded as well as classer notes.

All micron and fleece data is compiled for the sheep as hoggets and a notional fleece value (on a dollar basis) is allocated to every animal.

Hoggets are then ranked according to fleece value and that information is combined with bodyweight to decide what management option will be taken, that is, whether the animal will become a crossbred dam or Merino dam.

"The RFID tags are a great selection aid that undoubtedly helps the genetic advancement of our Merino ewe flock," David adds.

While he cannot calculate the actual return on investment from using the RFID tags, David points to just one aspect of the tags and PSM that is making a huge difference to flock management on 'Coolbaroo'.

The Strongs also re-use the RFID tags, so they are a one-off cost apart from the male part of the tag, which costs around 20 cents each.

David has no doubt that PSM and RFID tags will play a big part in the future management on 'Coolbaroo'.

"It definitely makes running the enterprise much more interesting. My finger is right on the pulse. In a drought for example, we will know very quickly where to start culling.

"I am very enthusiastic about it."

RFID tags are a one-off cost

Precision Pays. Producer profiles on how precision sheep management is achieving accuracy, confidence and on-farm profitability. 5