Standardised ranking values (SRVs): the statistical population approach to easy on-farm identification of superior animals

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Abstract: Though farmers are keen to recognise the importance of identification of superior animals for breeding purposes using available genetic selection methods, they are also critical of the complexity to apply these methods at the farm level and even to properly understand the values for decision-making when choosing animals. A most valuable technique for undertaking this analysis (i.e. EBV) is still an elite option, depending on outside farm elaboration. Similar situation happens with EPDs (NSIP 2006). A complementary technique named as Standardised Ranking Values (i.e. SRVs) is herein presented and tested in a variety of scenarios - at the farm level and implemented by the farmer himself/herself - showing the versatility of the technique. SRVs, though based in fundamental statistical principles, are easy to understand and easy to apply. They give to the farmer autonomy in what trait(s) to base his/her selection criteria since they can be worked out for one trait or for a combined set of related traits. On the other hand, each trait can be weighted as per the personal interest of the farmer. SRVs are sufficiently reliable to ensure that the best (i.e. elite) animals are identified. The fundamentals of SRVs are based in the probabilistic normal distribution of group performance, and the positioning of animals under the normal curve within ranks bound by the standardised deviations of the normal distribution related to the average group performance. Its application depends on the availability of a calculator and/or a computer incorporating spreadsheets (e.g. Excel™). SRVs provide farmers with an indication of the phenotypic merit of their animals and their ranking as either ELITE (top 2.5% of the population or beyond +2 STDEV); SUPERIOR (remaining top 13.5% of the population, or between +1 and +2 STDEV); AVERAGE (at least 68% of the population; or between -1 and +1 STDEV) and INFERIOR or CULLING (16% of the bottom level of the population; or below -1 STDEV) SRVs are not competitive with EBVs, nor with EPDs but on the other hand, they can be used for increased understanding of these more complex techniques. Using case-study data generated from different farm operations the SRV technique was tested in a comparative manner to EBV results to confirm its consistency and reliability. A Z test for pairs confirmed the consistency of the SRV results compared to EBV results.

Keywords: animal genetic evaluation, SRVs, EBVs, EPDs, animal performance, farming systems

Introduction

Animal selection is an important issue in the process of ensuring the best genetic material in breeding herds. Traditionally, *Estimated Breeding Values* (i.e. EBVs) have been used in Australia (MLA 2004) for quantifying the genetic value of animals; however they are perceived to be complex and difficult to be accessed by the farmers to enable them to make quick and reliable decisions at the farm level. The literature also reports the use of the *Estimated Predicted Difference* (EPD) technique, similar to EBVs, in the USA as an institutional genetic tool for evaluation of sheep and cattle performance (NSIP 2006; ABRI 2005).

This paper deals with the implementation of a complementary technique to the above previously mentioned techniques named as *Standardised Ranking Values (i.e. SRVs).*This technique is mainly proposed within a farming systems perspective to facilitate the implementation of on-farm phenotypic selection decisions and to enable the farm business manager to conduct the phenotypic evaluation of his/her animals in the most objective way as possible at the farm level. It is thought that SRVs might also be a tool to facilitate a better understanding and use of EBVs, as demonstrated within the case scenarios of this paper.

The paper offers a background about the techniques for genetic performance evaluation, describes the methodology supporting this research, discusses the results and provides a series of conclusions. Basic data and tabulated results are presented in the Appendix.

Background

Performance evaluation and selection of superior animals has been the backbone of the improvement in agriculture (i.e. animals and plants) that have allowed the increase in efficiency of individual genotypes and populations, and evolution of the farming systems.

Breeding is frequently about making comparisons between one animal and another, or more particularly the traits measured in these animals. It is thus important that measurements are made on valid terms. It is, for example, difficult and unwise to compare animals of differing ages or to compare those reared and managed in different herds and environments (Willis 1998).

The literature is abundant in terms of justifying selection and breeding methods based in statistical principles that support some of the more common techniques: Estimated Breeding Values (EBVs) and Expected Progeny Difference (EPDs); (Cameron 1997 and Hammond et al 1992).

Estimated breeding values (EBVs) are the most recognised technique in Australia for performing genetic evaluation of animals across species. An EBV is an estimate of an animal true breeding value. EBVs are benchmarked, which allows the animal under evaluation to be fairly and directly compared to a benchmark, the current breed average (MLA 2004).

EBVs give a ranking as a nominal value (number) that expresses the difference (+ or -) between the individual animal and the benchmark to which the animal is being compared. For example, if an animal were to have an EBV of +6 for post weaning, it means that the animal - and its likely progeny - has the genetic potential to be 6 kg heavier – up to 50% for the progeny -than the benchmark it is being compared to (MLA 2004).

The statistical algorithm that supports the EBV technique is as follows:

$$\mathbf{EBV = (Xi - \mu)\,h^2}$$

where,

EBV = Estimated Breeding Value for a particular trait;

Xi = Individual's performance for a particular trait;

μ = Breed average performance (i.e. regional, national, international);

$(Xi - \mu)$ = individual's selection differential for a particular trait; and

h^2 = Heritability index for that particular trait.

MLA (2004) states that an EBV is the best estimated of genetic merit of an animal. Therefore, given all the available data, the estimate is unbiased and as close to the true value of the genes as can be achieved. An EBV will never have an accuracy of 100%; however sires with many recorded progeny are approaching EBVs of 99% accuracy, recognising that the estimate is very close to the animal's true breeding value (MLA 2004). Rudder (1992) illustrates the importance that the accuracy of EBVs going through two major steps. Initially when the animal has its own records and records on relatives; and secondly, when it gets its own progeny.

EBVs adjust for environmental differences such as age, age of dam, rear type and nutrition. This allows for comparison of animals born in different season and years and also adjust for known genetic difference (MLA 2004).

Beatson and Parratt (1985) have discussed the importance of eliminating environmental effects on animals being compared. This is not only within a flock, but also between flocks in different environments. These authors also highlight the importance of expenses in relation to performance or progeny testing in a neutral environment. This expense can however, be minimised in an on-farm environment through the use of a sire referencing database to identify superior genetics.

Nowadays in Australia EBVs have a widespread application and a well defined organisational support (MLA 2004, BREEDPLAN 2004). However it is observed that within the farming community though EBVs are treated with respect, there is an extended level of misunderstanding regarding informed use of the values, as well as their meaning and usefulness in the aiding of selection processes. Though there is the broad perception that positive EBVs indicate superior animals, there is not the confidence to get information which of those positive EBV value animals are really average, superior and/or elite related to the overall population performance. Though indexes have been established to overcome this limitation still the positioning of different genetic value animals is unclear when using EBVs.

The USA National Sheep Improvement Program (NSIP 2006) uses *Expected Progeny Difference (i.e.* EPD) method to estimate the genetic merit of an animal for a single trait. Also EPDs are applied to cattle genetic evaluation (ABRI 2005). Fundamentals on EBVs and EPDs are found in Hammond (1992) and Bourdon (2000). Specifically, the EPD of an animal is the expected difference between the performance of that animal's progeny and the average progeny performance of all the animals in the breed, for that trait. EPDs are reported in the normal units of a trait, such a +0.5 kg for weights or –0.3 microns for wool fibre diameter. It is important to note that an EPD is not a ratio or an index. EPDs are expressed as deviations (+ or -) from the average population value, which is considered to be zero. Therefore EPDs always have either a positive or negative sign in front of them.

The fundamental statistical algorithm that supports an EPD value is as follows:

$$\mathbf{EPD = (Xi - \mu)}$$

where,

EPD = Expected Progeny Difference;

Xi = Performance of an animal's progeny;

μ = Average progeny performance of all the animals in the breed.

The positive or negative signs do not always mean *better* or *worse* – it depends on the trait. For example, a weaning weight EPD of +5.0 kg is good (i.e. more weight of lamb at weaning) but a fibre diameter EPD of –0.3 microns can also be good (i.e. smaller fibre diameter which is more valuable for wool producers). In general EPDs allow comparison of the genetic value of different animals. For example a ram with weaning weight EPD of +1.0 is good but a different ram with a weaning weight EPD of +2.0 is better (NSIP 2004). However EPDs do not allow to have an indication of how much the second ram is better to the first since similar to EBVs they do not have a cut-off point for having an indication of a ranked real genetic merit of that particular animal within the population of animals.

NSIP (2004) states that EPDs are used only in purebred animals and they are not calculated for commercial flocks since the central sheep database is only for full blood registered animals. It remains the development of a method that can be widely used by producers at their farm level to objectively identify superior commercial and/or stud animals.

The statistics of the SRV method

In parametric statistical analysis (Levine et al 2005) the assumption of data normality is an essential condition to proceed with estimation of values extendable to populations. This assumption of normality brings up the concept of normal probabilistic distribution of the population data, a cornerstone principle that is widely accepted by quantitative analysts. A normal probability data distribution has a like-bell shape and has at least three standard deviations to each side of the mean value. Considering the previously identified limitations of the commonly used genetic evaluation methods (i.e. their inability to grade the animal genetic value within ranks), the SRV was developed using these fundamental statistical principles. SRV is a technique able to rank the genetic merit of an animal, within the overall population of similar animals, for a single trait or for a set of combined traits.

The SRV method is based in the fundamental principle of data standardisation, i.e. Z test. It takes the selection differential (i.e. the individual animal variation related to the group average, i.e. Xi - μ) for a particular trait, and relates this difference to the population standard deviation for that specific trait. This is expressed in the formula hereafter, as follows:

$$\mathbf{SRV = (Xi - \mu)/\sigma}$$

where,

SRV = Standardised Ranking Value;;

Xi = Value to standardise (i.e. individual's performance for a particular trait)

μ = Average (AVG) group performance for that particular trait; and

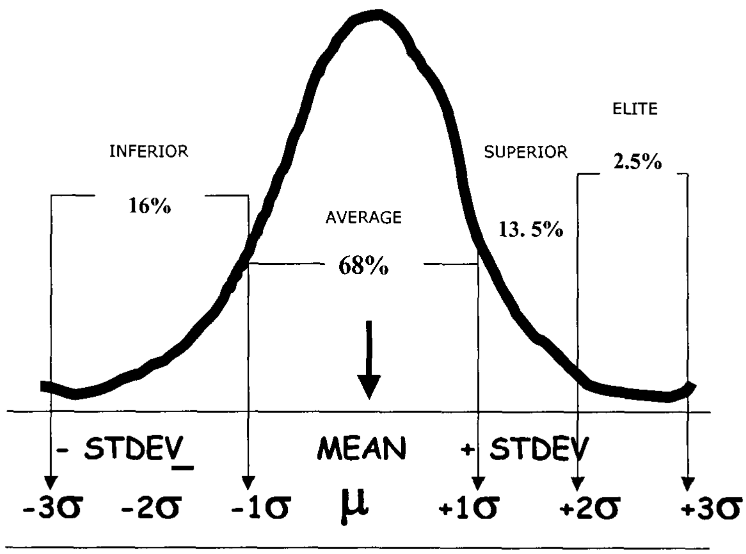
σ = Standard deviation (STDEV) group performance for that particular trait.

The operational process to implement the technique in Microsoft Excel® is described in Footnote 1 (Appendix).

The obtained SRV using the above formula is an index that positions a specific animal under the probabilistic normal distribution in terms of standardised deviations from the mean value of the group and/or population under analysis (i.e. normally between '0' and '3' standard deviations to each side of the average data value). This indicates that the animal is positioned in a comparative manner to all the similar animals from the whole population under analysis.

Figure 1 shows the standardised distribution of values of a normal population; and positions the group average and the total set of standardised deviations to the left and to the right of the mean value. It is possible to observe, as per traditional statistical theory, that there are at least 3 standard deviations to either side of the data mean (Levine et al 2005). The population percentages that fall within different standardised deviation ranges support cut-off points for the practical purposes of defining a decision criterion of ranking of an animal in evaluation. It could be said that standardised deviation ranks between -1 and +1 (i.e. 68% of the population) represent an *average animal* for the trait or set of traits in evaluation. These values are just around the left and right side of the average group and/or population value, which is placed in the centre of the distribution (see Figure 1). Values of standardised deviation between +1 and +2 (i.e. 13.5% of the population) indicate an *above average or superior animal* for that particular trait. These values are placed to the right hand side of the distribution as can be observed in Figure 1. Standardised deviation ranks beyond +2 (i.e. 2.5% of the population) indicate an *elite animal* for that particular trait or set of traits. These values are placed to the extreme right hand side in Figure 1. On the other hand, standardised deviation below -1 (i.e. 16% of the population) indicates an *inferior animal* for the particular trait(s) in analysis. These values are located towards the left hand side in the Figure 1.

Fiqure 1. Standardised normal distribution of data



The Z test is the universal statistical method to standardise data and it is the foundational technique to statistical significance analysis (Levin et al 2005). Therefore, if a method for phenotypic ranking of animals under the normal distribution assumption is built using the statistical principles of the Z test there is not reason to argue that it might not have the same universal validity as the existing techniques for similar purposes; thus increasing the scope of available methods for selection purposes. SRV, method was initially proposed for alpacas' evaluation by Charry, Lawrie and Johnson (1997).

The case-study scenarios

Case-study 1: EBVs and SRVs in ranking of meat sheep rams

In this case study, information from a meat sheep stud that produces terminal sires for prime lamb production was collected. The annual ram harvest 2005 records were taken and EBVs calculated for the trait yearly weight (YWT). SRVs were then calculated for the trait in an independent manner using the on-farm generated data. The objective of this scenario was to check the consistency of the individual SRVs, in a comparative manner with EBVs, and rank the animals as per the proposed SRV classification previously mentioned for the combined trait values. Using the data from this scenario a 'Z' test for the two-traits was conducted with a null hypothesis (i.e. H_0: $\mu_a = \mu_b$) stating that there were not meaningful differences between the values of the two groups. In the eventuality of not having enough level of confidence to reject this null hypothesis, the statistical procedure would be confirming that there is not evidence to, therefore, accept the alternative hypothesis that establishes that the two methods work with different levels of consistency in demonstrating the genetic value of an animal. The subsequent problem to evaluate is which one of the methods can produce the most simple evidence to visualise the superiority and/or inferiority of a specific animal and which one of the methods is able to be easily used by the farmer in a day-to-day situation. Results of the Z test for pairs of data can be seen in Table 1 indicating that the level of confidence at which the null hypothesis can be rejected is not meaningful; therefore the acceptance of the alternative hypothesis which states a difference in results between the two techniques (i.e. EBV and SRV) it is not possible to be supported.

Table 1. Z-Test: Two Sample for Means

	Variable 1	*Variable 2*
Mean	0.031746	-8.99E-16
Known Variance	1.14	1
Observations	63	63
Hypothesized Mean Difference	0.03	
z	0.0094736	
P(Z<=z) one-tail	0.4962206	
z Critical one-tail	1.644853	
P(Z<=z) two-tail	0.9924412	
z Critical two-tail	1.959961	

Table 2 (Appendix) shows that using SRV criteria it is possible to rank the animals from ELITE, through SUPERIOR, AVERAGE and INFERIOR. Also it is noted in Table 2 (Appendix) that the individual EBV and SRV values are consistent between themselves along the ranked animals.

Case-study 2: Multiple-trait EBV and SRV data and ranking of the elite rams as per a single trait criterion.

In this case-study scenario with data coming from the 2004 ram harvest from a wool stud, enrolled in the Merino Genetic Validation Program and prepared for the on-farm auction were used. EBV values for yearly weight-kg (YWT), eye-muscle depthness-mm (EMD) and fat-mm (YFAT) were provided. SRVs for each of these individual traits were calculated from the EBV data and the rank for each trait is described. Under the assumption that the farmer will make his/her decision in selecting the ELITE and/or SUPERIOR rams using the YWT criterion the animals were sorted out as per this variable. In doing this not only there is a clear indication of the animals that fall within the target classes but also the relationship of the remaining traits (FAT and EMD) to the priority selection criterion (e.g. YWT). Table 3 (Appendix) contains this information and therein it is possible to see that a farmer when analysing the data may confidently get an informed simple indication of what are the best rams with emphasis in YWT and their class positioning for the remaining traits FAT and EMD.

Case-study 3: The combined SRV criterion for ranking animal performance.

Table 4 (Appendix) offers a typical scenario where the set of data may overwhelm the farm business manager. Three traits with EBV and SRV values with ranking for individual traits are presented. Since there is not a specific ranking criterion for the classing of the animals, in a scenario where the farmer considers all the traits are important, this gives little space for a confident decision on "selection of the best animals" when all the traits have the same weight in an independent manner for decision-making. A proposed solution to this eventual real-life situation is offered herein creating a combined-two trait SRV (i.e. YWT + EMD) to rank the whole group of animals as per the combined SRV criterion, and facilitate decision-making, assuming that YWT and EMD are the key-decision issues

Case-study 4: Triple-trait combined SRV decision criterion incorporating subjective weighting of individual traits

In this case study ewe data were compiled from a meat sheep stud and on-yard performance values were obtained to generate the set of SRVs for the traits YWT, YFS and EMD. A triple-combined SRV was generated with a specific weighting for each trait following the subjective perspective of the farmer about the importance of each trait for his/her selection decisions. YWT was considered to weight 0.75 (i.e. 75%) of the subjective farmer's decision; EMD was given a 0.15 (i.e. 15%) of weighted value and YFS was allocated 0.10 (i.e. 10%) of weighted value. The ewes were sorted out as per this triple-ranking criterion. The data for this experiment can be seen in Table 5 (Appendix).

Discussion of results

Table 1 (Appendix) indicates that the level of confidence at which it is possible to reject the hypothesis of equality of mean performance between the two set of values is only 0.007% (i.e. CL = 1.00 - p for a two-tail test). Therefore it can be stated that the spectrum of EBV and SRV values perform in a similar manner when analysing similar sets of data. The 'Z test' is conclusive to test this assumption of similarity in performance of both techniques (i.e. EBVs and SRVs).

In Table 2 (Appendix) it is possible to observe that the animals have been organised in a descending manner as per their SRVs and their ranking is evident showing only one ELITE ram, six SUPERIOR rams, twenty five AVERAGE rams and the remaining are classified as INFERIOR rams for breeding purposes. It is interesting to observe that the EBV boundary between the SUPERIOR rams and the AVERAGE rams is definitely unclear. Also it should be noted that all the AVERAGE rams are EBV positive; and a most remarkable thing is that rams 33 to 35 though being classified as INFERIOR by the SRV technique continue offering positive EBVs. There is an evident consistency between the EBV and SRV values all along the set of data, i.e. animals with high EBVs offer high SRVs. However the cut-off point for best quality animals can only be clearly differentiated when SRV ranking criterion is taken into account. Therefore it can be stated that the SRV section offers a clear differentiation related to animal classing as described before; and definitely this classing should allow the farmer to make a more informed decision without stress in the management of complex data upon which he/she does not have total understanding confidence. With this type of classing the ELITE and SUPERIOR animals can be identified by the farmer, with advantage for premium stud breeding marketing purposes, while the AVERAGE rams might go to commercial breeders at suitable prices; and the INFERIOR rams should without hesitation head to the butchery.

In Table 3 (Appendix) it is possible to observe the classing and ranking of animals as per SRV criteria for each of the traits in analysis. However in order to facilitate decision-making the animals are ordered as per the YWT-SRV criterion. The farmer can observe in this table the complementary values of ELITE and SUPERIOR animals for the remaining traits. When evaluating EBVs, it is possible to observe, as an example for YWT, that most of the rams of Table 3 offer positive EBVs. When the classing is done using the SRV technique a meaningful number of rams classed as AVERAGE and INFERIOR as per SRV criterion continue offering positive EBVs.

Table 4 (Appendix) contains animals ordered by a two-combined trait SRV decision criterion. The traits YTW and EMD were brought together, with the same weight for decision-making purposes. Operationally what has been done is that the values for each individual trait are added up and divided by 2 to obtain an average SRV of the double-trait. The classing of the animals indicates six SUPERIOR rams while the remaining are allocated to the AVERAGE and INFERIOR classes under the SRV criterion.

Table 5 (Appendix) offers a similar situation to Table 4 though a combined-trait SRV has been organised including all the traits, i.e. YWT, YFS and YEMD. Each of these traits has been given a different weighted value for the setting of the combined index (i.e. YWT=0.75; YFS=0.10 and YEMD=0.15). This follows a hypothetical on-farm situation where the farmer wants to make selection considering a multiplicity of characteristics though having differential preference among characteristics. It is still possible to observe in Table 5 the genetic value of individual animals for individual traits as per SRV criteria, while the ranking order has been set out as per the triple combined SRV results. Results indicate, as per this criterion, that five (5) ewes are SUPERIOR related to the average farm performance for the traits, while the remaining ewes are classed as AVERAGE.

Conclusions

The conclusions of this study can be described as follows:

(a) The *standardised ranking value (SRV)* method is based in universal statistical principles of normal probabilistic data distribution. A ranking taking into account standardised deviations is proposed for purposes of better visualisation of the phenotypic value of a particular animal within a group of animals managed in similar conditions. The SRV ranking method proposes the classing of animals with SRVs below -1.0 as INFERIOR; animals with SRVs between -1.0 and +1.0 are classed as AVERAGE; animals with SRVs >1.00 and <=2.0 are classed as SUPERIOR; and animals with SRVs >2.0 are classed as ELITE. The reference point for this classification is the average value of the on-farm group in analysis.

(b) When ordering the list of animals in analysis using the SRV criterion, as those in Table 2 (Appendix), the highest EBVs come consistently at the top of the data set. The consistency in EBVs and SRVs is confirmed by the results of the Z test where it was not possible to reject the *null* hypothesis (Table 1 – Appendix) that stated the similarity of results for values generated either from EBV and SRV techniques.

(c) The evidence of case-study 1 indicates that when using the SRV method in a comparative manner with the EBV method for decision making in terms of ranking and/or classing the genetic quality of an animal, the SRV criterion is a reliable tool since it offers a rank within the group of similar animals for a determined trait or for a set of traits as per a specific proposed ranking system supported by standardised deviations related to the mean population value. Using the SRV criterion it is easier to identify the cut-off point between ELITE, SUPERIOR, AVERAGE and INFERIOR animals rather than with the EBV criterion (Tables 2, 3, 4 and 5 – Appendix).

(d) EBVs do not allow to differentiate in an easy manner between different genetic class animals. This creates a problem of misinformation when decisions need to be made to select elite animals within a population of animals using EBV criteria.

(e) The SRV criterion can be used for an *individual trait or for a combined set of traits* within a group. In the eventuality of traits with subjective differential weighting the farmer might *built SRVs for individual traits or for a combined set of traits* encompassing this specific preference.

(f) SRV criterion can be used to order and rank EBVs within the *proposed classing groups* (Table 2 - Appendix) making SRV a useful technique to complement the understanding, application and management of techniques such as EBV and EPD.

(g) It has been demonstrated that the use of SRVs might potentially be an useful practical tool to conduct genetic performance evaluation at the farm level, since it facilitates this exercise because of the simplicity in the understanding and application of the technique. Definitely the improvement of genetic decision-making, within a farming systems context, might be better implemented if SRVs were used.

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Appendix

Footnote 1: Operational implementation of SRV technique using Microsoft Excel®

In order to implement the technique the analyst must have access to a computerised spreadsheet (e.g. Microsoft Excel ®).

The ordered process is as follows:

(a) Data must be entered in a column manner in the Excel worksheet;

(b) Two columns must be created beside the raw data. First, for placing the SRV values (e.g. SRV for WEIGHT) and afterwards, for the classing of those SRVs (e.g. RANK for WEIGHT).

(c) At the bottom end of each column that contains the raw data you should work out the AVERAGE and the STANDARD DEVIATION for that specific set of data. You will need these values for working out the SRV for each individual animal and for each particular trait. You can observe the positioning of these values and the labelling within the tables that are part of this Appendix.

For working out the AVERAGE from a column of raw data for a particular trait, place the pointer on the cell where the AVERAGE value should appear. Locate now the '*fx*' icon from the Excel commands. Click on the icon. You will move to a window that will ask you what you want to do i.e. 'search for a function'. Type therein "AVERAGE". The function will appear afterwards in the below window. Click on the specific AVERAGE function and follow the prompts. The end result will be that you will get the AVERAGE value of the specific set of raw data from that column in the cell that you chose to place the AVERAGE. Proceed in the same manner to work out the STANDARD DEVIATION one cell below the AVERAGE. The end result is that you will have in those cells something like this: =AVERAGE(CELL RANGE WHERE THE DATA ARE); =STDEV(CELL RANGE WHERE THE DATA ARE).

(d) Now let's work out the operational procedure for generating the set of SRV values:

Let's assume that you want to work out the SRV for 200 day weight (i.e. we will label that column as 200-WGT SRV).

Now you move to the first cell of that column. This cell must be in the row where the first animal raw data appears to the left. Therein YOU WILL HAVE TO CREATE THE SRV FORMULA FOR THAT ANIMAL AND FOR THE SPECIFIC TRAIT 200-WGT. Afterwards you will have to copy that formula below for the remaining number of animals for which you want to work out the SRVs. You will create that formula writing the following instruction in the specific cell we have mentioned before, as follows:

=((cell where the individual data is – $cell where the AVERAGE value is)/($cell where the STDEV value is): PLEASE NOTE THE $ SIGNS BEFORE THE CELLS WHERE AVERAGE AND STDEV ARE. This $ sign must be placed before the cell letter and before the cell number. After writing this, with the necessary brackets, you press enter and you should have a value in that specific cell. Now go to the first line commands of Excel; find he 'format' command. Click on it. Find the 'cell' command. Click on it. Find now the command 'Number'. Click on it. Now make sure that the cell will have at least two decimals. Press OK. Now you are ready to copy this formula onto the remaining cells of the column. Proceed and do the same operation for as many traits you wish to generate SRVs.

(e) Now you will have to interpret the SRVs on a column on the immediate right hand side of the SRV values. Call this column e.g. 200-WGT RANK. If you are familiar with the 'WHAT IF' function of Excel you can create the formula in one cell and copy it to the remaining cells. Otherwise you will have to observe the SRV values and interpret them as per the classing criteria explained in this paper, i.e. ELITE, SUPERIOR, AVERAGE and INFERIOR. Therefore the final thing you will do is to write the classing of each SRV towards the right of each value in the immediate column.

Table 2 Rams data with ranking as per YWT-SRV

No.	YWT	EBVs	SRVs	RANK	No.	YWT	EBVs	SRVs	RANK
1	92.5	2.6	2.35	ELITE	33	76.5	0.1	-0.05	INFERIOR
2	86.5	1.9	1.45	SUPERIOR	34	76.5	0.1	-0.05	INFERIOR
3	86.0	1.4	1.37	SUPERIOR	35	76.5	0.1	-0.05	INFERIOR
4	86.0	1.4	1.37	SUPERIOR	36	76.0	-0.1	-0.13	INFERIOR
5	84.0	1.2	1.07	SUPERIOR	37	75.5	-0.2	-0.20	INFERIOR
6	84.0	1.2	1.07	SUPERIOR	38	75.5	-0.2	-0.20	INFERIOR
7	84.0	1.5	1.07	SUPERIOR	39	75.5	-0.4	-0.20	INFERIOR
8	83.5	1.2	1.00	AVERAGE	40	75.5	-0.4	-0.20	INFERIOR
9	83.0	1.2	0.92	AVERAGE	41	75.0	-0.3	-0.28	INFERIOR
10	83.0	1.1	0.92	AVERAGE	42	74.5	-0.2	-0.35	INFERIOR
11	83.0	1.1	0.92	AVERAGE	43	74.5	-0.6	-0.35	INFERIOR
12	82.0	1.1	0.77	AVERAGE	44	74.5	-0.4	-0.35	INFERIOR
13	82.0	1.0	0.77	AVERAGE	45	74.0	-0.3	-0.43	INFERIOR
14	82.0	1.0	0.77	AVERAGE	46	73.5	-0.6	-0.50	INFERIOR
15	81.5	0.8	0.70	AVERAGE	47	73.5	-0.6	-0.50	INFERIOR
16	81.5	0.8	0.70	AVERAGE	48	73.5	-0.9	-0.50	INFERIOR
17	81.5	0.8	0.70	AVERAGE	49	73.5	-0.9	-0.50	INFERIOR
18	81.5	0.8	0.70	AVERAGE	50	72.0	0.9	-0.73	INFERIOR
19	81.0	0.6	0.62	AVERAGE	51	72.0	-0.6	-0.73	INFERIOR
20	81.0	0.6	0.62	AVERAGE	52	72.0	-0.8	-0.73	INFERIOR
21	80.5	0.6	0.55	AVERAGE	53	71.5	-0.9	-0.80	INFERIOR
22	80.5	0.6	0.55	AVERAGE	54	71.0	-1.1	-0.88	INFERIOR
23	80.5	0.6	0.55	AVERAGE	55	71.0	-1.1	-0.88	INFERIOR
24	80.0	0.5	0.47	AVERAGE	56	70.5	-1.1	-0.95	INFERIOR
25	79.5	0.5	0.40	AVERAGE	57	70.0	-1.0	-1.03	INFERIOR
26	79.5	0.5	0.40	AVERAGE	58	69.5	-1.3	-1.10	INFERIOR
27	79.5	0.5	0.40	AVERAGE	59	65.0	-1.9	-1.78	INFERIOR
28	79.5	0.5	0.40	AVERAGE	60	63.5	-2.2	-2.00	INFERIOR
29	79.0	0.3	0.32	AVERAGE	61	63.5	-2.5	-2.00	INFERIOR
30	78.5	0.3	0.25	AVERAGE	62	60.5	-2.6	-2.45	INFERIOR
31	77.5	0.3	0.10	AVERAGE	63	54.5	-3.5	-3.35	INFERIOR
32	77.0	0.2	0.02	AVERAGE	**AVG**	**76.8**			
					STDEV	**6.7**			

CRITERIA TO READ SRVs:

Values below -1.00 = INFERIOR
Values between -1.00 and +1.00 = AVERAGE
Values between >+1.00 and <= +2.00 = SUPERIOR
Values > +2.00 = ELITE

Table 3 Rams data for auction-sale with ranking criteria as per SRV for YWT

LOT No.	FAT EBV	YWT EBV	EMD EBV	FAT SRV	FAT RANK	EMD SRV	EMD RANK	YWT SRV	YWT RANK
1	-0.97	5.77	0.78	1.48	SUP	0.99	AVG	3.23	ELITE
9	-0.01	5.42	0.44	-0.14	AVG	0.62	AVG	2.88	ELITE
54	-0.78	5.17	-0.71	1.16	SUP	-0.61	AVG	2.63	ELITE
10	0.68	4.81	0.41	-1.30	INF	0.59	AVG	2.27	ELITE
8	0.22	4.51	-0.31	-0.53	AVG	-0.18	AVG	1.97	SUPERIOR
42	-0.29	4.45	-0.54	0.33	AVG	-0.43	AVG	1.91	SUPERIOR
7	-0.85	4.43	-0.84	1.28	SUP	-0.75	AVG	1.89	SUPERIOR
12	-0.54	4.41	-1.35	0.75	AVG	-1.29	INF	1.87	SUPERIOR
45	-0.86	4.34	-1.36	1.29	SUP	-1.30	INF	1.80	SUPERIOR
57	-0.56	4.19	-0.74	0.79	AVG	-0.64	AVG	1.65	SUPERIOR
60	0.23	2.96	-1.27	-0.55	AVG	-1.21	INF	0.42	AVERAGE
4	0.89	2.95	-0.17	-1.66	INF	-0.03	AVG	0.41	AVERAGE
11	-0.03	2.92	0.05	-0.11	AVG	0.21	AVG	0.38	AVERAGE
47	-0.74	2.9	-0.81	1.09	SUP	-0.71	AVG	0.36	AVERAGE
3	-0.39	2.86	-0.75	0.50	AVG	-0.65	AVG	0.32	AVERAGE
31	0.35	2.85	0.07	-0.75	AVG	0.23	AVG	0.31	AVERAGE
21	-0.62	2.72	-0.51	0.89	AVG	-0.39	AVG	0.18	AVERAGE
32	0.37	2.7	-0.27	-0.78	AVG	-0.14	AVG	0.16	AVERAGE
74	-0.46	2.61	-0.28	0.62	AVG	-0.15	AVG	0.07	AVERAGE
64	-0.28	2.6	-0.22	0.31	AVG	-0.08	AVG	0.06	AVERAGE
72	0.82	2.37	-0.06	-1.54	INF	0.09	AVG	-0.17	AVERAGE
51	-0.15	2.35	0.3	0.10	AVG	0.47	AVG	-0.19	AVERAGE
79	0.12	2.28	0.42	-0.36	AVG	0.60	AVG	-0.26	AVERAGE
27	-0.38	2.27	-0.14	0.48	AVG	0.00	AVG	-0.27	AVERAGE
69	-0.15	1.91	1.00	0.10	AVG	1.22	SUP	-0.63	AVERAGE
36	0.77	1.72	1.62	-1.46	INF	1.89	SUP	-0.82	AVERAGE
77	0.88	1.71	-0.98	-1.64	INF	-0.90	AVG	-0.83	AVERAGE
70	-0.34	1.63	-0.45	0.42	AVG	-0.33	AVG	-0.91	AVERAGE
24	0.10	1.29	-0.52	-0.33	AVG	-0.40	AVG	-1.25	INFERIOR
20	0.19	0.52	0.04	-0.48	AVG	0.19	AVG	-2.02	INFERIOR
40	0.09	0.46	1.45	-0.31	AVG	1.70	SUP	-2.08	INFERIOR
AVG	**-0.09**	**2.98**	**-0.14**						
STD	**0.59**	**1.17**	**0.93**						

CRITERIA TO READ SRVs.

Values below -1.00 = INFERIOR
Values between -1.00 and +1.00 = AVERAGE
Values between >+1.00 and <=+2.00 = SUPERIOR
Values >+2.00 = ELITE

Table 4 SRVs rams data generated from EBVs data and organised as per a combined (YWT+EMD) SRV

LOT No.	FAT EBV	YWT EBV	EMD EBV	FAT SRV	FAT RANK	YWT SRV	YWT RANK	EMD SRV	EMD RANK	YTW-EMD COMBINED SRV	COMBINED SRV RANK
78	-0.57	5.14	1.44	0.80	AVG	1.83	SUP	1.69	SUP	1.76	SUPERIOR
1	-0.97	5.77	0.78	1.48	SUP	2.36	ELITE	0.99	AVG	1.67	SUPERIOR
9	-0.01	5.42	0.44	-0.14	AVG	2.06	ELITE	0.62	AVG	1.34	SUPERIOR
16	-0.62	5.13	0.39	0.89	AVG	1.82	SUP	0.57	AVG	1.19	SUPERIOR
6	-0.54	3.87	1.23	0.75	AVG	0.75	AVG	1.47	SUP	1.11	SUPERIOR
10	0.68	4.81	0.41	-1.30	INF	1.55	SUP	0.59	AVG	1.07	SUPERIOR
17	-0.15	3.66	1.19	0.10	AVG	0.57	AVG	1.43	SUP	1.00	AVERAGE
18	-0.15	3.06	1.42	0.10	AVG	0.06	AVG	1.67	SUP	0.86	AVERAGE
58	0.41	2.52	1.48	-0.85	AVG	-0.40	AVG	1.74	SUP	0.67	AVERAGE
55	-0.33	3.37	0.63	0.40	AVG	0.32	AVG	0.83	AVG	0.57	AVERAGE
8	0.22	4.51	-0.3	-0.53	AVG	1.29	SUP	-0.18	AVG	0.56	AVERAGE
68	0.11	3.17	0.73	-0.34	AVG	0.15	AVG	0.93	AVG	0.54	AVERAGE
28	0.92	2.99	0.75	-1.71	INF	0.00	AVG	0.95	AVG	0.48	AVERAGE
15	0.89	2.42	1.16	-1.66	INF	-0.49	AVG	1.39	SUP	0.45	AVERAGE
42	-0.29	4.45	-0.5	0.33	AVG	1.24	SUP	-0.43	AVG	0.41	AVERAGE
36	0.77	1.72	1.62	-1.46	INF	-1.08	INF	1.89	SUP	0.40	AVERAGE
66	-0.19	3.75	-0.1	0.16	AVG	0.64	AVG	0.08	AVG	0.36	AVERAGE
23	0.81	4.03	-0.4	-1.52	INF	0.88	AVG	-0.22	AVG	0.33	AVERAGE
67	0.77	3.7	-0.2	-1.46	INF	0.60	AVG	-0.08	AVG	0.26	AVERAGE
7	-0.85	4.43	-0.8	1.28	SUP	1.22	SUP	-0.75	AVG	0.24	AVERAGE
61	-0.05	3.45	-0.1	-0.07	AVG	0.39	AVG	0.03	AVG	0.21	AVERAGE
57	-0.56	4.19	-0.7	0.79	AVG	1.02	SUP	-0.64	AVG	0.19	AVERAGE
69	-0.15	1.91	1.00	0.10	AVG	-0.92	AVG	1.22	SUP	0.15	AVERAGE
35	-0.73	3.27	-0.1	1.07	SUP	0.24	AVG	0.06	AVG	0.15	AVERAGE
53	-0.24	3.4	-0.2	0.25	AVG	0.35	AVG	-0.06	AVG	0.14	AVERAGE
11	-0.03	2.92	0.05	-0.11	AVG	-0.06	AVG	0.21	AVG	0.07	AVERAGE
31	0.35	2.85	0.07	-0.75	AVG	-0.12	AVG	0.23	AVG	0.05	AVERAGE
5	-0.76	3.49	-0.5	1.12	SUP	0.42	AVG	-0.34	AVG	0.04	AVERAGE
22	-1.50	2.05	-1.3	2.37	ELITE	-0.80	AVG	-1.22	INF	-1.01	INFERIOR
56	-0.88	3.33	-2.4	1.33	SUP	0.29	AVG	-2.46	INF	-1.08	INFERIOR
76	-0.24	2.48	-2	0.25	AVG	-0.43	AVG	-2.01	INF	-1.22	INFERIOR
75	0.28	1.15	-1.2	-0.63	AVG	-1.56	INF	-1.15	INF	-1.36	INFERIOR
AVG	**-0.09**	**2.98**	**-0.14**								
STD	**0.59**	**1.17**	**0.93**								

CRITERIA TO READ SRVs:

Values below -1.00 = INFERIOR
Values between -1.00 and +1.00 = AVERAGE
Values between >+1.00 and <=+2.00 = SUPERIOR
Values > +2.00 = ELITE

Table 5 Single and triple-combined SRVs for on-farm decision making

ID	YWT	YFS	YEMD	YWT SRV	YFS SRV	YEMD SRV	TRIPLE COMB-SRV	COMB-SRV RANK
307	59.5	3.0	28	2.61	-0.02	-0.14	1.96	SUPERIOR
216	55.0	3.0	34	1.80	-0.02	1.81	1.35	SUPERIOR
333	53.5	3.5	32	1.53	0.77	1.16	1.23	SUPERIOR
287	51.5	5.0	27	1.17	3.13	-0.47	1.19	SUPERIOR
291	53.0	3.0	31	1.44	-0.02	0.83	1.08	SUPERIOR
338	51.0	4.0	33	1.08	1.56	1.48	0.97	AVERAGE
321	52.0	3.0	25	1.26	-0.02	-1.12	0.94	AVERAGE
259	50.0	4.5	28	0.90	2.35	-0.14	0.91	AVERAGE
253	50.5	3.5	32	0.99	0.77	1.16	0.82	AVERAGE
242	51.0	2.5	29	1.08	-0.80	0.18	0.73	AVERAGE
251	49.0	3.5	30	0.72	0.77	0.51	0.62	AVERAGE
264	49.5	3.0	30	0.81	-0.02	0.51	0.61	AVERAGE
250	50.0	2.5	32	0.90	-0.80	1.16	0.59	AVERAGE
317	50.0	2.5	25	0.90	-0.80	-1.12	0.59	AVERAGE
301	47.5	3.0	35	0.45	-0.02	2.13	0.33	AVERAGE
326	48.0	2.5	29	0.54	-0.80	0.18	0.32	AVERAGE
277	46.0	4.0	27	0.18	1.56	-0.47	0.29	AVERAGE
285	47.0	3.0	29	0.36	-0.02	0.18	0.27	AVERAGE
306	47.5	2.5	33	0.45	-0.80	1.48	0.26	AVERAGE
223	47.5	2.5	32	0.45	-0.80	1.16	0.26	AVERAGE
271	47.0	2.5	26	0.36	-0.80	-0.79	0.19	AVERAGE
330	39.0	4.0	25	-1.09	1.56	-1.12	-0.66	AVERAGE
298	40.5	2.5	28	-0.82	-0.80	-0.14	-0.69	AVERAGE
327	39.5	3.0	30	-1.00	-0.02	0.51	-0.75	AVERAGE
272	38.5	3.0	24	-1.18	-0.02	-1.44	-0.88	AVERAGE
303	39.0	2.5	26	-1.09	-0.80	-0.79	-0.90	AVERAGE
293	39.5	2.0	28	-1.00	-1.59	-0.14	-0.91	AVERAGE
234	38.0	3.0	26	-1.27	-0.02	-0.79	-0.95	AVERAGE
258	38.5	2.5	30	-1.18	-0.80	0.51	-0.96	AVERAGE
279	38.5	2.5	26	-1.18	-0.80	-0.79	-0.96	AVERAGE
294	37.5	3.0	26	-1.36	-0.02	-0.79	-1.02	INFERIOR
329	38.5	2.0	25	-1.18	-1.59	-1.12	-1.04	INFERIOR
278	36.5	3.0	28	-1.54	-0.02	-0.14	-1.16	INFERIOR
299	33.5	2.5	21	-2.08	-0.80	-2.42	-1.64	INFERIOR
AVG	45.0	3.0	28.4					
SRDEV	5.5	0.6	3.1					

YWT = Yearly body weight
YFS = Yearly fat score
YEMD= Yearly eye muscle depthness

CRITERIA TO READ SRVs:

Values Below −1.00 = INFERIOR
Values between −1.00 and +1.00 = AVERAGE
Values between >+1.00 and <=+2.00 = SUPERIOR
Values >+2.00 = ELITE