Outside sires -
Estimating genetic merit when there is insufficient information

SIL Technical Note

Relates to: Breeding values for outside sires when there is little progeny information
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Date: 10 June 2007

Summary

- Some rams used as sires may have been born outside the flock(s) being evaluated
- SIL does not routinely use 'background data' from the flocks such sires were born into or from other flocks where they have relatives
- Until their progeny supply sufficient performance information, their genetic merit is difficult to estimate
- When outside sires have insufficient information available in an evaluation, SIL has an option to use results from the large-scale ACE evaluation to derive more robust BVs
- This is termed the Outside Sires Method (OSM)
- A quick reference guide to use of the OSM is presented at the end of this document

Background

SIL uses state-of-the-art methods to estimate genetic merit for animals in flocks that record performance and pedigree. Using the animal model BLUP methods, genetic merit makes use of genetic connections across groups to remove non-genetic effects (differences due to grazing mob, birth rank, age of dam, date of birth, sex) and family information to derive the most accurate estimates of genetic merit possible from the data.

A benefit from this approach is the ability to estimate and remove year effects, thereby allowing genetic gains over time to be studied. SIL illustrates this with genetic trend graphs for breeding values (BVs) and for indexes. 1995 is set as a base year, when the average animal had a (genetic merit) of zero.

The problem

Animals with relatives, such as rams brought in to be used as sires, have little or no information on which to base reliable estimates of genetic merit for some traits. Animal model BLUP methods assign these animals to the base year (1995) with BVs near zero.

As a consequence their progeny will also tend toward the base year in the absence of performance measurements on themselves and their half-siblings (half-sibs).

This is unsatisfactory when the sires were purchased on the basis of high genetic merit from evaluations of different populations of animals, where they had many relatives with high merit. It affects the estimates of merit for single traits in such sires and their progeny. It also impacts on composite genetic merit, or indexes, where there is sufficient progeny information for some traits, but insufficient for others.

It is more unsatisfactory, the further we move on from 1995.

Selection decisions are usually made before all data on progeny are available. The later measurements are made (e.g. hogget or 2 year-old or later), the more likely a sire has no progeny with performance measurements. Lack of information on progeny performance is most clearly manifest, and for longest, in BVs for reproduction traits.

Definition of an outside sire

Sires are a fundamental element in the genetic structure of a flock(s) and the genetic evaluation makes use of this. An outside sire is defined here as

- a ram used in a flock that came from another flock
- that other flock is not in the genetic evaluation
- there is insufficient performance information on progeny of the ram to base a reliable estimate of genetic merit for the ram

Most rams used fail to qualify as outside sires on one or more of these criteria. However getting a good "starting BV" is a problem for the few rams that are classified as "outside sires", and for their progeny in some situations.

Getting better BVs for Outside Sires

SIL has a solution to provide better BVs for outside sires. It uses results from the latest ACE evaluation (across-flock and across-breed). How this is done is explained below.

The SIL Outside Sire Method (OSM)

1. Identifying outside sires

Prior to the evaluation, the SIL genetic engine checks whether the Outside Sires Method option was selected. If it was, a check is made of the dataset for each goal trait group (equivalent to sub-index) being evaluated to identify outside sires based on TWO criteria:

a) Their birth flock is not one of the flocks selected for the evaluation

b) They have less "progeny" with performance records than a critical threshold. Thresholds are listed in Table 1 (see Quick Reference Guide on last page).

   - Animals contribute to the count if they have one or more records for any of the predictor traits for that goal trait group
   - NOTE that "progeny" counts are made for the first two generations of descendants i.e. **progeny AND grand-progeny**. This is because some sires have significant numbers of grand-progeny with performance information.
   - For Reproduction, this is the number of daughters (and grand-daughters) lambing, NOT the number of lambing records they have in total. If a ewe lambs twice, she will have two lambing records but counts only as one daughter lambing. The OSM takes account of whether hogget lambing was included as an option in the evaluation.

Animals identified as outside sires are noted so that adjustments to BVs can be made after the current genetic evaluation has been performed.

2. Genetic evaluation

Adjustments for outside sires are made post-genetic evaluation. The genetic evaluation is a standard SIL evaluation specified in the usual way but the OSM option is switched on.

Currently, the OSM is operational for traits listed in the table on the Quick Reference Guide at the end of this document. Other Goal Trait Groups may be added to the OSM in the future as robust BVs become available from ACE evaluations.

3. Determining evaluation adjustment factors

SIL works out the difference between the current flock(s) evaluation and the ACE evaluation and adjusts the BVs by this amount (see next section). This accounts for ACE BVs being generally higher, or lower, than the current evaluation.

4. Breeding values for outside sires in ACE

Where the outside sire is present in the ACE dataset, for each trait its new BV is its ACE BV corrected for the **evaluation adjustment factor**.

5. Breeding values for outside sires NOT in ACE

Where the outside sire is NOT present in the ACE dataset, for each trait its new BV is the "average" for the distribution of BVs of other sires with the same birth year in the ACE dataset, corrected for the **evaluation adjustment factor**.

Thus outside sires of the same birth year, and not in ACE, will be given the same BV.

It is expected that BVs may go up or down subsequently as progeny data become available.

6. Progeny of outside sires

Progeny of outside sires do not get their BVs adjusted in most situations. This is because before selection they or their half-sibs usually have performance measurements for key traits or closely related traits. If they have sufficient half-siblings with performance measurements, their sire will not be classed as an outside sire!

The key exception is Reproduction which is measured late. Often important selection decisions must be made before such information is available in sufficient quantity. For rams identified as outside sires for Reproduction, progeny BVs are adjusted by half the difference between the sire's new BV and his original BV in the current evaluation.

7. Flags for BVs and indexes

BVs derived by the OSM are flagged on SIL reports by an **asterisk** (*).

Indexes contained BVs derived by the OSM are **not flagged**.

Where sires have been identified as outside sires, but there are no corresponding BVs in the ACE dataset, BVs are flagged with a hash (#). This indicates an outside sire adjustment would be desirable but that it is not possible to do this with the OSM.

8. What is stored on the SIL database

The SIL database stores BVs together with flags that identify those produced by the OSM. For animals where the original BVs were replaced by OSM BVs, only the latter are stored.

When to use the SIL Outside Sires Method

If a sire has insufficient progeny performance data, use the OSM as part of the genetic evaluation. This will impact on the sire's BVs and, for reproduction, on those of his progeny. This option must be explicitly selected as SIL does not routinely use the OSM.

There is no point in doing this if no sires will be defined as outside sires.

The OSM should not be used to derive BVs for traits present in ACE but not being assessed in the flock(s) being evaluated. In this case homebred sires will have insufficient progeny information but will not be classified as outside sires since they were born in these flock(s). So "true" outside sires will get adjusted BVs from the OSM but homebred sires will not.

Judgement is needed in situations where not all flocks in an evaluation are recording certain traits. For example, where most flocks are not recording meat scanning but a few are, "better" BVs for a few outside sires from the OSM will be compared those from homebred sires that do not have progeny with measurements. In such cases, the goal trait group (Meat in this example) should not be evaluated OR excluded from the index of overall merit.

Bear in mind that the BVs produced by the SIL OSM may not be highly accurate. It can subsequently go up or down when sufficient progeny information comes available. However, it is not pegged back to the 1995 base year which is often undesirable.

Interpreting and using SIL outputs

The OSM flags BVs as either adjusted (*) or not adjusted (#) when it would be desirable to do so. BVs without flags are based on measurements made on the animal and it's relatives.

These will commonly be seen on Sire Summaries. SIL reports can also provide estimates of family size for sires (number of progeny or number of daughters lambing, for reproduction).

It is worth noting that some sires may have a small number of progeny with performance measurements but if this is below the thresholds specified for the OSM they will be classified as outside sires and this information will not be used.

Bear in mind that as progeny information becomes available in sufficient quantities, sires previously classified as "outside" will not be classified as such any longer and BVs will change to reflect performance of their progeny.

Other relevant technical notes

SIL has a number of technical notes available on its website. Those listed below are relevant as background material for this note on the SIL Outside Sires Method (OSM).

- ACE evaluations
- Accuracy – breeding values and indexes
- Accuracy – amount of data from sib and daughter lambing

Need more information?

Contact your SIL bureau, send an email to silhelp@sheepimprovement.co.nz or telephone 0800-745-435 (**0800-SIL-HELP**).

SIL Outside Sire Method – quick reference guide

- SIL evaluations can use the optional Outside Sire Method (OSM) to estimate genetic merit (BVs) where sires have little or no performance measurements collected on progeny in the flocks being evaluated
- This MUST be chosen (it is not used by default) at the time the genetic evaluation is specified and run
- Use is made of the most recent ACE evaluation to provide estimates of:
  - genetic merit for individual sires if available, or if not available, average genetic merit for individual sires based on their year of birth
  - average evaluation effects to correct for differences between ACE and the current evaluation
- Sires are classified as outside sires when they have insufficient descendants (1st two generations) with performance records (see table to right)
- For Reproduction, where sires have BVs derived by the OSM, BVs of their progeny are also adjusted
- BVs derived by the OSM are flagged on official SIL reports by an '*'. Indexes containing BVs derived by the OSM are not flagged.
- Where sires have been identified as outside sires, but ACE does not provide a BV to use in the OSM, BVs are flagged with the '#' symbol, indicating that they are based on less data than the OSM threshold

Thresholds for each goal trait group. Sires born in a flock outside the analysis and with fewer "descendant" performance records than this threshold are classed as outside sires.

Goal trait group	Threshold - number of animals with records
Growth	10
Meat	10
CT meat	10
Reproduction	20
Wool	10
WormFEC	10
¶InnerValue	10
¶Facial eczema	10
¶Twinning rate	20
¶Hogget lambing	20
¶Survival	50
¶Dags	10
¶Resilience	10
¶Fine wool	10
¶Wool quality	10

¶ OSM not operational for these Goal Trait Groups at this date

When to use the OSM

- You would use the OSM when some sires have been used from flocks not in the genetic evaluation and they have few progeny performance records for key traits.
- The OSM should not be used to derive BVs for traits present in ACE but not being assessed in the flock(s) being subject to genetic evaluation.
- Judgement needs to be used when not all flocks being evaluated are recording a goal trait group. For example, most flocks are not recording meat scanning measurements but a few are. In this case, it may be best to exclude the Meat goal trait group from the evaluation OR from the index used to characterize overall merit.