# International Genetic Evaluation for Female Fertility Traits

***Hossein Jorjani***[1,2]
[1]*Interbull Centre,* [2]*Department of Animal Breeding and Genetics,*
*Swedish University of Agricultural Sciences,*
*Box 7023, S-750 07 Uppsala, Sweden*
*Hossein.Jorjani@hgen.slu.se*

## Abstract

In anticipation of an upcoming official test-run for an international genetic evaluation, the available traits (submitted for the Interbull pilot study) were grouped according to the guidelines agreed upon in the latest Interbull Technical Workshop. Consequently, genetic correlations were estimated for each trait group.

## Introduction

Previously published across country genetic correlations (Jorjani, 2005a, b, 2006) were estimated in anticipation of using multiple trait multiple across country evaluation (MT-MACE) model. Therefore, details of the data editing and evaluation model were different from the usual practice of international genetic evaluation (IGE) at the Interbull Centre. As an example it can be mentioned that the phantom parent group size was set to include 500 animals, i.e. while in the usual practice phantom parent group sizes, irrespective of the heritability of the traits, are much smaller.

However, because of some unanticipated problems (most notably related to the bending of the covariance matrices (Jorjani, 2006)), implementation of MT-MACE is for the time being postponed. Consequently, researchers and practitioners of dairy cattle IGE participating in the latest Interbull Technical Workshop[1] concluded that implementation of single trait MACE is necessary in the meantime. In an ST-MACE setting the choice of traits to be included in each analysis is crucial. Therefore, it was prudent to agree on some clear rules for grouping of the traits. Two such rules are a) separate evaluations for heifers and cows and b) the use of simple traits, as opposed to combined or composite traits. These rules are deemed to pose no obstacle for IGE because in the same workshop a majority of the participants stated that their respective countries would be submitting new and/or more traits for the forthcoming evaluation.

In the light of these developments it is interesting to see how large are the correlations between the traits submitted for the Interbull pilot study under the usual practice of IGE at the Interbull Centre. The objective of this paper is to show correlations among the submitted traits when they were grouped according to the two rules mentioned above.

## Trait groups

At the onset of the Interbull pilot study on the female fertility traits it was decided to concentrate on two aspects of the fertility complex, namely the animal's ability to become pregnant and the animal's ability to re-cycle after calving. Two other abilities, to show maturity/heat and to resist fertility disorders, were not considered because there were not many countries with interest for the former and Interbull genetic evaluation for calving ease and stillbirth would cover, at least partly, the latter.

There are potentially a large number of measurements that are related to the ability to conceive and to re-cycle. Some simple measurements are related only (or to a higher extent) to one of these abilities. For example conception rate (CR) is related to the ability to become pregnant, and the interval between

[1] The latest Interbull Technical Workshop was held in Wageningen, The Netherlands, March 2-3, 2006.

calving and first insemination (CF) is related to the ability to re-cycle. However, some other measurements combine the two abilities. Calving interval (CI) and days open (DO) are two examples of combining the two abilities in one measurement. There are also measurements that are composite in the sense that they are linear (or otherwise any sort of) combination of other measurements, e.g. different fertility indices.

The clear consensus arrived at in the latest Interbull Technical Workshop was that composite measurements should be avoided, combined measurements should be tolerated for the time being, and simple measurement should be favored. Further, there was a general agreement that heifers and cows need to be evaluated separately.

Therefore, in an ideal situation the trait groups will be consist of the following traits:

| Trait group | T1 | T2 | T3 | T4 |
|---|---|---|---|---|
| | Heifer's ability to become pregnant | Cow's ability to become pregnant | Cow's ability to re-cycle | Combined traits |
| Main (core) candidate trait(s) | Confirmed conception rate | Confirmed conception rate | Interval calving to first insemination | Calving interval, days open |
| Alternative traits | Number of inseminations, non-return rate, interval between first and last insemination | Number of inseminations, non-return rate, interval between first and last insemination | | |

With a not so strict interpretation of these rules the following trait groups can be identified among the traits submitted for the Interbull pilot study (I emphasize again that there will be many more traits submitted from the member countries in the upcoming test run):

| Trait group | T1 | T2 | T3 | T4 |
|---|---|---|---|---|
| | Heifers | cows | cows | Cows |
| | CA1 = NR | CA3 = NR | CA2 = CF | DF5 = DO |
| | DF1 = NI | DE3 = NR | DF2 = CF | ES4 = DO |
| | FR3 = CR | DF3 = NI | NL2 = CF | GB4 = CI |
| | GB1 = NR | FR3 = CR | NZ2 = PM ≈ CF | IR2 = CI |
| | IS3 = CR | IS3 = CR | | NL4 = CI |
| | | NL3 = NR | | US4 = DO |

CA = Canada, DE = Germany-Austria, DF = Denmark, Finland, Sweden, ES = Spain, FR = France, GB = Great Britain, IR = Ireland, IS = Israel, NL = The Netherland, NZ = New Zealand, US = United States of America, and CF = Interval between calving and the last insemination, CI = Calving interval, CR = conception rate, DO = Days open, FL = Interval between the first and the last insemination, NI = number of inseminations, NR = Non-return rate

## Correlations

In the following a series of three tables will be shown for each trait group as follows:

a) The first one will show the estimated correlations based on the above trait combinations (using the usual practice at the Interbull Centre),
b) The second one is the average of all previously estimated correlations (not using the usual practice at the Interbull Centre), and
c) The third one is the maximum of all previously estimated correlations (not using the usual practice at the Interbull Centre).

Tables marked as (b) and (c) are the results of weighted bending of correlations. Number of common bulls between countries was used as the weighting factor.

**Table 1a.** Estimated correlations for trait group 1: Heifer's ability to become pregnant (using the usual practice at the Interbull Centre).

| | CA1 | DF1 | FR3 | GB1 | IS3 |
|---|---|---|---|---|---|
| CA1 | | 0.73 | 0.62 | 0.83 | 0.83 |
| DF1 | | | 0.49 | 0.58 | 0.42 |
| FR3 | | | | 0.52 | 0.43 |
| GB1 | | | | | 0.93 |
| IS3 | | | | | |
| | | Top 100 bulls | | | |
| Own country | 3 | 96 | 54 | 11 | 94 |
| # countries | 6 | 5 | >6 | 5 | 3 |

**Table 1b.** Average of previously estimated correlations for trait group 1: Heifer's ability to become pregnant (not using the usual practice at the Interbull Centre).

| | CA1 | DF1 | FR3 | GB1 | IS3 |
|---|---|---|---|---|---|
| CA1 | | 0.67 | 0.71 | 0.77 | 0.49 |
| DF1 | | | 0.54 | 0.55 | 0.47 |
| FR3 | | | | 0.45 | 0.62 |
| GB1 | | | | | 0.67 |
| IS3 | | | | | |

**Table1c.** Maximum of previously estimated correlations for trait group 1: Heifer's ability to become pregnant (not using the usual practice at the Interbull Centre).

| | CA1 | DF1 | FR3 | GB1 | IS3 |
|---|---|---|---|---|---|
| CA1 | | 0.76 | 0.78 | 0.83 | 0.84 |
| DF1 | | | 0.57 | 0.64 | 0.68 |
| FR3 | | | | 0.52 | 0.83 |
| GB1 | | | | | 0.85 |
| IS3 | | | | | |

**Table 2a.** Estimated correlations for trait group 2: Cow's ability to become pregnant (using the usual practice at the Interbull Centre).

| | CA3 | DE3 | DF3 | FR3 | IS3 | NL3 |
|---|---|---|---|---|---|---|
| CA3 | | 0.90 | 0.82 | 0.79 | 0.92 | 0.94 |
| DE3 | | | 0.73 | 0.93 | 0.83 | 0.79 |
| DF3 | | | | 0.73 | 0.86 | 0.82 |
| FR3 | | | | | 0.80 | 0.71 |
| IS3 | | | | | | 0.94 |
| NL3 | | | | | | |
| | | Top 100 bulls | | | | |
| Own country | 4 | 50 | 78 | 11 | 50 | 19 |
| # countries | >8 | 8 | 6 | 9 | >8 | >8 |

**Table 2b**. Average of previously estimated correlations for trait group 2: Cow's ability to become pregnant (not using the usual practice at the Interbull Centre).

| | CA3 | DE3 | DF3 | FR3 | IS3 | NL3 |
|---|---|---|---|---|---|---|
| CA3 | | 0.90 | 0.78 | 0.75 | 0.53 | 0.93 |
| DE3 | | | 0.74 | 0.89 | 0.55 | 0.79 |
| DF3 | | | | 0.78 | 0.83 | 0.74 |
| FR3 | | | | | 0.62 | 0.65 |
| IS3 | | | | | | 0.62 |
| NL3 | | | | | | |

**Table 2c.** Maximum of previously estimated correlations for trait group 2: Cow's ability to become pregnant (not using the usual practice at the Interbull Centre).

| | CA3 | DE3 | DF3 | FR3 | IS3 | NL3 |
|---|---|---|---|---|---|---|
| CA3 | | 0.93 | 0.84 | 0.81 | 0.85 | 0.96 |
| DE3 | | | 0.79 | 0.93 | 0.84 | 0.84 |
| DF3 | | | | 0.81 | 0.90 | 0.83 |
| FR3 | | | | | 0.82 | 0.75 |
| IS3 | | | | | | 0.85 |
| NL3 | | | | | | |

**Table 3a**. Estimated correlations for trait group 3: Cow's ability to re-cycle (using the usual practice at the Interbull Centre).

| | CA2 | DF2 | NL2 | NZ2 |
|---|---|---|---|---|
| CA2 | | 0.95 | 0.92 | 0.49 |
| DF2 | | | 0.98 | 0.56 |
| NL2 | | | | 0.65 |
| NZ2 | | | | |
| | Top 100 bulls | | | |
| Own country | 11 | 59 | 42 | 59 |
| # countries | >6 | 7 | >7 | 8 |

**Table 3b.** Average of previously estimated correlations for trait group 3: Cow's ability to re-cycle (not using the usual practice at the Interbull Centre).

| | CA2 | DF2 | NL2 | NZ2 |
|---|---|---|---|---|
| CA2 | | 0.94 | 0.91 | 0.50 |
| DF2 | | | 0.97 | 0.57 |
| NL2 | | | | 0.64 |
| NZ2 | | | | |

**Table 3c.** Maximum of previously estimated correlations for trait group 3: Cow's ability to re-cycle (not using the usual practice at the Interbull Centre).

| | CA2 | DF2 | NL2 | NZ2 |
|---|---|---|---|---|
| CA2 | | 0.96 | 0.92 | 0.55 |
| DF2 | | | 0.98 | 0.64 |
| NL2 | | | | 0.74 |
| NZ2 | | | | |

**Table 4a.** Estimated correlations for trait group 4: Cow's combined ability to become pregnant and re-cycle (using the usual practice at the Interbull Centre).

| | DF5 | ES4 | GB4 | IR2 | NL4 | US4 |
|---|---|---|---|---|---|---|
| DF5 | | 0.89 | 0.93 | 0.77 | 0.94 | 0.91 |
| ES4 | | | 0.90 | 0.82 | 0.89 | 0.92 |
| GB4 | | | | 0.90 | 0.96 | 0.86 |
| IR2 | | | | | 0.83 | 0.79 |
| NL4 | | | | | | 0.91 |
| US4 | | | | | | |
| | | | Top 100 bulls | | | |
| Own country | 48 | 0 | 4 | 3 | 40 | 26 |
| # countries | >9 | 9 | >9 | 9 | >8 | 9 |

**Table 4b**. Average of previously estimated correlations for trait group 4: Cow's combined ability to become pregnant and re-cycle (not using the usual practice at the Interbull Centre).

| | DF5 | ES4 | GB4 | IR2 | NL4 | US4 |
|---|---|---|---|---|---|---|
| DF5 | | 0.90 | 0.92 | 0.79 | 0.93 | 0.91 |
| ES4 | | | 0.90 | 0.82 | 0.90 | 0.93 |
| GB4 | | | | 0.88 | 0.96 | 0.85 |
| IR2 | | | | | 0.85 | 0.80 |
| NL4 | | | | | | 0.89 |
| US4 | | | | | | |

**Table 4c.** Maximum of previously estimated correlations for trait group 4: Cow's combined ability to become pregnant and re-cycle (not using the usual practice at the Interbull Centre).

| | DF5 | ES4 | GB4 | IR2 | NL4 | US4 |
|---|---|---|---|---|---|---|
| DF5 | | 0.92 | 0.93 | 0.81 | 0.94 | 0.93 |
| ES4 | | | 0.92 | 0.83 | 0.92 | 0.94 |
| GB4 | | | | 0.90 | 0.96 | 0.87 |
| IR2 | | | | | 0.87 | 0.82 |
| NL4 | | | | | | 0.93 |
| US4 | | | | | | |

## References


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