Simultaneous de-regression of cow and bull breeding values

Mario Calus

Ghyslaine Schopen

Roel Veerkamp

June 20, 2014

Introduction

- Accuracy of genomic prediction depends on size of the reference population (RP)

- RP have been extended by:
  - Genotyping all bulls with EBV (nationally)
  - Exchanging genotypes of bulls (internationally)

- Further extension is possible by including cows
  - *How should cow information be included properly?*

Introduction

- Genomic prediction models use deregressed proofs (DRP)

- (Approximate) de-regression procedures used for bulls may not be appropriate for cows
  - Reliability Cow EBV << Reliability Bull EBV

- Objective is to test alternative approach to de-regress
  - EBV (=DRP)
  - EDC (i.e. appropriate weights of de-regressed EBV)

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"De-regression" of EDC

Obtain weights for DRP, i.e. "dEDC" for all animals:

1. Initialize $dEDC = EDC_{EBV}$

For each animal:

2. Compute EDC due to information in the RP (i.e. EDC_{RP})
3. Compute $EDC_{DRP} = EDC_{EBV} - EDC_{RP}$
4. Repeat 2 & 3 until convergence

Per iteration (where EDC_{DRP} are computed for all animals):

■ Set up and invert coefficient matrix of MME for RP once

■ Per animal: adjust inverse to compute its EDC_{RP}

De-regression of EBV

- "Matrix" de-regression:

$$\begin{bmatrix} X'R^{-1}X & X'R^{-1}Z \\ Z'R^{-1}X & Z'R^{-1}Z + A^{-1}\dfrac{\sigma_e^2}{\sigma_A^2} \end{bmatrix} \begin{bmatrix} \hat{\mu} \\ \hat{a} \end{bmatrix} = \begin{bmatrix} X'R^{-1}y \\ Z'R^{-1}y \end{bmatrix}$$

- Iteratively compute *DRPs* and $\hat{\mu}$ to account for mean EBV

- Using de-regressed EDC (R^{-1})

Procedure to test de-regression method

1. Compute EBV
2. For animals in RP:
   a) "De-regress" EDC (=dEDC)
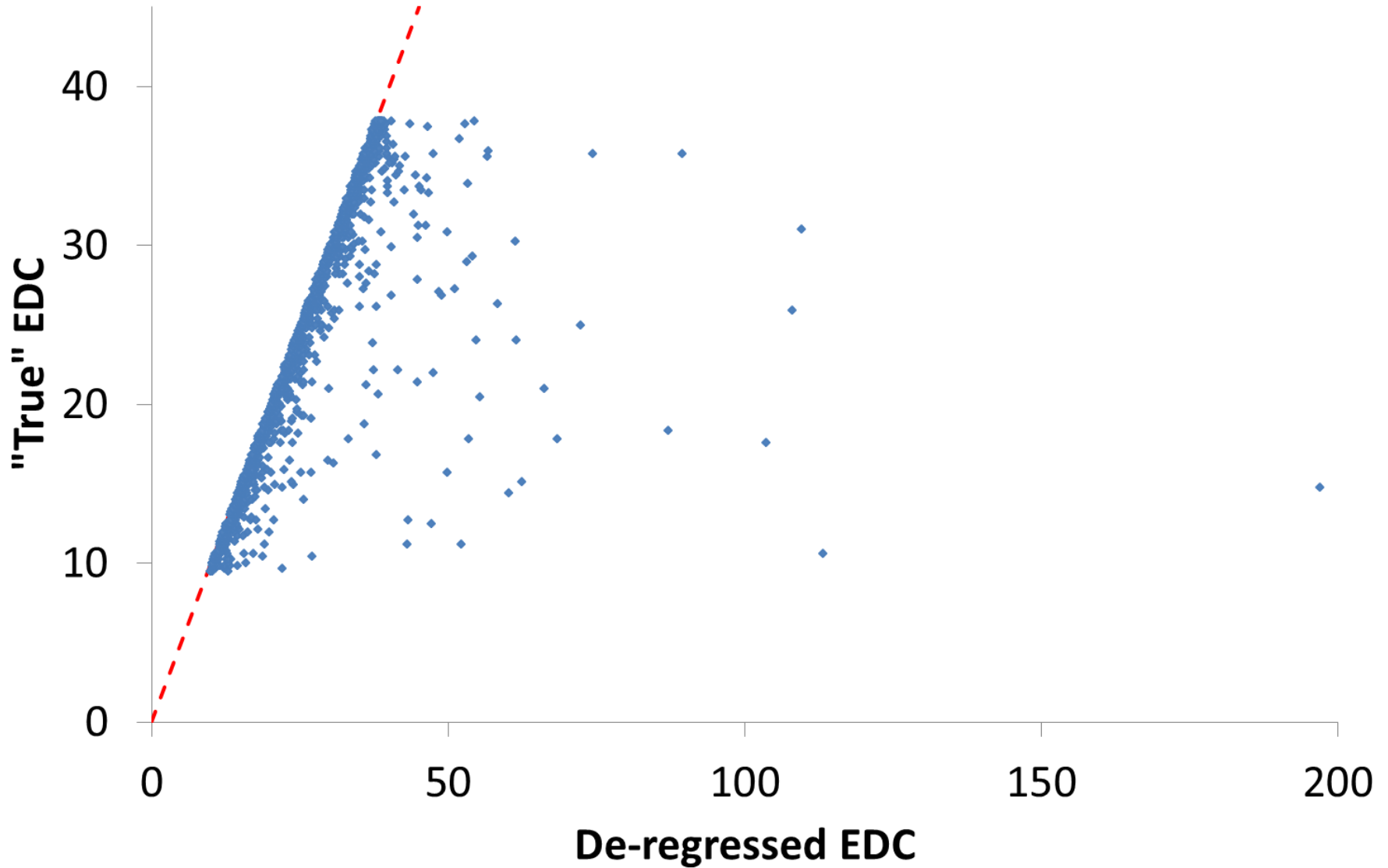   b) De-regress EBV (=DRP)
   c) Compute EBV using dEDC and DRP

Expectations:

- EBV (2c) = EBV (1)
- For bulls: EDC (2a) = EDC from daughters outside RP
- For cows: EDC (2a) = EDC from own records
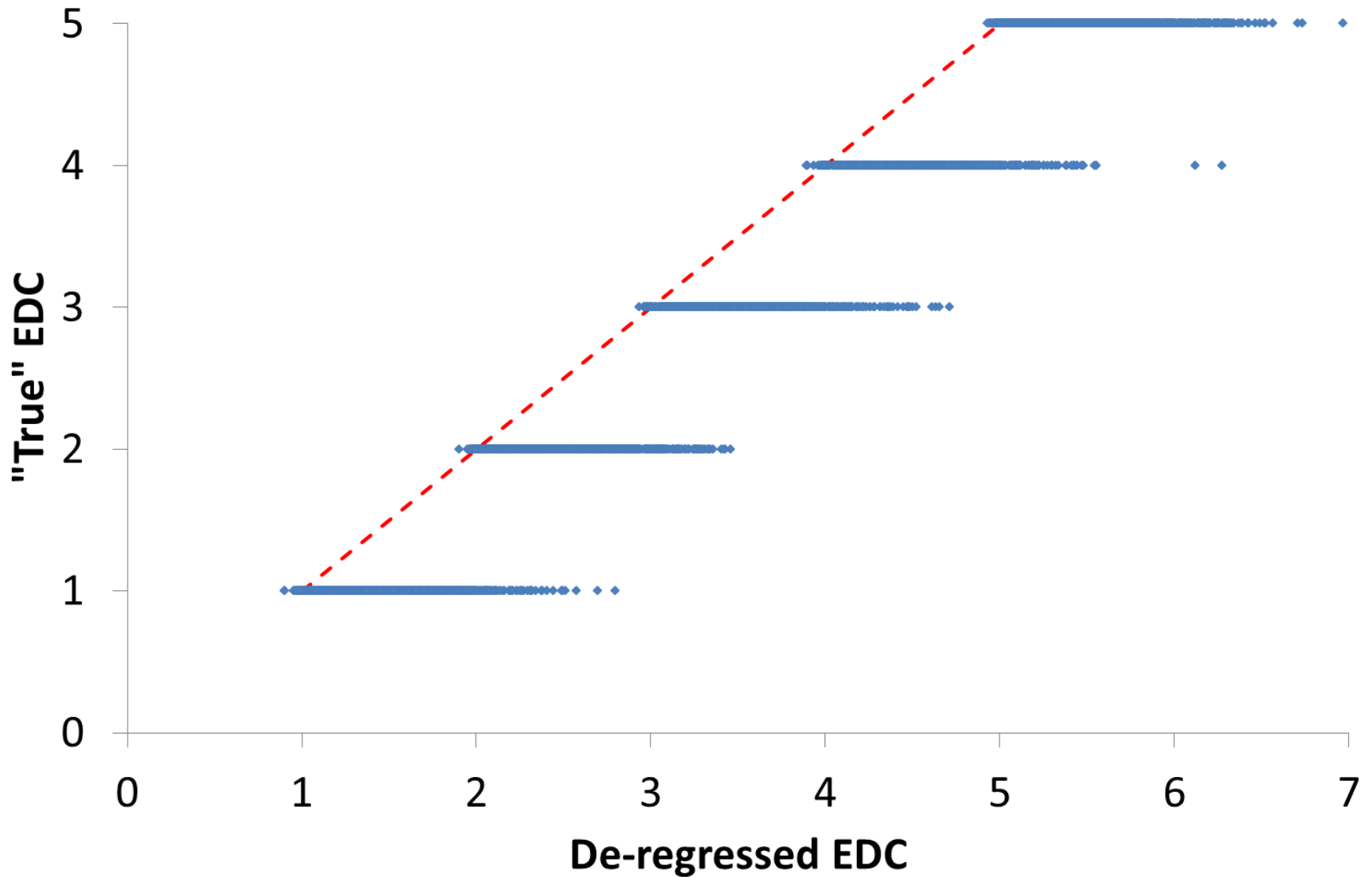
Data used

- 15,252 animals in RP
  - 1,532 bulls & 13,720 cows

- Phenotypes were simulated:
  - Such that "true" weights (EDC) were known
  - 50-200 daughters (with 1 record) per sire (outside RP)
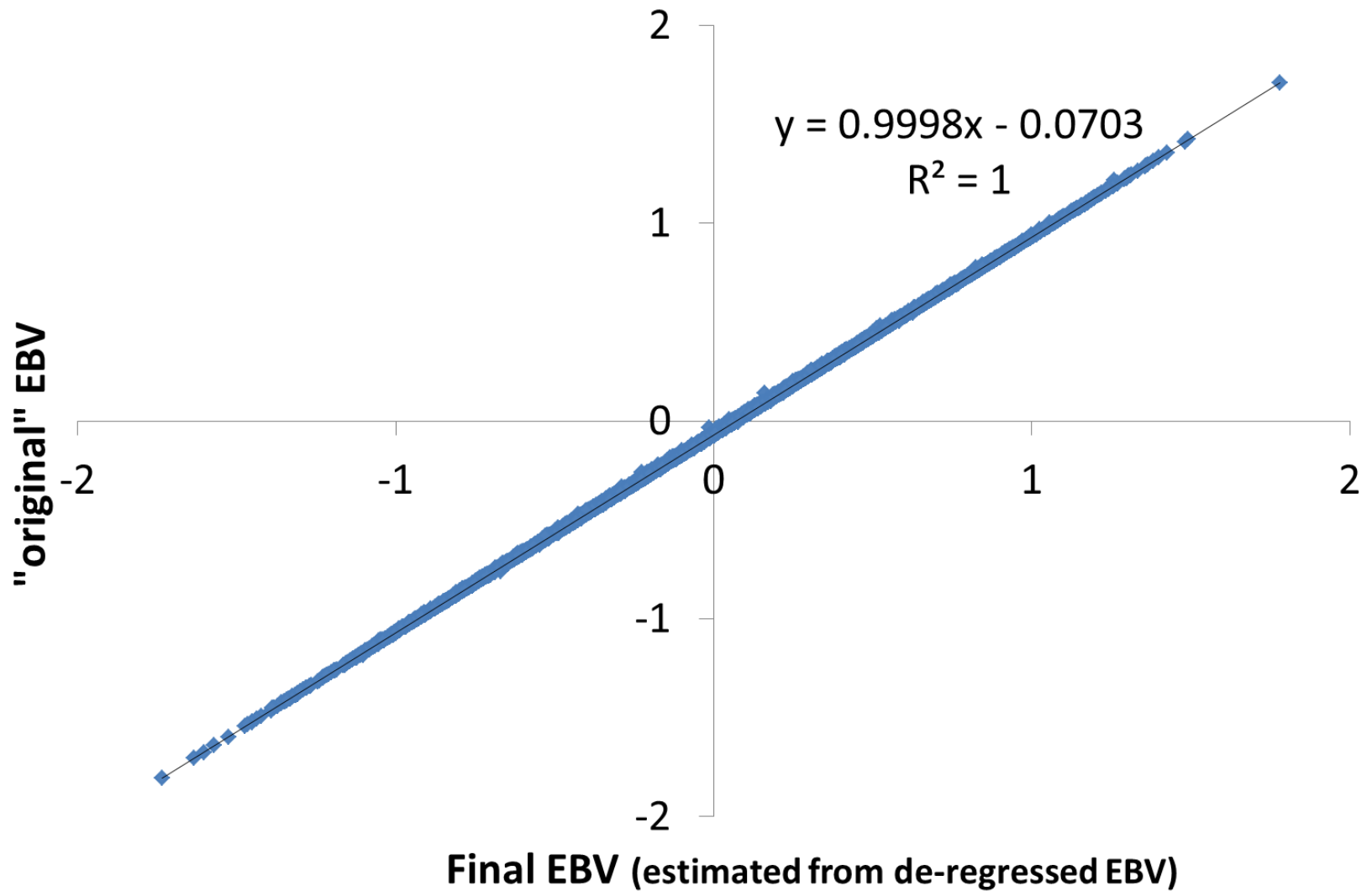 - 1-5 records per cow in the data
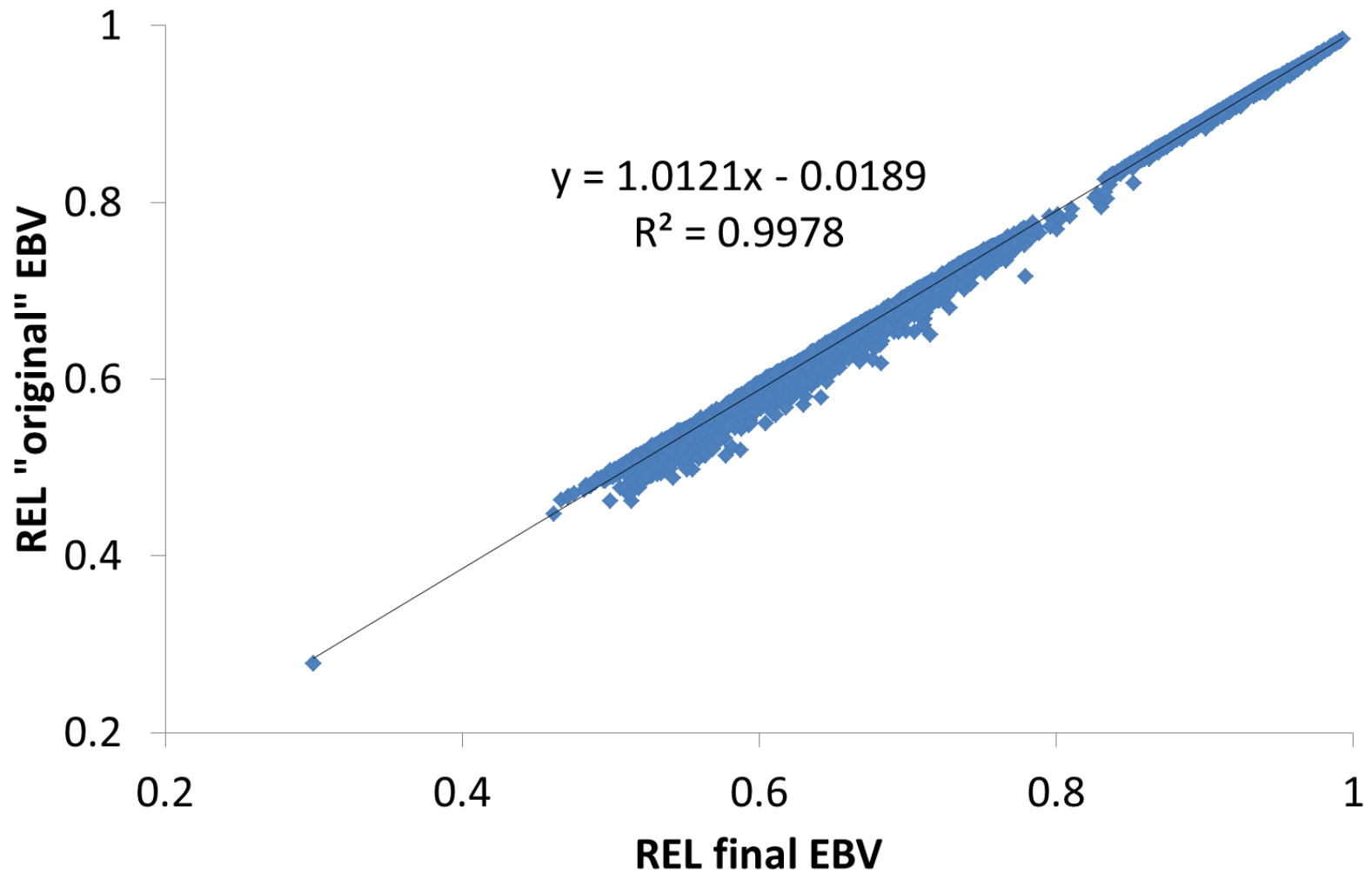
"De-regressed" EDC bulls (after 5 iterations)

"De-regressed" EDC cows (after 5 iterations)

Original vs. final EBV

$y = 0.9998x - 0.0703$
$R^2 = 1$

"original" EBV

Final EBV (estimated from de-regressed EBV)

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Reliability original vs. final EBV

Conclusions

- "De-regressed" EDC overestimate true EDC
  - Especially for bulls with many (grand)daughters in RP

- Final and initial EBV matched very well

- Similar results were obtained with 1 iteration to de-regress EDCs (not shown)

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