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IndexWizard

an R-package to work with selection indices based on estimated breeding values

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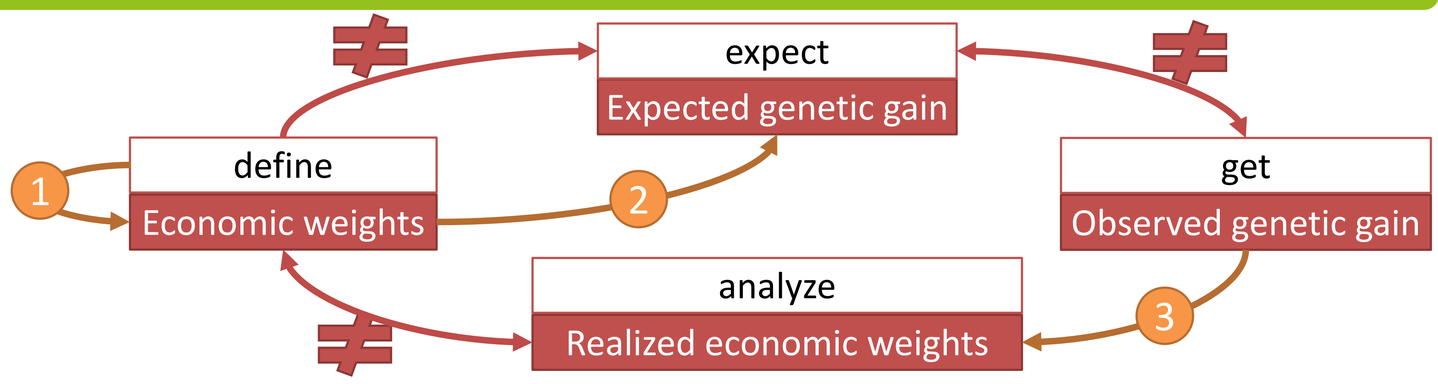
Background and Aim

- Breeding goals are composed of interrelated traits
- Selection index theory provides a framework to find economically optimal combination of selection criteria based on economic weights [1]
- Derivation of economic weights and translation into genetic gain is oftentimes not intuitive [2,3]
- Simianer *et al.* [4] provide a flexible extension of the Selection index to
  - ✓ Analyze the composition of Index and relevance of single traits (1)
  - ✓ Analyze the Composition of expected gain (2)
  - ✓ Post-hoc derive „realized economic weights“ based on observed genetic gain (3)

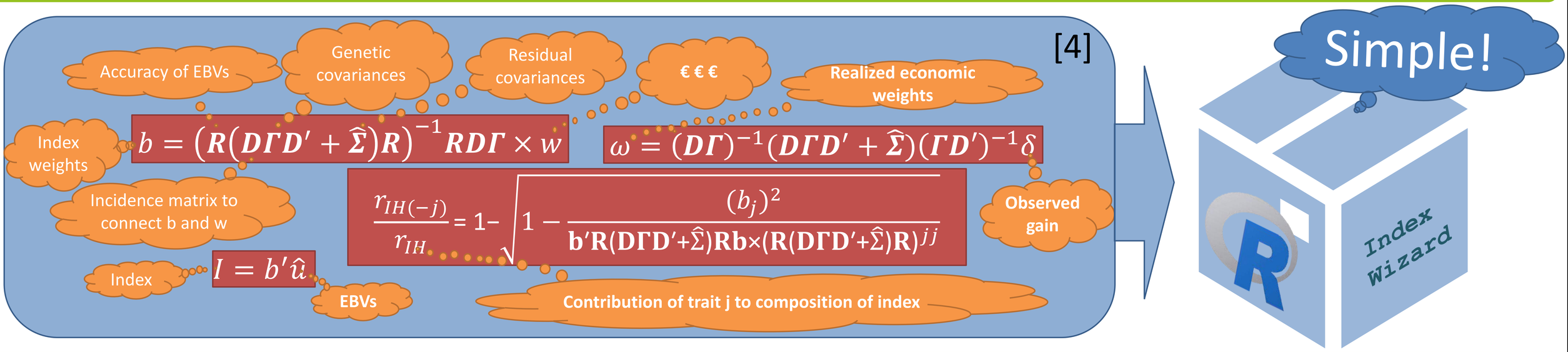
⇒ Generate simple to use R package „IndexWizard“ for analysis of complex selection indices



Solution

```
> devtools::install_github("johannesgeibel/IndexWizard")
> library("IndexWizard")
```

General Approach



Results

Genetic covariance matrix

```
> G
           milk longevity  repro
milk       144.00     18.72 -21.60
longevity   18.72    144.00  61.92
repro      -21.60     61.92 144.00
```

Reliabilities

```
> r2
   milk longevity
  0.743     0.673
```

Economic weights

```
> w
  milk longevity repro
   0.5       0.4   0.1
```

Empirical covariance

```
> H
           milk longevity
milk       144.00     8.64
longevity    8.64   144.00
```

Relative empirical gain

```
> del_u
     milk longevity
     0.57      0.43
```

One simple function for calculations

```
> Ind <- IndexWizard::SelInd(
  r2 = r2,
  G = G,
  w = w,
  H = H,
  d_G_obs = del_u
)
```

Custom `print()` method combined with definitions of resulting objects

```
> Ind
An object of class SelInd. The index is based on:
   - n = 3 breeding goal traits
   - 3 traits with economic weight != 0
   - m = 2 index traits
-------------------------------------------------
Vaiance of the index (`var_I`), expected genetic
gain (`dG`)
and assumed selection intensity (`i`):
$var_I:
[1] 52.72
```

Possible output

```
# - Index weights
# - Variance of index
# - Composition of expected genetic trend
# - Composition of expected phenotypic trend
# - Correlation between Index and single traits
# - Contribution of single traits to overall Index
# - Change of trend by change of weight for single
#   trait
# - Realized economic weights
# e.g. index weights:
> Ind$b |> round(2)
    milk longevity
    0.51      0.48
# or composition of expected gain
> Ind$d_G_exp_scaled |> round(2)
     milk longevity     repro
     0.48      0.42      0.09
```

Direct feedback based on input

```
- H is given
  --> setting up E based on r2, G and H
  --> residual errors are assumed to be correlated!
- no selection intensity provided
  --> can only compute the relative genetic and
phenotypic trend
...
```

Detailed documentation based on examplary study

```
> vignette(
  "CaseStudy",
  package = "IndexWizard"
)
```

Custom `summary()` method

```
> summary(Ind)
An object of class SelInd. The index is based on:
   - n = 3 breeding goal traits
   - 3 traits with economic weight != 0
   - m = 2 index traits
```

References

[1] Hazel LN, Lush JL (1942) The efficiency of three methods of selection. J Hered. 33:393–399

[2] Nielsen HM, Amer PR, Byrne TJ (2014) Approaches to formulating practical breeding objectives for animal production systems. Acta Agric Scand Sect — Anim Sci. 64:2–12.

[3] Haberland AM, Pimentel ECG, Ytournel F, Erbe M, Simianer H (2013) Interplay between heritability, genetic correlation and economic weighting in a selection index with and without genomic information. Anim Breed Genet. 130:456–67.

[4] Simianer H, Heise J, Rensing S, Pook T, Geibel J, Reimer C (2022) How economic weights translate into genetic and phenotypic progress, and vice versa. Submitted

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