Breeding values for feed intake

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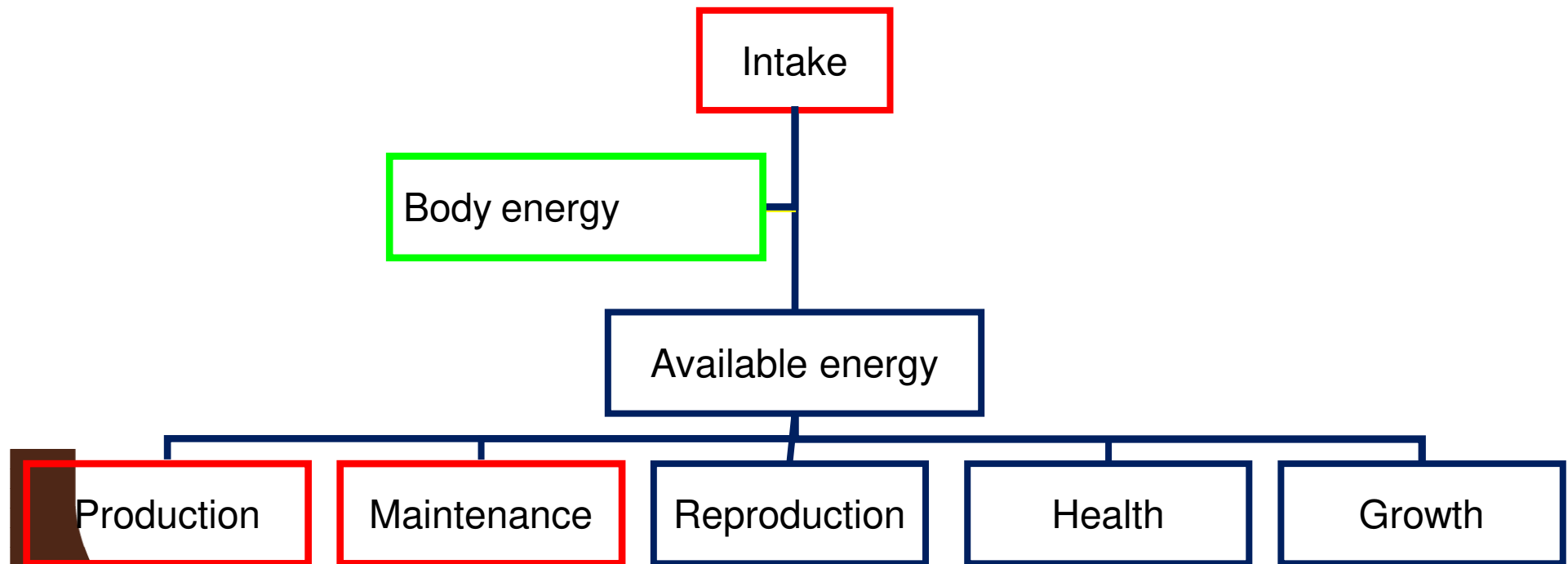
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Interest in genetics of feed efficiency

- Feed efficiency
    - Feed important variable cost
    - Environmental/greenhouse gasses
    - "More for less"

- Develop (procedure to predict) feed intake (DMI) breeding values for Dutch bulls and cows

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How is feed used?

```
                          ┌─────────────┐
                          │   Intake    │
                          └──────┬──────┘
     ┌──────────────┐            │
     │  Body energy │────────────┤
     └──────────────┘            │
                          ┌──────┴──────┐
                          │ Available   │
                          │   energy    │
                          └──────┬──────┘
   ┌──────┬───────────┬─────────┼──────────┬──────────┐
┌──┴────┐ ┌┴─────────┐ ┌┴─────────┐ ┌┴──────┐ ┌┴──────┐
│Produc-│ │Mainten-  │ │Reproduc- │ │Health │ │Growth │
│ tion  │ │ ance     │ │  tion    │ │       │ │       │
└───────┘ └──────────┘ └──────────┘ └───────┘ └───────┘
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Using feed intake data

1. Data on 3200 cows in lactation 1,2 and 3

      - dry matter intake (DMI)

      - collection of feed intake, milk yield and body weight

      - genotypes (1300 cows + sires of cows)

2. Parameters estimated

      - base for routine evaluation

Parameters (1)

Trait	heritability	Genet. Stdev (kg/day)
Dmi lact 1	0.28	1.24
Dmi lact 2	0.25	1.39
Dmi lact 3	0.20	1.51

Parameters (2) – genetic correlations

	dmi1	dmi2	dmi3	milk	fat	protein	body weight
dmi1							
dmi2	0.88						
dmi3	0.80	0.89					
milk	0.55	0.58	0.56				
fat	0.58	0.60	0.58	0.50			
protein	0.59	0.61	0.59	0.91	0.65		
body weight	0.67	0.45	0.41	0.10	0.10	0.10	

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Using feed intake data

1. Data on 3200 cows in lactation 1, 2 and 3

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2. Parameters estimated

      - base for routine evaluation

3. Model routine evaluation

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Model for dry matter intake

DMI = experiment

+ year*month

+ calving season

+ age at calving

+ stage of lactation

+ breed

+ perm. environment

+ cow

+ error

Cow: usage of pedigree and genotypes

Using feed intake data

1. Data on 3200 cows in lactation 1,2 and 3
    - collection of feed intake, milk yield and body weight
    - genotypes

2. Parameters estimated
    - base for routine evaluation

3. Model routine evaluation

4. Compute EBVs using:
    - direct DMI
    - genomic prediction
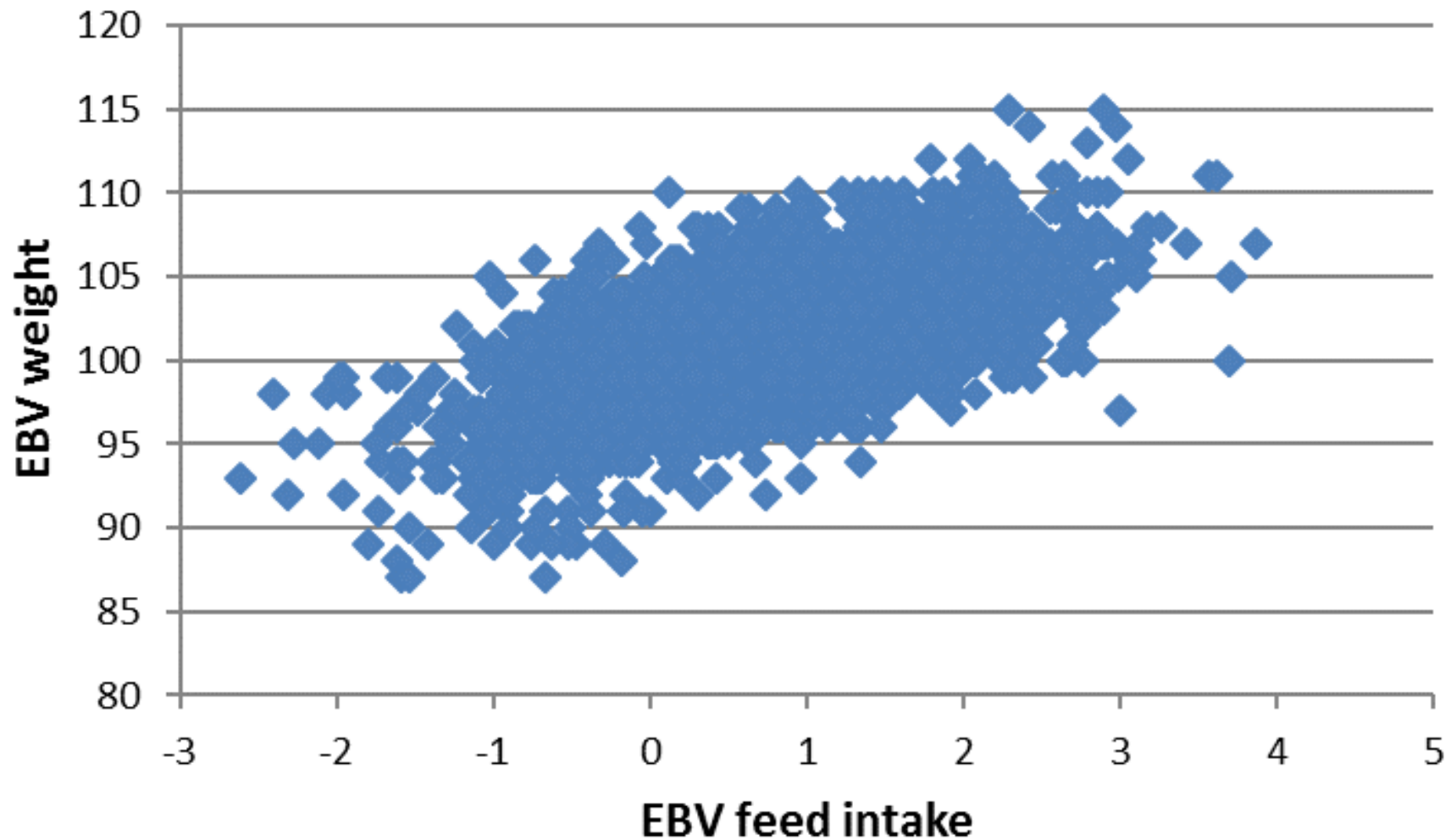   - indicators milk production traits and body weight
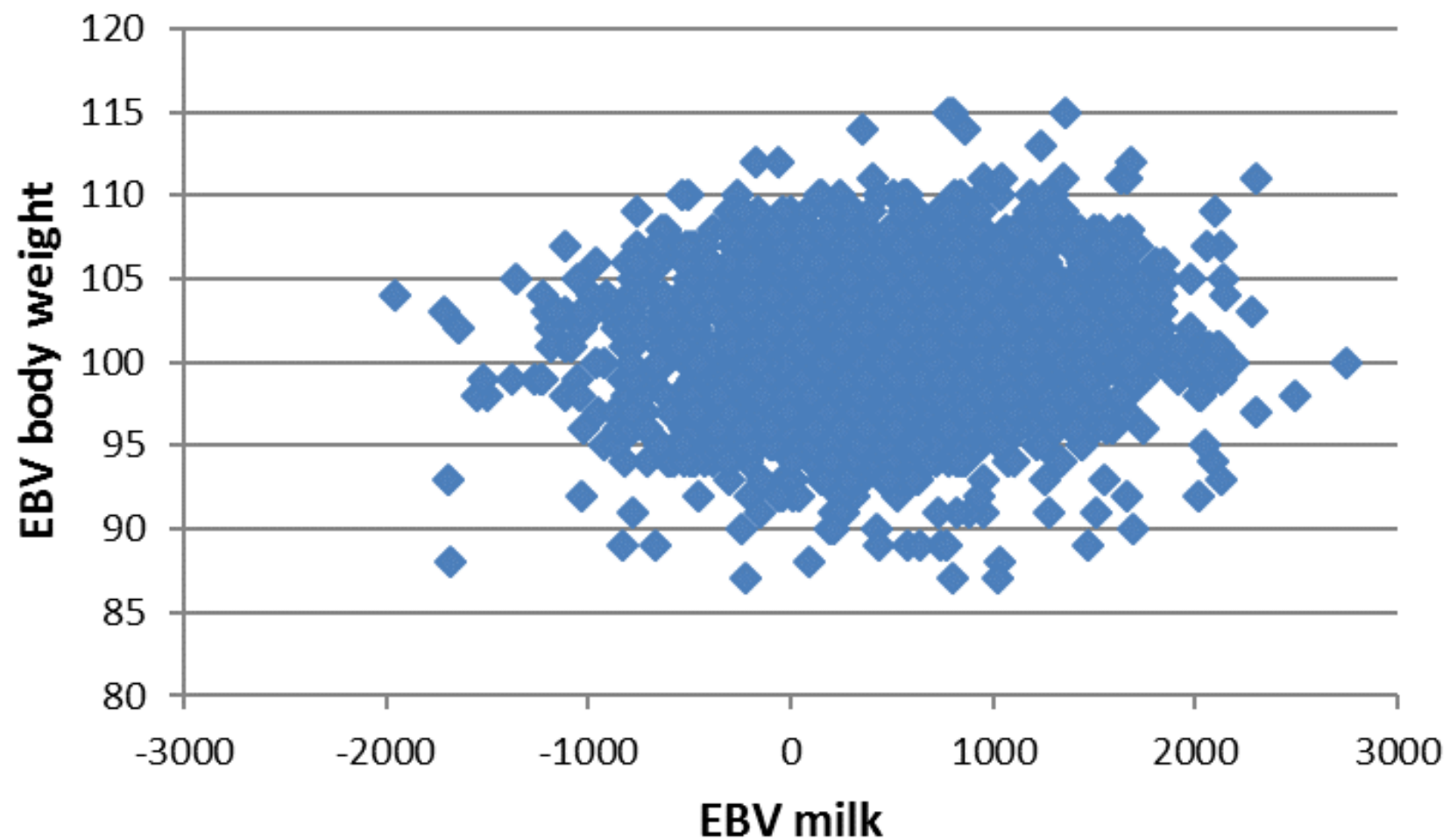
Computing EBV DMI
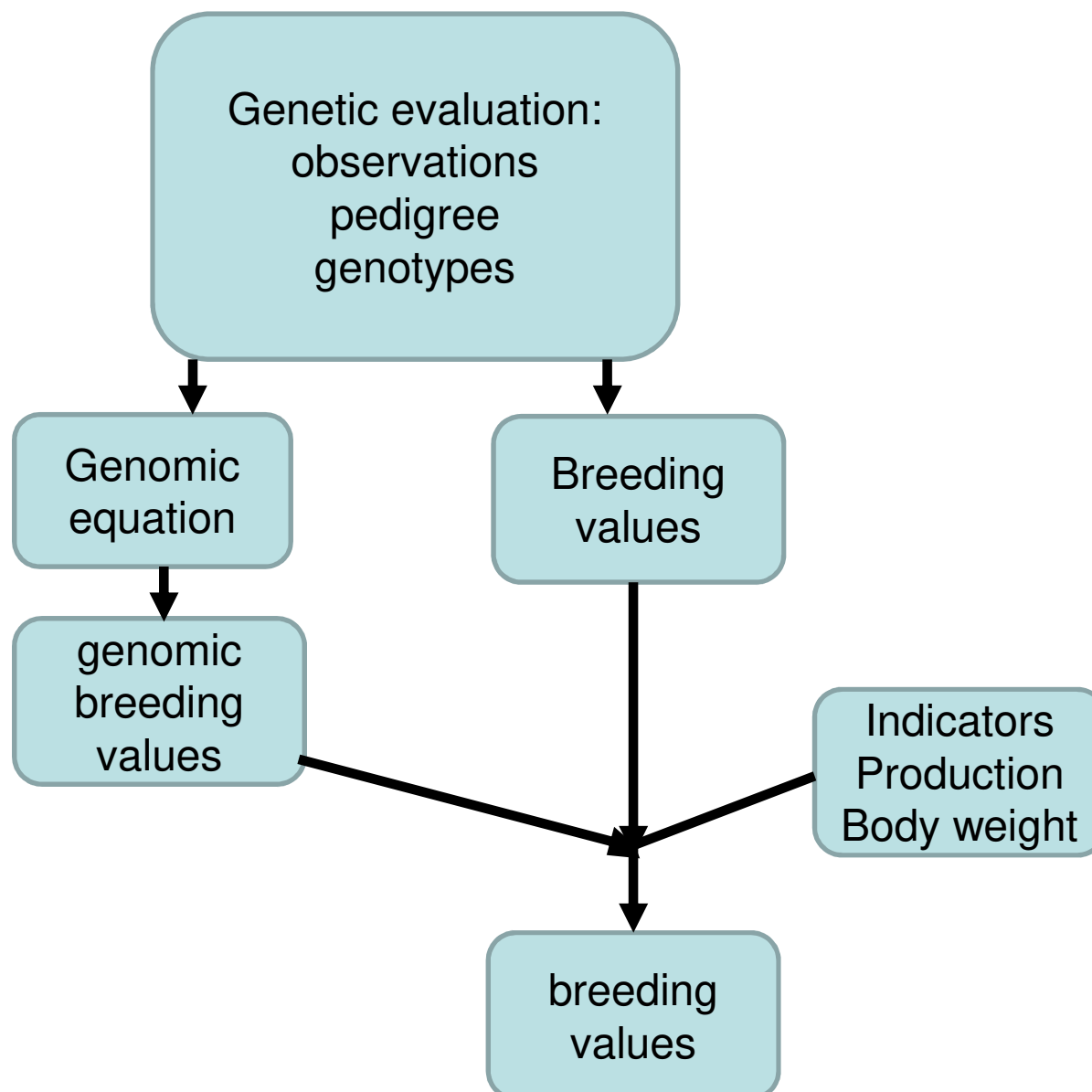
Milk *vs* dry matter intake
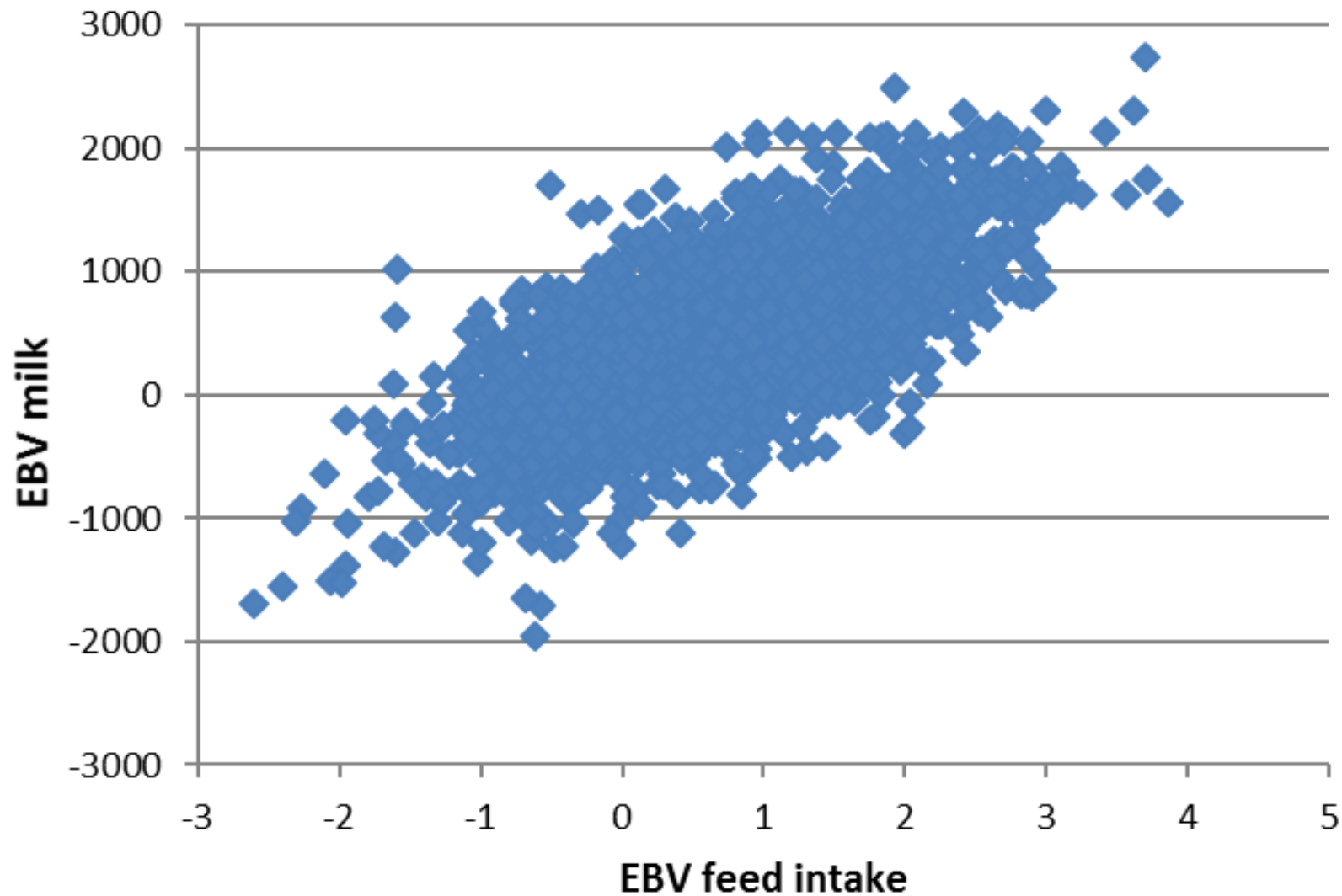
Body weight *vs* dry matter intake

Milk *vs* body weight

Results on bulls - Holstein
based on genomics and indicators

year of birth	number	rel dmi	ebv dmi	ebv milk	ebv fat	ebv prot	ebv lactose	ebv body weight
2006	444	60	0.11	239	-1	2	13	0.4
2007	324	58	0.22	294	1	4	15	0.2
2008	340	59	0.55	409	10	9	19	6.6
2009	345	56	0.60	448	12	9	21	6.3
2010	343	56	0.94	478	17	13	23	14.2
2011	264	54	1.12	674	22	18	33	11.7
2012	233	54	1.34	628	29	20	31	14.8
2013	171	54	1.59	887	34	26	42	15.8

Reliability based on predictors and genomics
-> maximum determined by correlation of predictors with dmi

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Extra direct information dmi

only genomic information

Birth year	Number bulls with extra dmi info	Average effect extra dmi info	Average effect reliability extra dmi info	Stdev effect extra dmi info
2006	224	-0.02	5	0.17
2007	158	0.03	5	0.17
2008	162	-0.01	5	0.19
2009	106	-0.05	5	0.18
2010	142	0.00	4	0.17
2011	132	-0.10	5	0.17
2012	127	-0.01	5	0.16
2013	110	-0.10	4	0.16

0.17 is about 12% of genetic stdev

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Breeding goal – effect on selection response

- Breeding goal represented by NVI = Total Merit Index

- **Current NVI contains:**   **Alternative NVI:**
  - Production index (Inet)   Inet with DMI
  - Udder health index   Udder health index
  - Fertility index   Fertility index
  - Calving traits index   Calving traits index
  - Conformation U + F&L   Conformation U + F&L

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Breeding goal – effect on selection response (2)

- Current Inet:

  $Inet_{2015}$ = 0.3 lactose + 2.1 fat + 4.1 protein

  weights milk components = price paid by factory – feed cost

- Inet with dmi*:

  $Inet_{dmi}$ = 0.5 lactose + 2.7 fat + 5.4 protein – 60.2 kg dmi

  weights milk components = price paid by factory
  weight dmi   = cost feed (energy)

 $Inet_{dmi}$ direct relationship with maintenance (size/efficiency of cow)

  * Production EBV = kg/305 days
     dmi EBV   = kg /day

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Results on bulls – Holstein : earnings!

year of birth	number	ebv dmi	ebv milk	ebv fat	ebv prot	ebv lactose	current Inet	Inet with DMI
2006	444	0.11	239	-1	2	13	€ 10	€ 8
2007	324	0.22	294	1	4	15	€ 23	€ 19
2008	340	0.55	409	10	9	19	€ 64	€ 52
2009	345	0.60	448	12	9	21	€ 68	€ 55
2010	343	0.94	478	17	13	23	€ 96	€ 71
2011	264	1.12	674	22	18	33	€ 130	€ 106
2012	233	1.34	628	29	20	31	€ 152	€ 121
2013	171	1.59	887	34	26	42	€ 191	€ 157

Earning less as no increase of production went together with increase feed intake, more than only needed for production
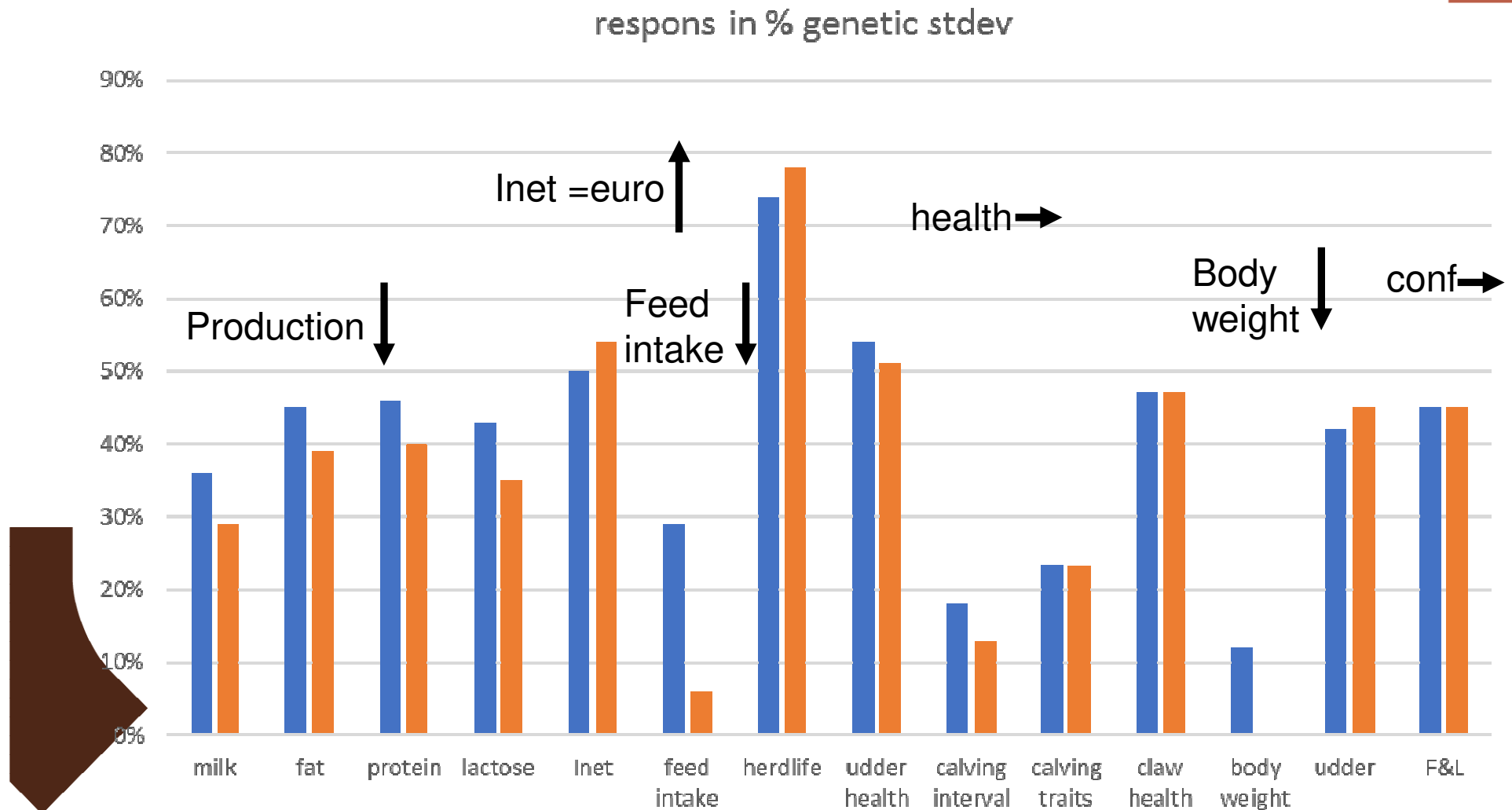
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Inet vs Inet with dry matter intake
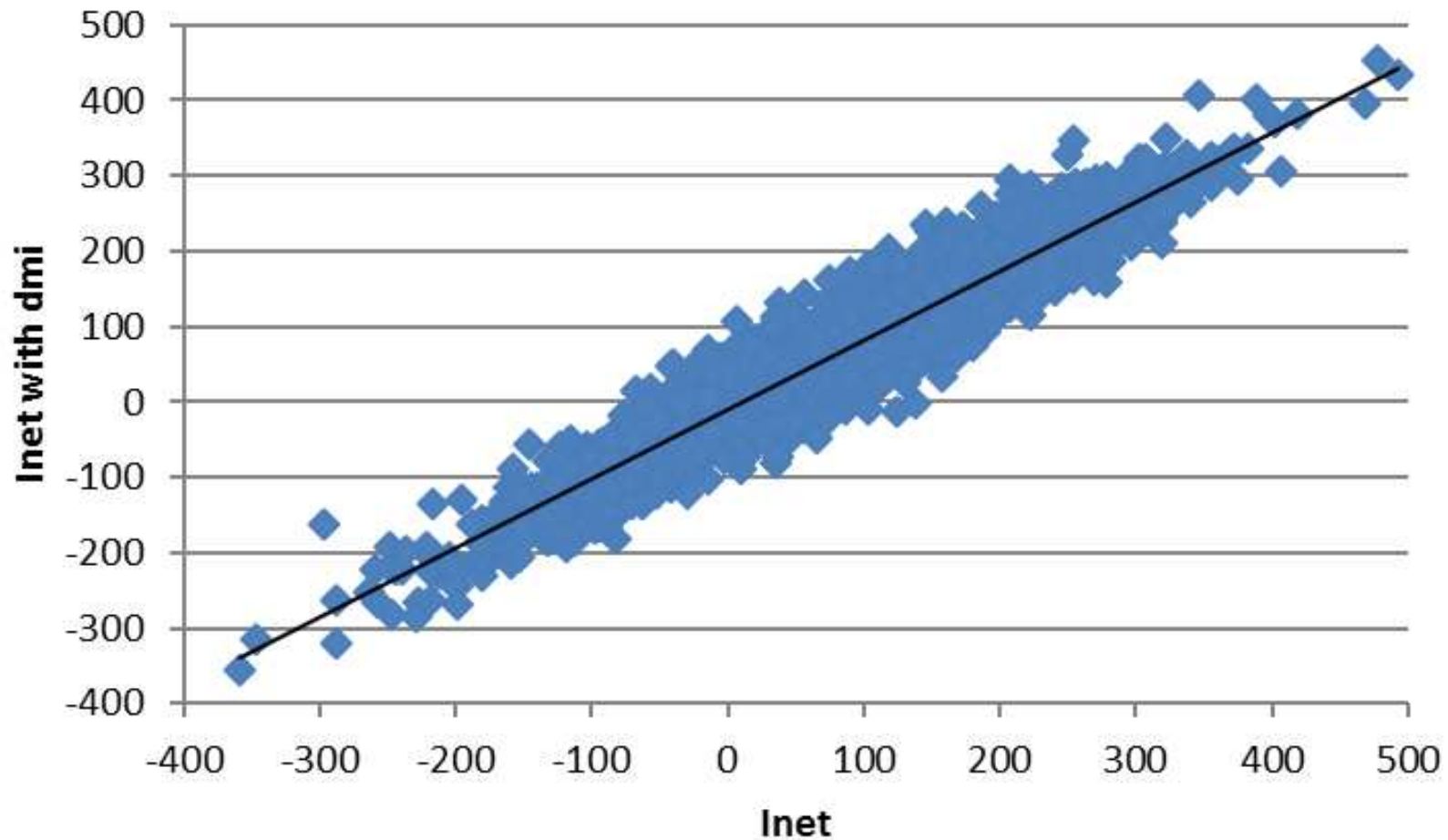
correlation   0.95
spread difference 36 euro -> 30% of genetic st.dev.

Effect on selection: dmi part of TMI

respons in % genetic stdev

Production ↓   Inet =euro ↑   Feed intake ↓   health →   Body weight ↓   conf →

Legend: ■ current NVI   ■ NVI with DMI

Categories: milk, fat, protein, lactose, Inet, feed intake, herdlife, udder health, calving interval, calving traits, claw health, body weight, udder, F&L

Feed intake and response. EHRC meeting 2017

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Next step: Feed intake for maintenance

- DMI EBV = feed intake for production AND maintenance (kg/day)
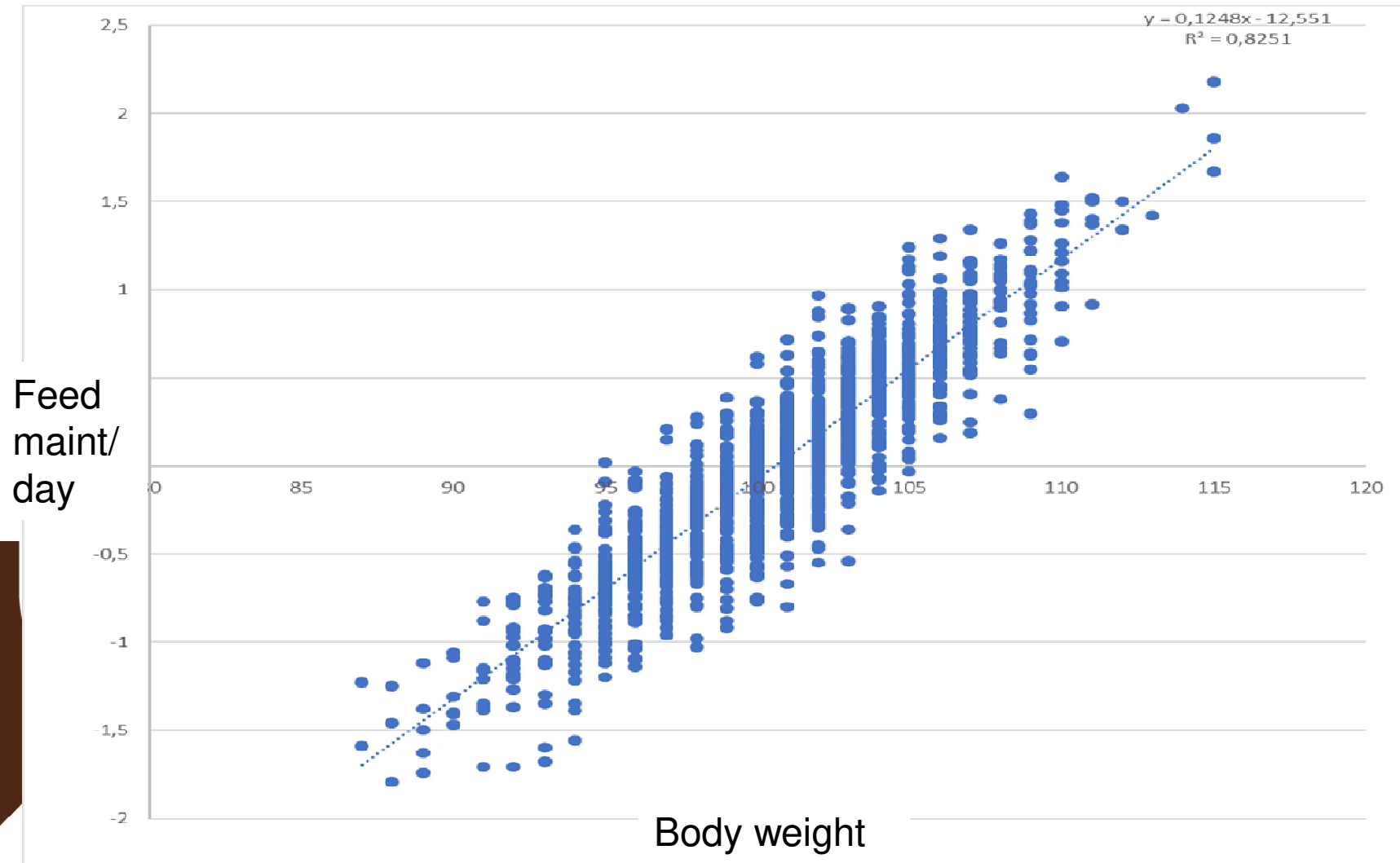
  Remove feed for production

- EBV Feed for maintenance
  - Body weight
  - Activity
  - Digestion of feed

  – EBV Feed per day (kg/day)

  – EBV Feed Cost for Maintenance per lactation (eur/lactation)

Farmer can see how much extra feed or extra feed cost is needed to keep a cow

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Feed for maintenance vs body weight

Adding feed intake to breeding goal :

A. Increase of feed intake in relation with

  – Milk, fat and protein yield increase

  – Less increase in body weight

Or

B. Produce more milk with the same size of cow

Or

C. Produce more milk from the same amount of feed

Which option depends on how much weight in TMI on production and on feed intake

Summary

- Dry matter intake EBVs available, based on
    - 3200 cows and indicators
    - genomic prediction available

- DMI part of breeding goal NVI
    - more efficient (in euro's)
    - no effect on health

- More data collected coming years
    - Increase of reliability genomic prediction

- End result: more efficient cow

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