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Use of serial pig body weights for genetic improvement

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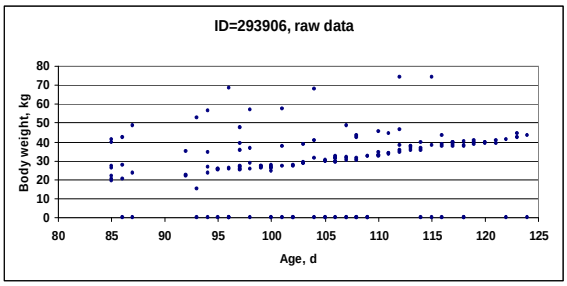
Introduction

Sample weight data from electronic feeders for swine



Objective

- Find algorithms to „clean“ the data

- Find whether the data is useful for genetic analyses of short-term gains

Robust Regression

- Weighted least squares
- Weights=f(residual, SD)
- Determines outliers
- ROBUSTREG in SAS

Methods of Robust Regression

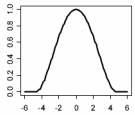
M- estimation (Huber, 1973):

$$\min \sum_{i=1}^{n} w_i^2 e_i^2$$

$$Bisquare\ weight\ \ function: w(e_i, \sigma, wf) = \left[1 - \left(\frac{e_i}{\sigma\ wf}\right)^2\right]^2$$

wf – weight factor

$$OUTLIER = \begin{cases} 1\ if\ |e_i| > c\ wf \\ 0\ \ otherwise \end{cases}$$



c – cutoff value

Data

3,888 Duroc pigs,

Osborne FIRE ®
feeder station

↓

884,132 weight data
(June 2004-Feb. 2007)

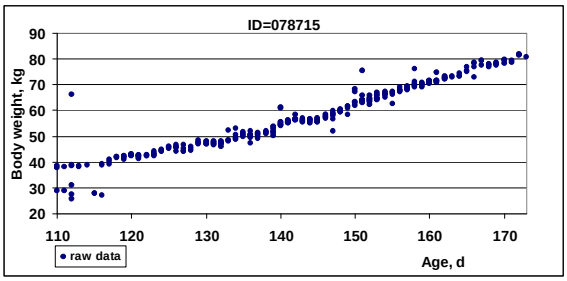
Age at beginning of test: 77-149 days
Age at end of test: 95-184 days

Statistical model for robust regression:

Body weight = $a_0 + b_1$*age + b_2*age^2 + e

Results RR

Effect of cutoff (c) values on outlier detection



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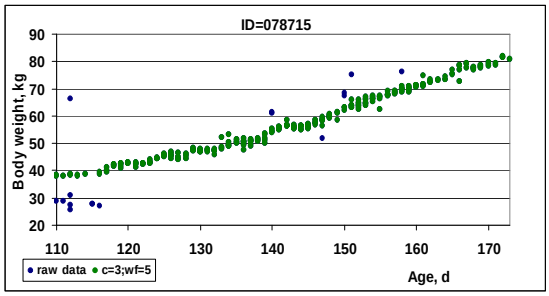

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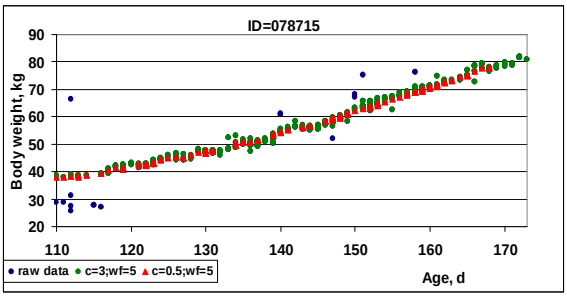

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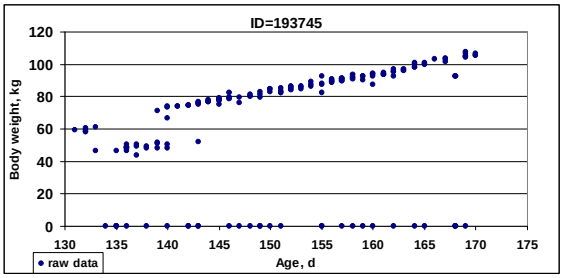

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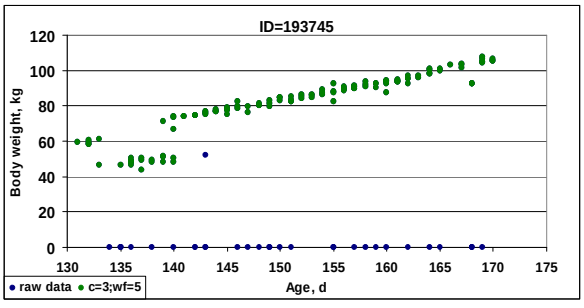

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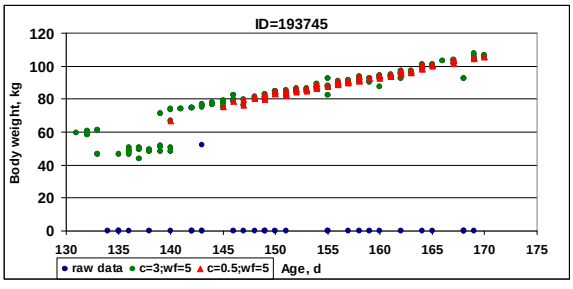

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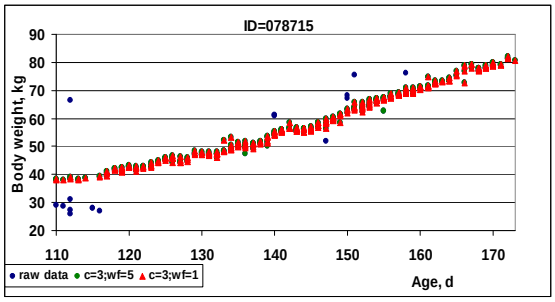
Effect of wf-values (weight function) on outlier detection



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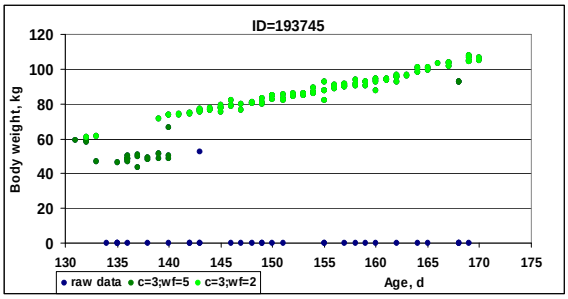

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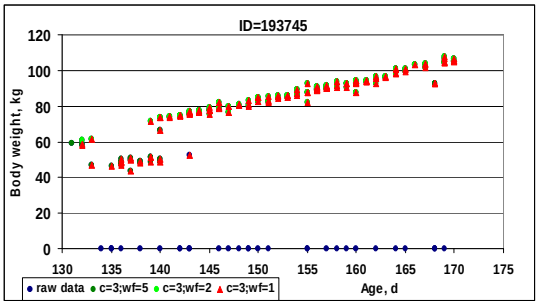
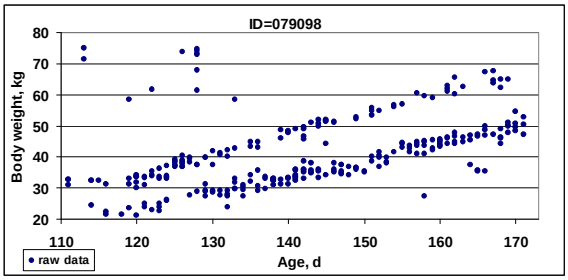


Abnormal growth patterns



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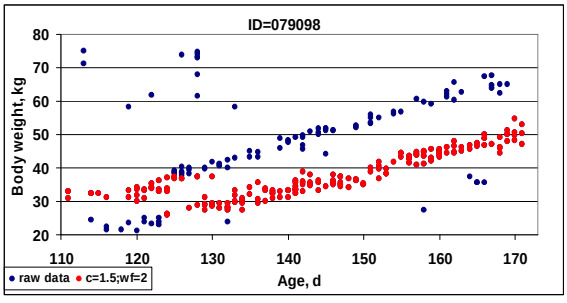

Results RR abnormal

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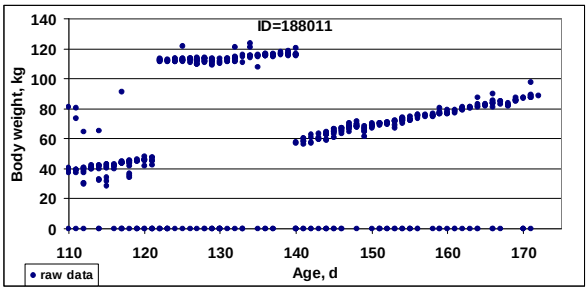

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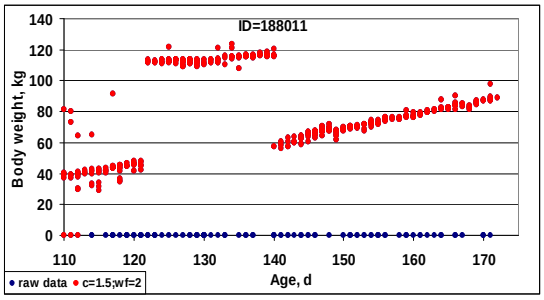

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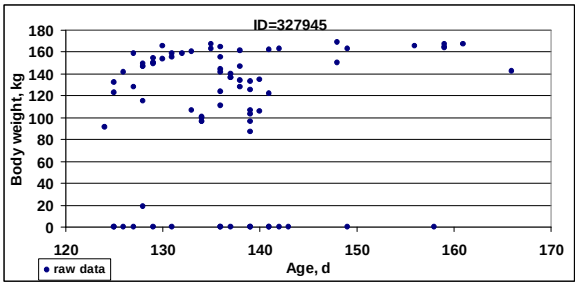

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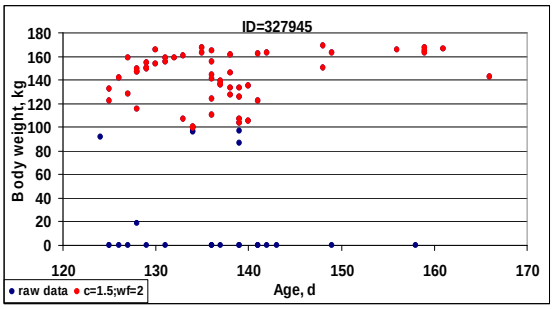


Data Cleaning

884,132 BW rec. (3,888 animals)

1

Robust regression

M estimation
k=1.5; c=2

607,597 BW rec.

2

Animals ≥ 50 BW rec.
SE residual DG ≤ 2 kg

Calculation of
daily gain (DG)

89,443 DG rec.

Discard records >,< $\bar{x}$ ± 3 SD

69,068 DG rec. (1,921 animals)

Pedigree

# Animals	Daily	Weekly	Bi-weekly
In pedigree	3,003	2,961	2,785
With records	1,921	1,884	1,735

Simple Statistics

Mean (SD) of daily gain and age

	Daily	Weekly	Bi-weekly
N	69,068	9,057	4,232
Age, d	129 (21)	127 (21)	126 (20)
Daily gain, g	861 (998)	869 (357)	872 (318)

Genetic analyses – Repeatability model

$$y = X\beta + Z_1a + Z_2pe + Z_3l + e$$

ß: - CG: pen - test date (Daily)
pen - year - test week (Weekly)
pen - year - test bi-week (Bi-weekly)
- Age (linear covariate)

a: additive effect
pe: permanent environmental effect
l: litter effect
e: residual effect

Parameters of short-term gain

DG	V_{animal}	V_{litter}	V_{pe}	V_e	h^2
Weekly	3,241 (1,269)	1,251 (733)	4,171 (1,023)	45,804 (852)	0.06 (0.02)
Bi-weekly	3,102 (1,371)	1,369 (924)	5,982 (1,256)	23,992 (777)	0.09 (0.04)

Gains over n days and parameters

- Using repeatability models

Daily gains:

$$y_{ijk} = \mu + a_i + pe_i + l_j + e_{ijk}$$

$$\sigma_a^2 \quad \sigma_{pe}^2 \quad \sigma_l^2 \quad \sigma_e^2$$

Daily gains averaged over n days:

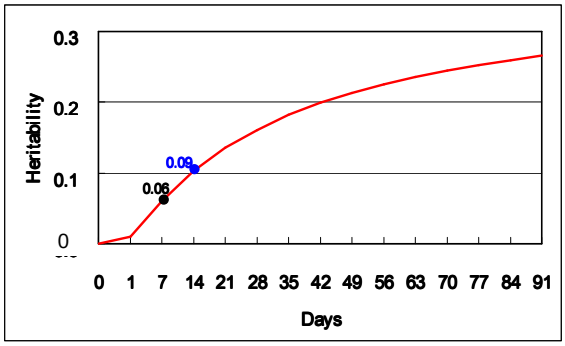
$$\frac{\sum y_{ijk}}{n} = \mu + a_i + pe_i + l_j + \frac{\sum e_{ijk}}{n}$$

$$\sigma_a^2 \quad \sigma_{pe}^2 \quad \sigma_l^2 \quad \frac{\sigma_e^2}{n}$$

Parameters of short-term gain

DG	V_{animal}	V_{litter}	V_{pe}	V_e	h^2
Daily-Expected	3,100	1,300	5,000	330,000	0.009
Daily-Estimated	328 (365)	0.1 (0.4)	0.1 (0.2)	773,000 (4,639)	0.0004 (0.0005)

Expected heritabilities of Daily gain averaged over n days



Conclusions

- Robust regression is an efficient method for 'cleaning' serial BW data
- BW data from automatic feeder stations (Weekly, Bi-weekly) are useful for genetic analyses
- Random regression analyses of ADG may be successful for longer intervals