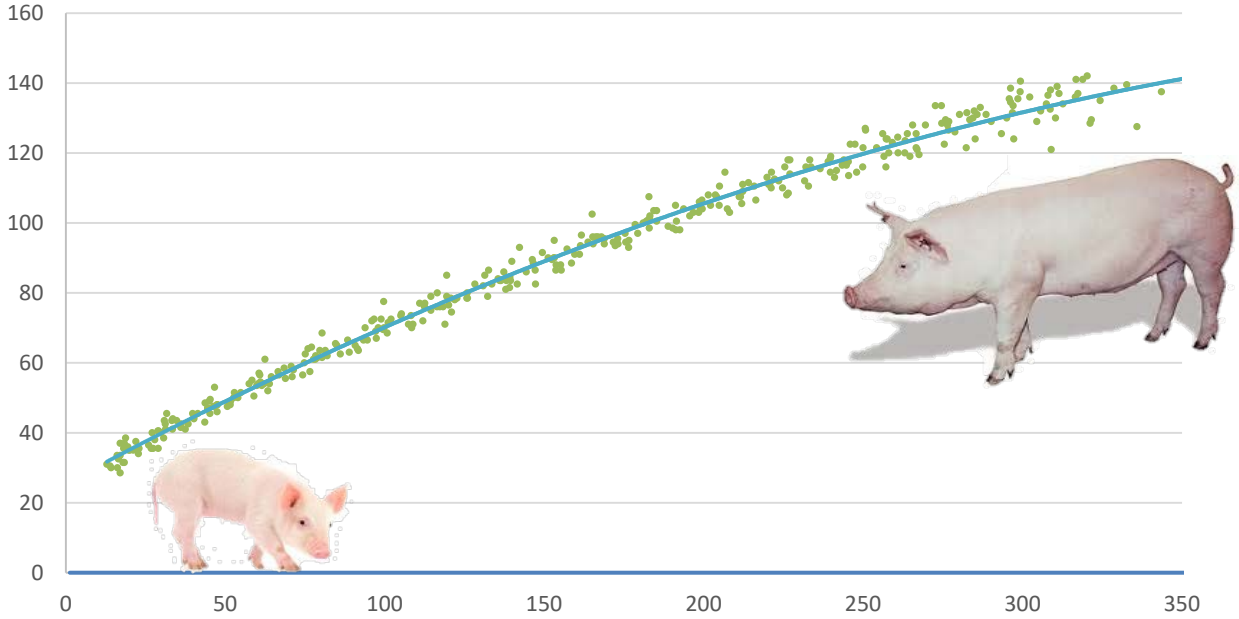
Performance curves for on-farm optimization: evaluation of published growth models



Frederik Leen, EAAP 2016, Belfast

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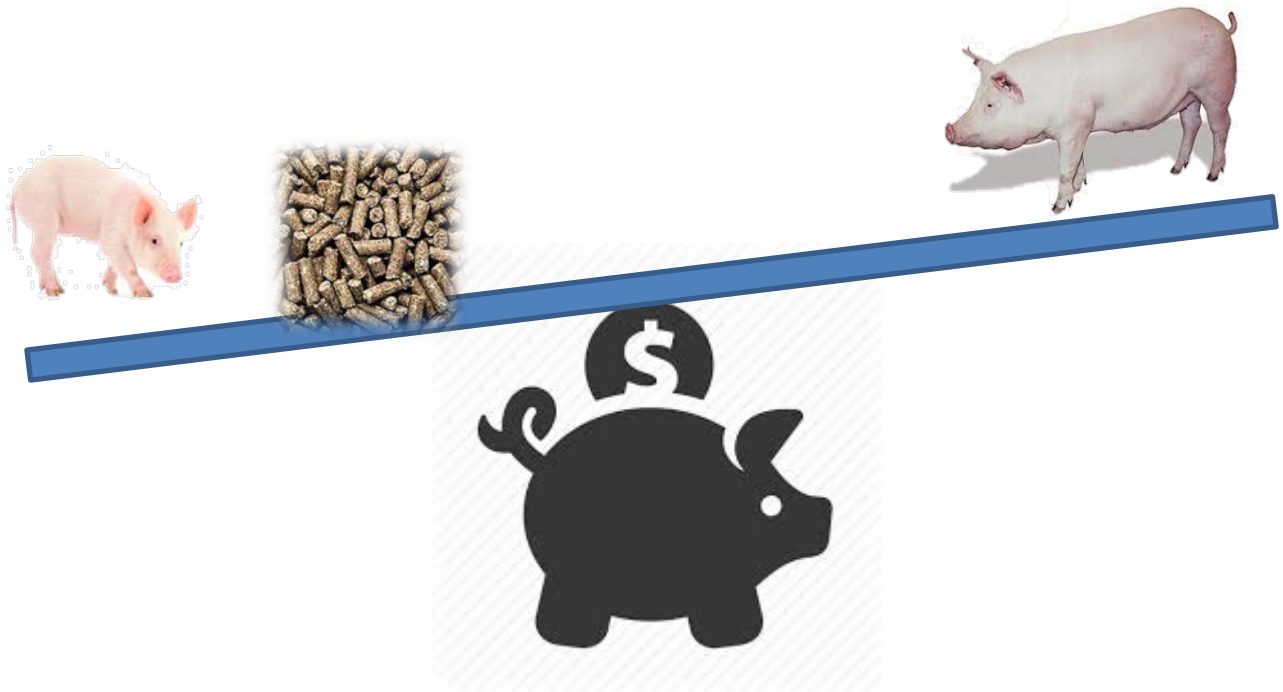
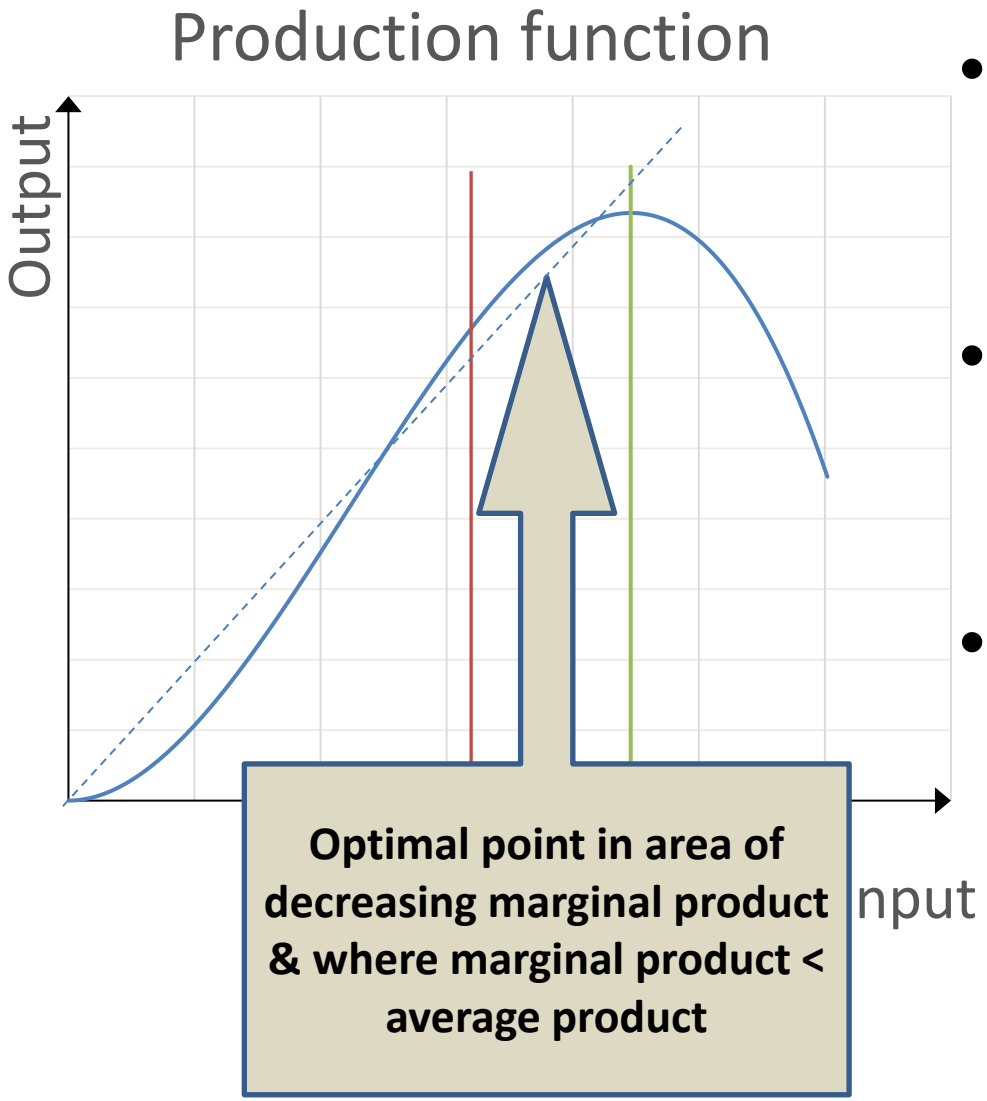
Why economic optimization?

- Optimize input use and output production
- Maximise economic return
- Strategy to enhance farm profitability



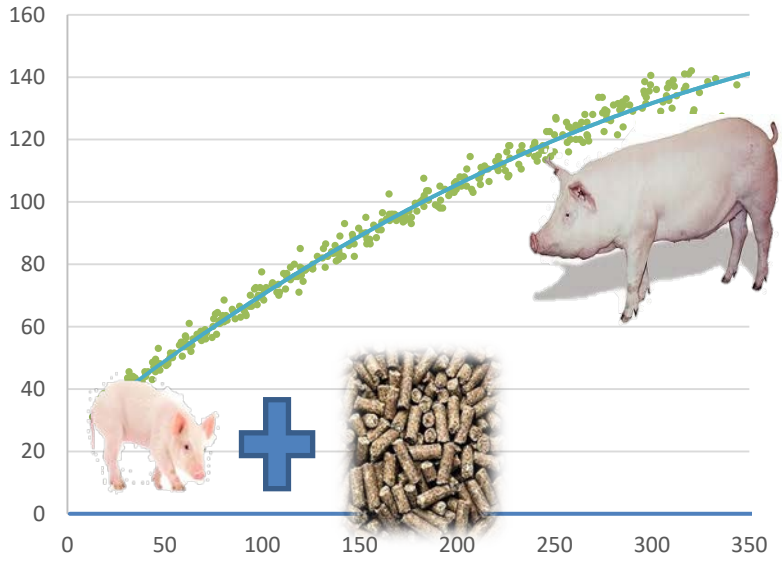
Recap of some production economics



- Description of technical transformation of inputs into output
- Shape can be estimated with *data driven* techniques
- E.G. Estimate parameters of a Cobb-Douglas: $Y = A(x_1^{\alpha} x_2^{\beta})$

Rationale for the study

- A production function can also be mechanistically modelled
- Enables farm-specific curvature of the function
- This is not the case with data-driven techniques



But which performance curves are accurate and enable on-farm calibration, in order to be used in on-farm optimization?

Objective of the study

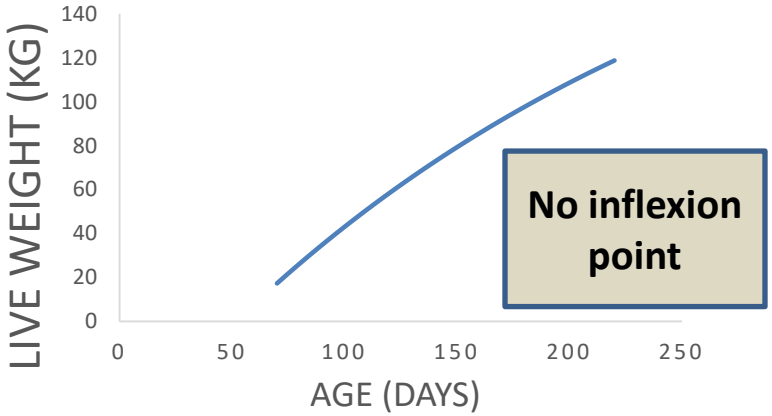
- **Evaluate a list of published empiric dynamic performance curves:**
  - for accuracy
  - model performance after calibration with limited data
  - today only results for growth models will be presented

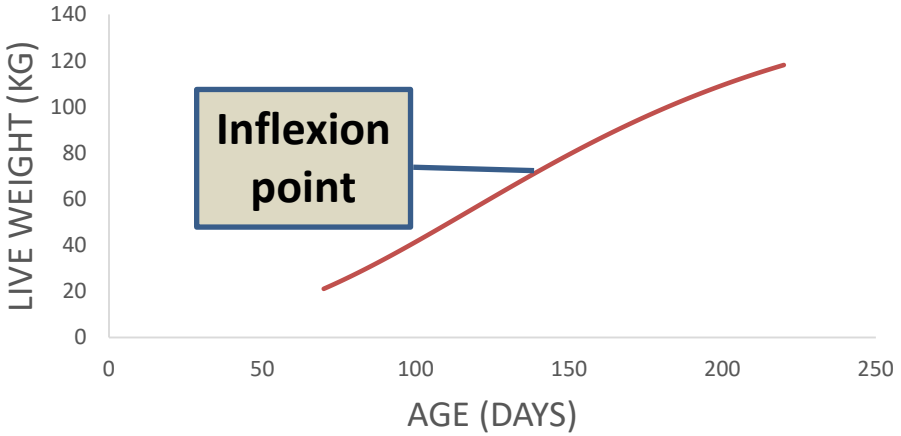
M&M: data sources

4 animal performance trials :

- All pigs Piétrain x Hybrid cross
- 4 sexes in each trial: barrows, boars, GnRH-vaccinated boars, gilts
- Fed *ad libitum* on multi-phase diets
- Trials A,B: individually housed, standardized conditions
- Trials C,D: group housed, controlled commercial conditions

M&M: overview of models





Monomolecular:

$$W(t) = W_f - (W_f - W_0)e^{-kt}$$

Gompertz: $W(t) = W_0 e^{\left(\frac{\mu_0}{D}(1-e^{-Dt})\right)}$

Bridges: $W(t) = W_f(1 - e^{-e^{m}t^{a}})$

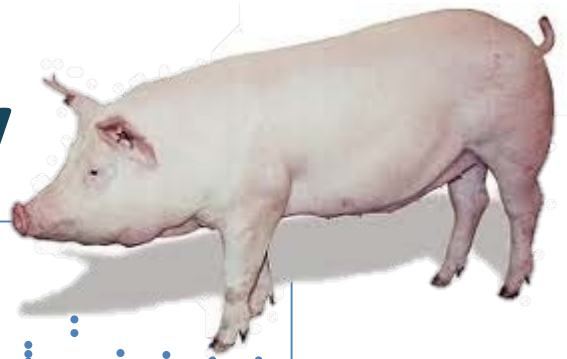
Giesen: $W(t) = \int_{t_0}^{t} ae^{(-bt-\frac{c}{t})}dt$

CFIW: $W(t) = W_f - (W_f - W_0)e^{-k\sum_{t0}^{t-1} a(1-e^{-bW}t)}$

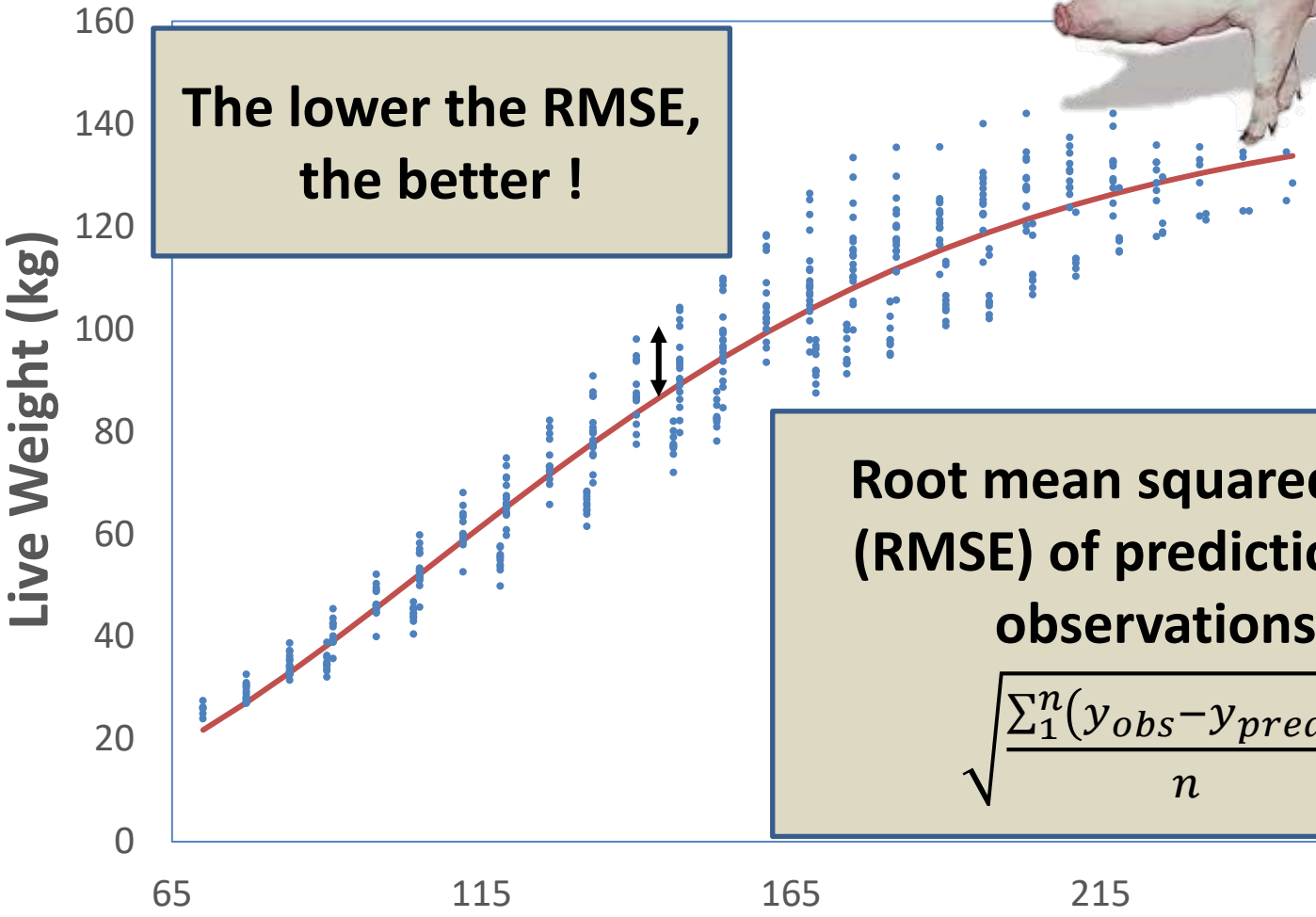
Richards: $W(t) = \frac{W_0 W_f}{[W_0^D + (W_f^D - W_0^D)e^{-kt}]^{1/D}}$

Concave or Sigmoid shape and inflexion point depend on *parameter D*

M&M: Accuracy



The lower the RMSE, the better !



Root mean squared error (RMSE) of predictions vs. observations:

$$\sqrt{\frac{\sum_1^n (y_{obs} - y_{pred})^2}{n}}$$

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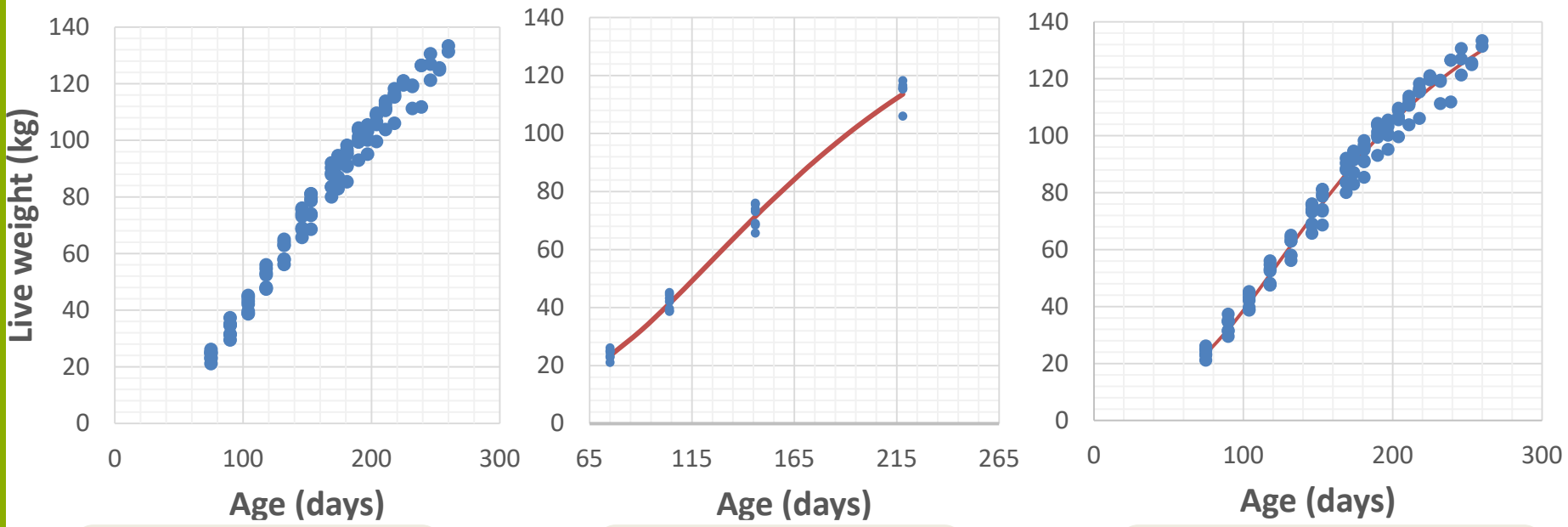
M&M: Performance after calibration



All observations for a sex in a trial

Observations at start, +/- 40 kg, +/- 70 kg and at delivery

Model calibrated to these observations

RMSE for predictions with calibrated model

$$\sqrt{\frac{\sum_1^n (y_{obs} - y_{pred})^2}{n}}$$

Calibrated model quality: linear regression of Observed vs. Predicted values:

$$Observation = \alpha + \beta \times Prediction$$

$$\alpha \approx 0 \; and \; \beta \approx 1$$

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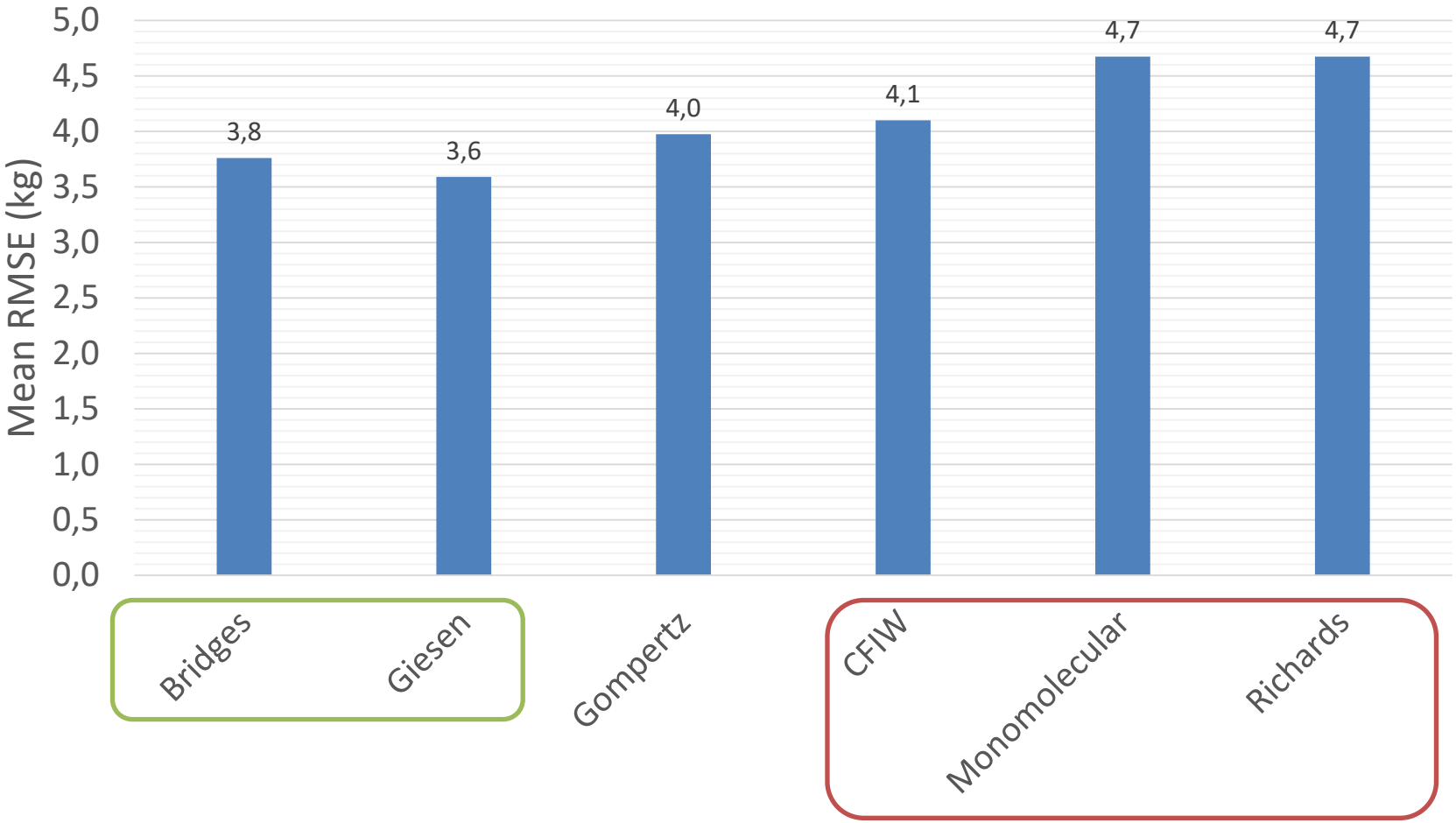
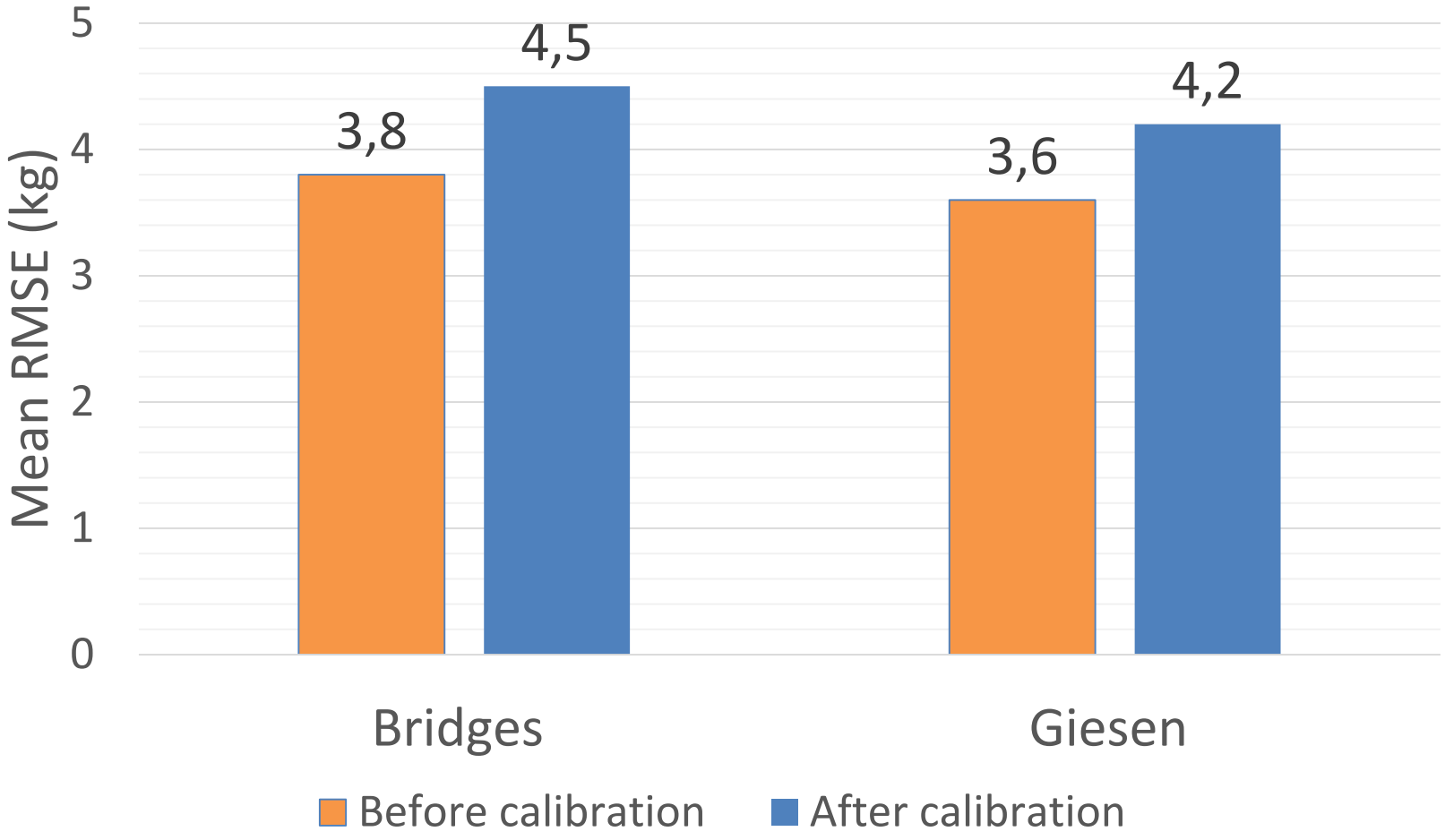
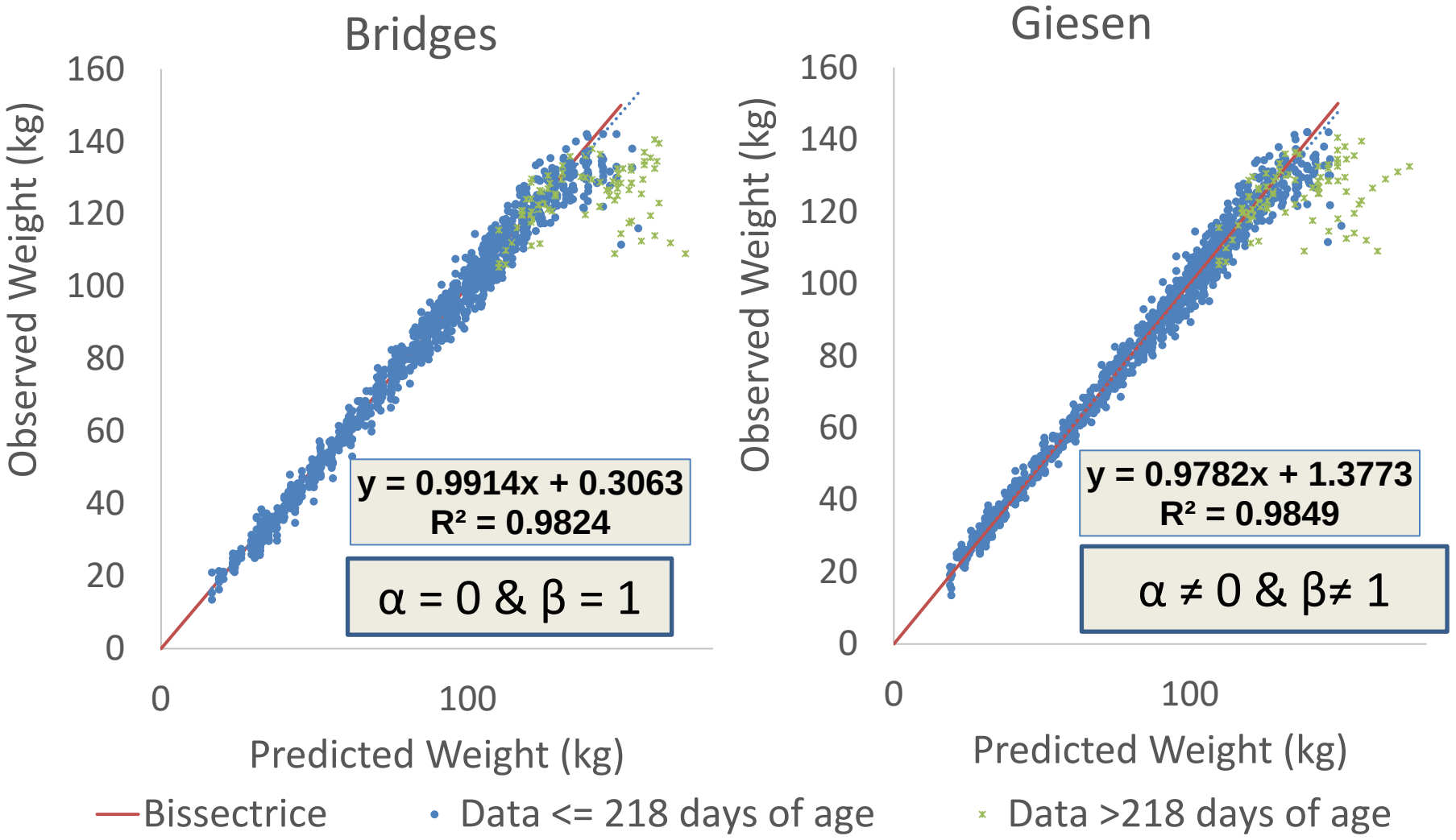
Results: live weight models



Results: model performance after calibration



Results model performance after calibration



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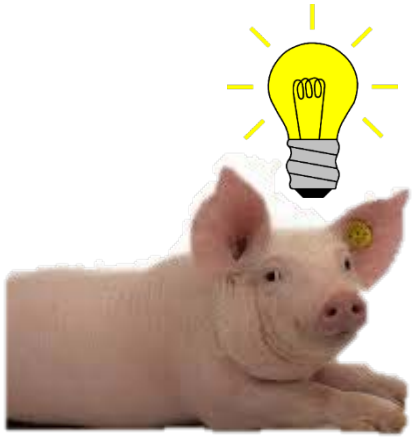
Conclusions & Recommendations

- Both Giesen and Bridges yield a good estimate of a sex-specific weigth curve
- Results indicate that Bridges is slightly better

- Remark
  - Stability of model parameters over several production cycles needs investigation.



Thank you

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