Detecting perturbations in dairy cows liveweight trajectories

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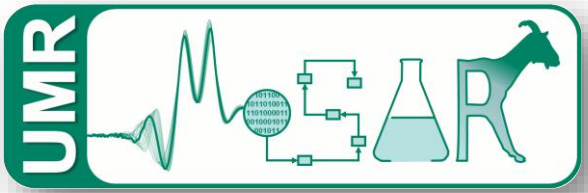
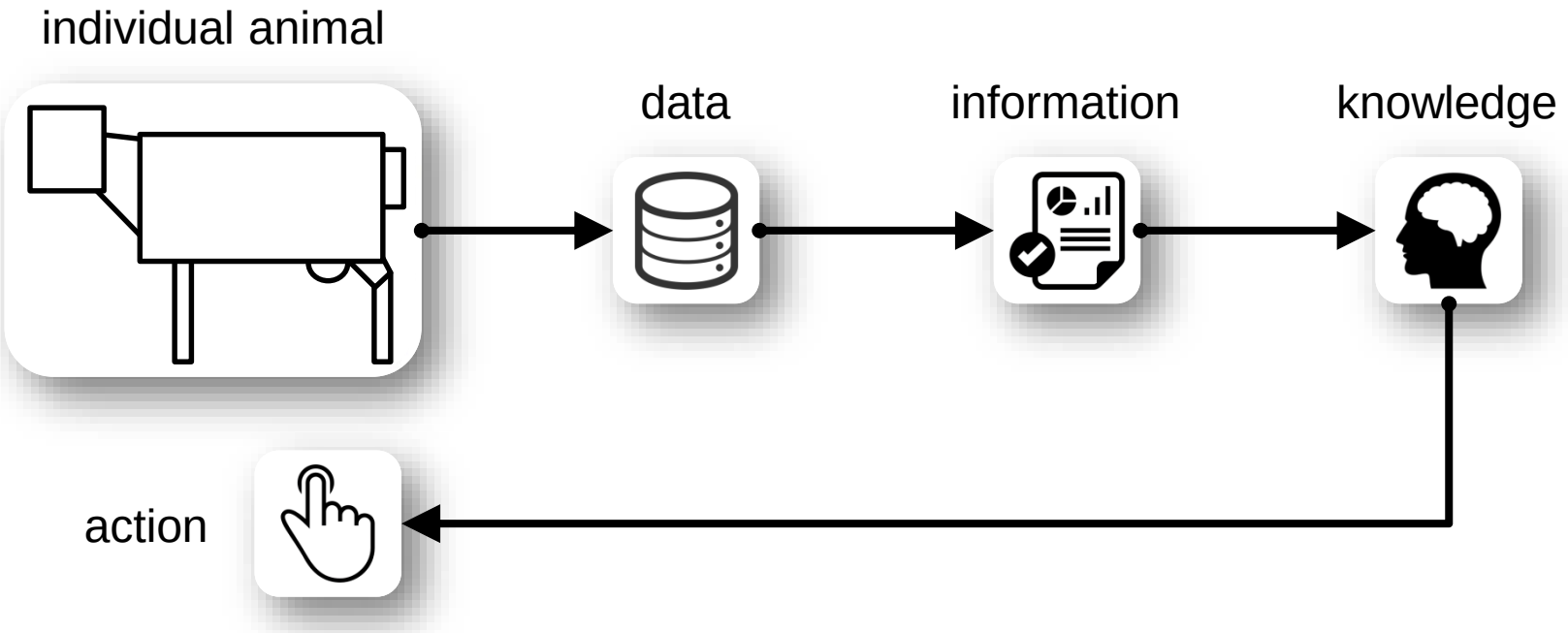


Context

- Precision Livestock Farming



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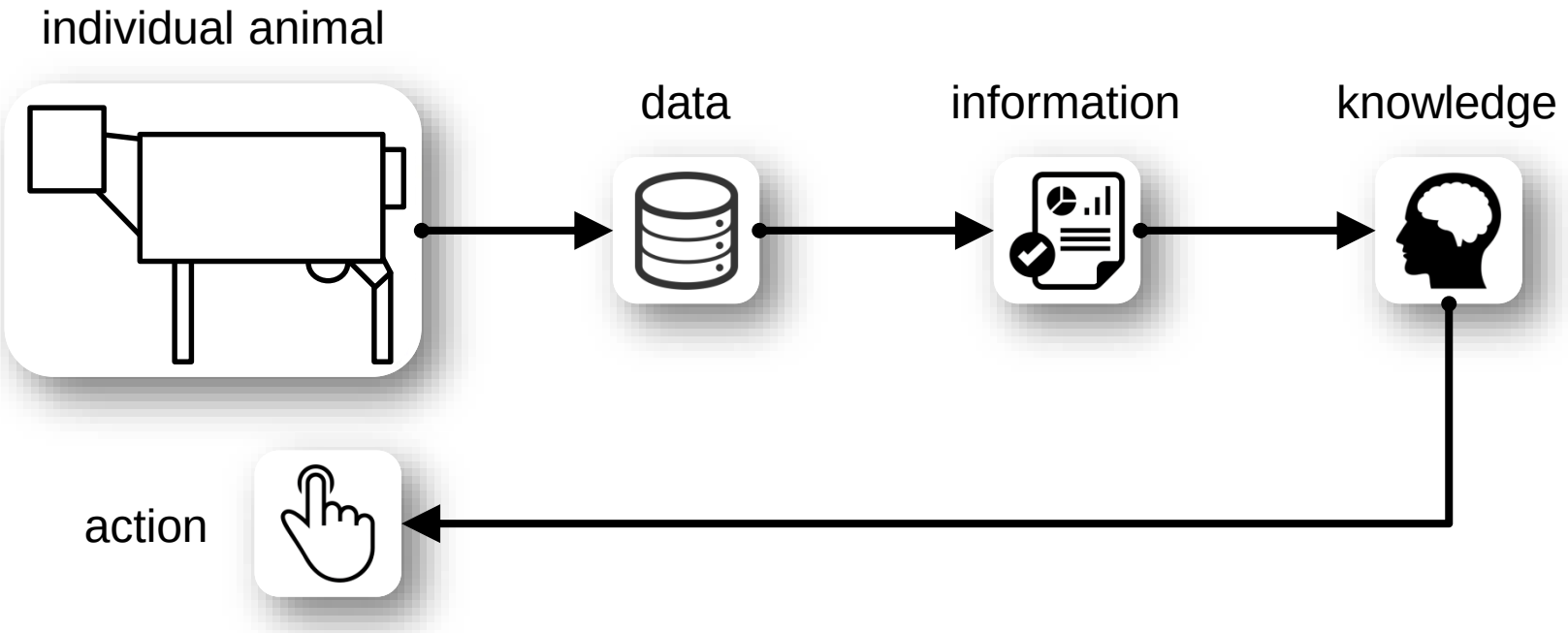

Context

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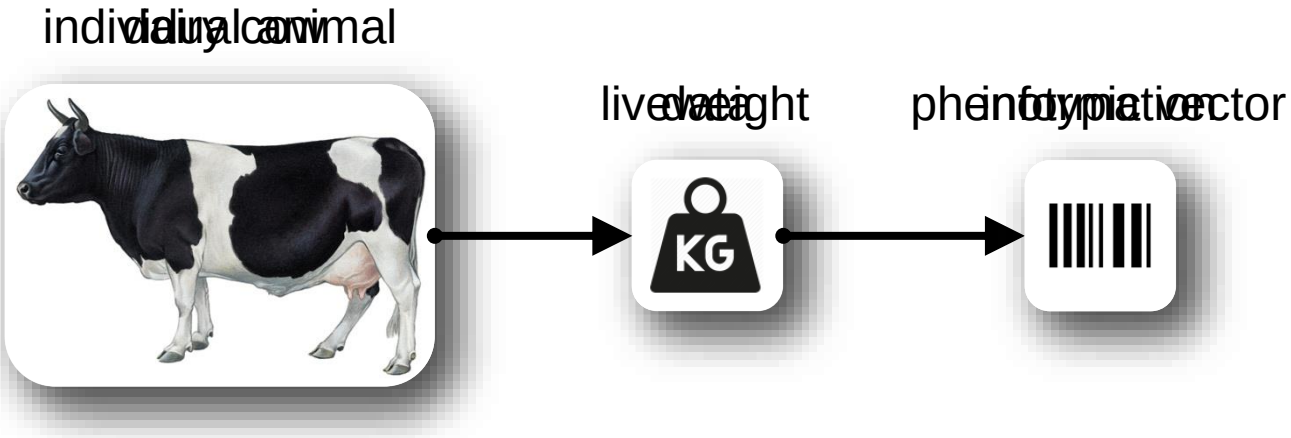
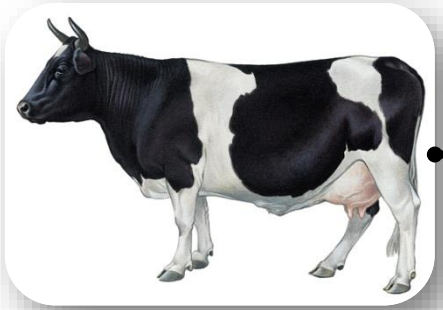


Context

- Precision Livestock Farming

dairy cow



liveweight

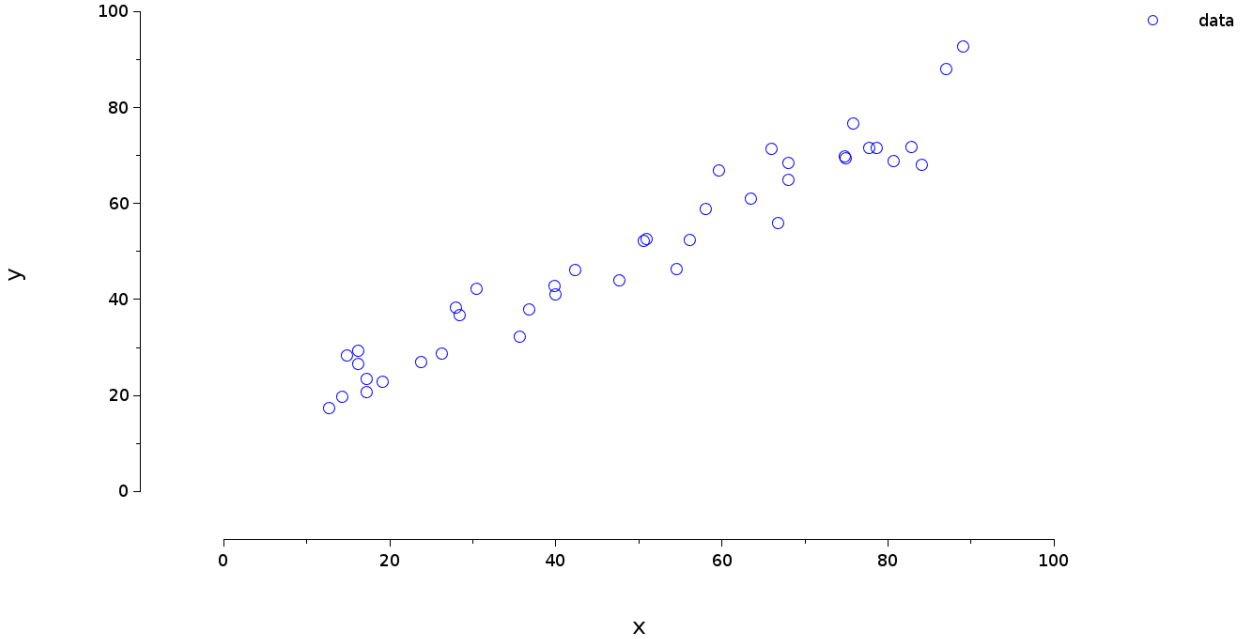
phenotypic vector

: synthetic & standardized metrics on liveweight dynamics during lactation

Analytic model as an interpretive tool of liveweight trajectories

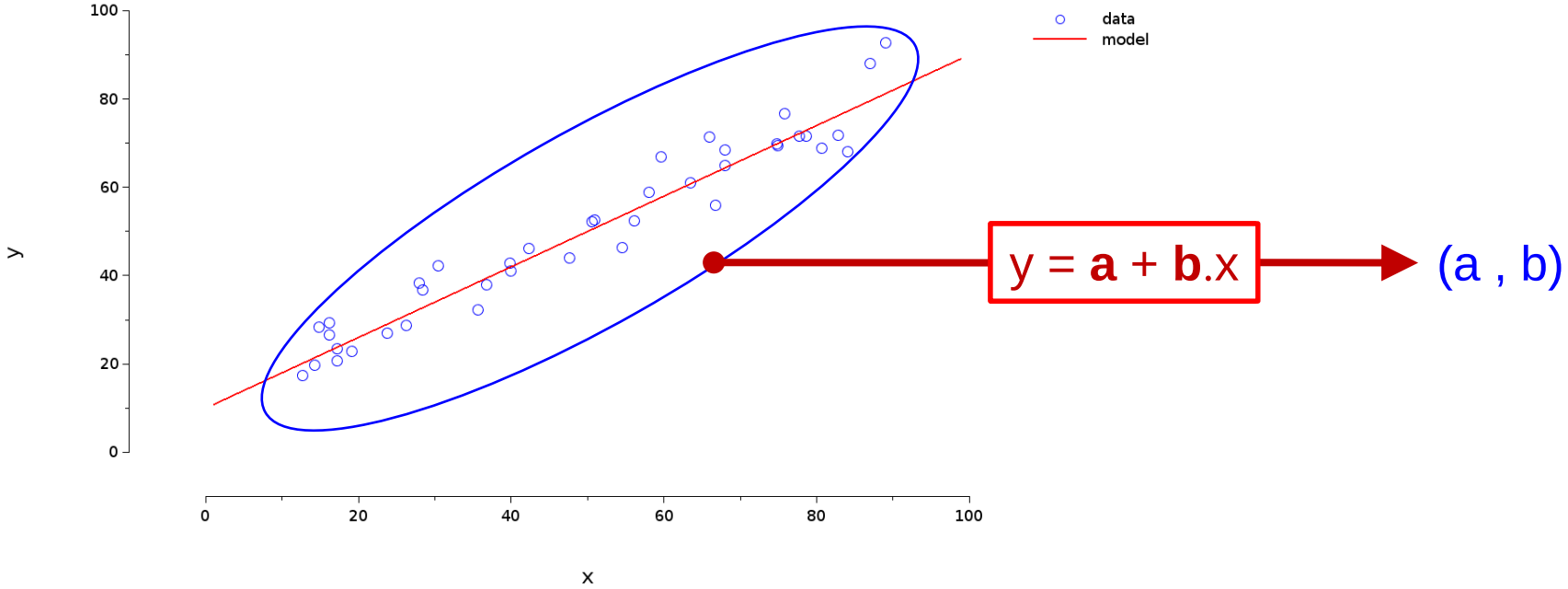
Objective

- Model as an interpretive tool



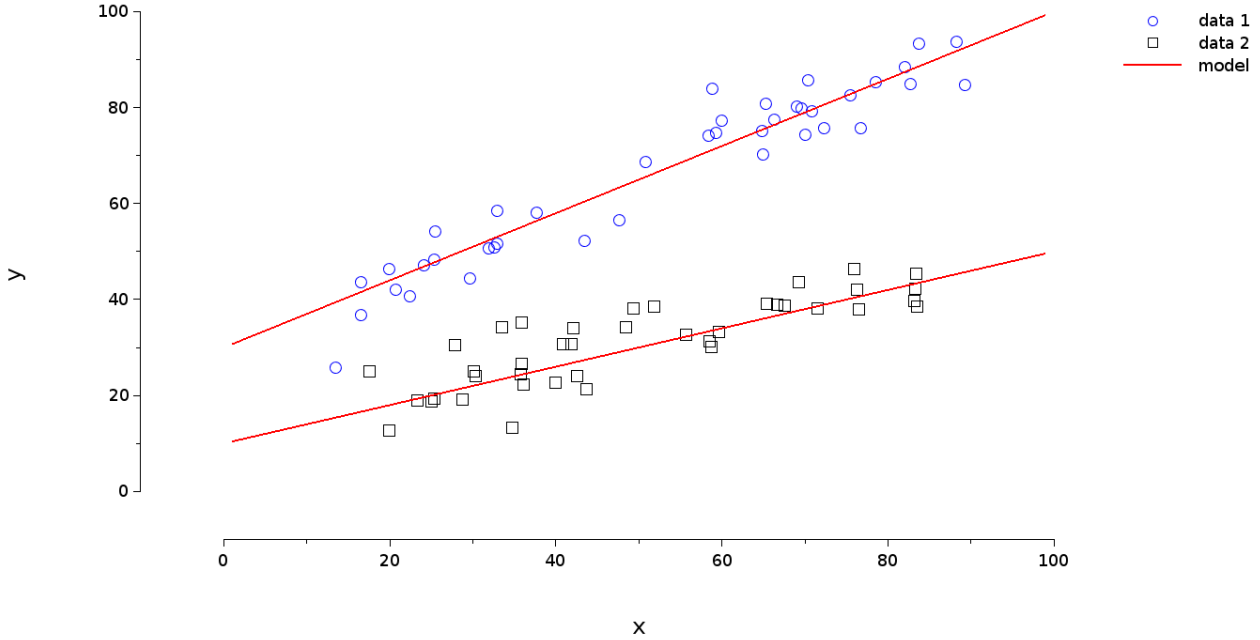
Objective

- Model as an interpretive tool



Objective

- Model as an interpretive tool... to compare datasets



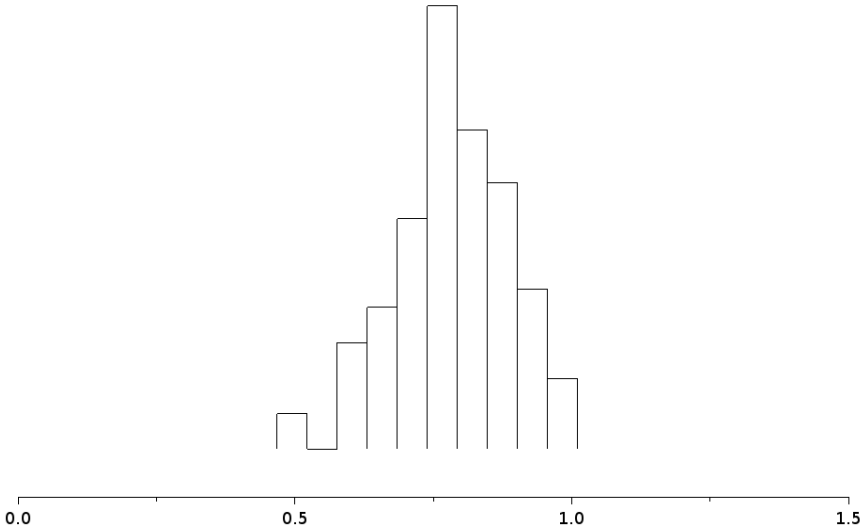
$(a , b)_1$

$(a , b)_2$

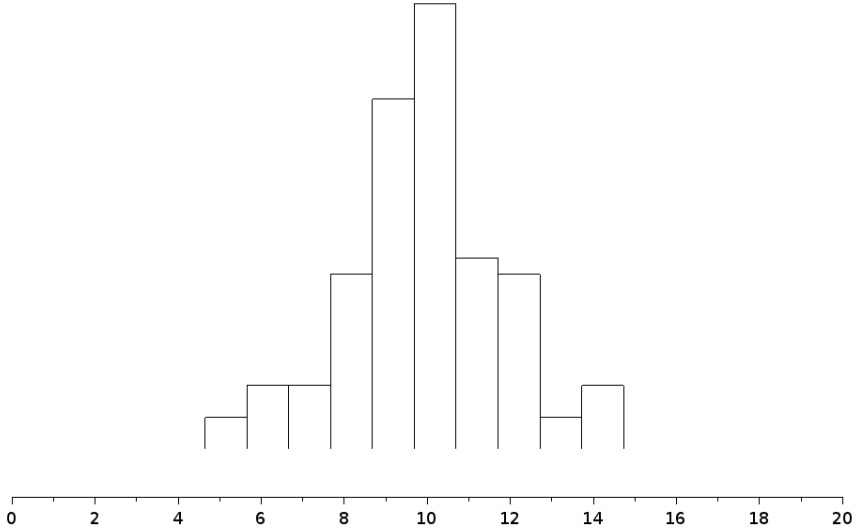
Objective

- Model as an interpretive tool... to analyze variability

a

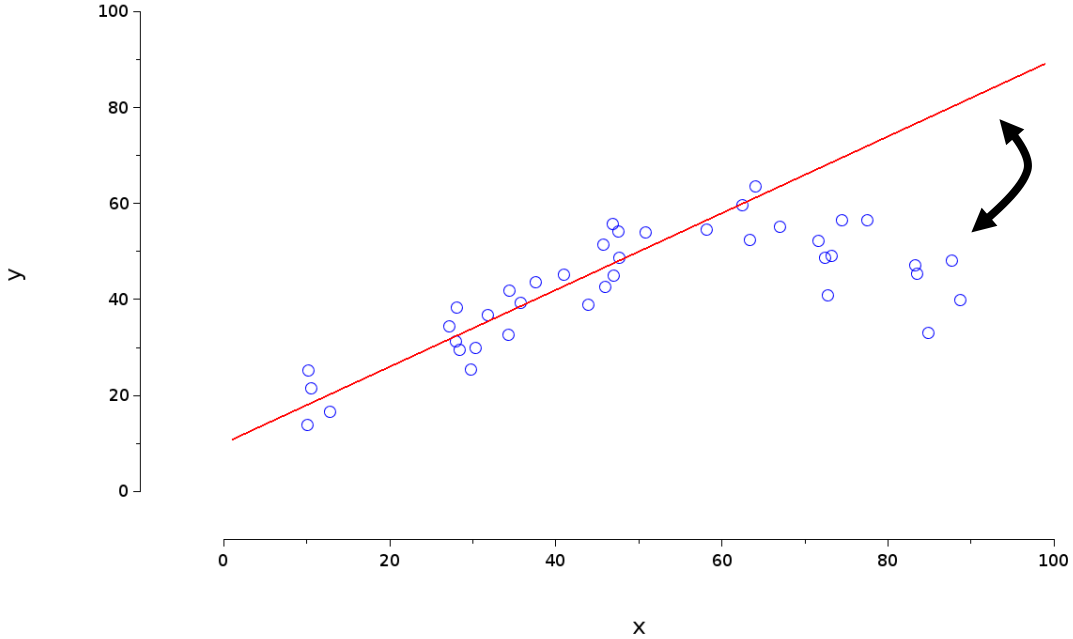


b



Objective

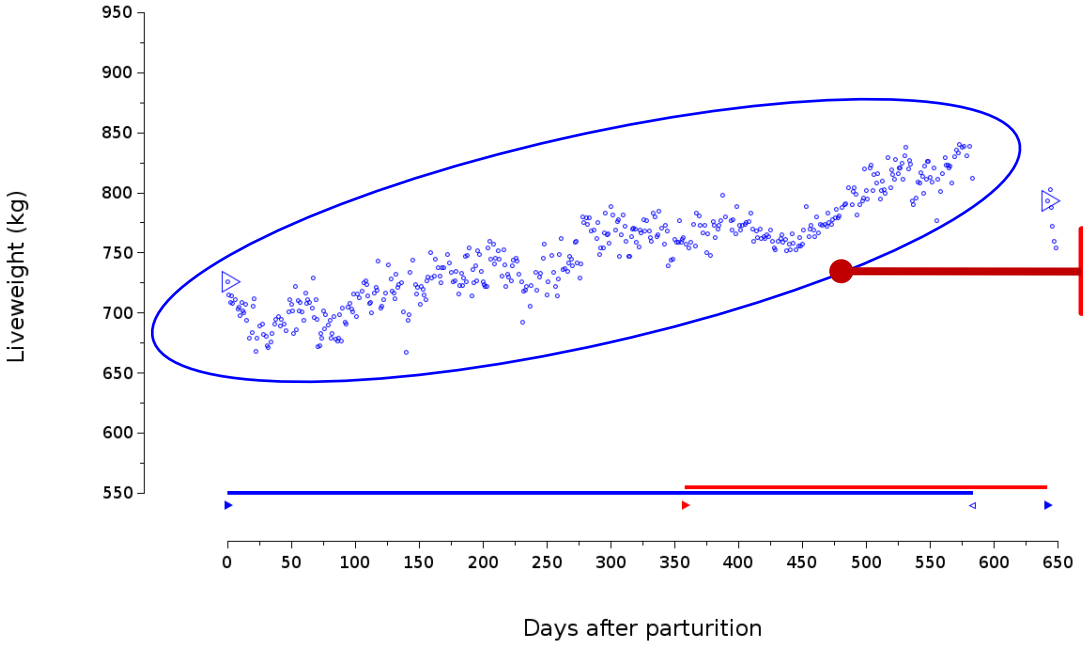
- Model as an interpretive tool... to benchmark



i.e., detect deviations from expectation

Objective

- Model as an interpretive tool



PWM*

(parameters)

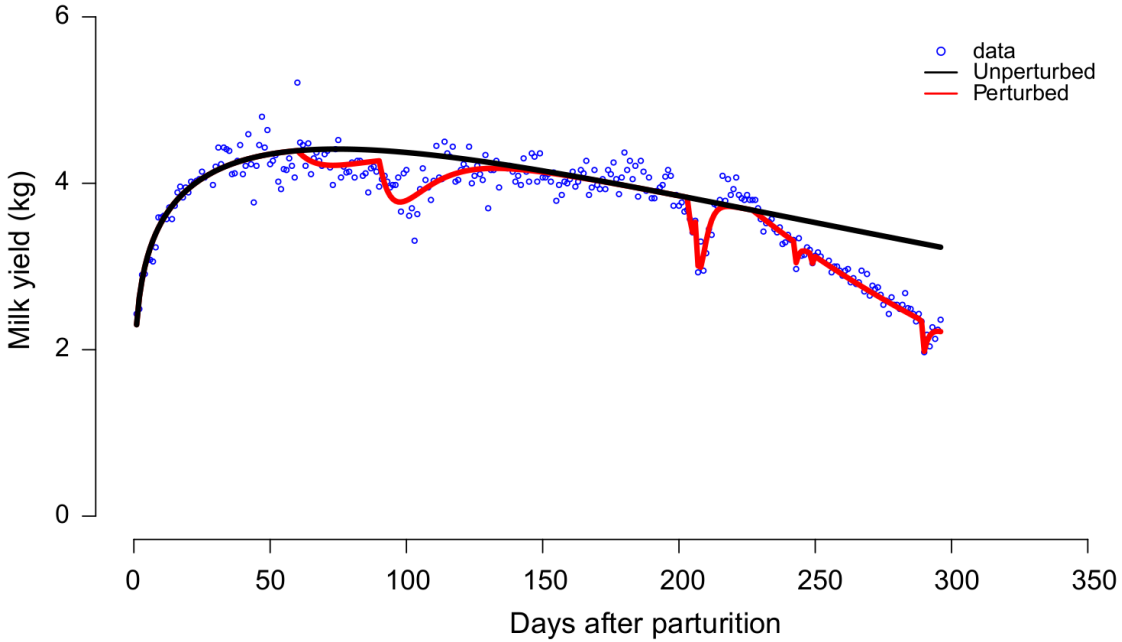
- Dynamics key features
- Perturbations (when and how)

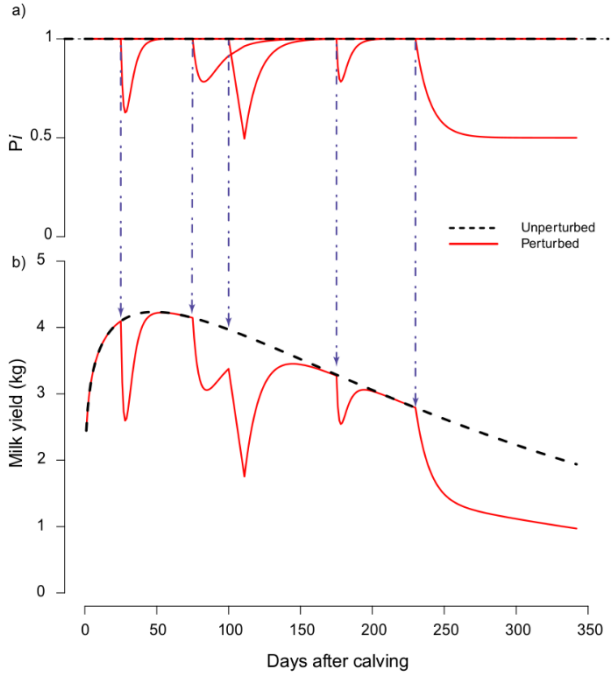
*PWM =Perturbed Weight Model

PWM Rationale

Gomes et al., 2018. *69th EAAP*
Ben Abdelkrim et al., 2019. *PCI Anim. Sci.*

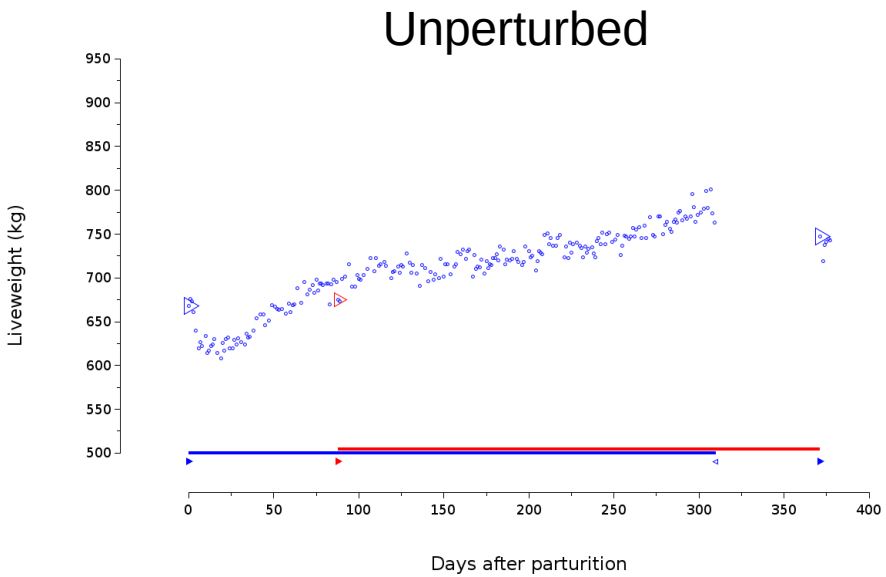
- PLM: Perturbed Lactation Model

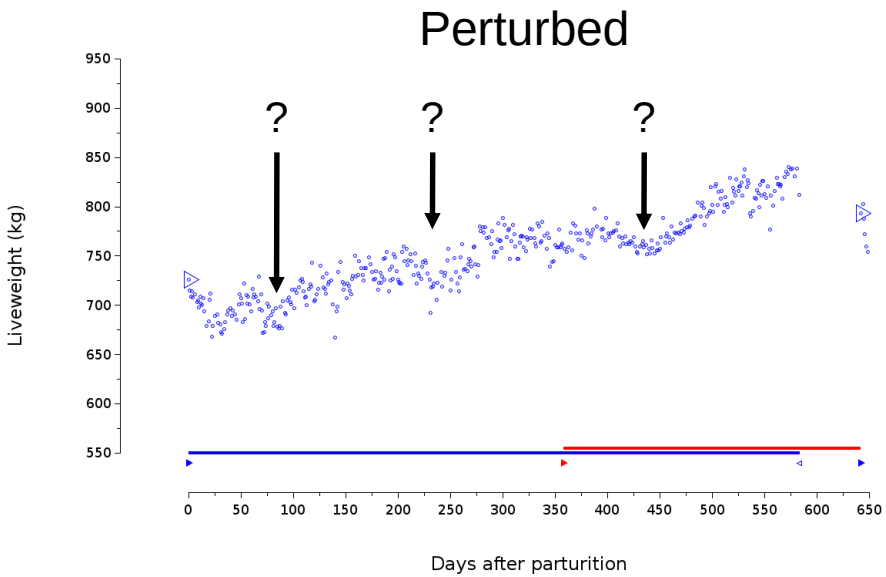




Data

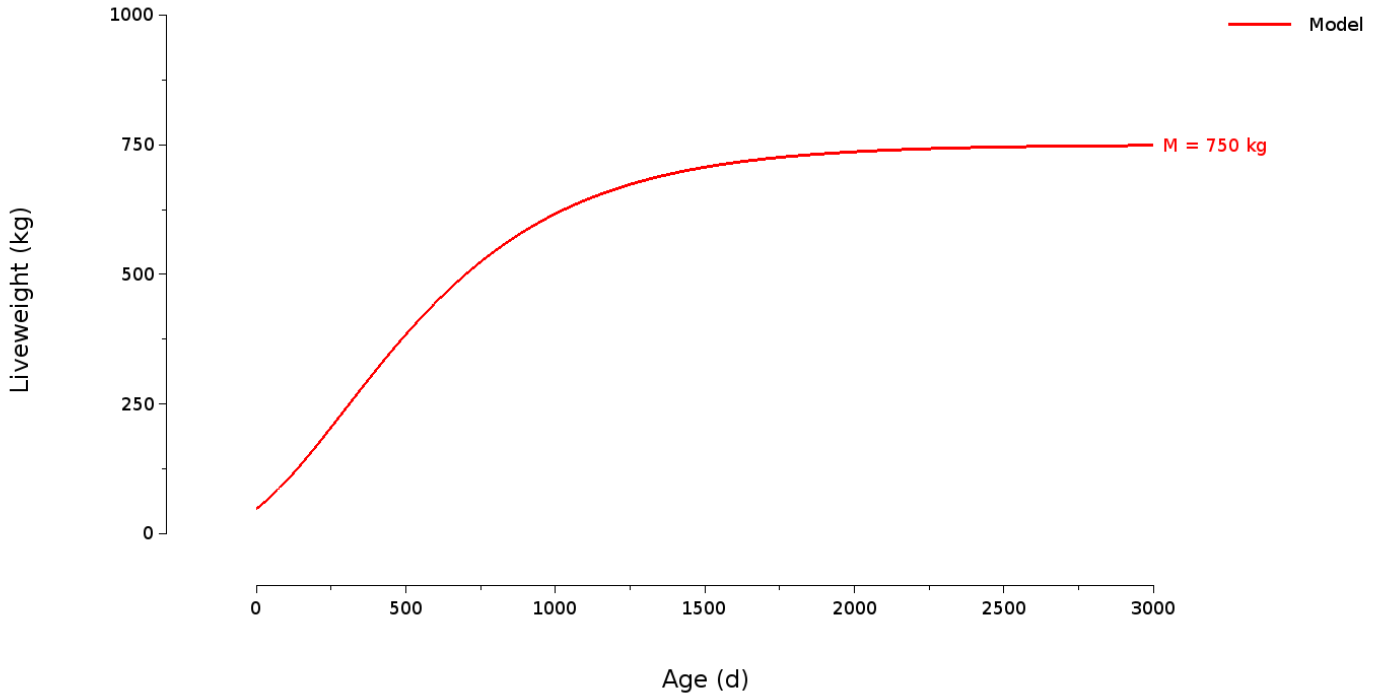
- Liveweight timeseries (France; commercial herds; Holstein)





#1 Long term growth

West et al. 2001. *Nature*



#1 Long term growth

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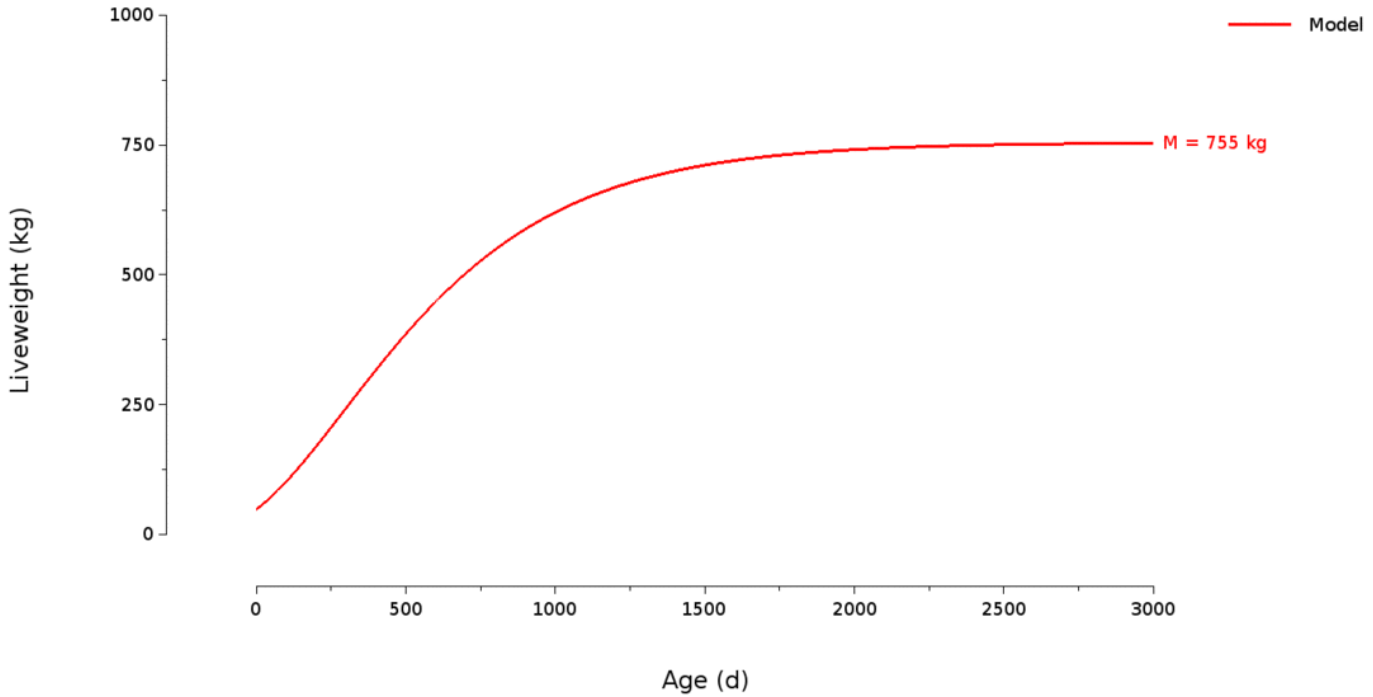
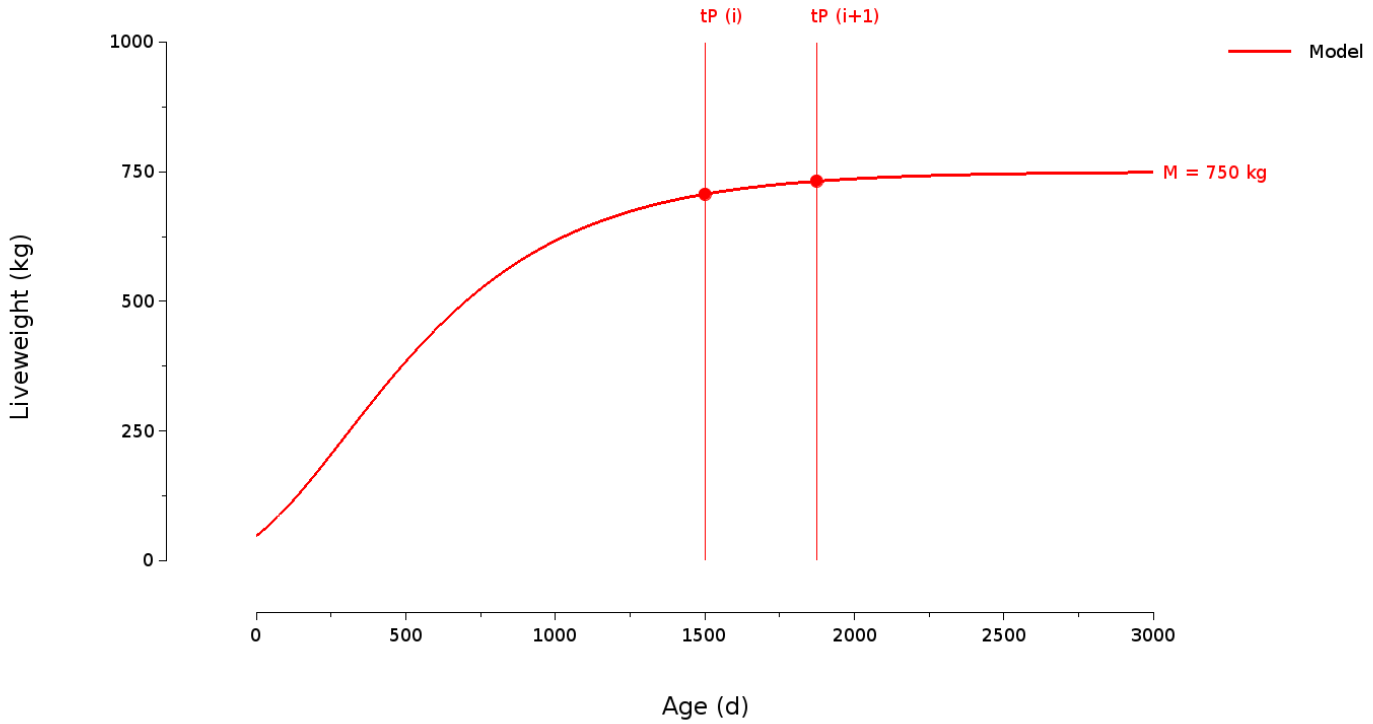
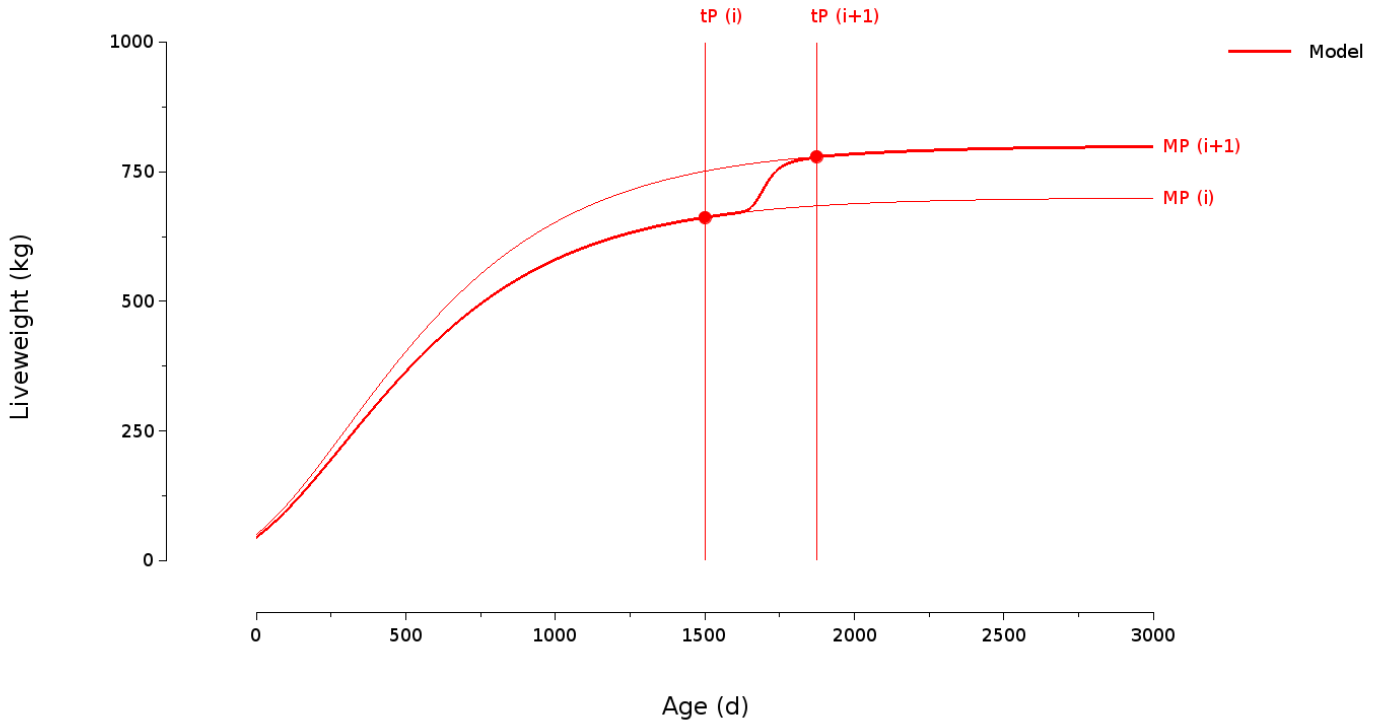


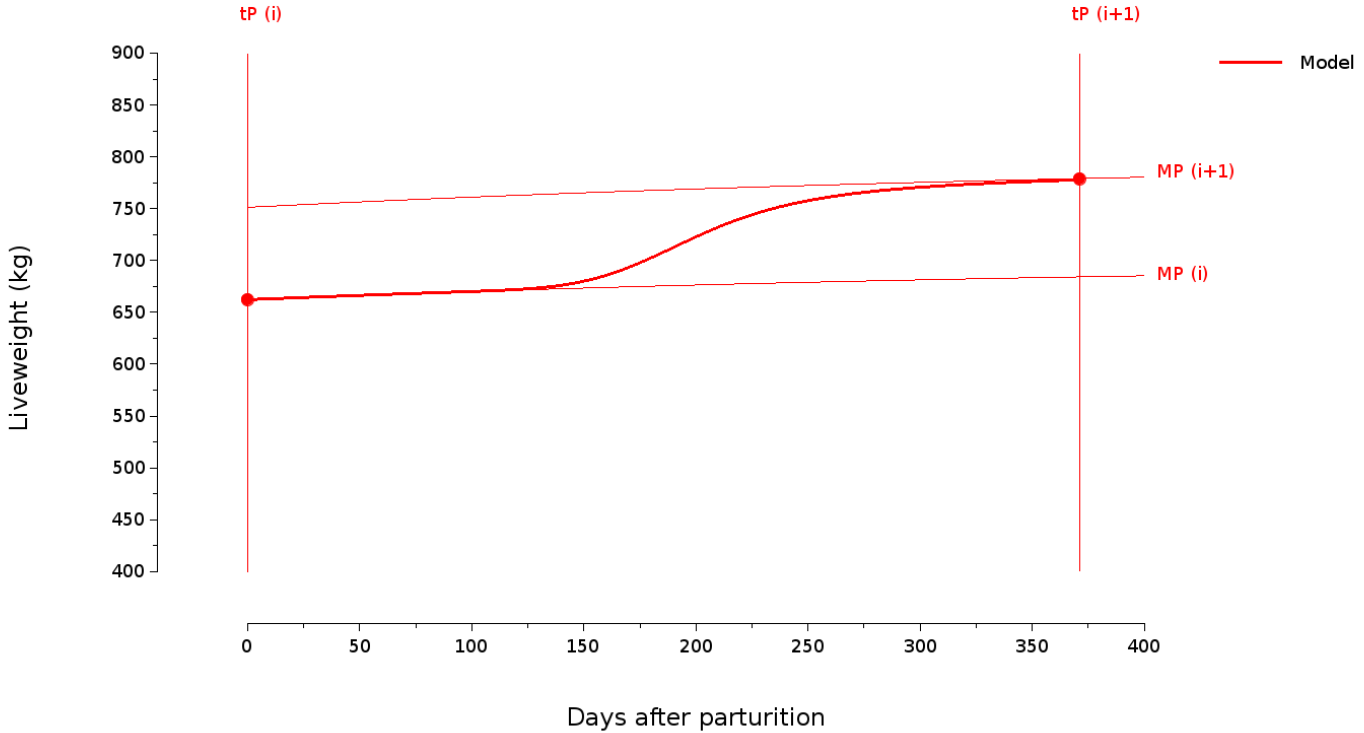
Input: Parturition times



#2 Mid-term change in reserves

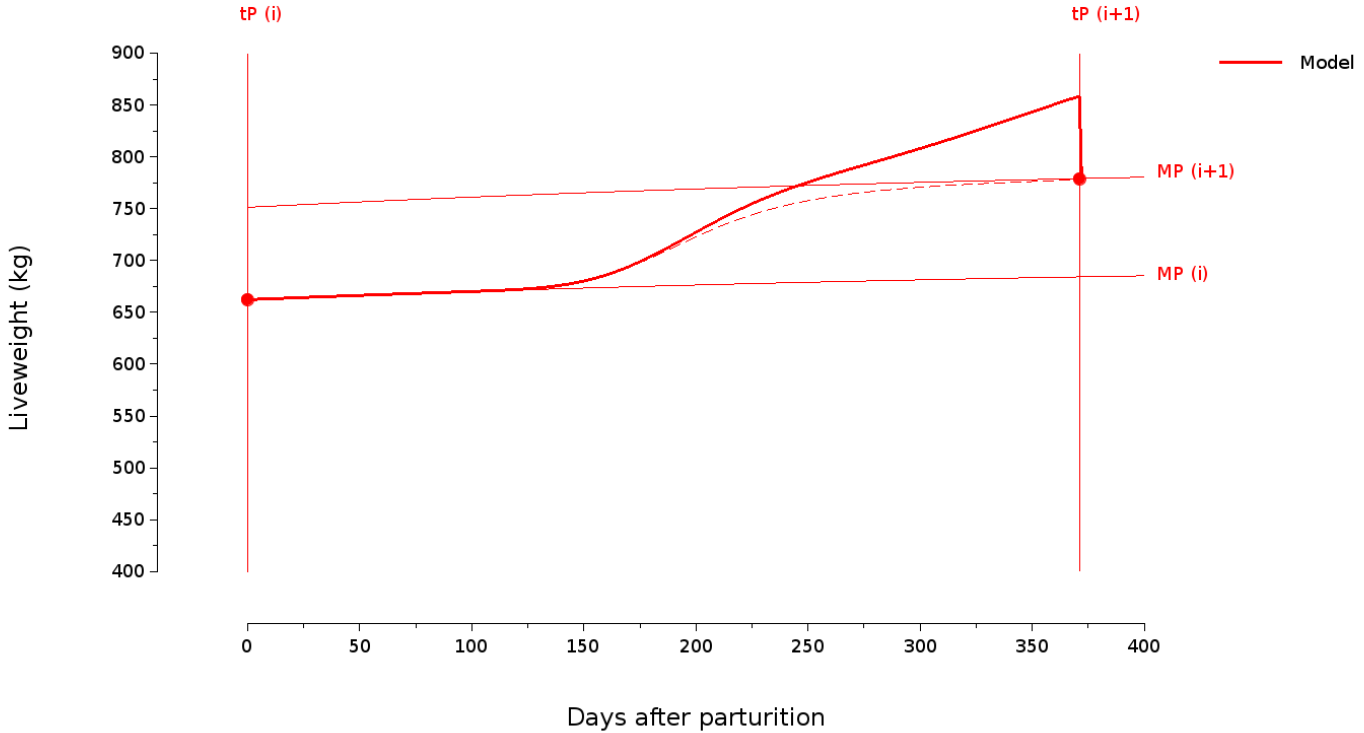


Zoom: Parturition to next parturition

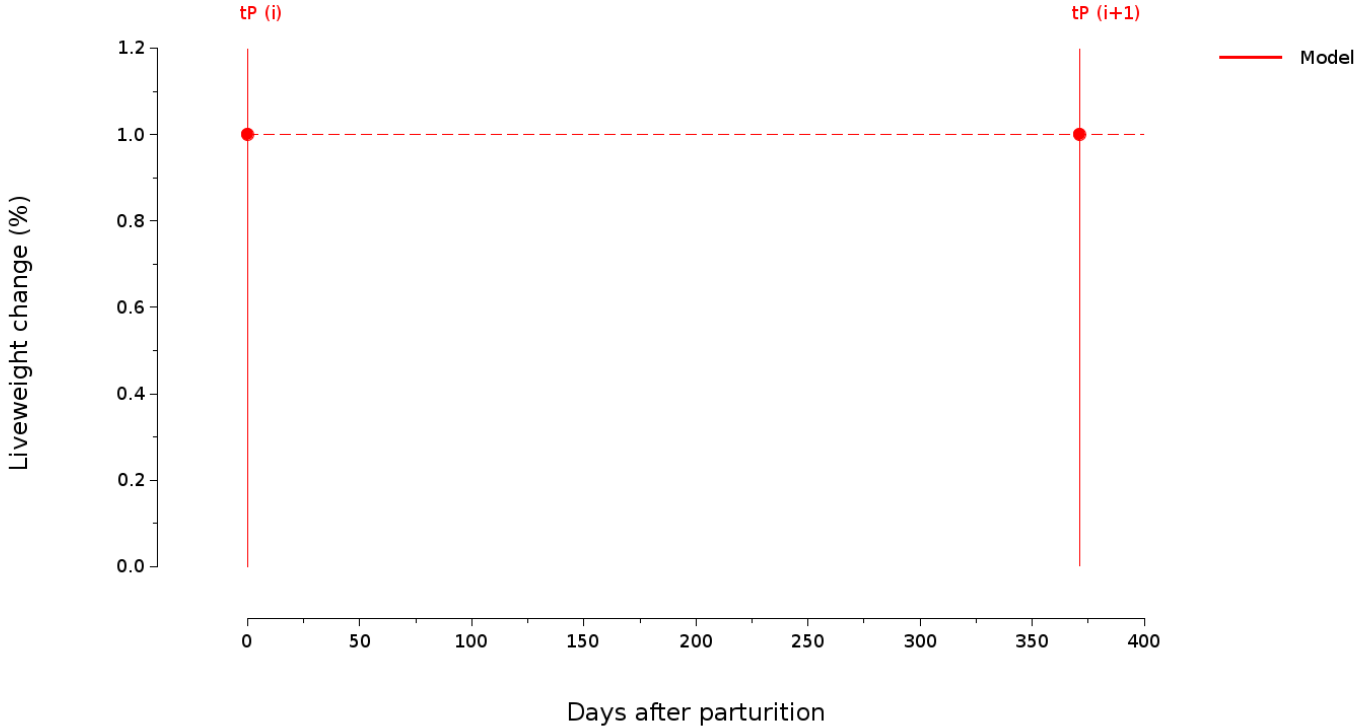


#3. Gravid uterus load

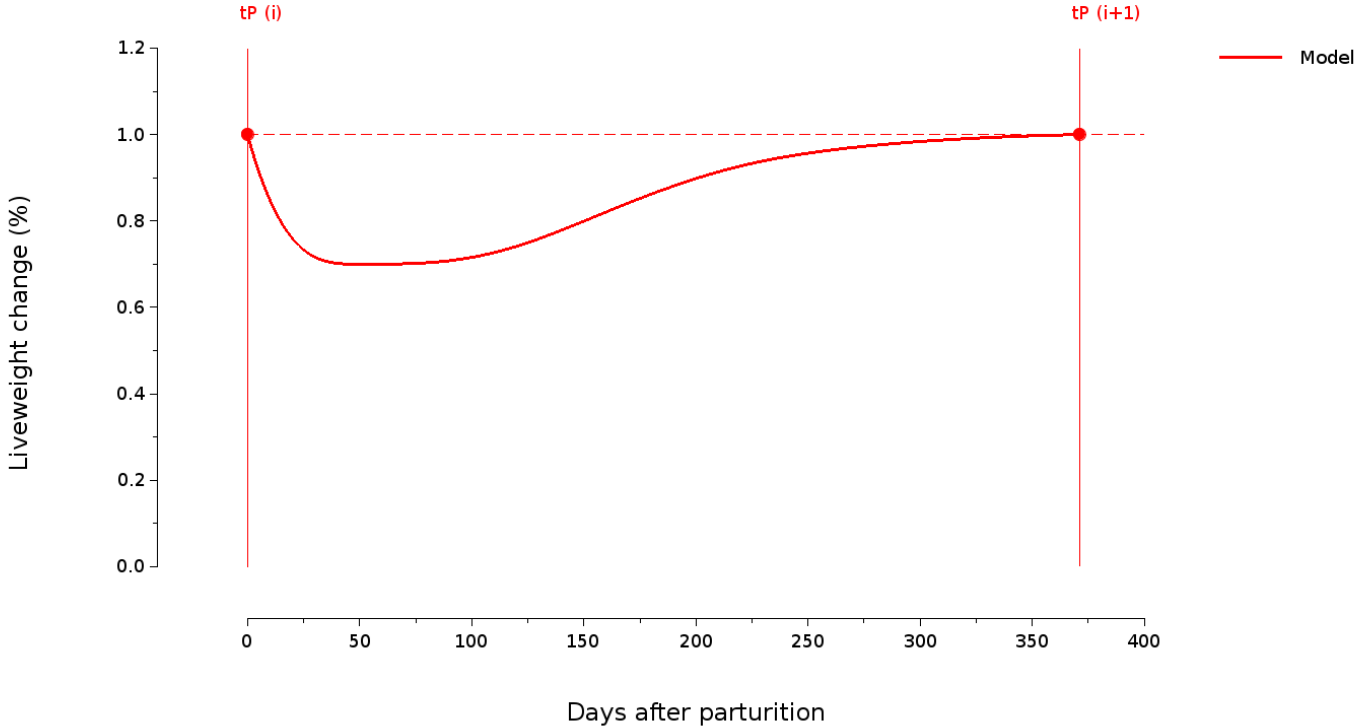
Laird, 1966. *Growth*



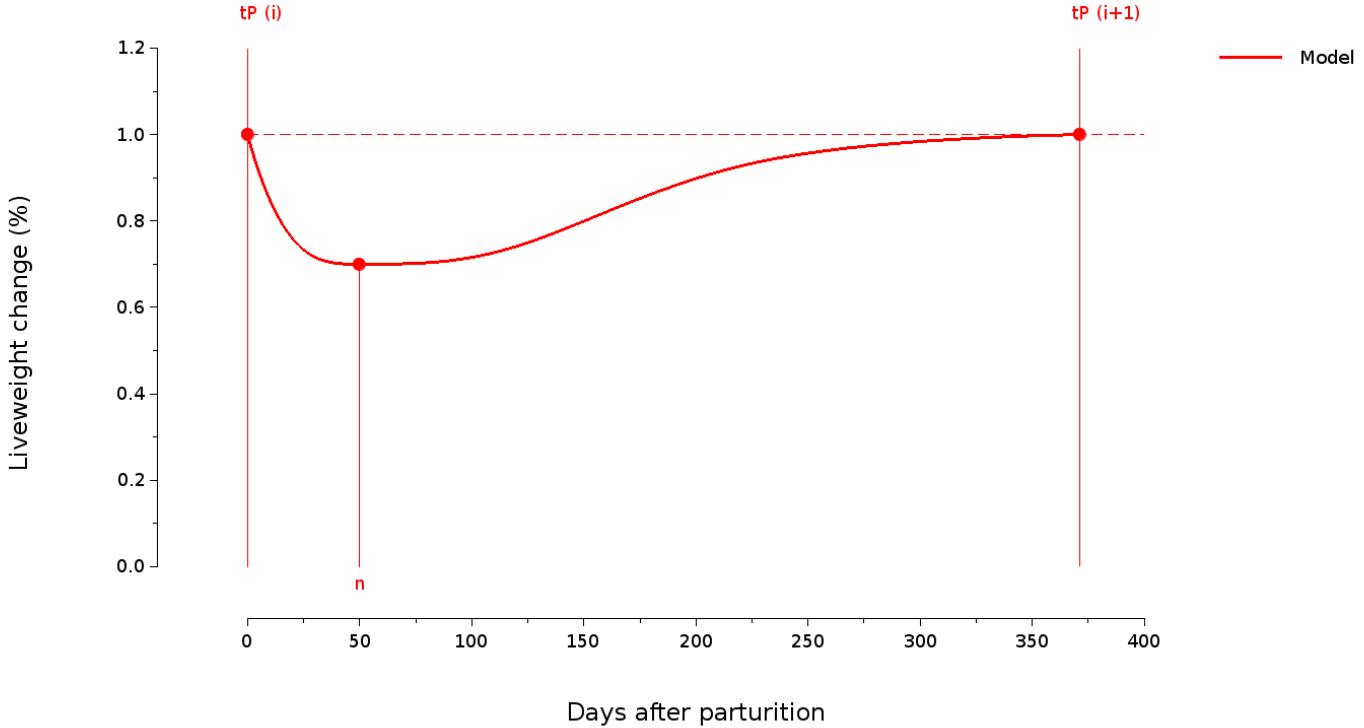
Rescale : baseline trajectory



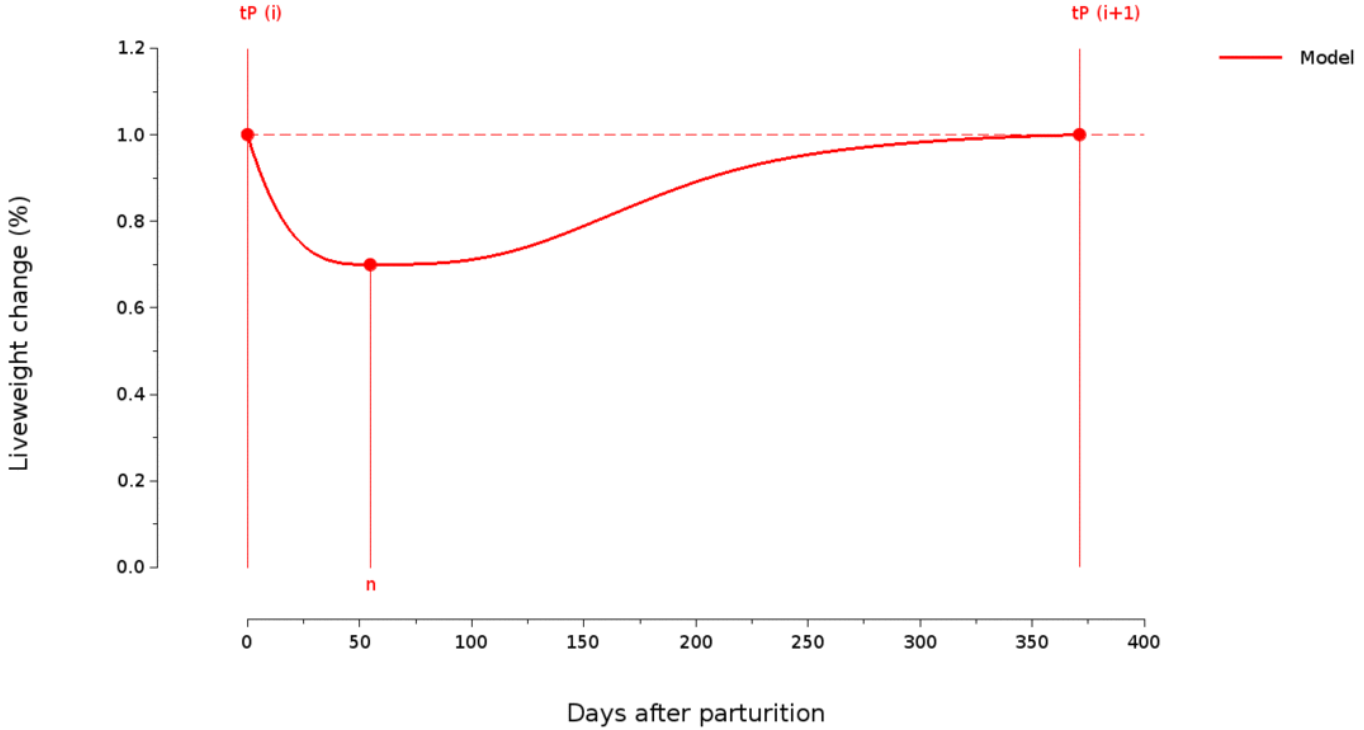
#4. % depletion-repletion of reserves



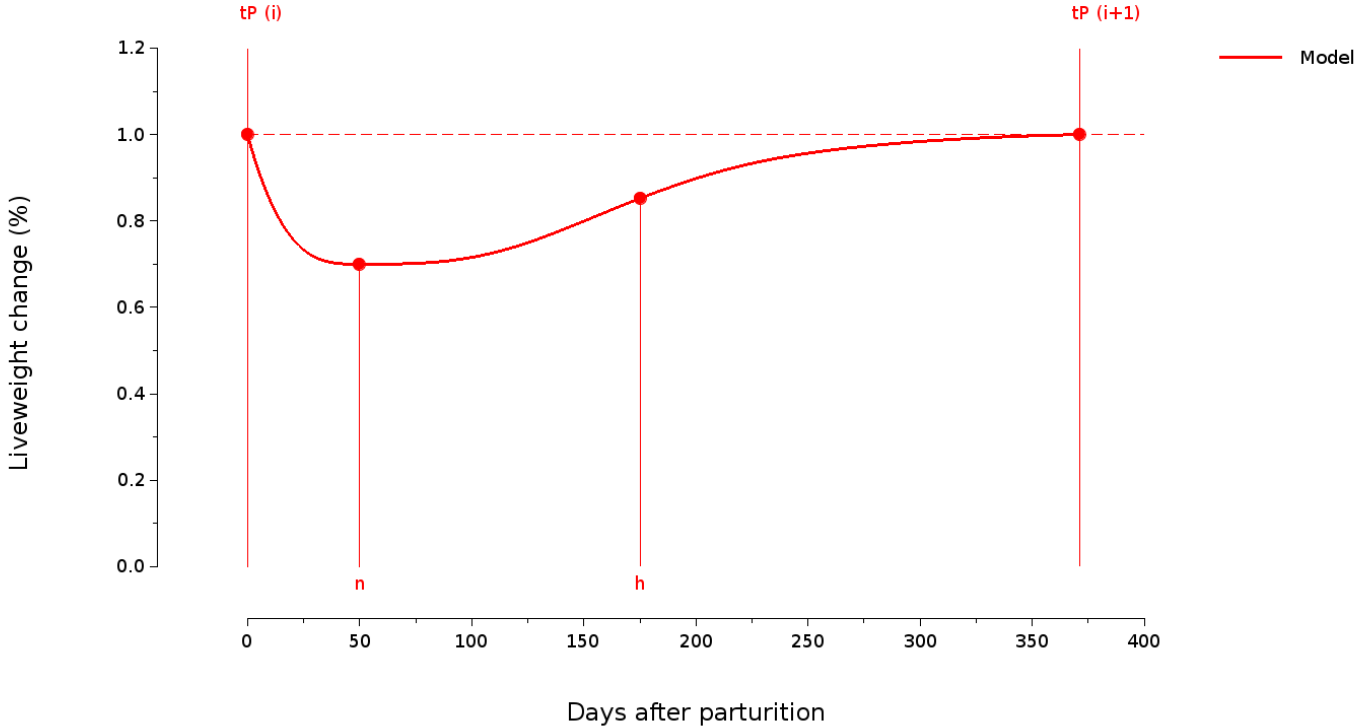
Parameter n: time of nadir



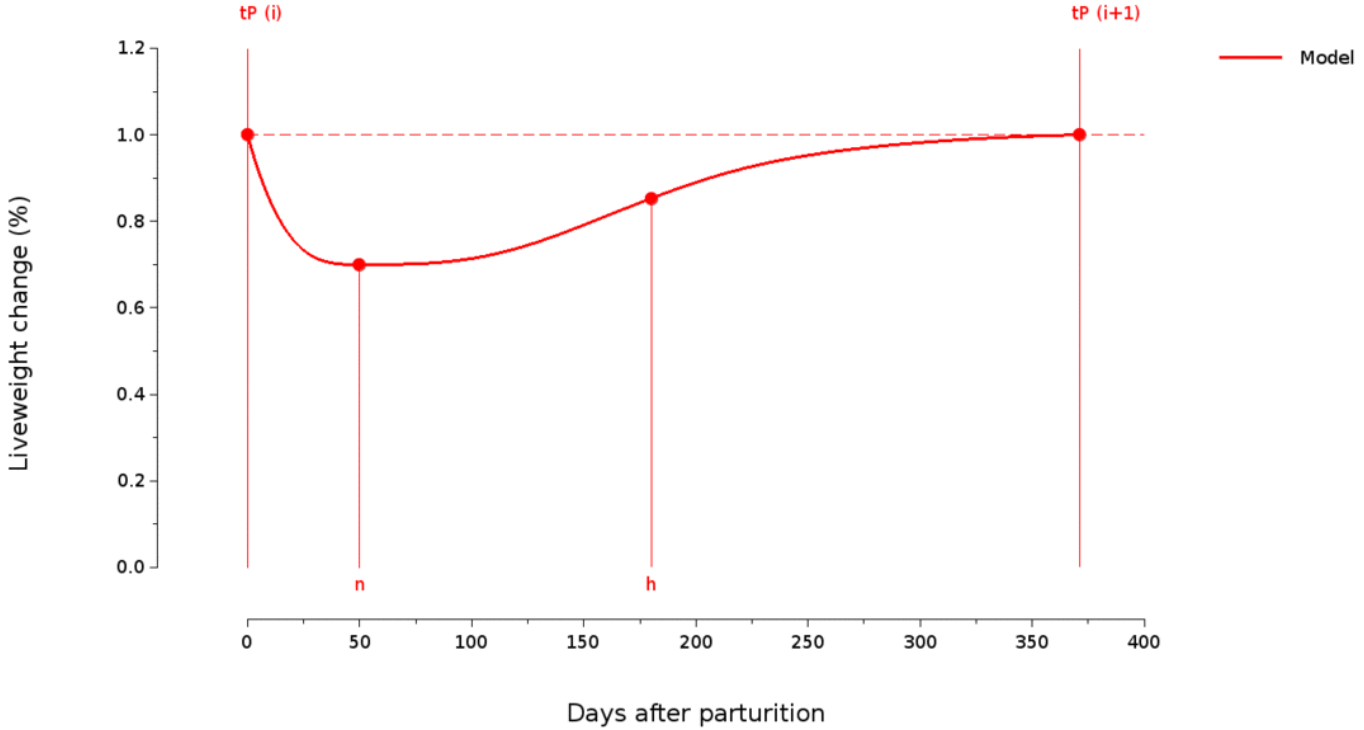
Parameter n: time of nadir



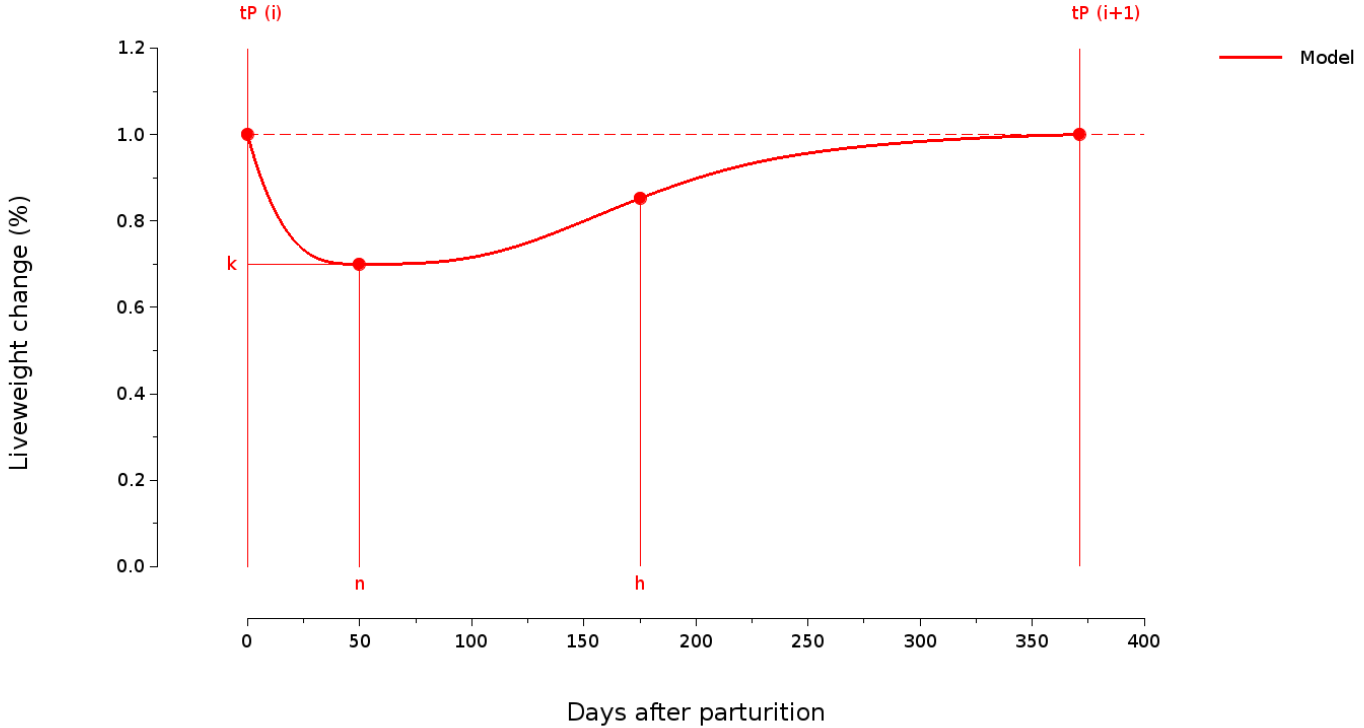
Parameter h: time of half repletion



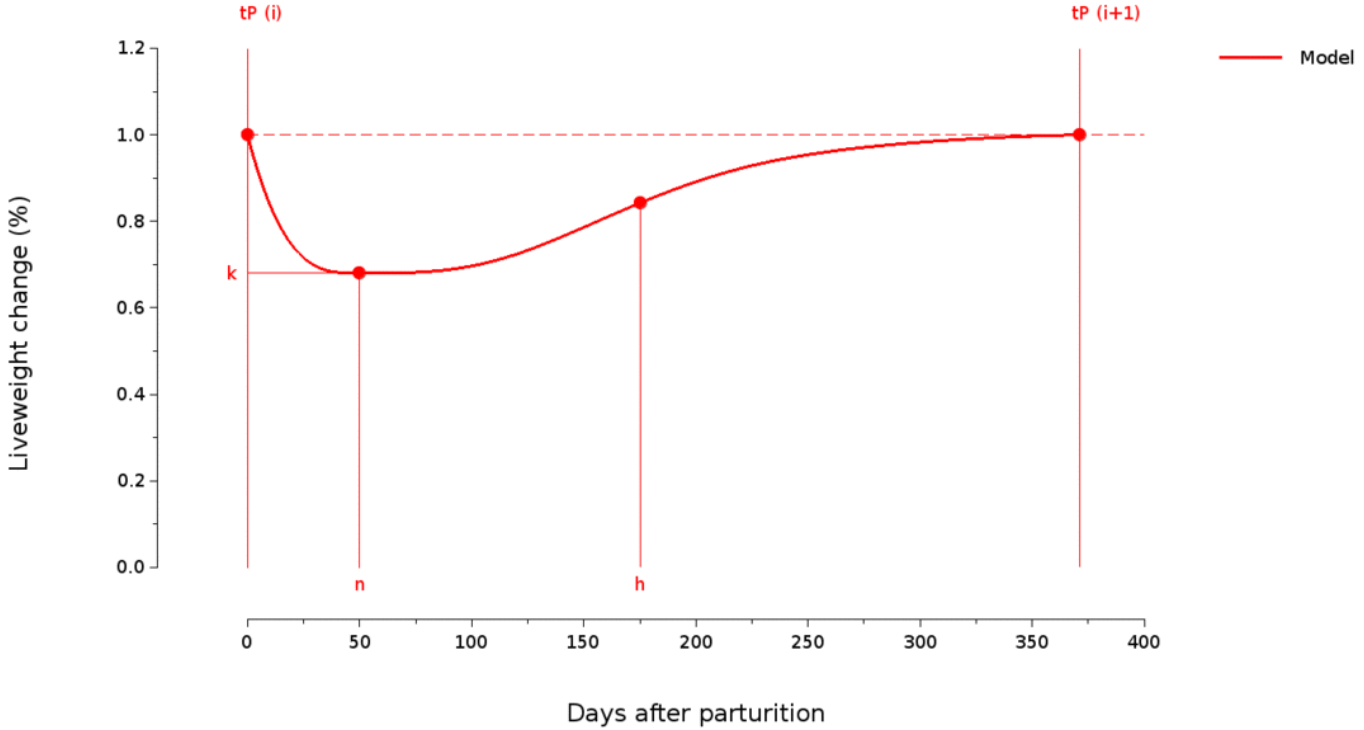
Parameter h: time of half repletion



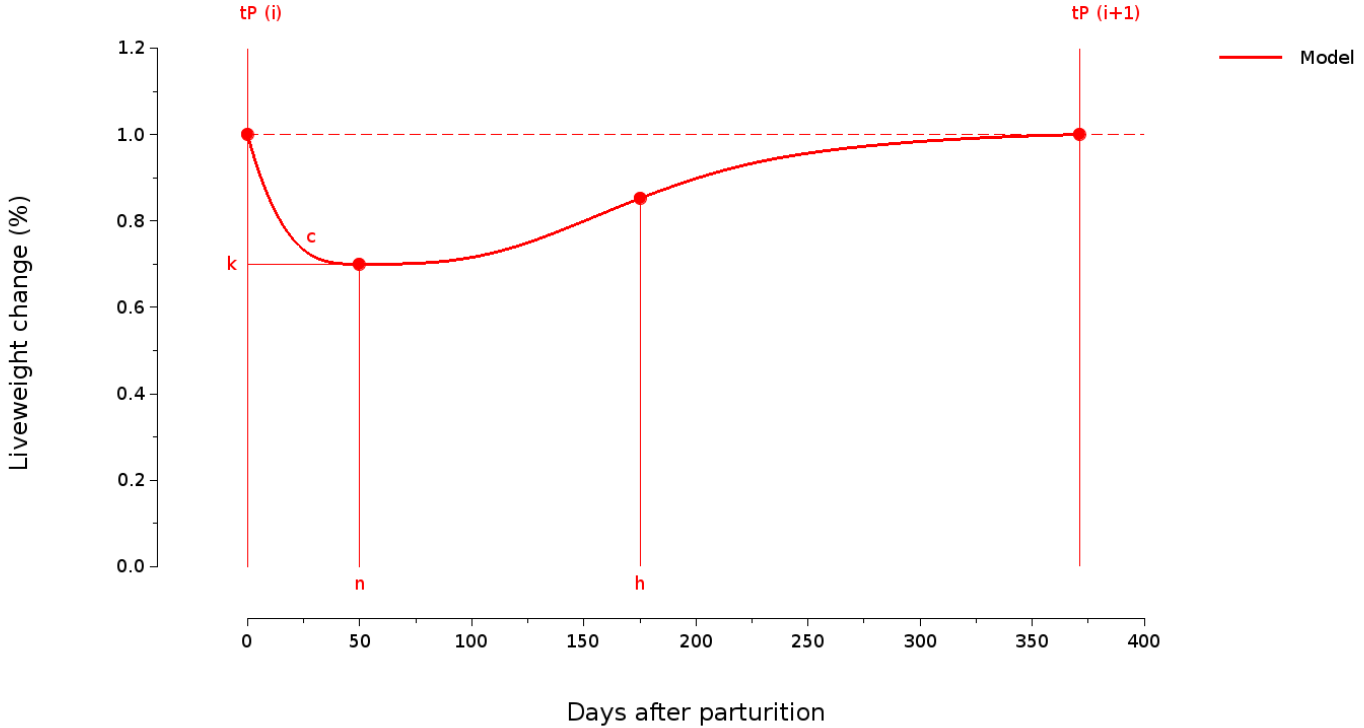
Parameter k: intensity of depletion



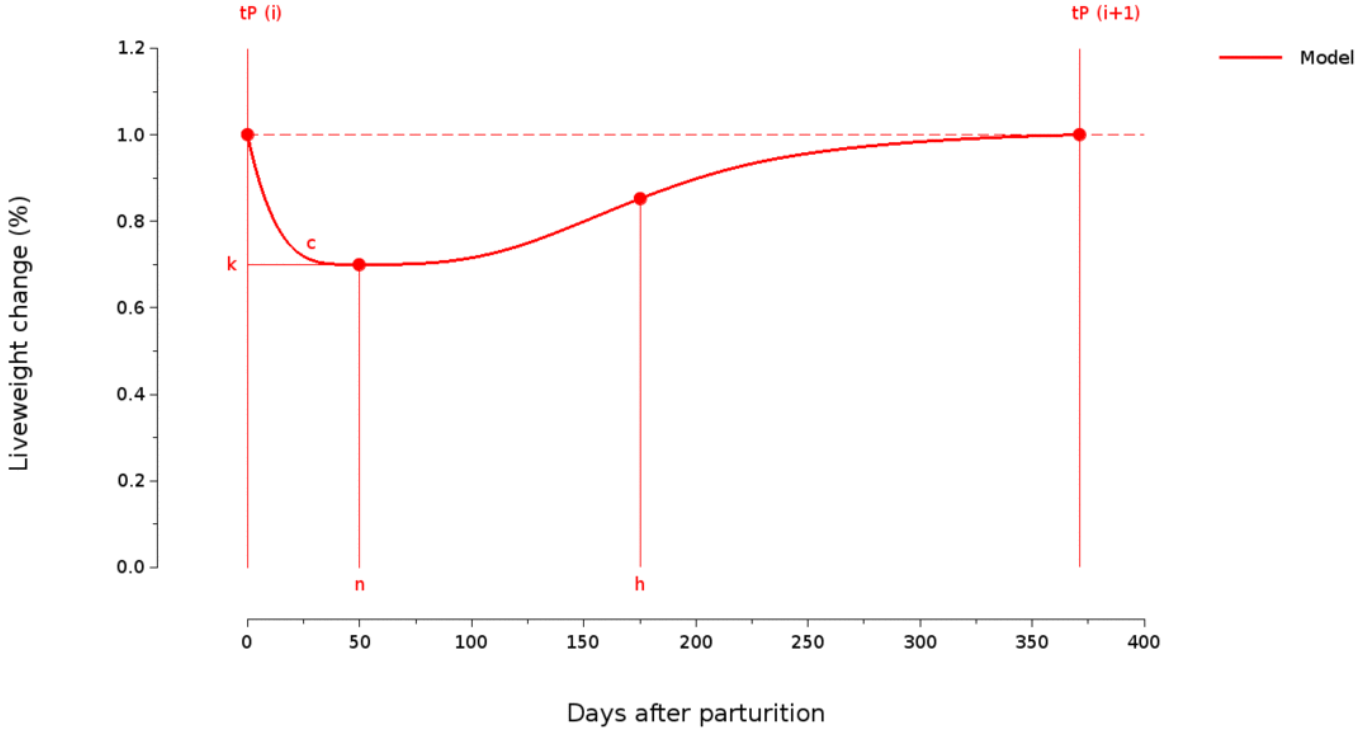
Parameter k: intensity of depletion



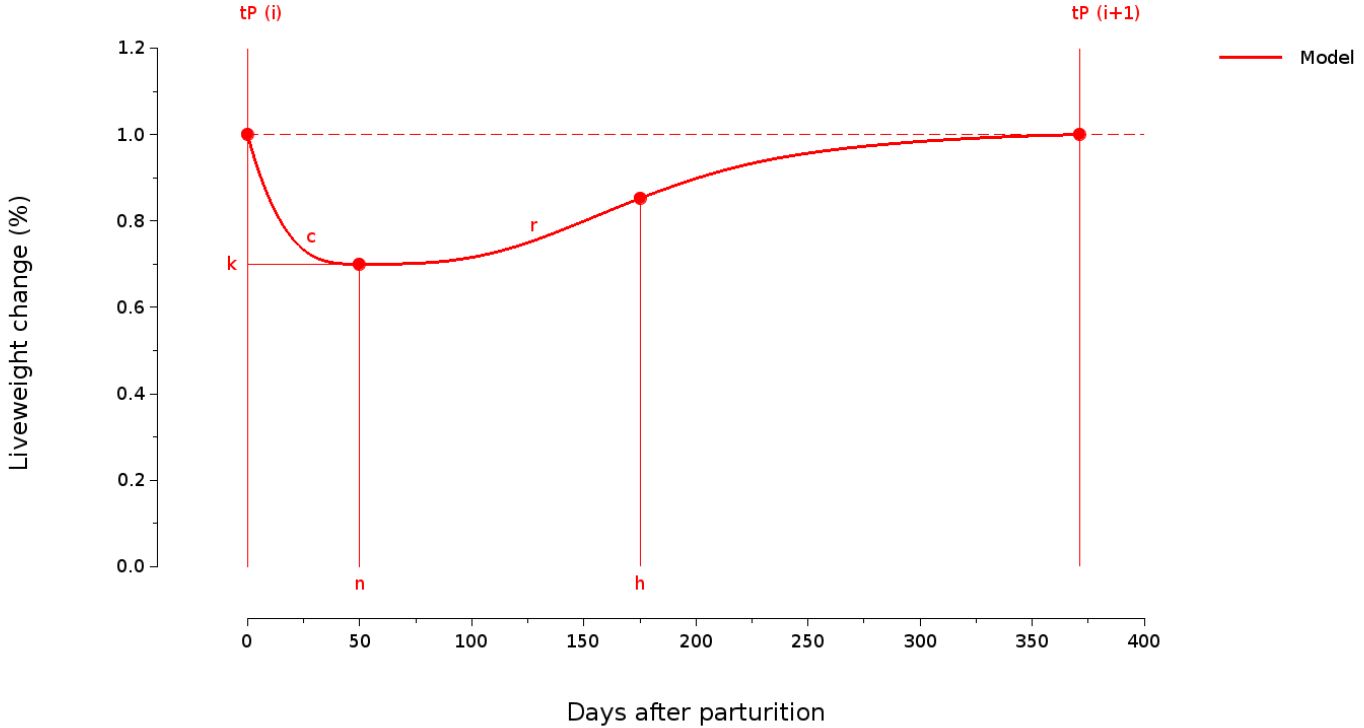
Parameter c: shape of depletion



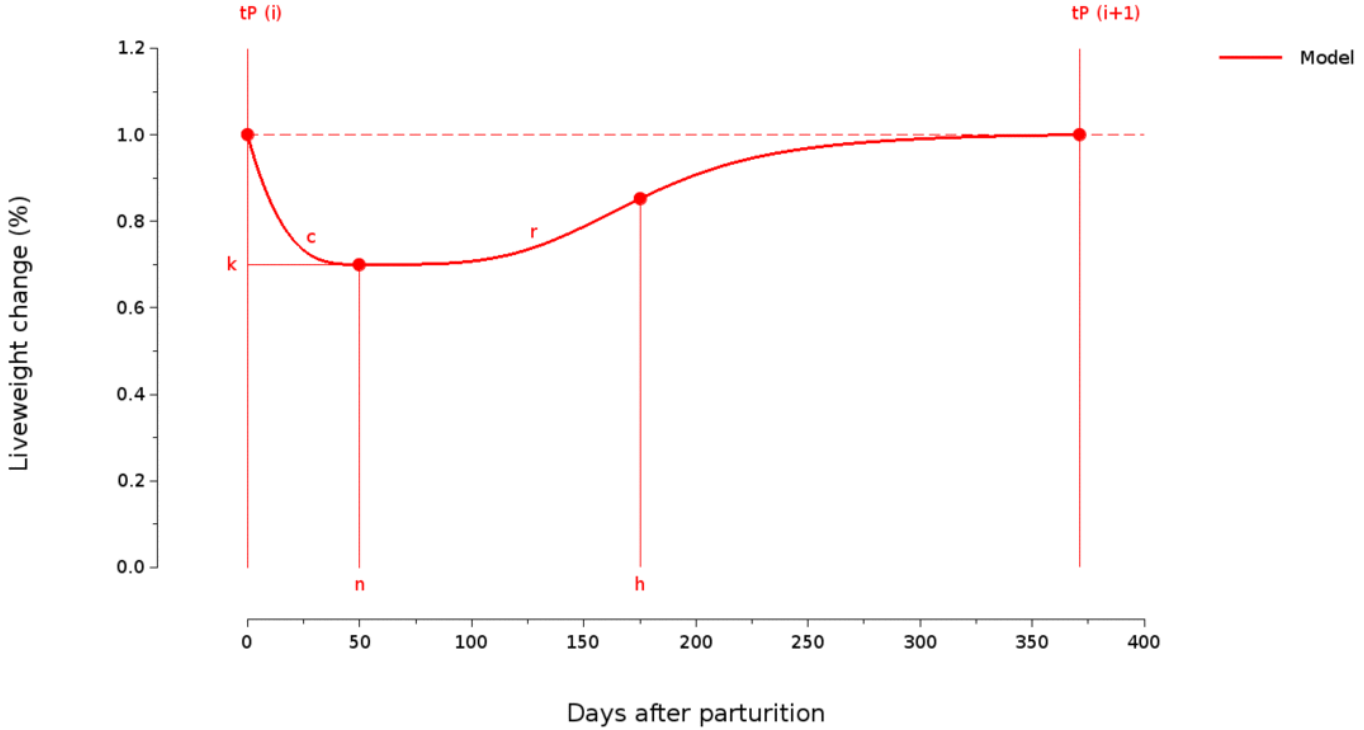
Parameter c: shape of depletion



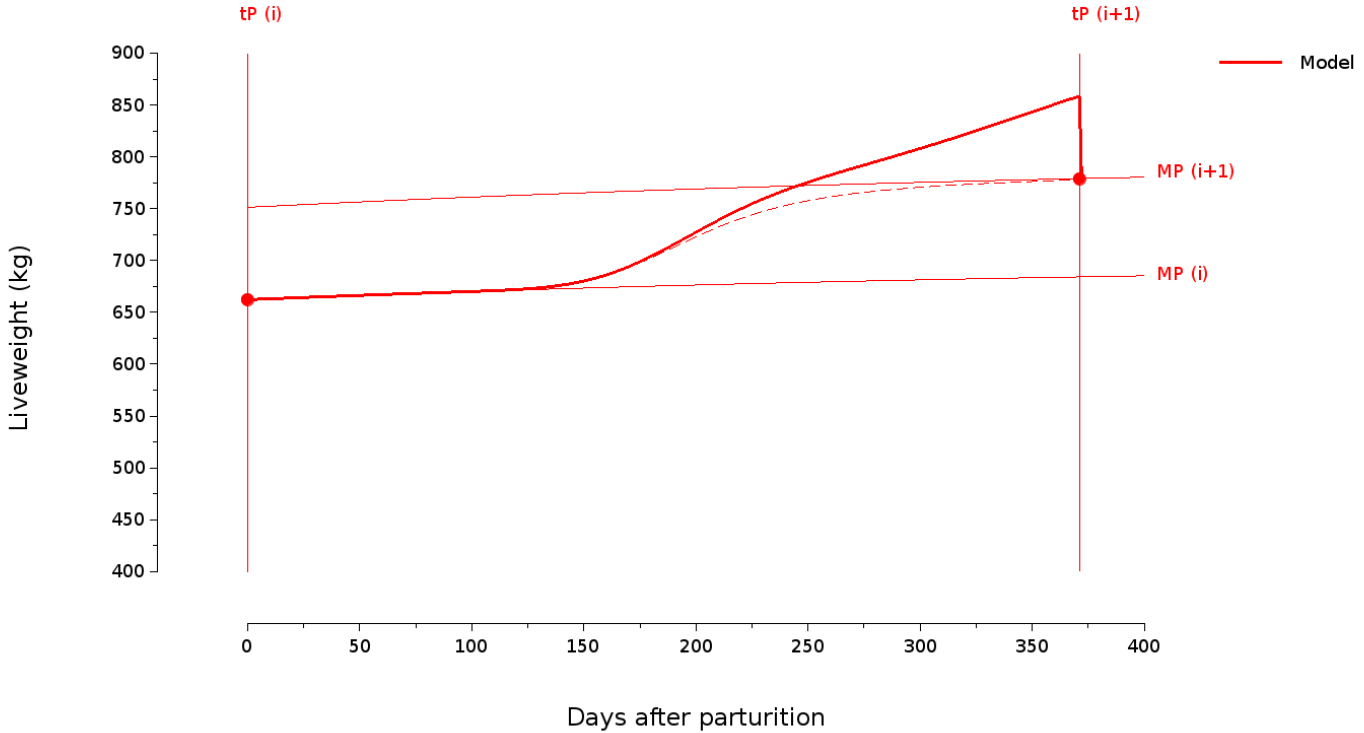
Parameter r: shape of repletion



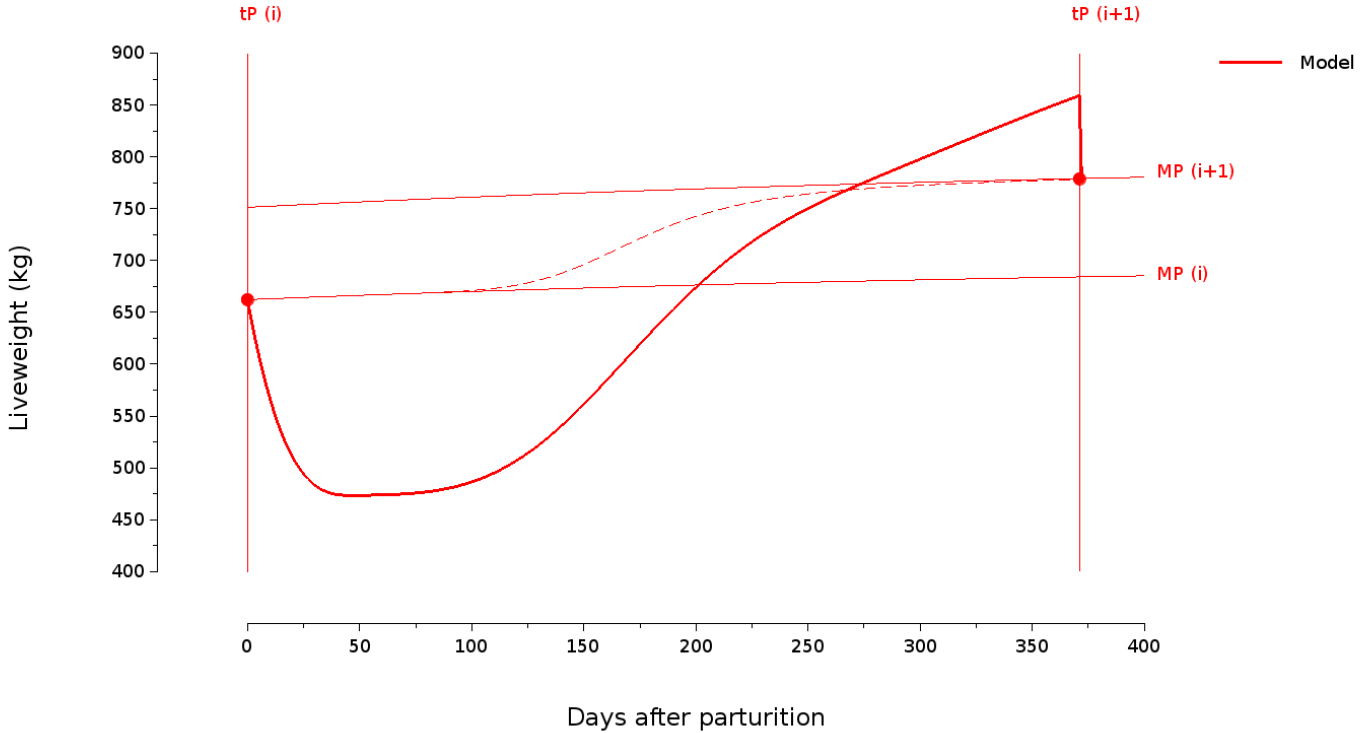
Parameter r: shape of repletion



Rescale baseline



UWM : Unperturbed Weight Model



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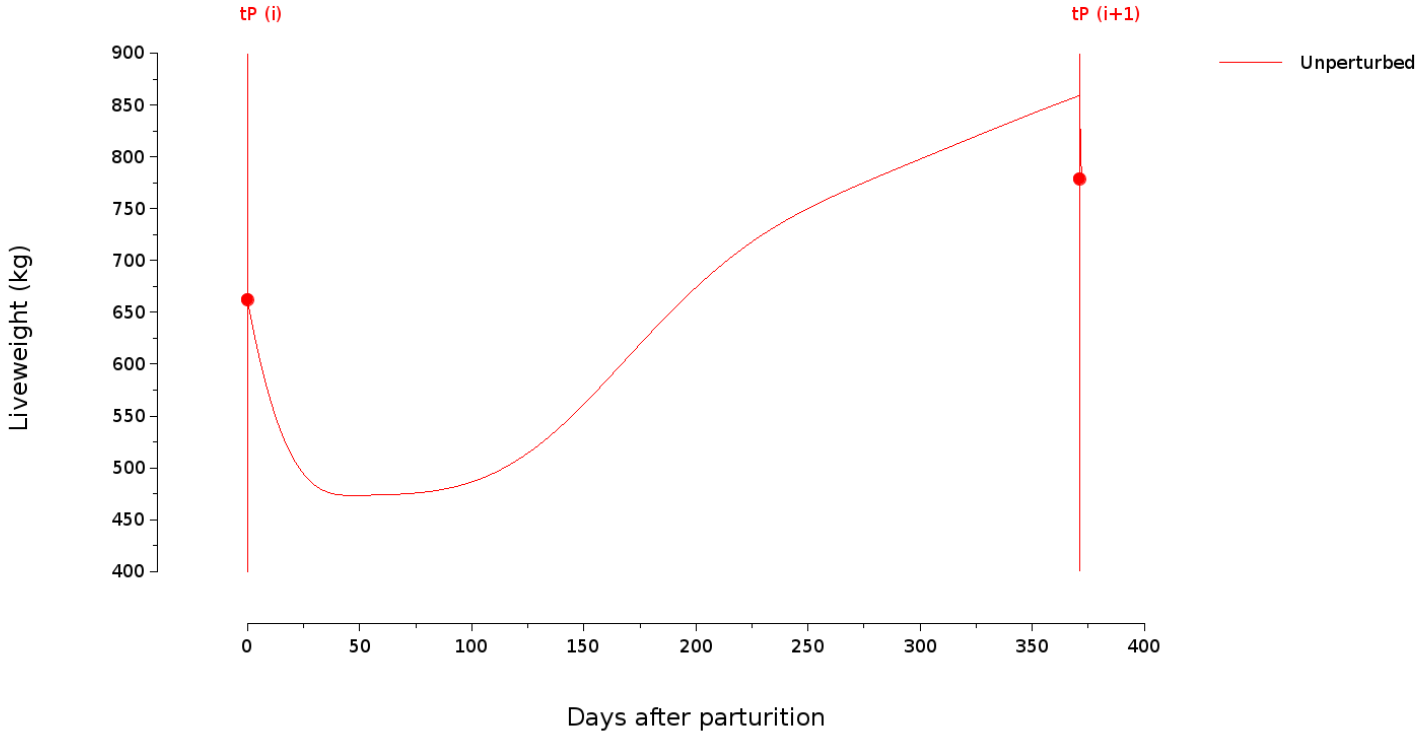
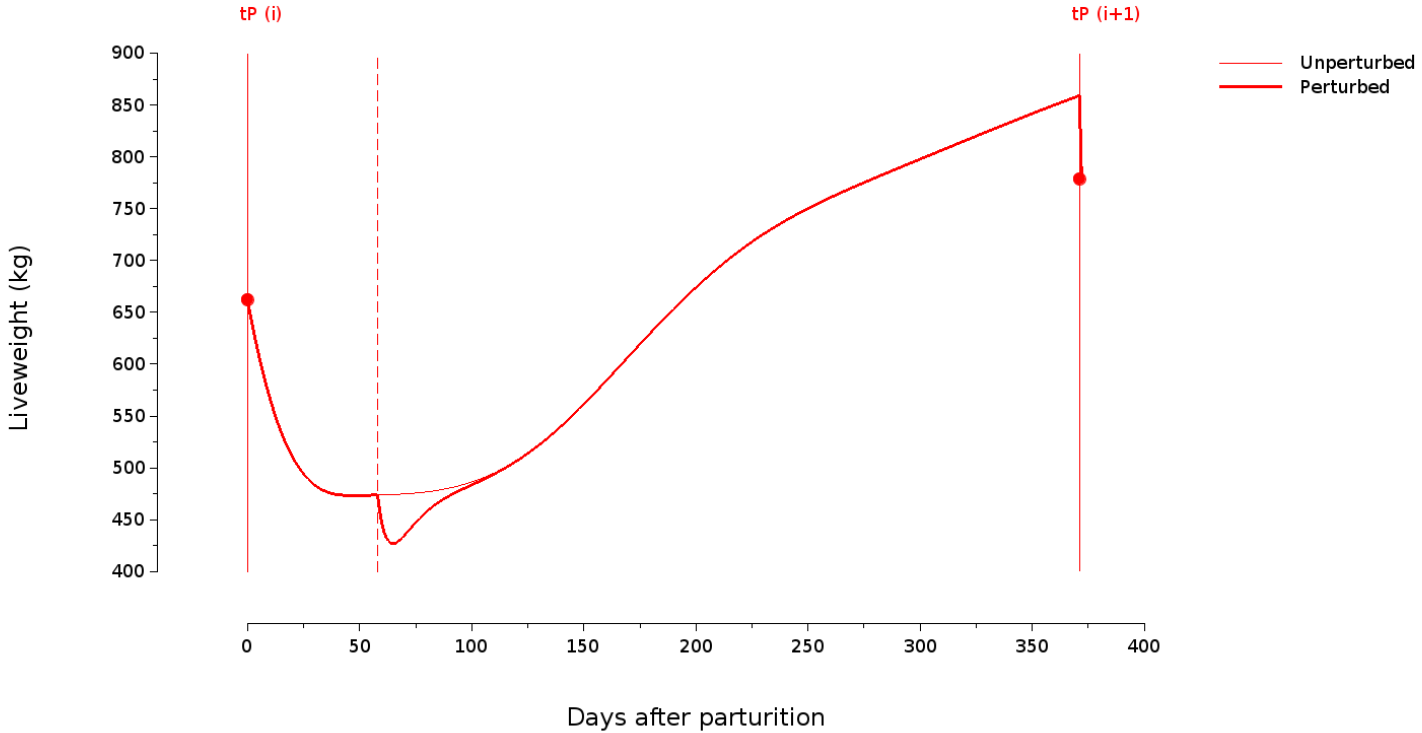
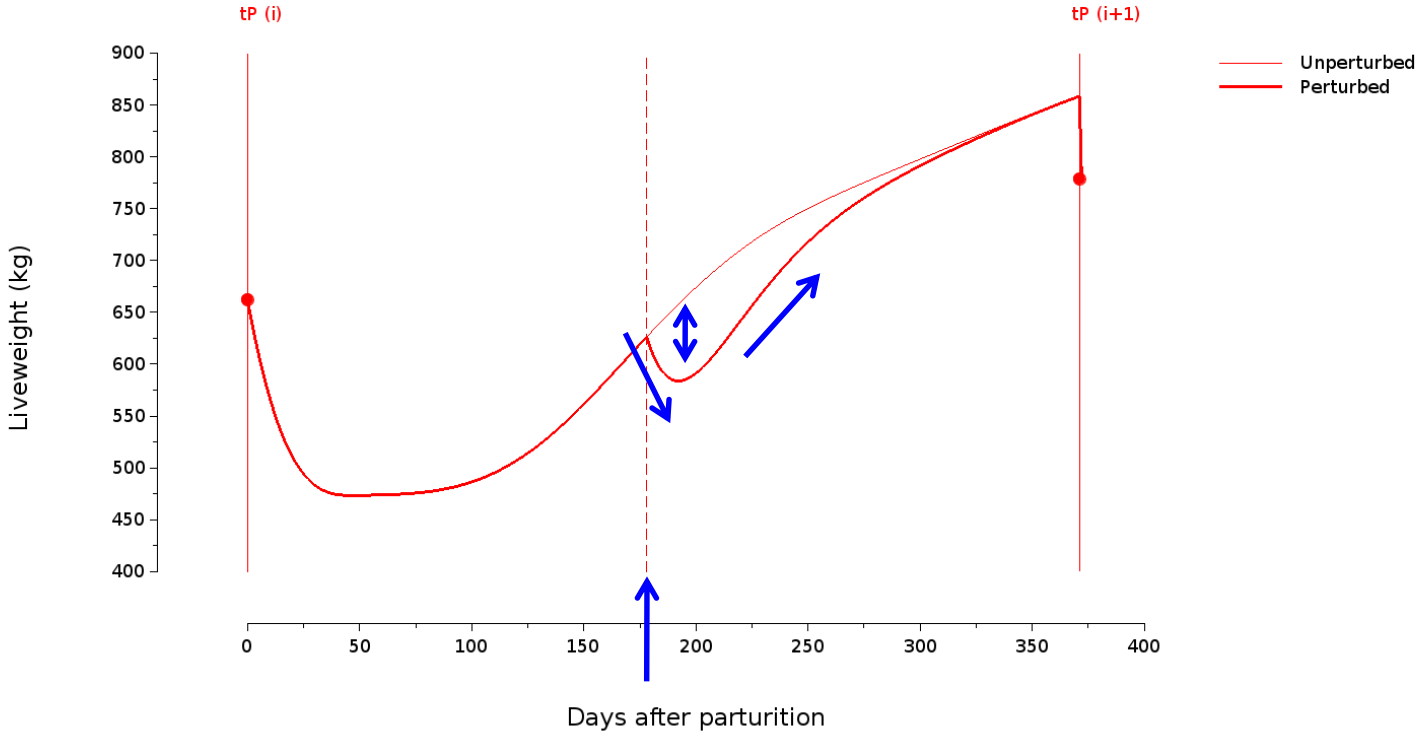


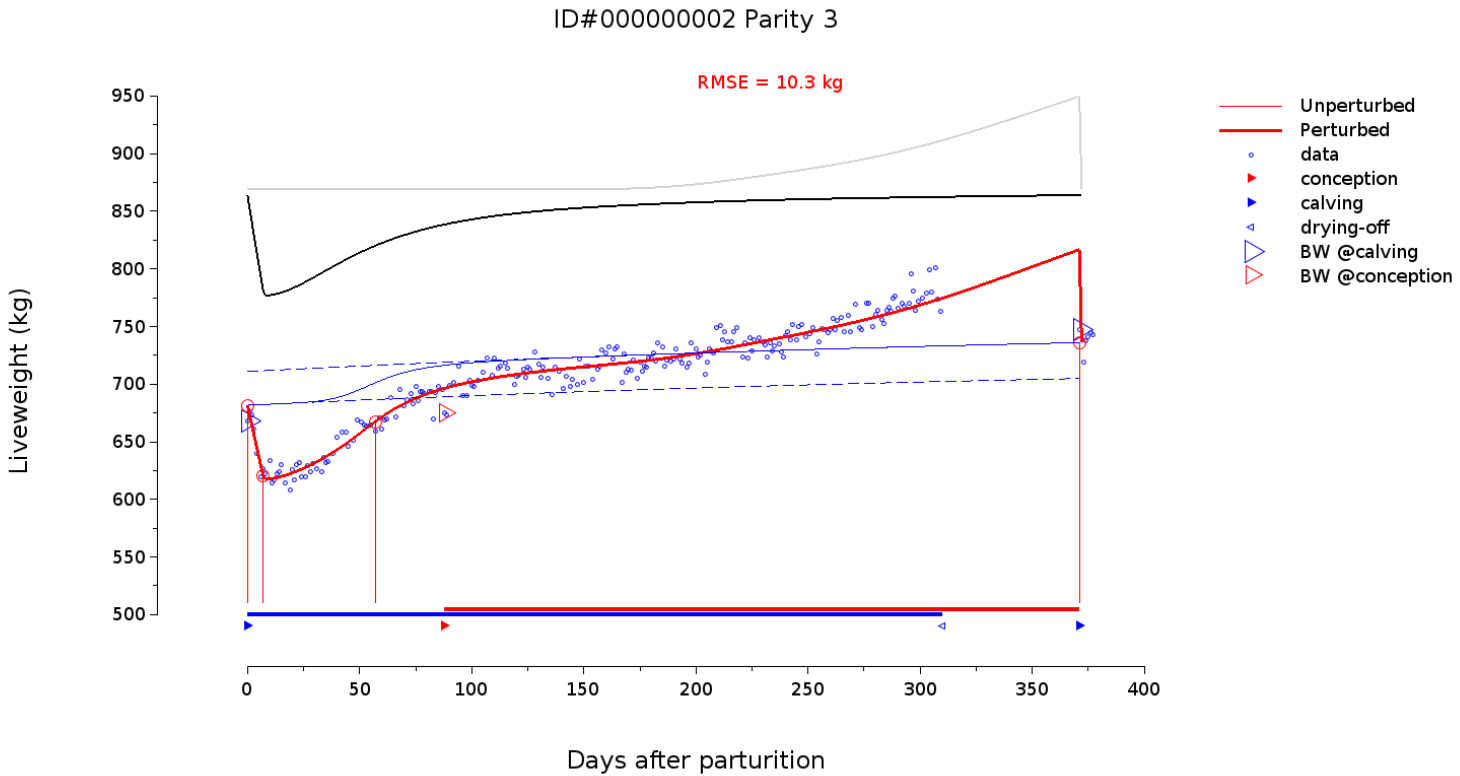
PWM : Perturbed Weight Model



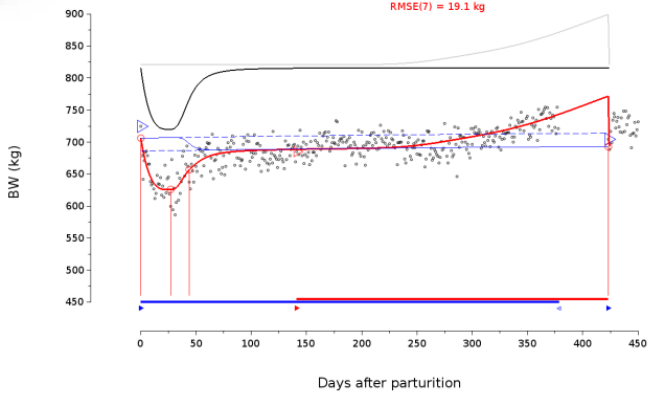
PWM : Perturbed Weight Model

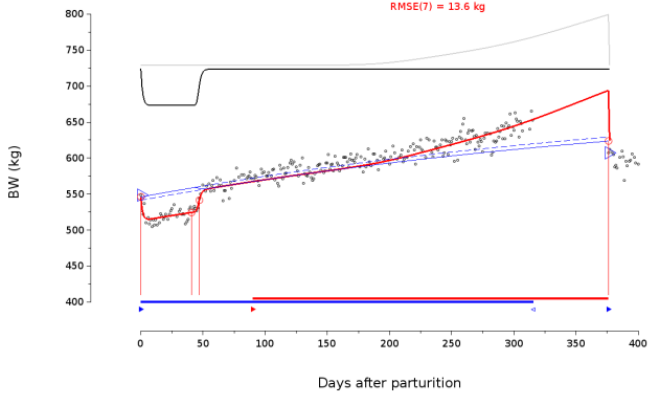


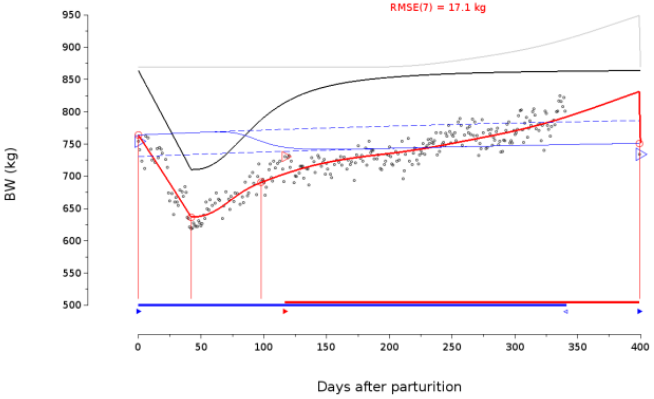
Fitting UWM: liveweight decomposit°

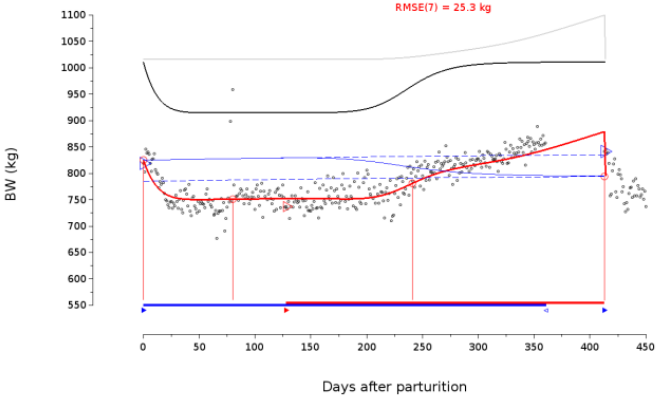


Fitting UWM: "smart smoothing"

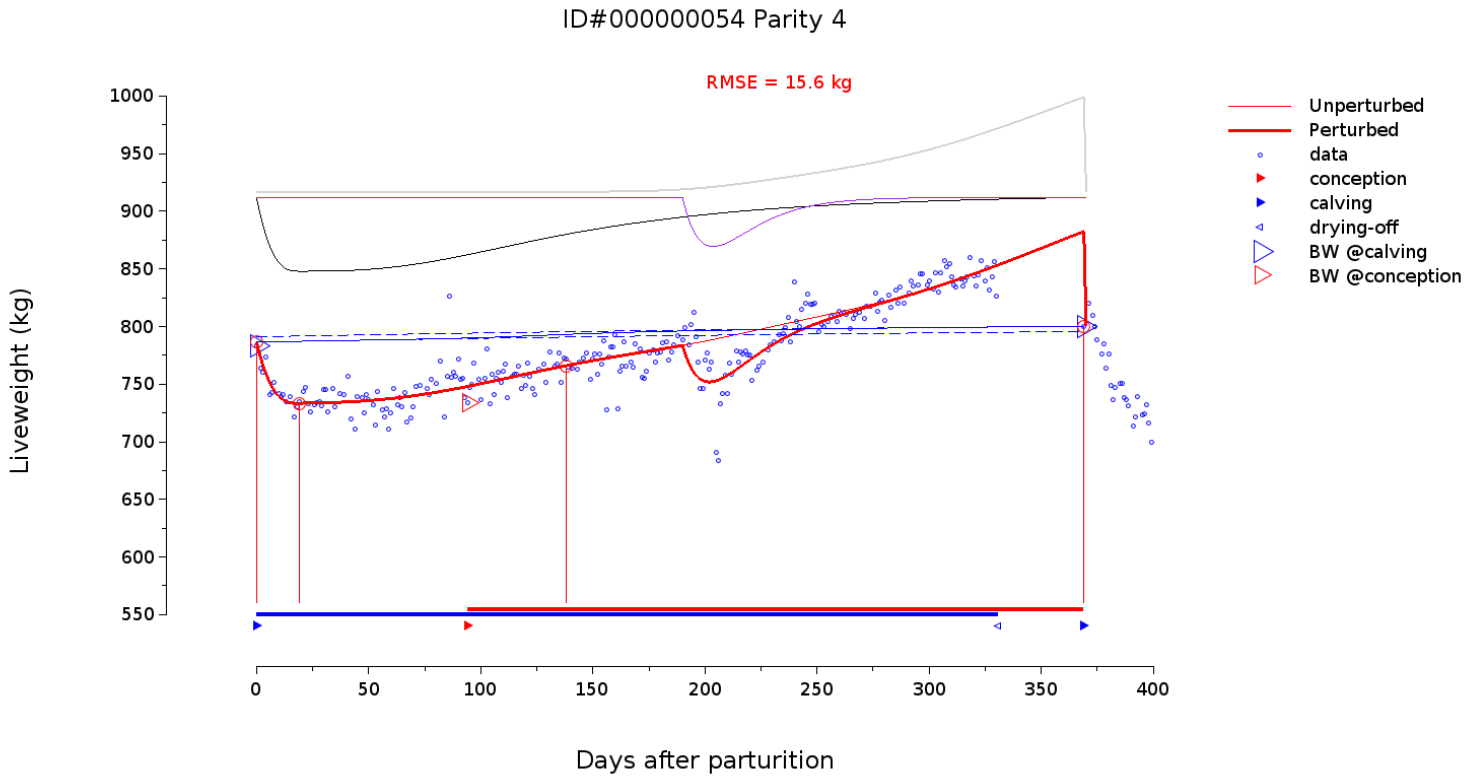








Fitting PWM: 1 perturbation



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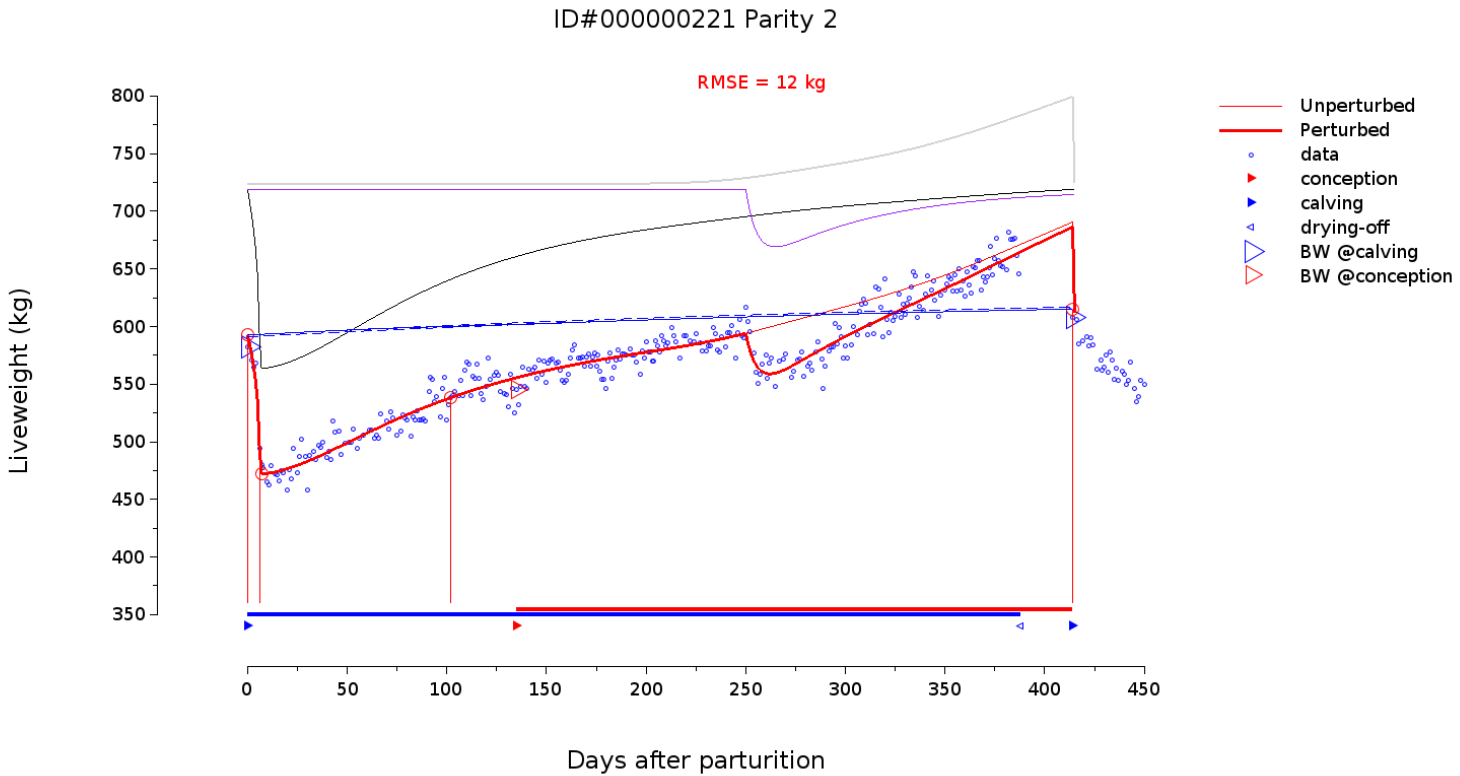
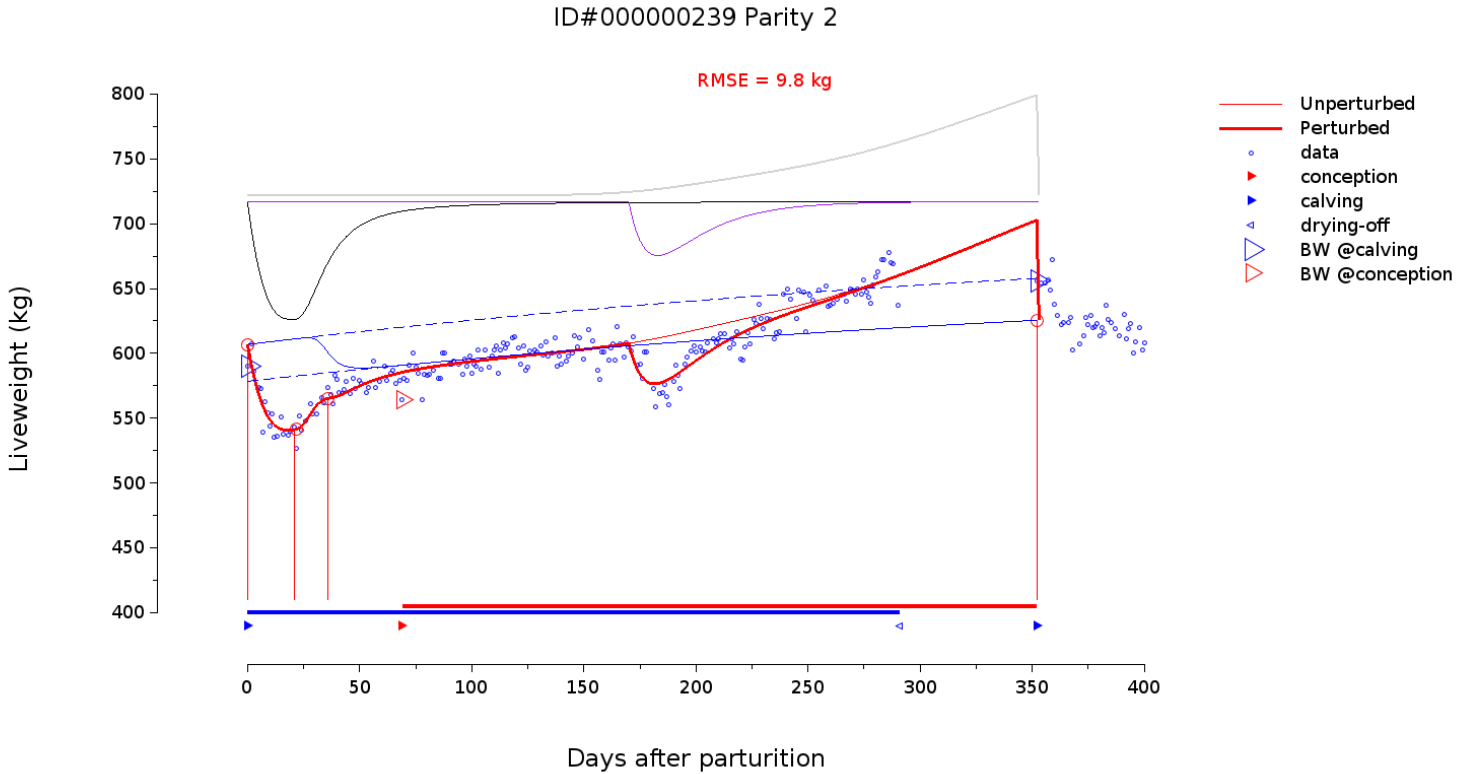
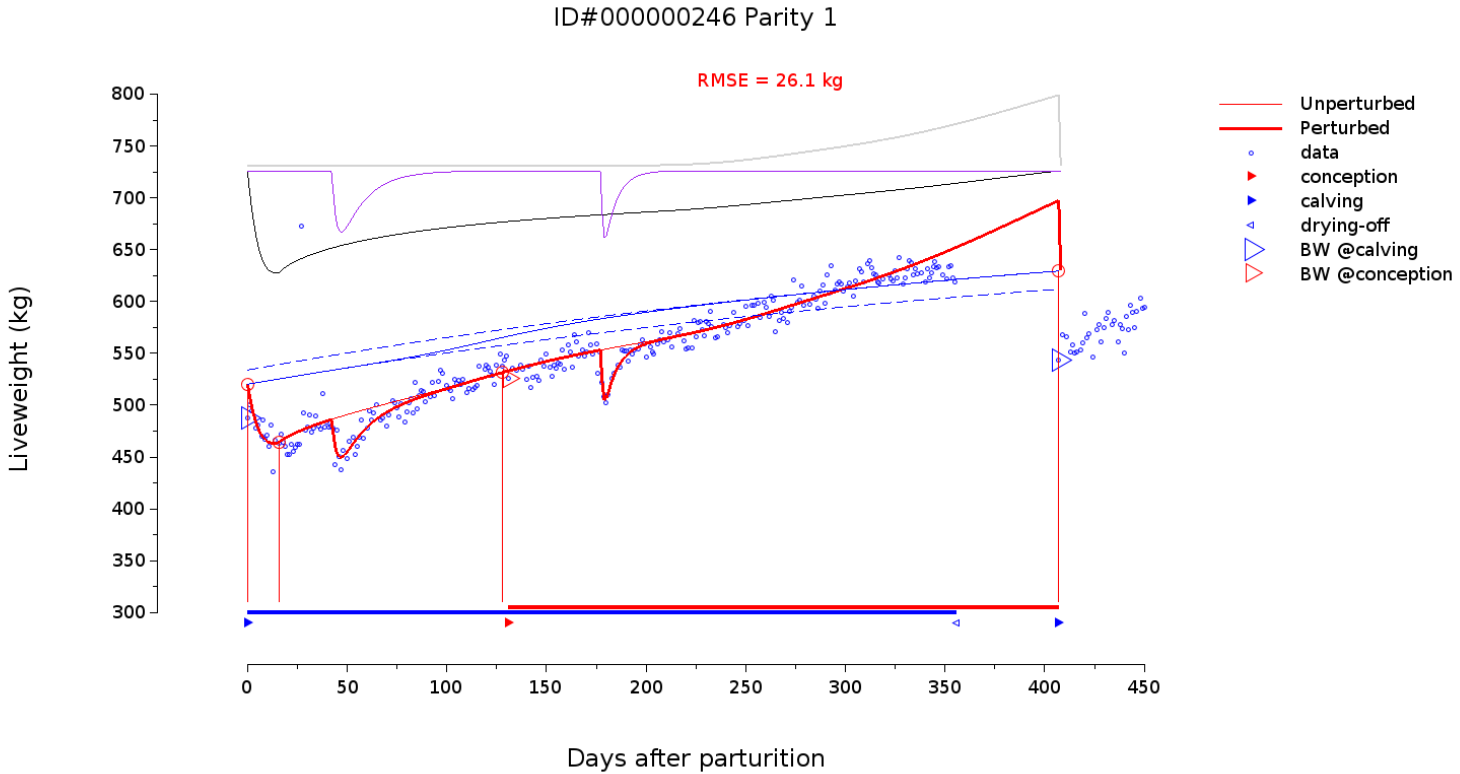


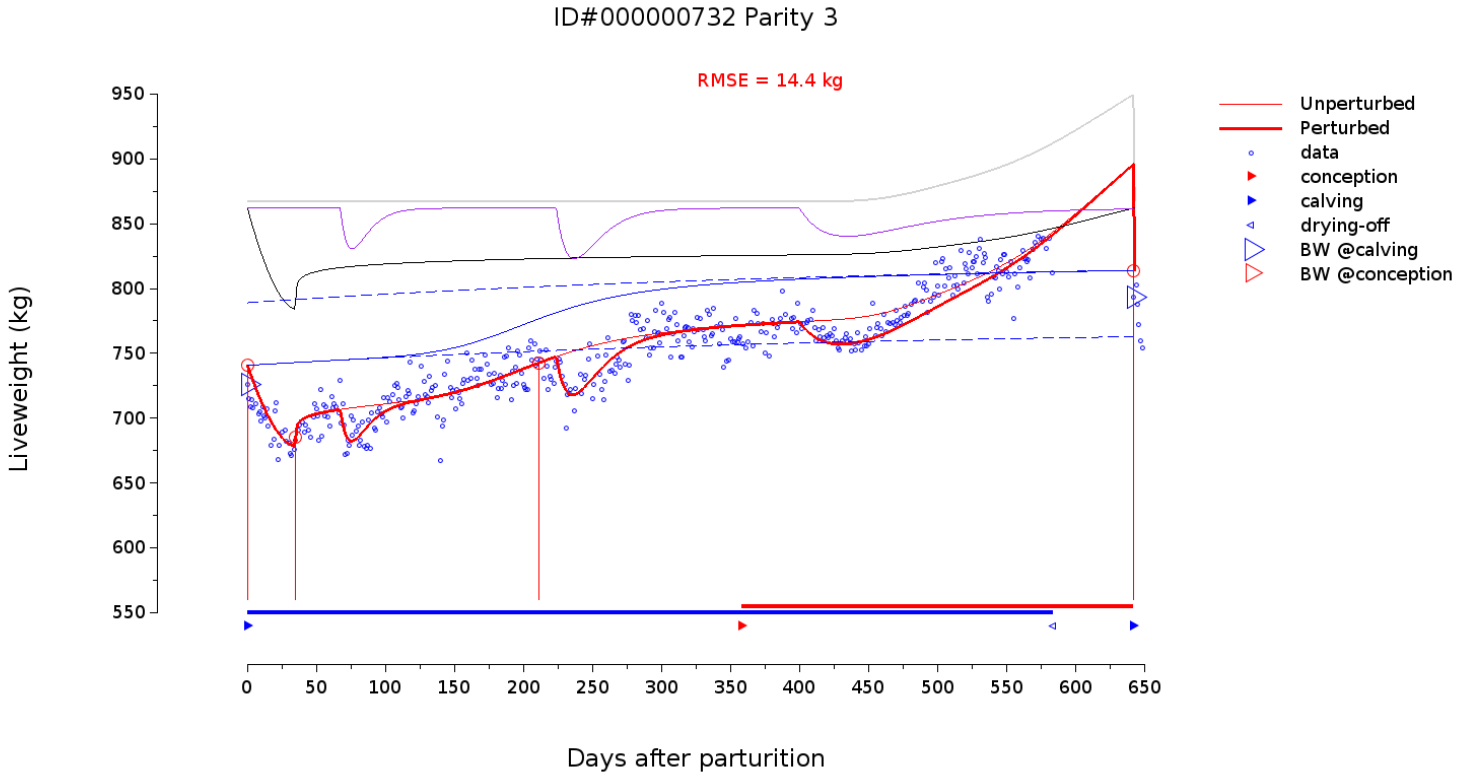
Fitting PWM: 1 perturbation



Fitting PWM: 2 perturbations



Fitting PWM: 3 perturbations

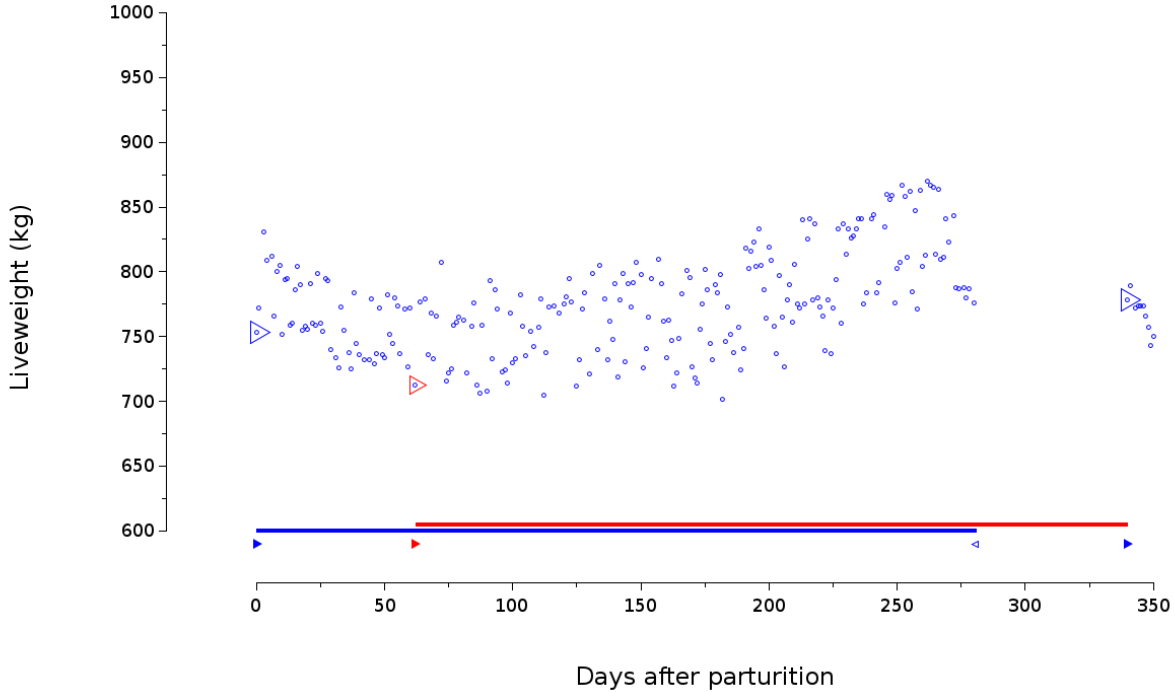


#1 Interpretive NOT explicative

- Liveweight = ... + reserves + digestive tract content

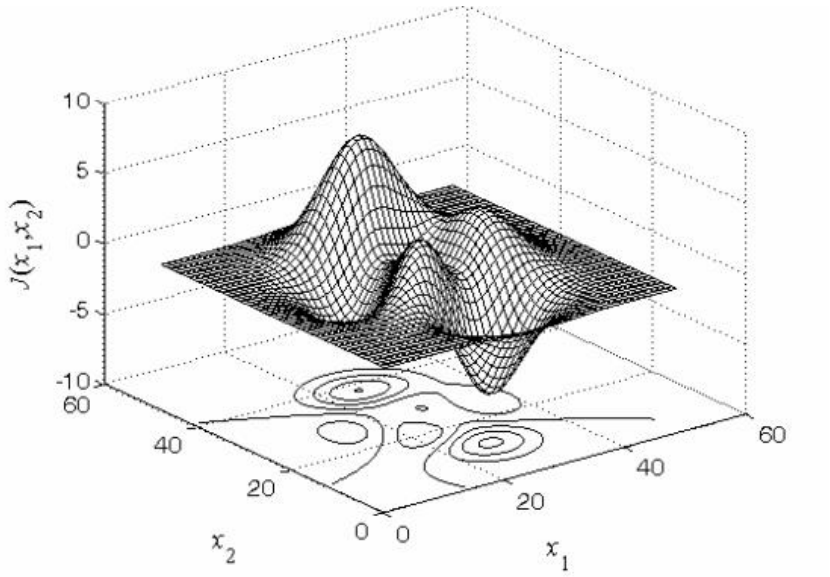
#2 We need DATA !

- Availability + Quality



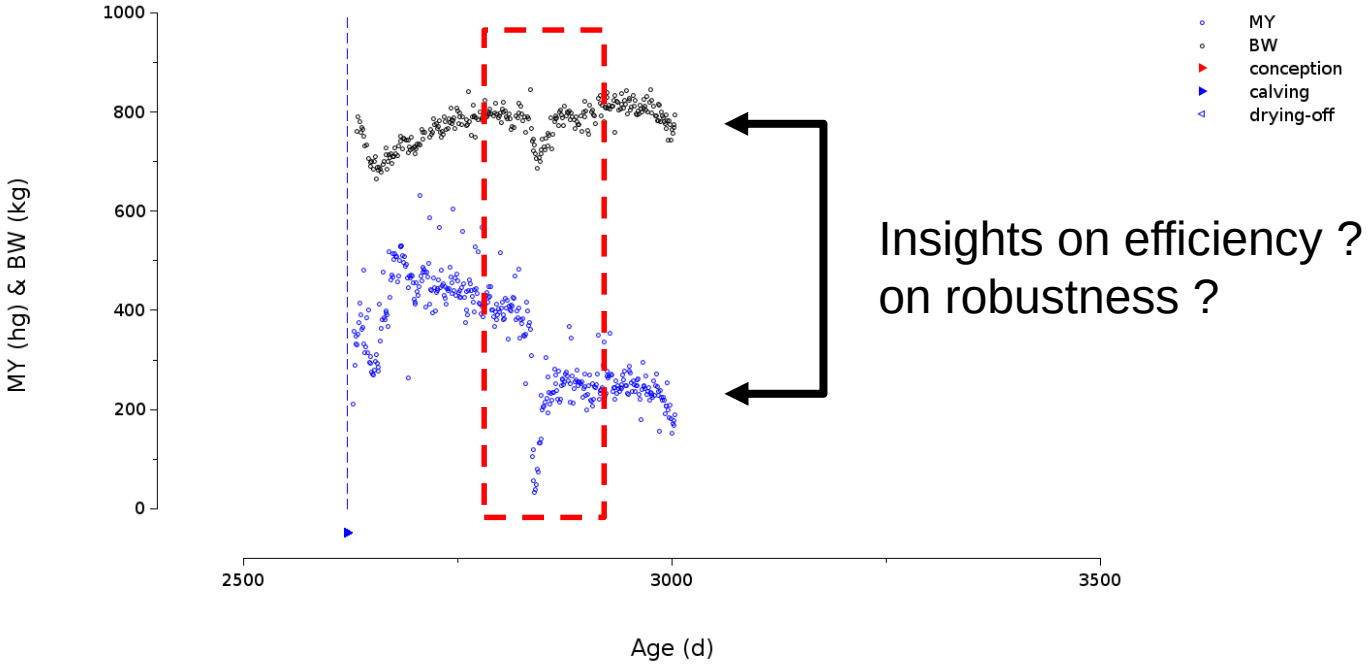
#3 Model identifiability ?

- Locally identifiable
- PWM fitting algorithm
  - Repeated fits
  - Keep most often detected perturbations



#4 PLM+PWM

- Detect simultaneous milk/liveweight perturbations



Next steps*

**Fresh ideas welcome !*
Come and see me at the coffee break.
I'll be outside...

- Fit on various datasets
  - analyze variability, classify profiles, generate benchmarks
- Optimize fitting algorithm
  - make it fast, effective... and available for who wants !
- Move forward real time decision support tool
  - early detection of perturbation ?

Thank you for your attention

“In theory, there is no difference between theory and practice. But, in practice, there is.”

Jan L. A. van de Snepscheut