A dynamic model as a tool to describe the variability of lifetime body weight trajectories in dairy goats

Olivier MARTIN, Laurence PUILLET

olivier.martin@agroparistech.fr

Precision livestock farming

- Primarily developed through the automation of data acquisition
- Innovation potential of managing individual variability in farming systems
- Lack of interpretive tools to capitalize on raw data material

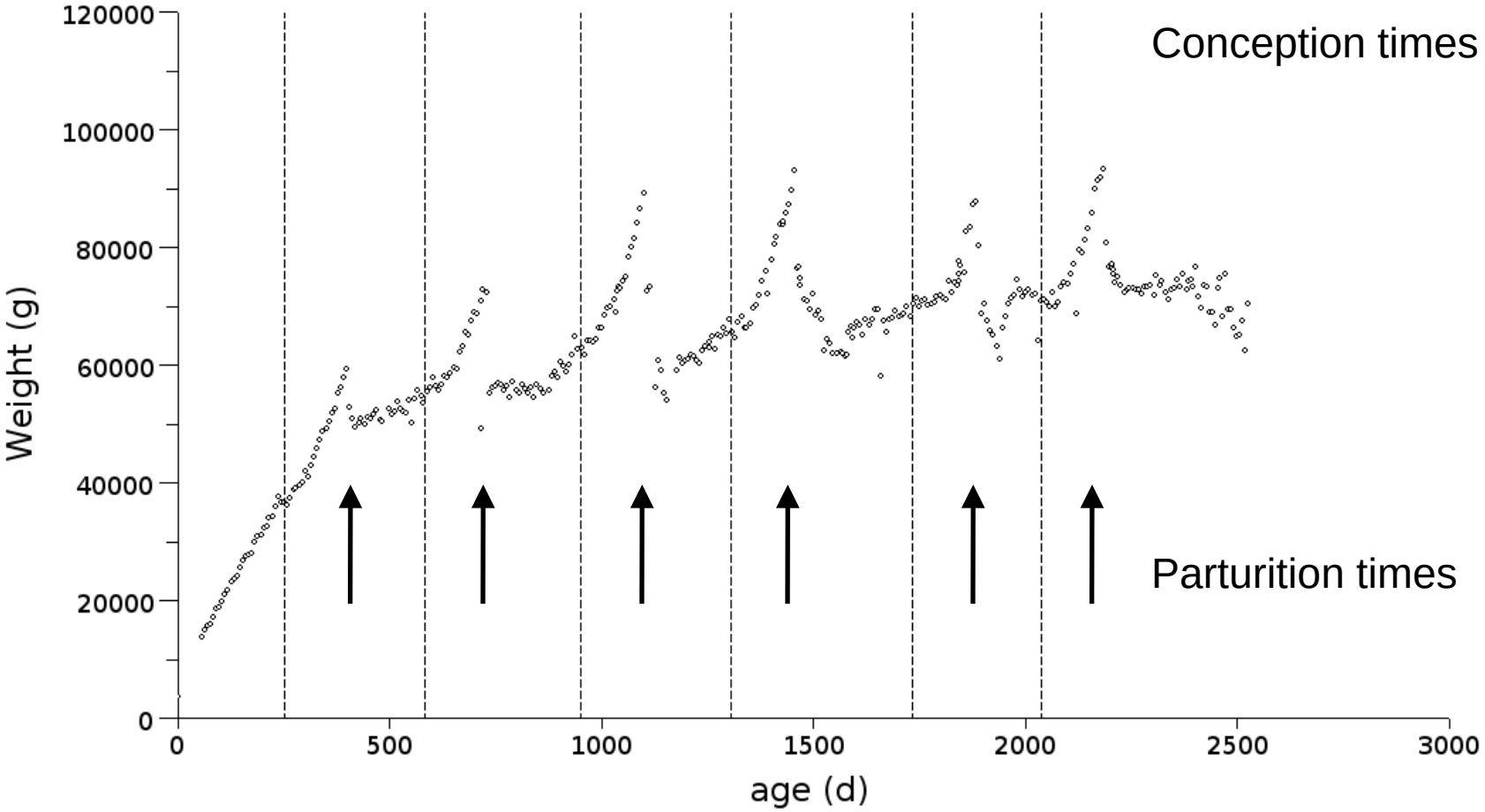
Phenotypic information

- Challenge to design tools to produce phenotypic information
  - Standardized and usable information
  - Providing
    - Quantification of variability
    - Benchmarks for decision support

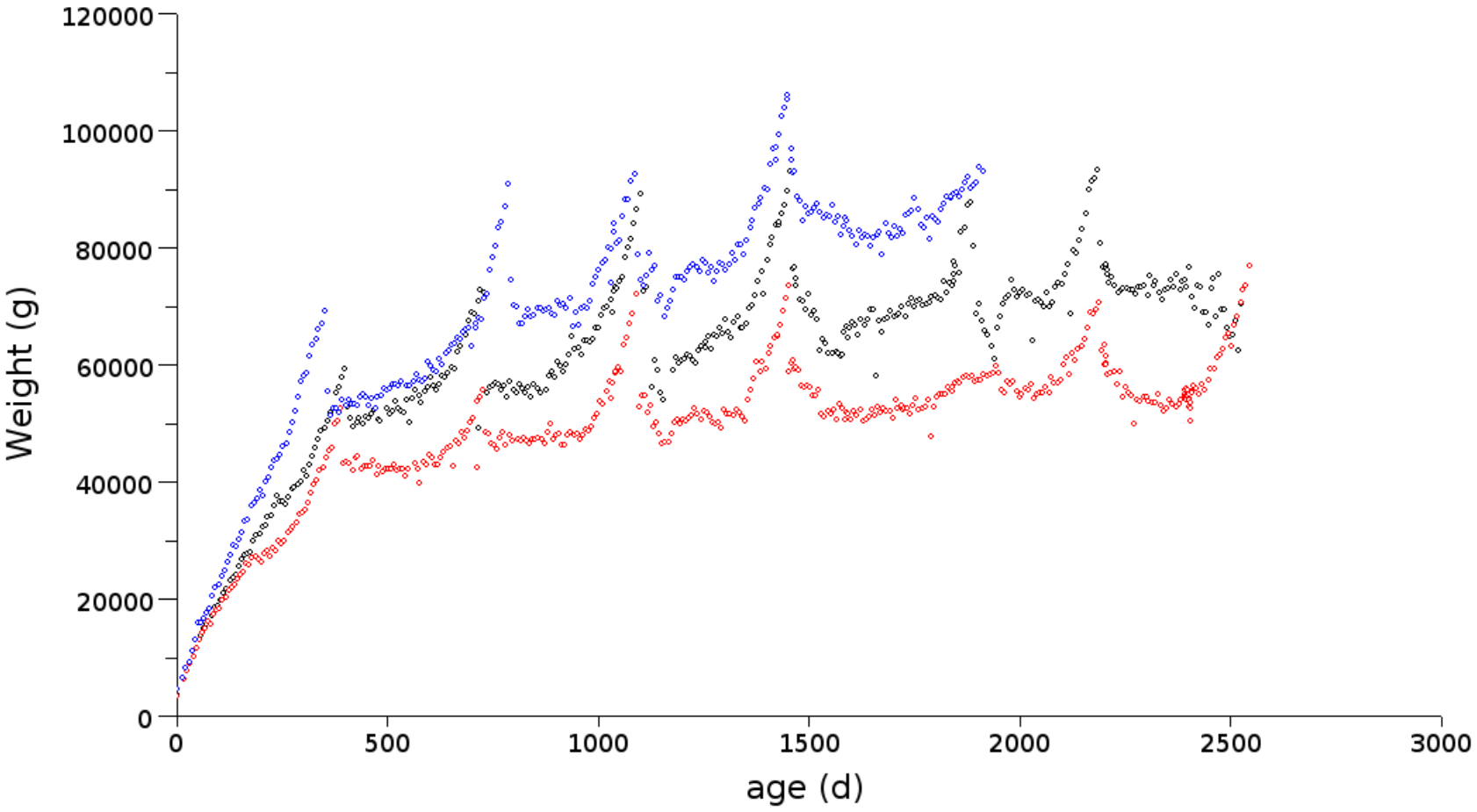
This work

- Dairy goats
- Lifetime body weight trajectories
- A model to translate individual time series raw data into phenotypic information

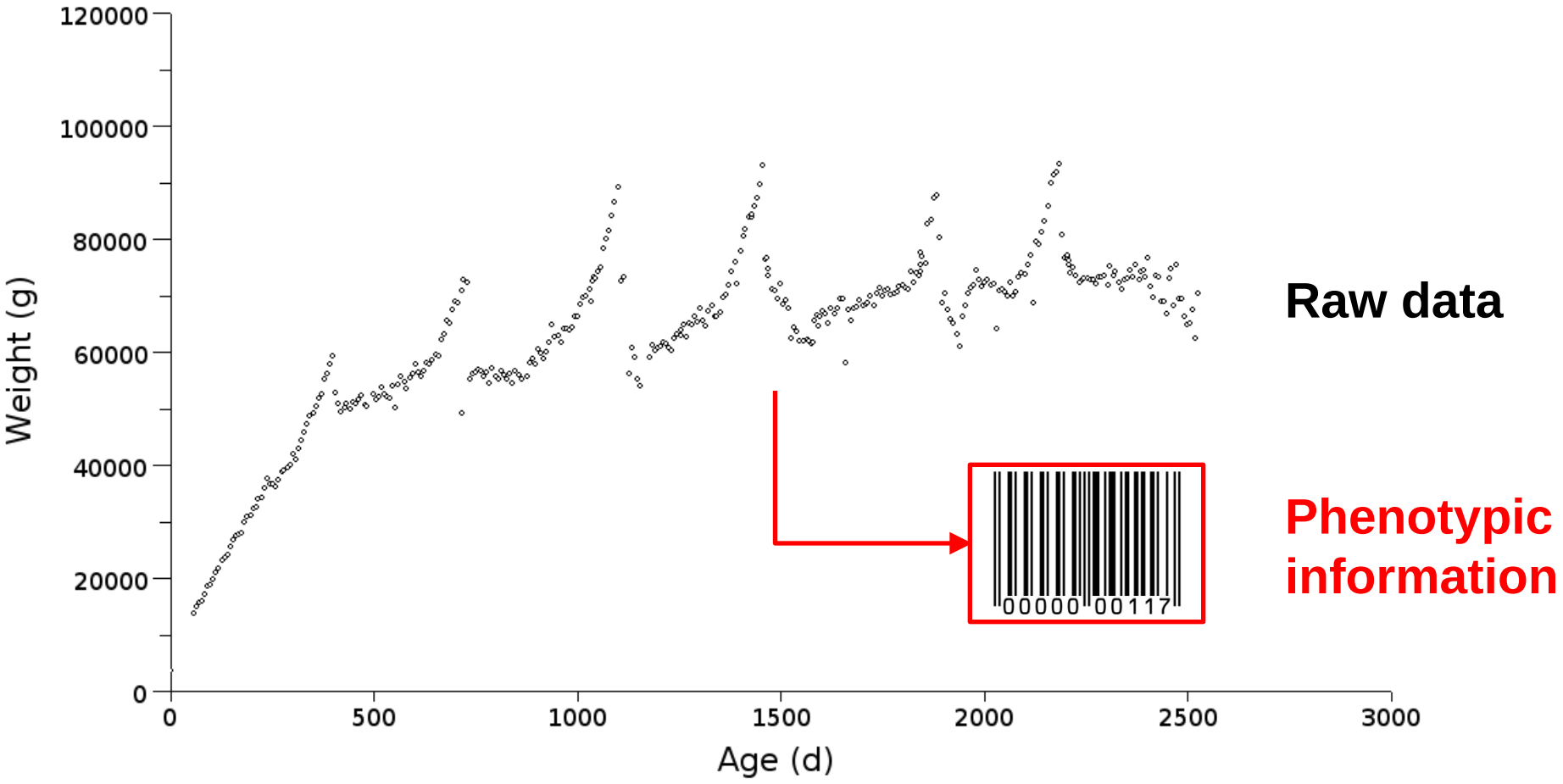
Lifetime body weight trajectory



How different ?



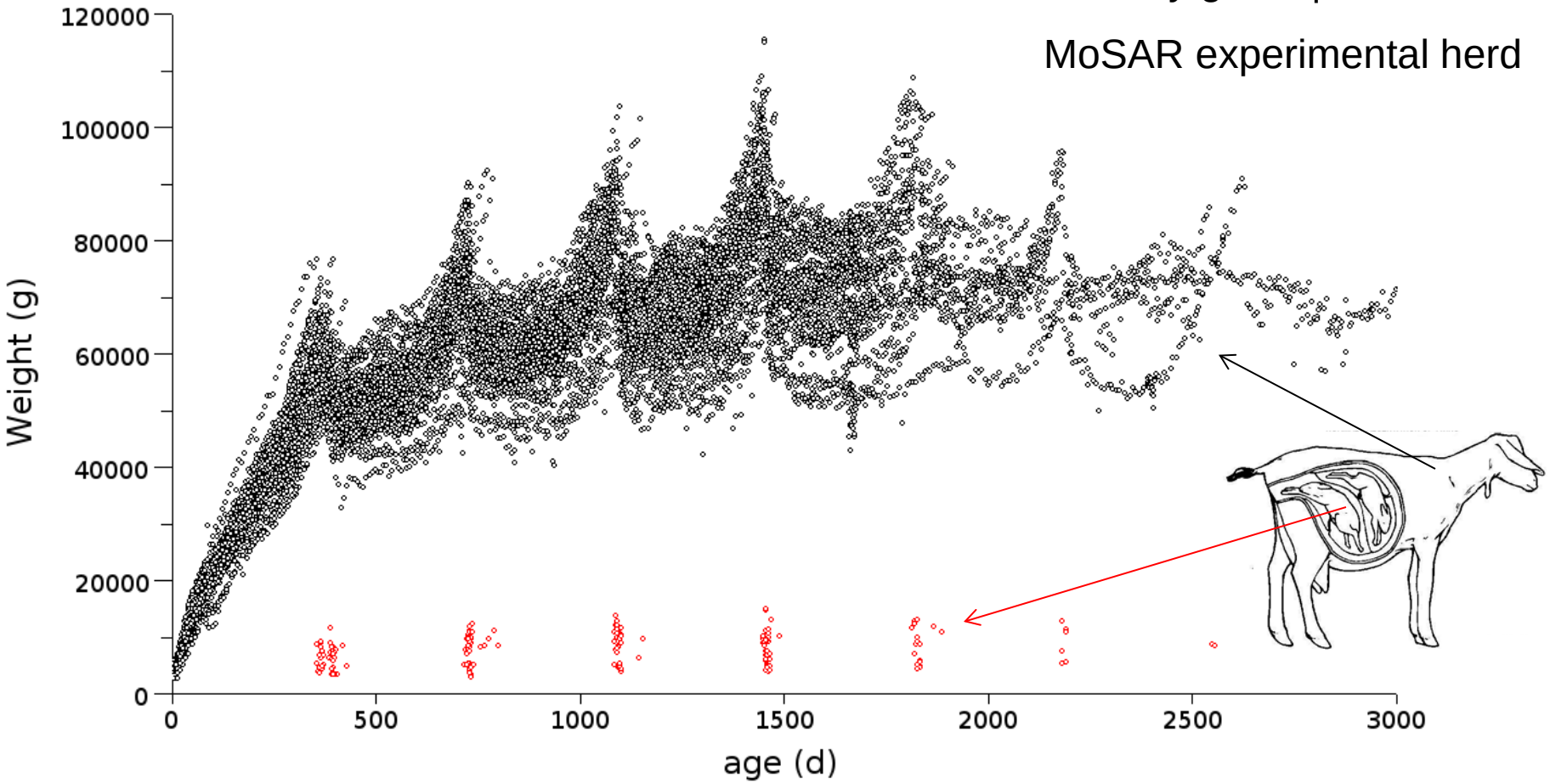
Interpretive tool



Raw data

45 dairy goats | 2005 - 2010

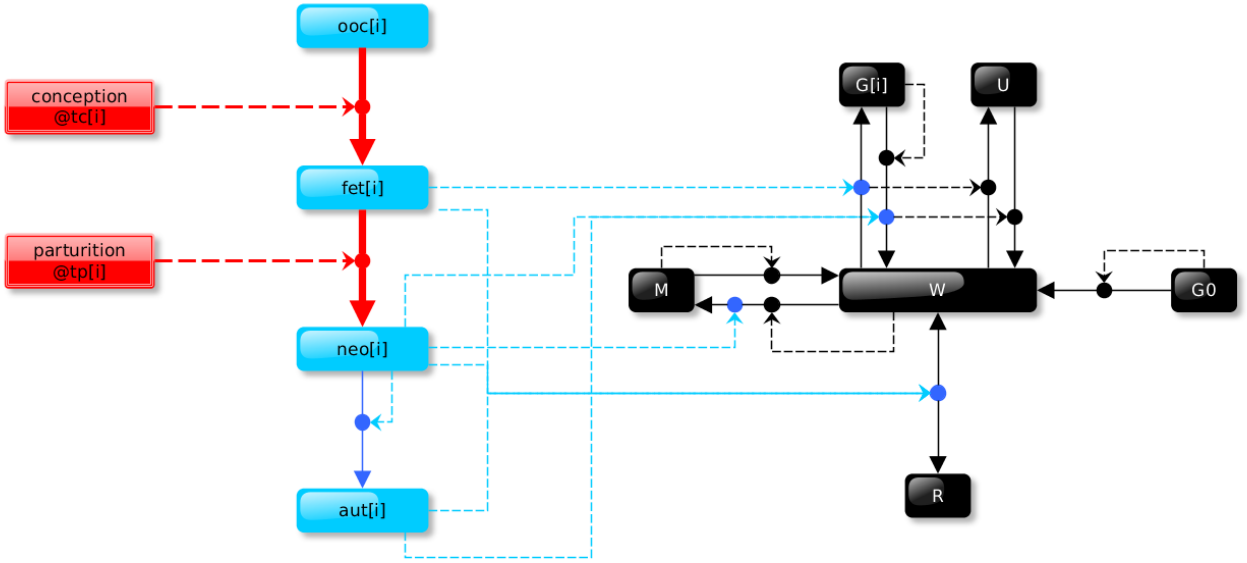
MoSAR experimental herd



The model

- ODE
- Reproductive cycles
- Parameters
  - 2 + 6 / repro. cycle

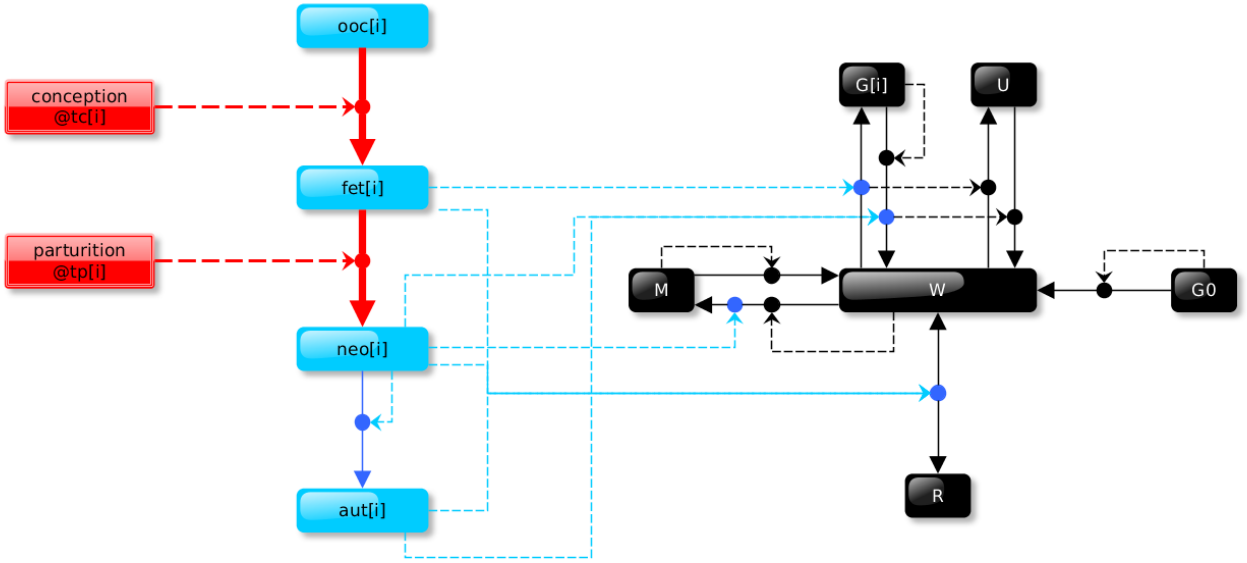
- BW variations
  - Genetic potential
  - Reserve balance
  - Uterine load
  - Maternal investment

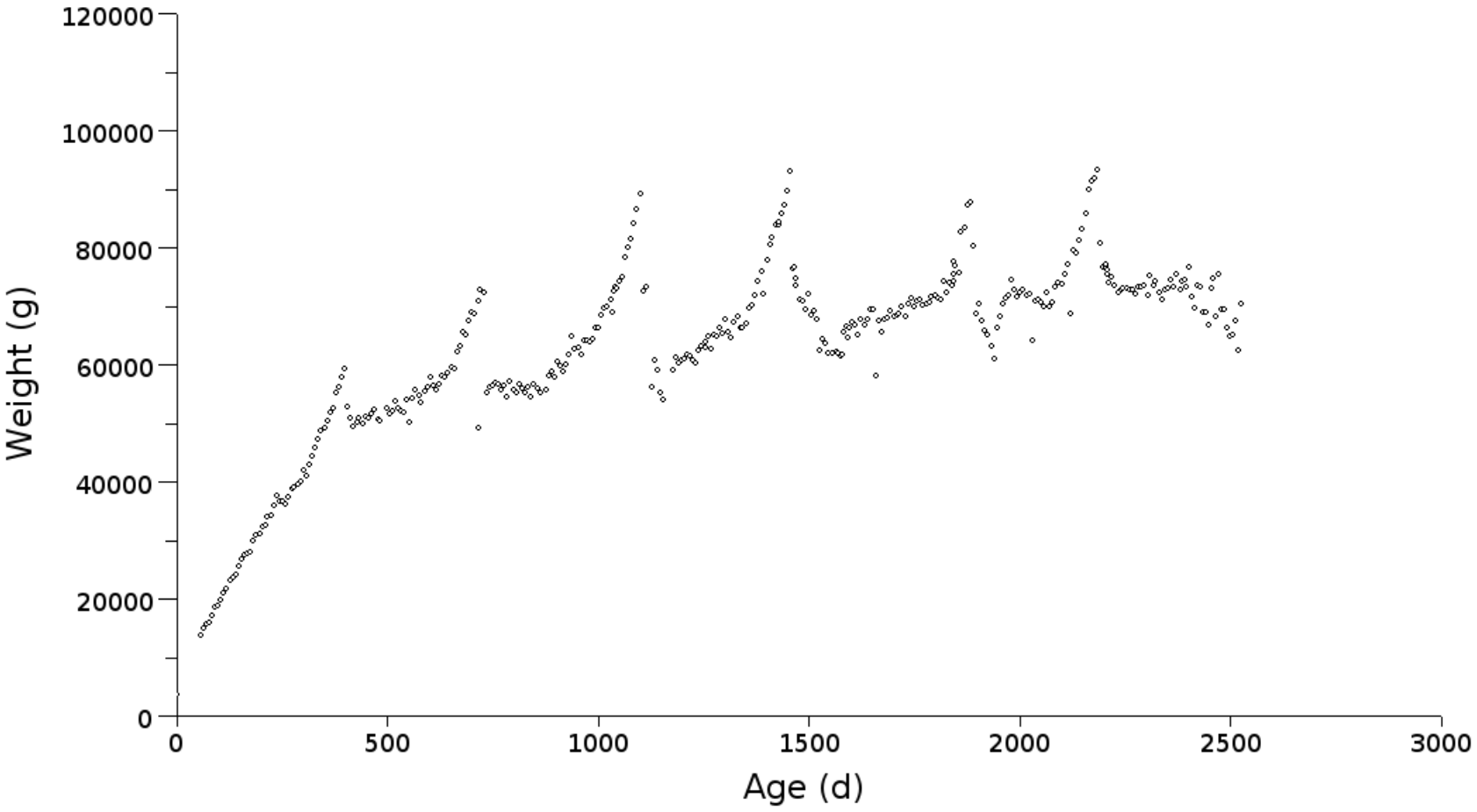


The model called GRUM

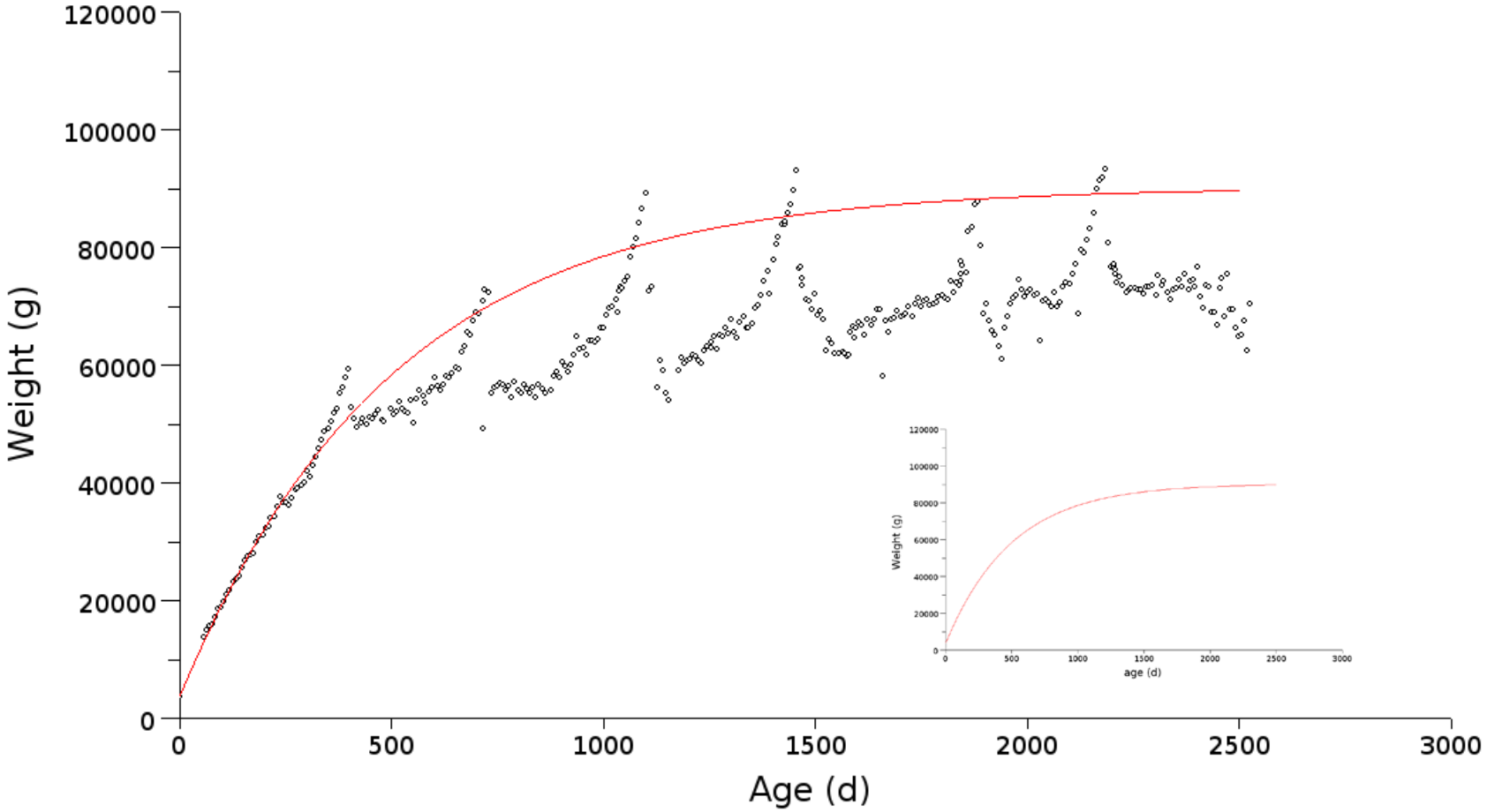
- ODE
- Reproductive cycles
- Parameters
  - 2 + 6 / repro. cycle

- BW variations
  - **G**enetic potential
  - **R**eserve balance
  - **U**terine load
  - **M**aternal investment

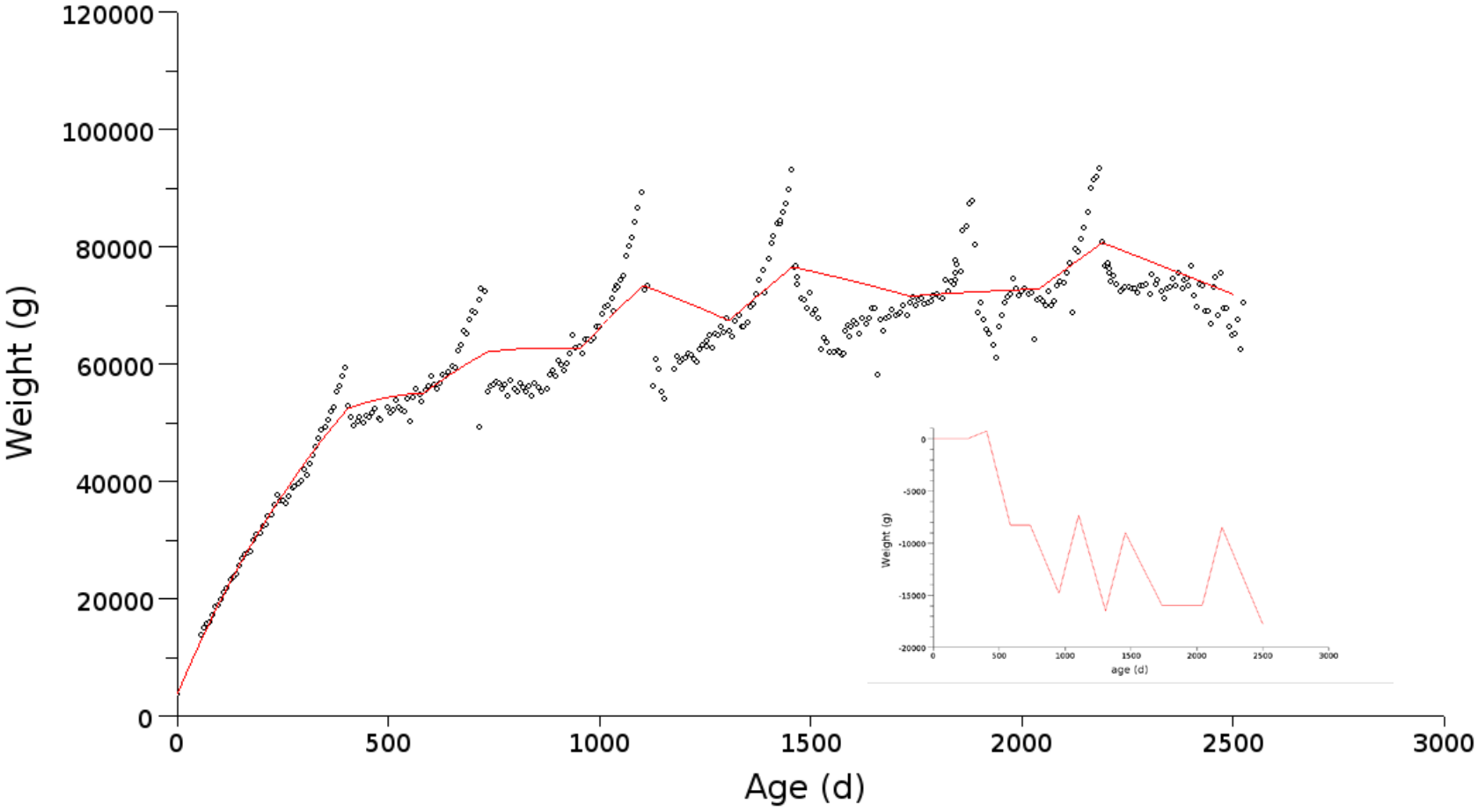



120000
100000
80000
60000
40000
20000
0
Weight (g)
0
500
1000
1500
2000
2500
3000
Age (d)

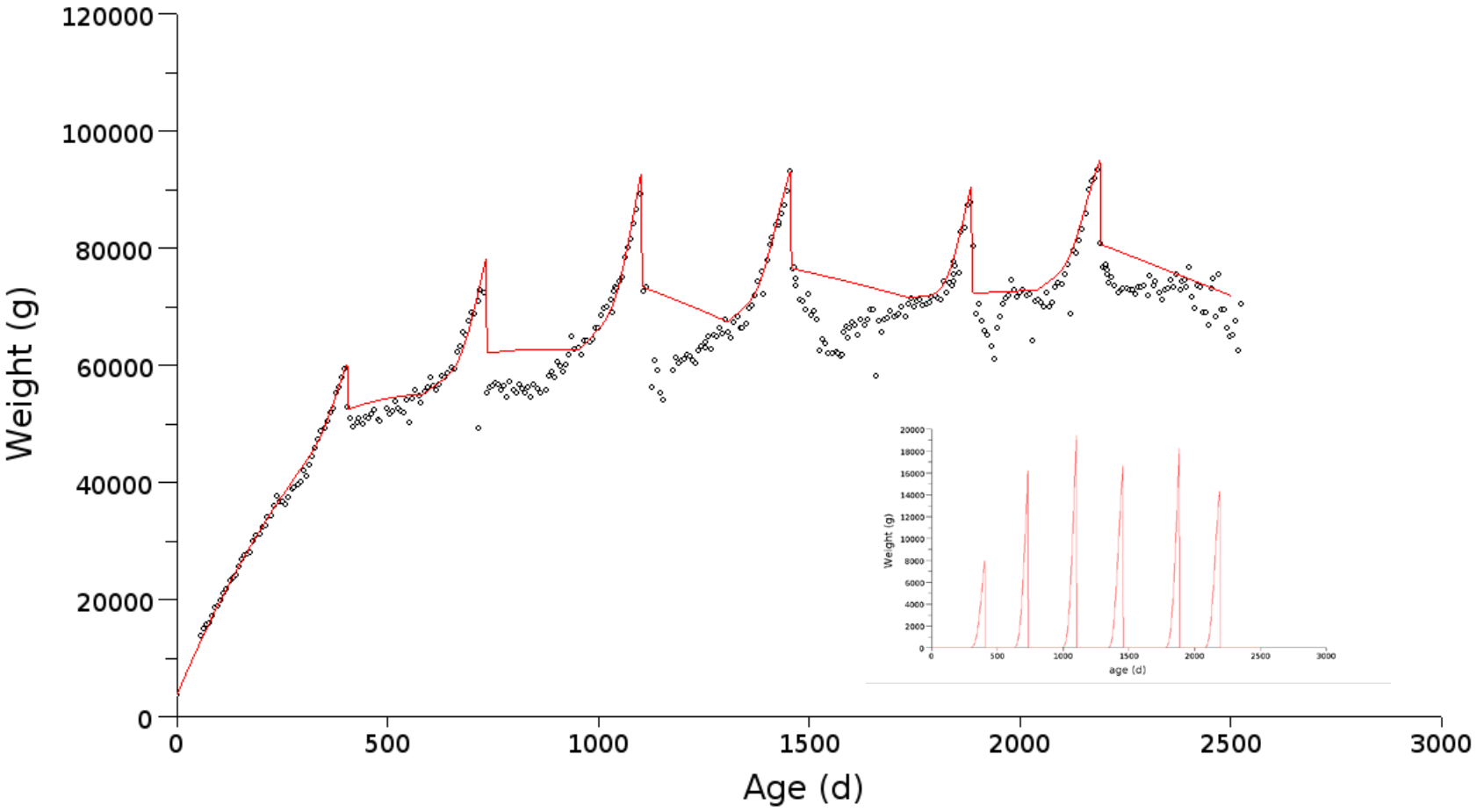
G


Weight (g)
120000
100000
80000
60000
40000
20000
0
0
500
1000
1500
2000
2500
3000
Age (d)
Weight (g)
age (d)

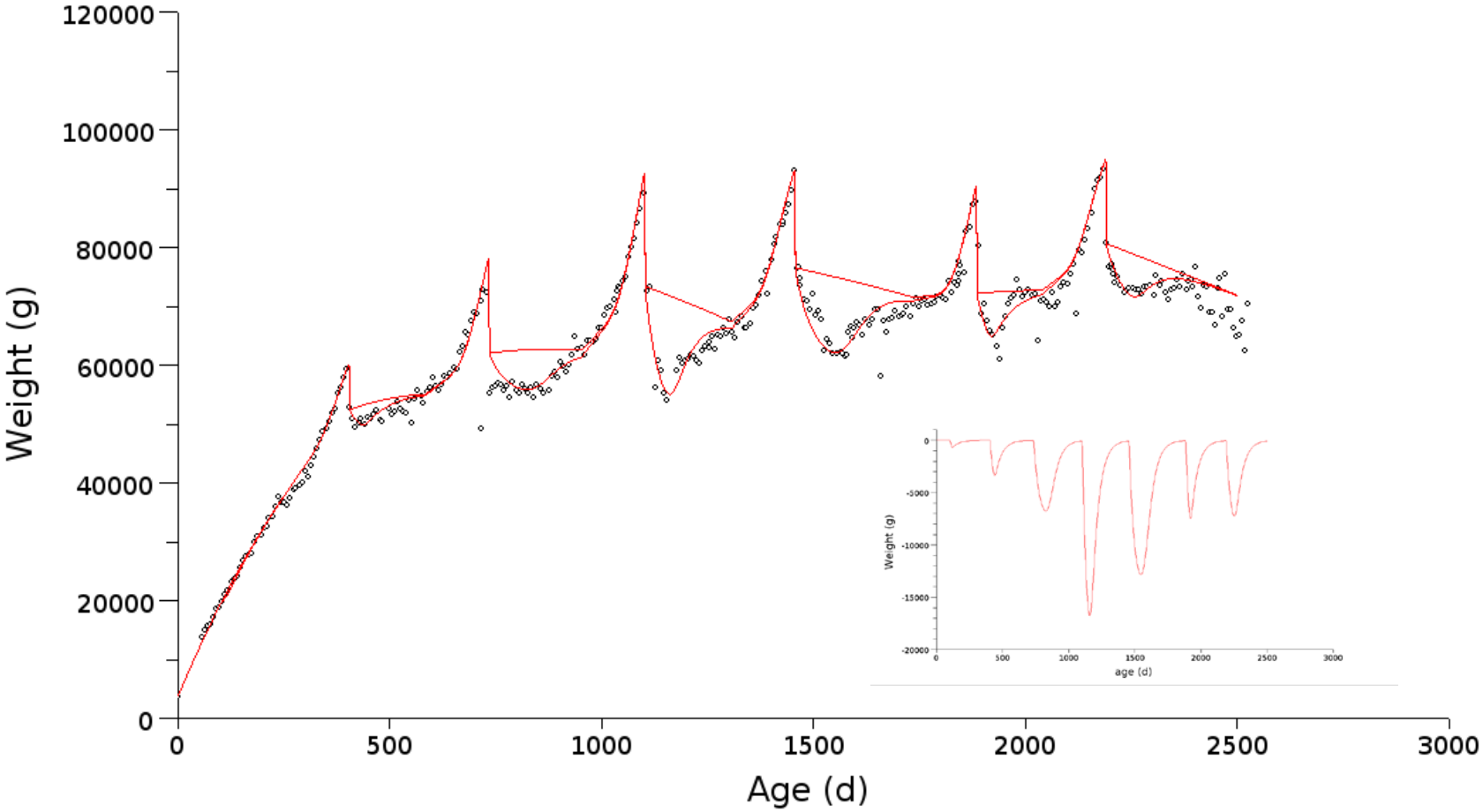
GR


Weight (g)
120000
100000
80000
60000
40000
20000
0
0
500
1000
1500
2000
2500
3000
Age (d)
Weight (g)
0
-5000
-10000
-15000
-20000
0
500
1000
1500
2000
2500
3000
age (d)

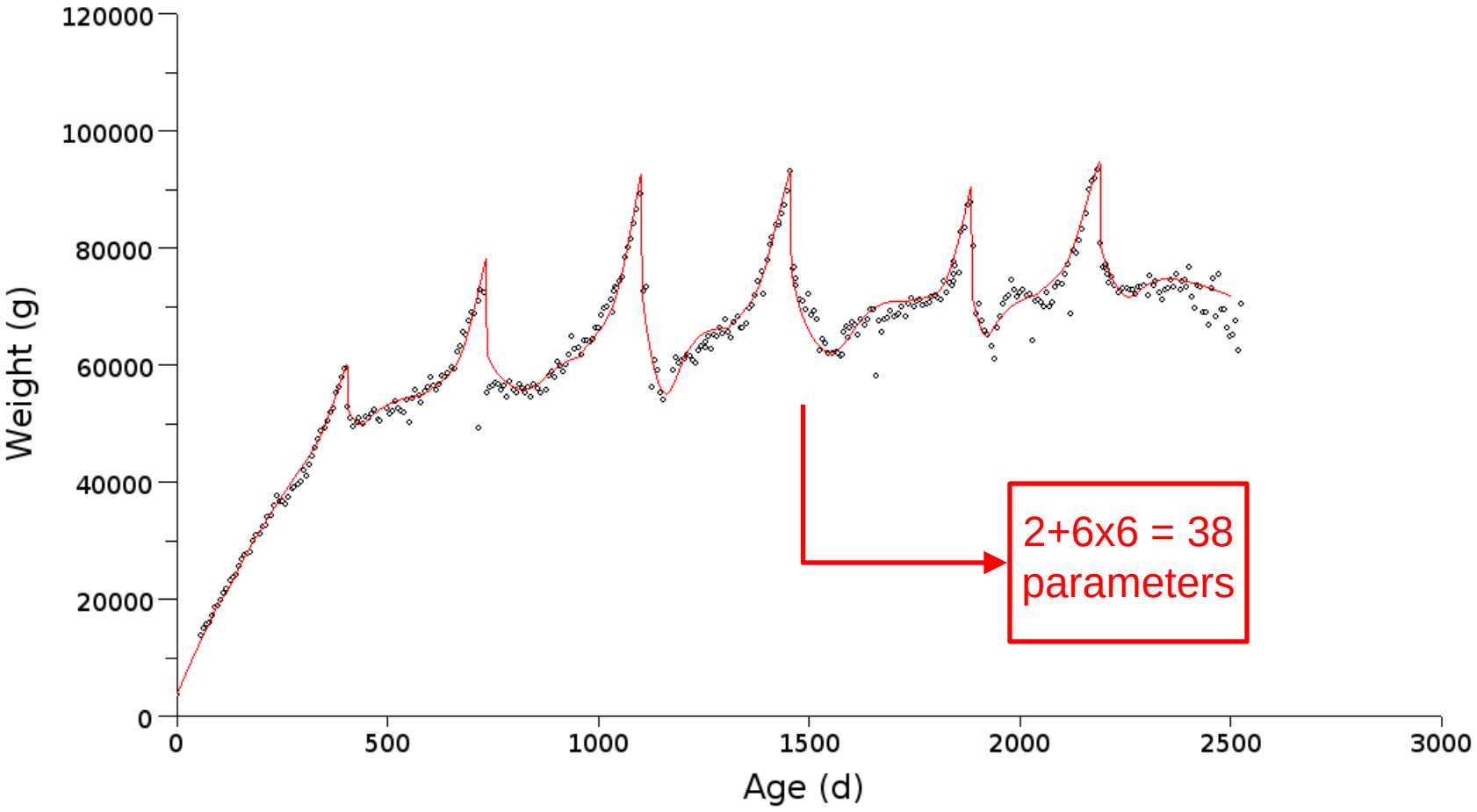
GRU


Weight (g)
Age (d)
0
20000
40000
60000
80000
100000
120000
0
500
1000
1500
2000
2500
3000
Weight (g)
age (d)

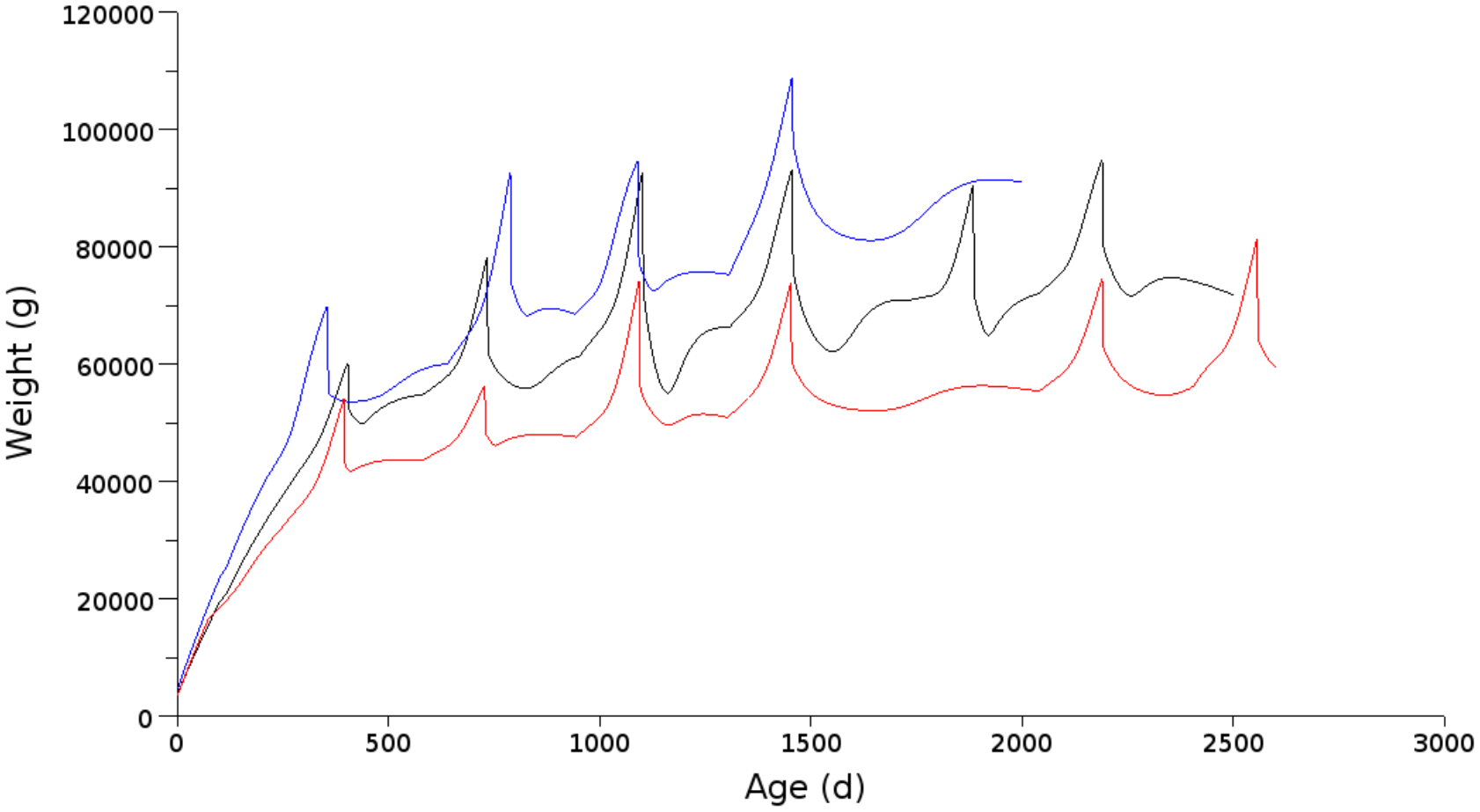
GRUM


Weight (g)
Age (d)
0
20000
40000
60000
80000
100000
120000
0
500
1000
1500
2000
2500
3000
Weight (g)
age (d)
-5000
-10000
-15000
-20000

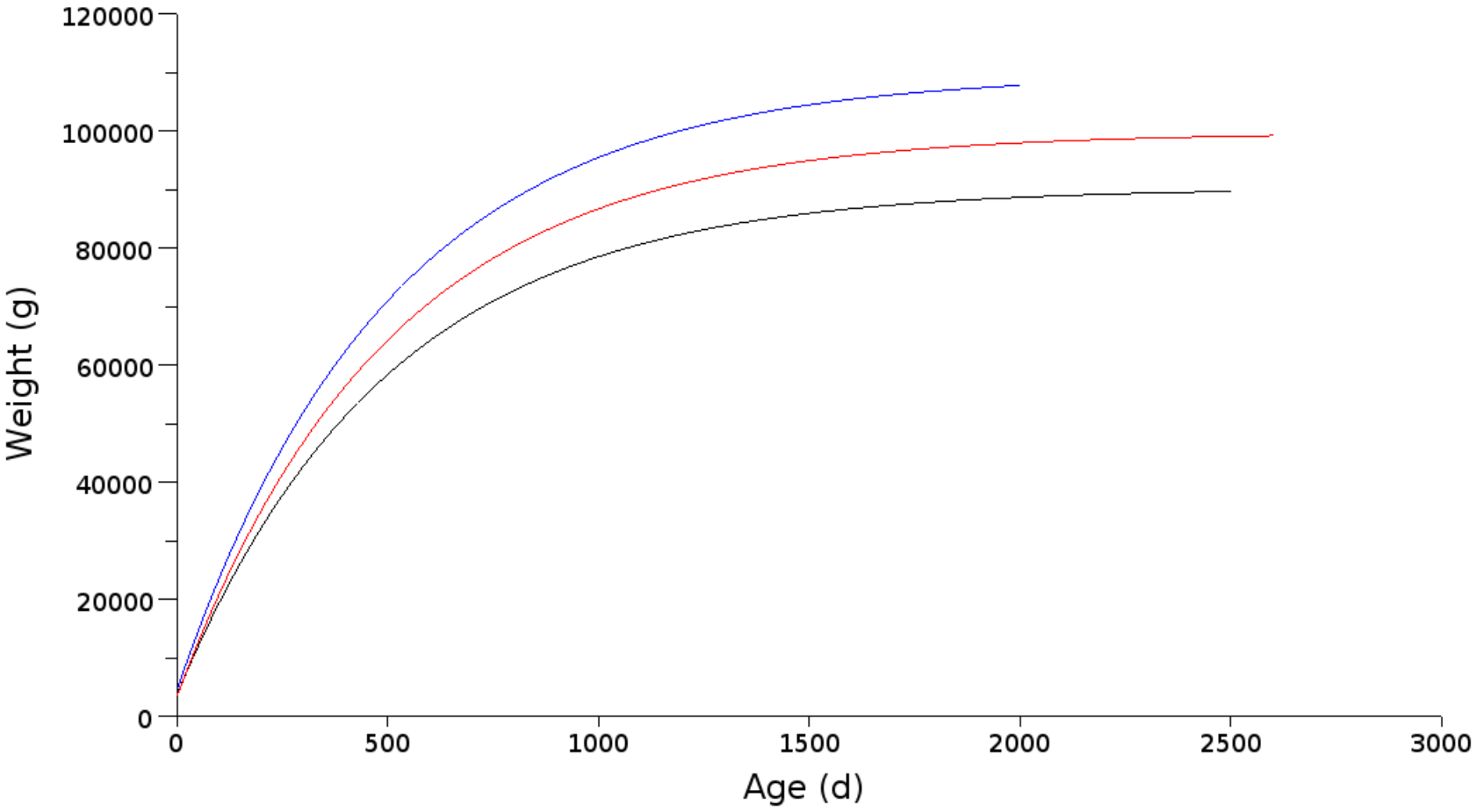
GRUM


120000
100000
80000
60000
40000
20000
0
Weight (g)
0
500
1000
1500
2000
2500
3000
Age (d)
2+6x6 = 38
parameters

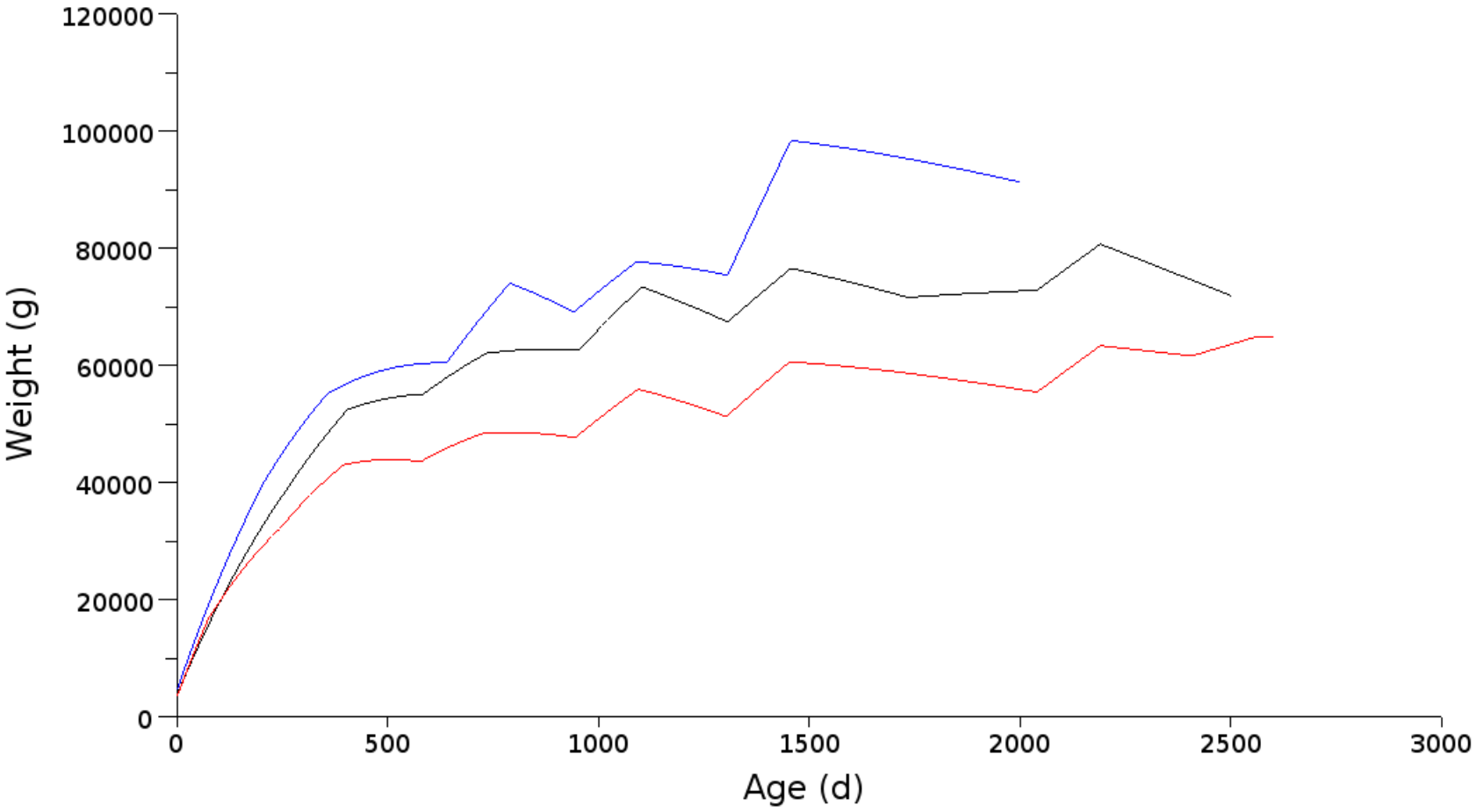
GRUMs


120000
100000
80000
60000
40000
20000
0
Weight (g)
0
500
1000
1500
2000
2500
3000
Age (d)

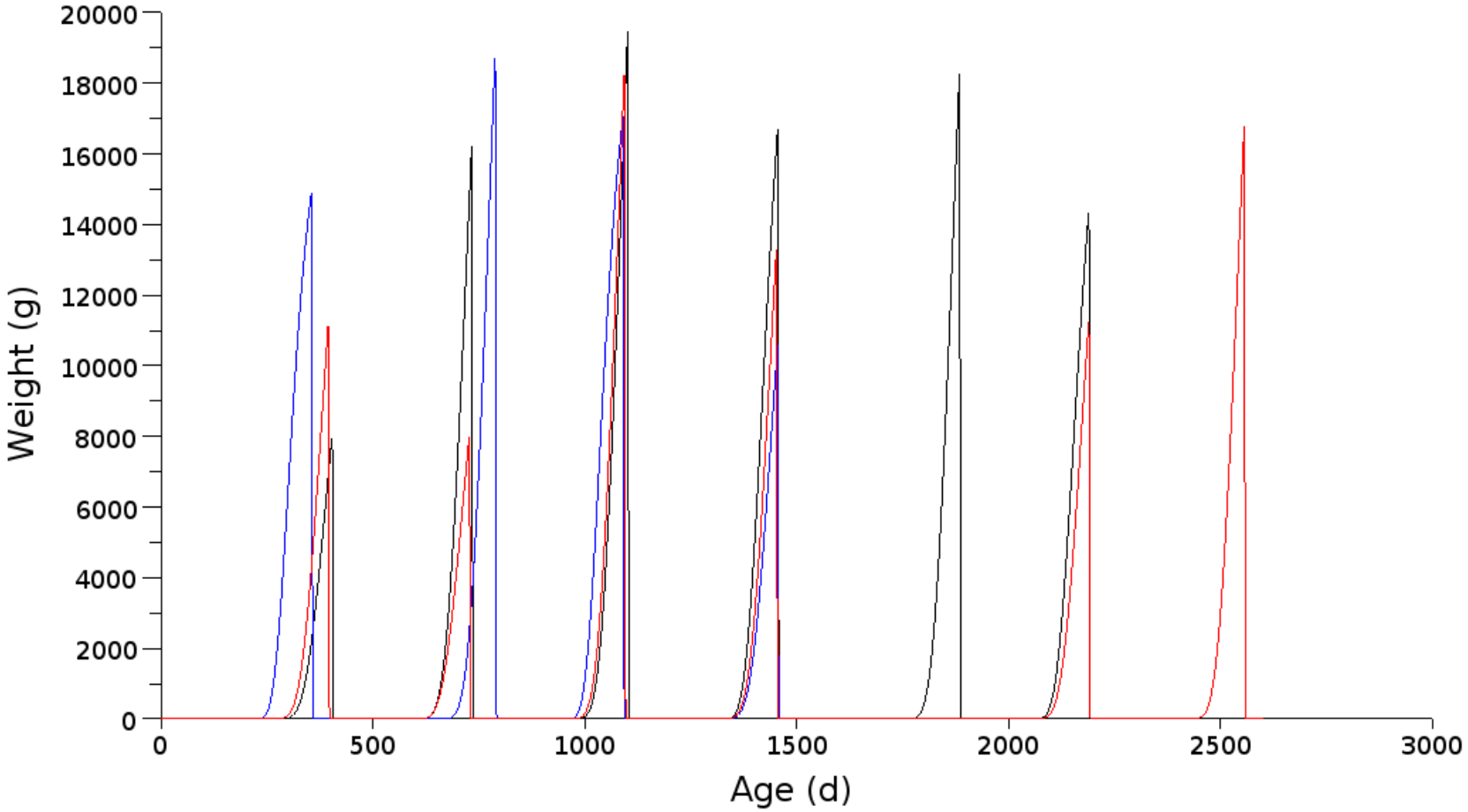
How different ?



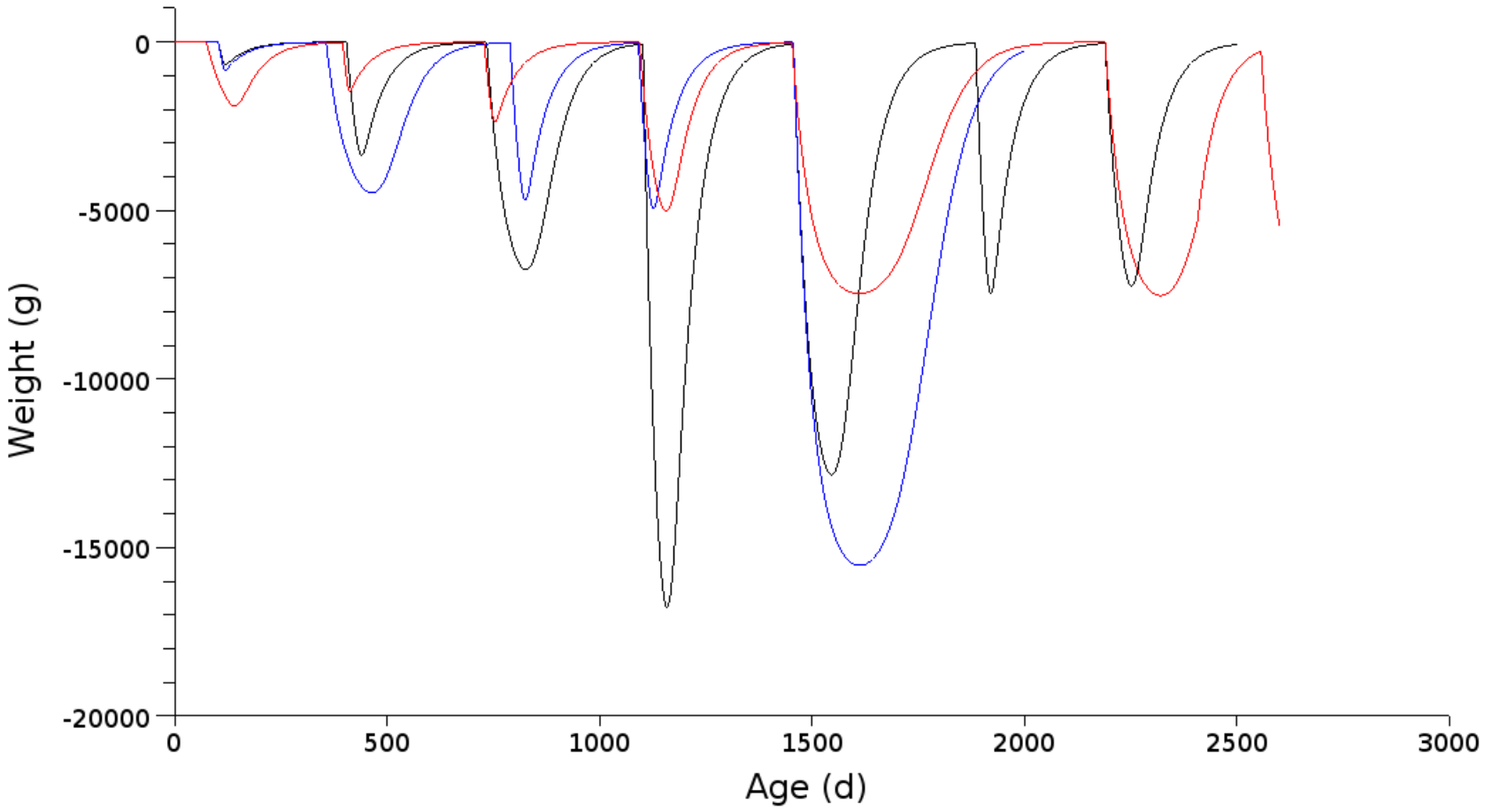
How different ?



How different ?

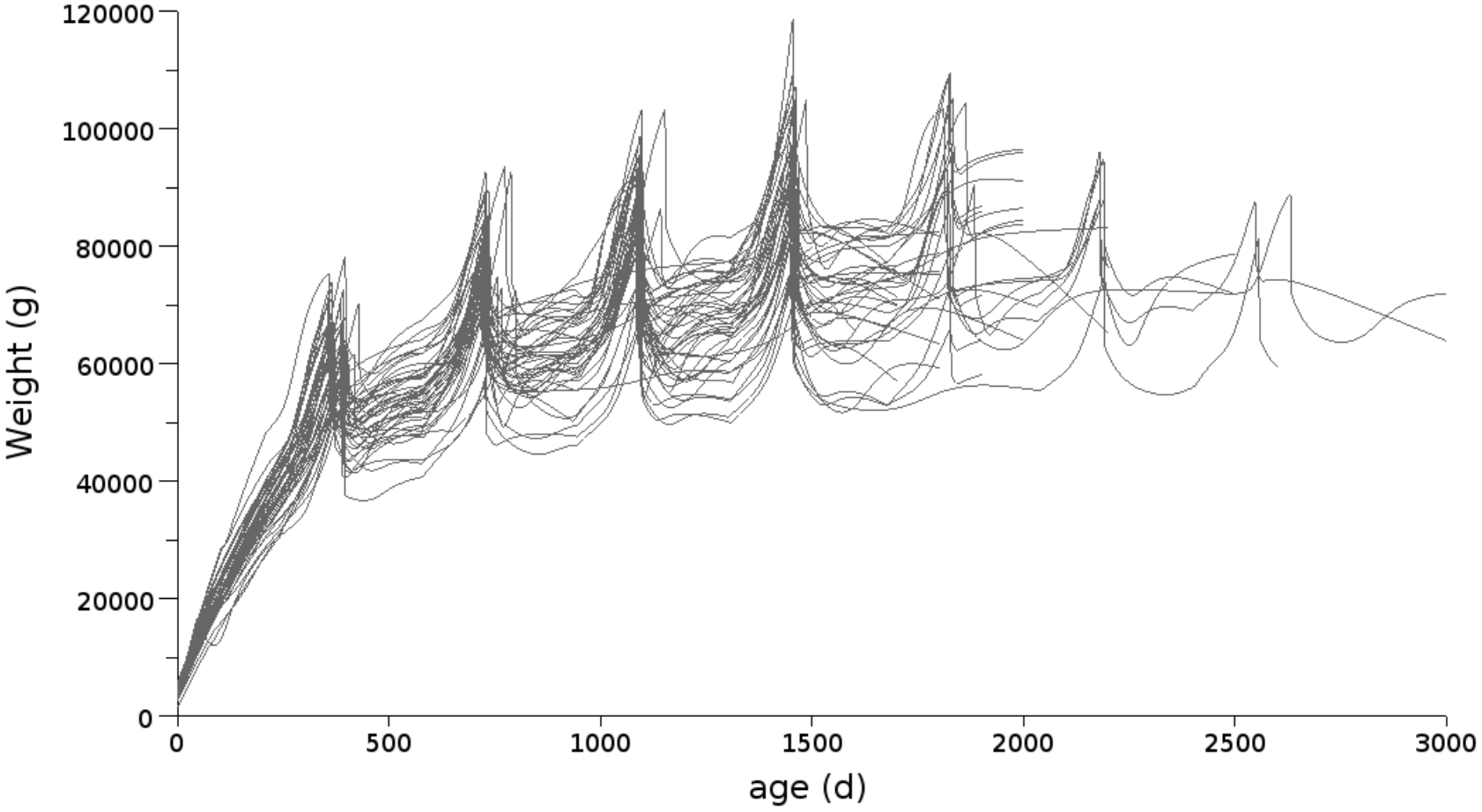


How different ?

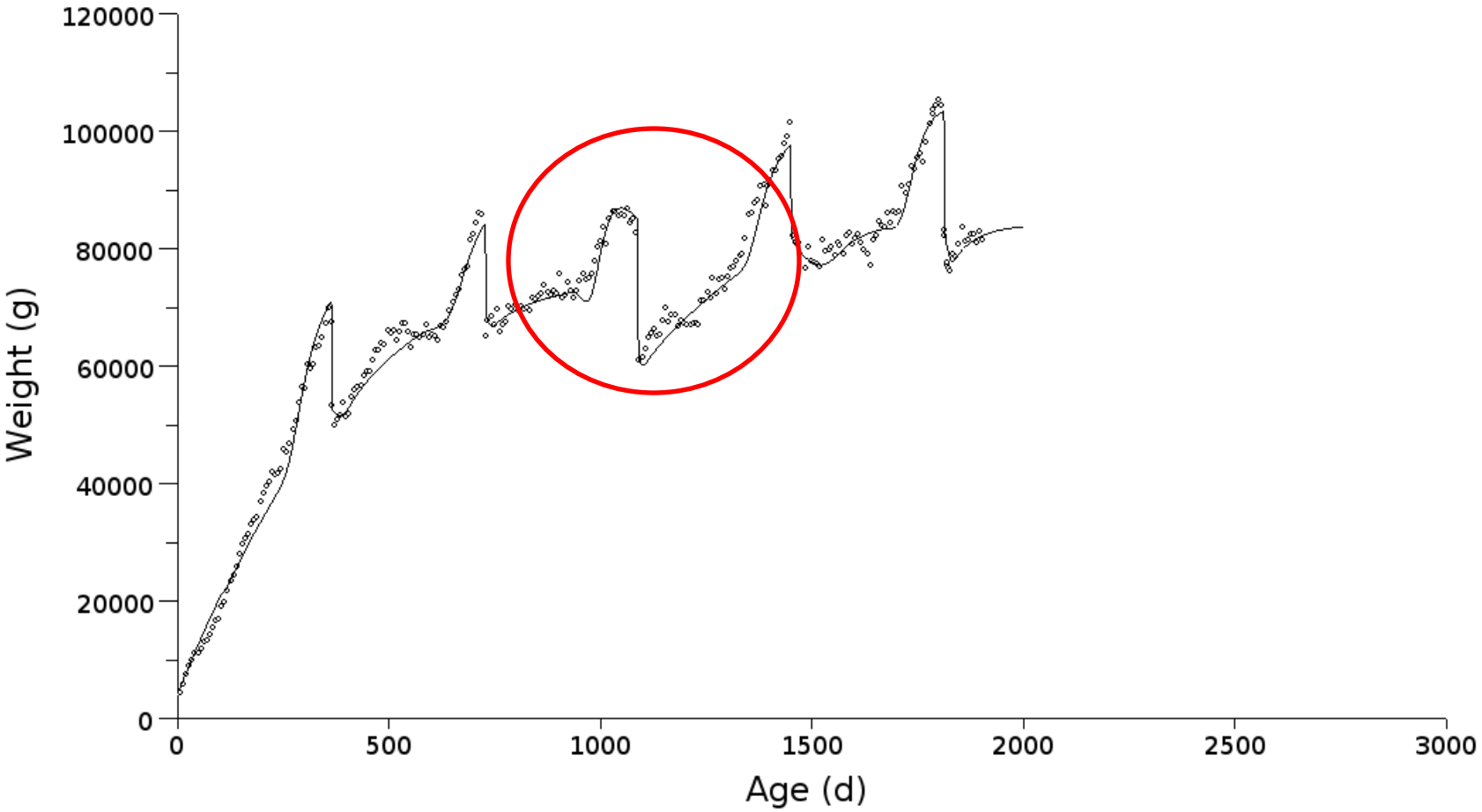


Fitting

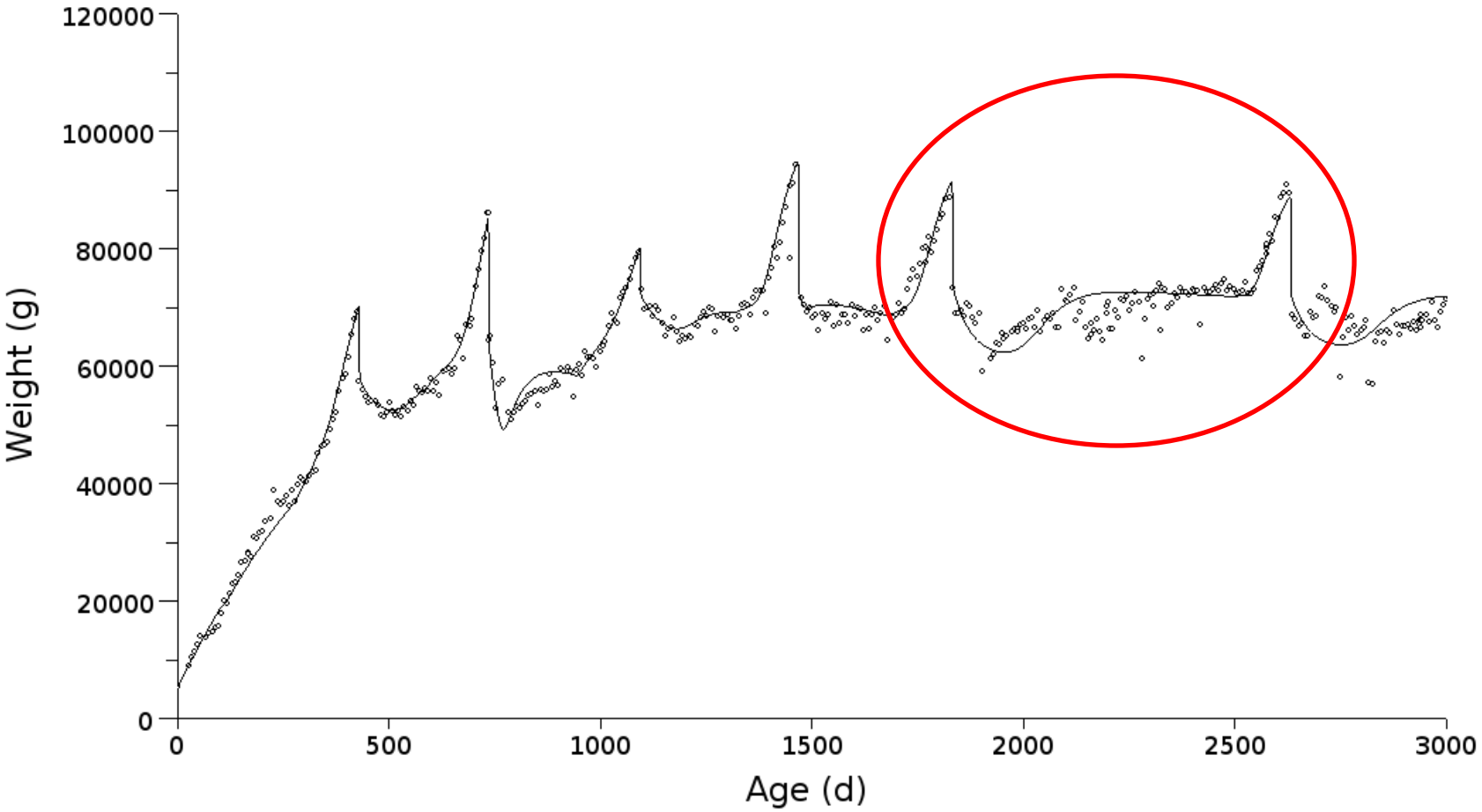
RMSE ~ 3 kg



Flexibility



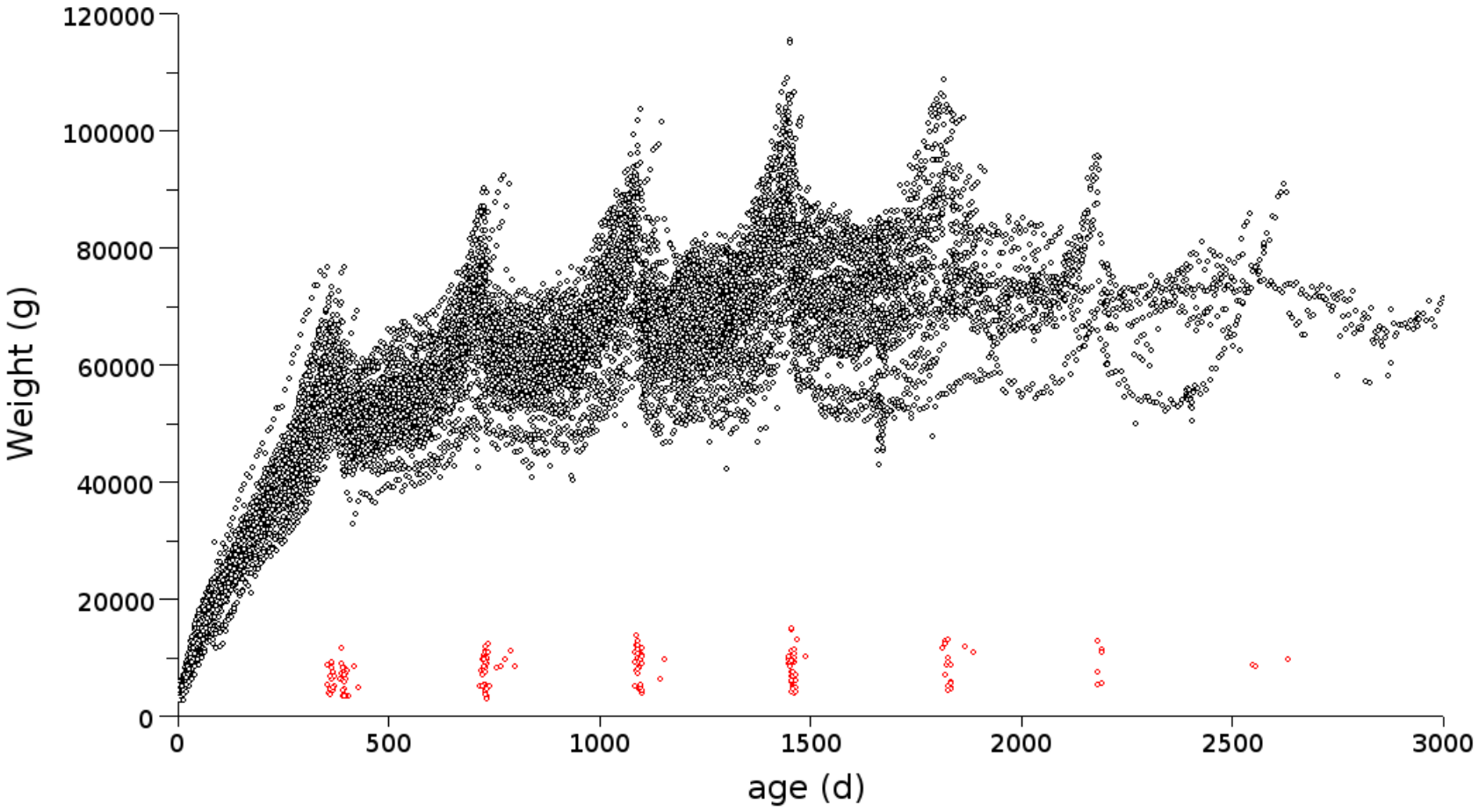
Flexibility



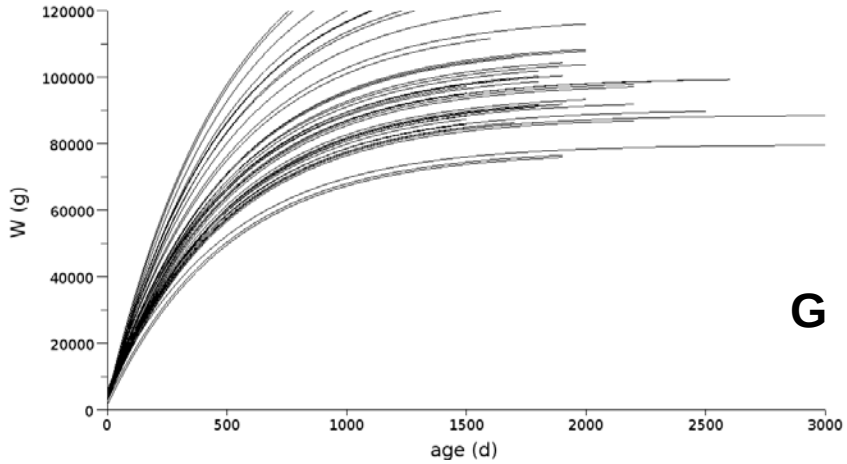
So…to conclude

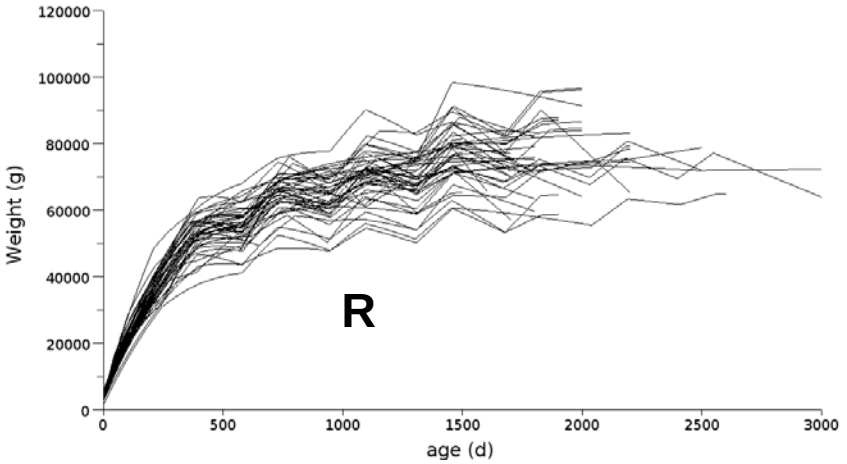
- Where we are
- What is the next step
- Where we are going

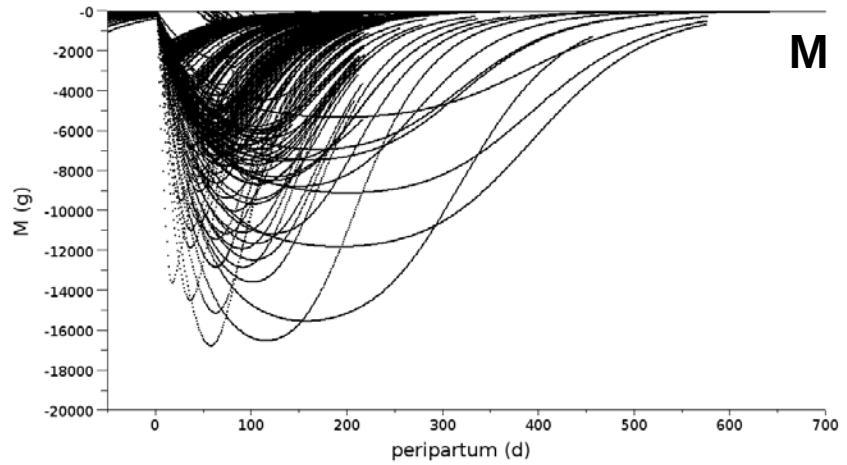
Where we are

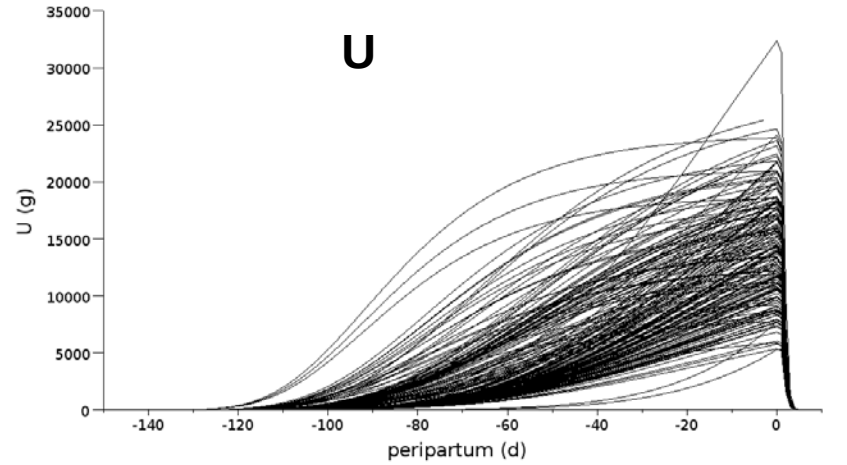

120000
100000
80000
60000
40000
20000
0
Weight (g)
0
500
1000
1500
2000
2500
3000
age (d)

Where we are

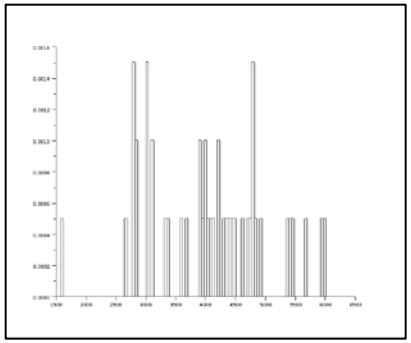
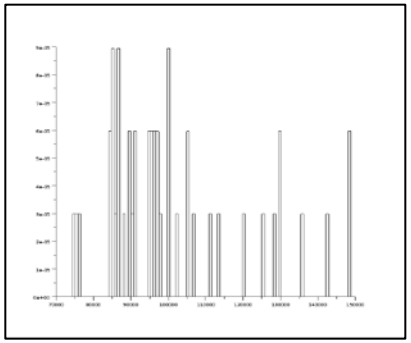
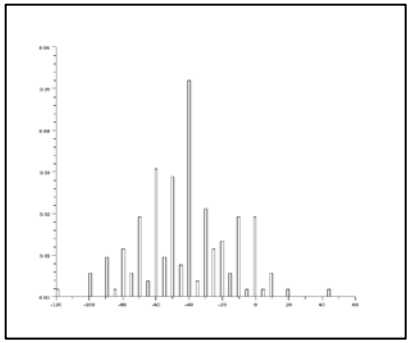
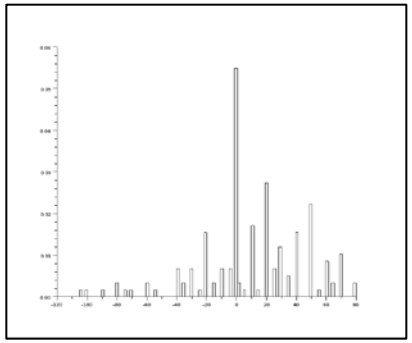

G
W (g)
age (d)
0
20000
40000
60000
80000
100000
120000
0
500
1000
1500
2000
2500
3000


R
Weight (g)
age (d)
0
20000
40000
60000
80000
100000
120000
0
500
1000
1500
2000
2500
3000

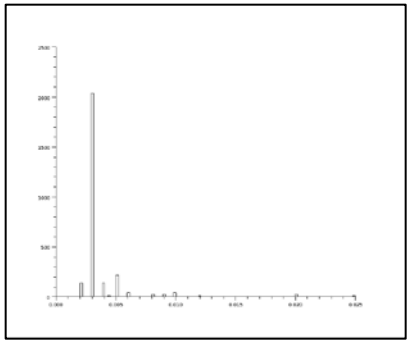
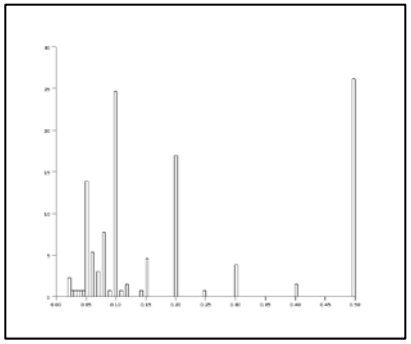
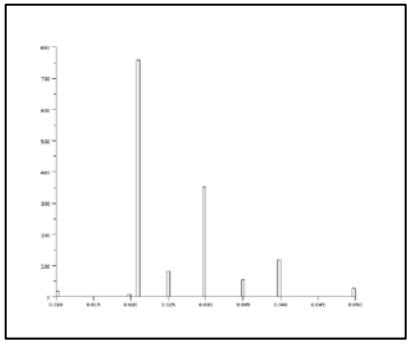
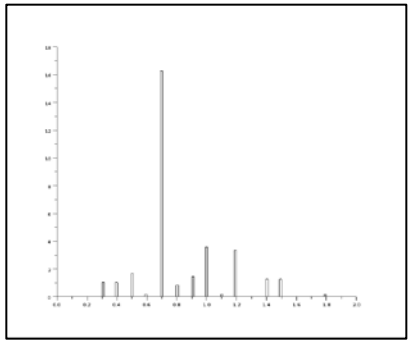

M
M (g)
peripartum (d)
-0
-2000
-4000
-6000
-8000
-10000
-12000
-14000
-16000
-18000
-20000
0
100
200
300
400
500
600
700


U
U (g)
peripartum (d)
0
5000
10000
15000
20000
25000
30000
35000
-140
-120
-100
-80
-60
-40
-20
0

Where we are

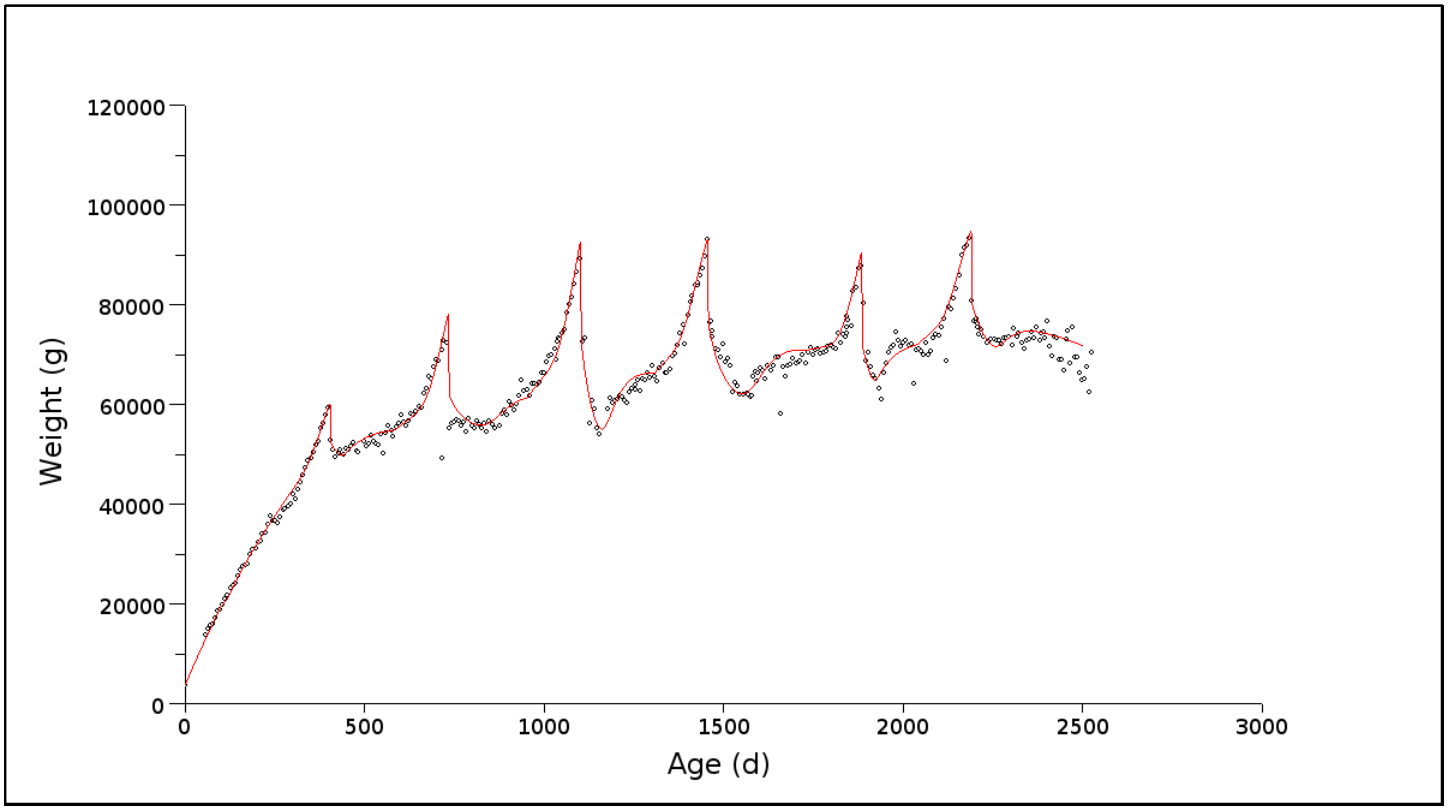





Variability of lifetime BW trajectories

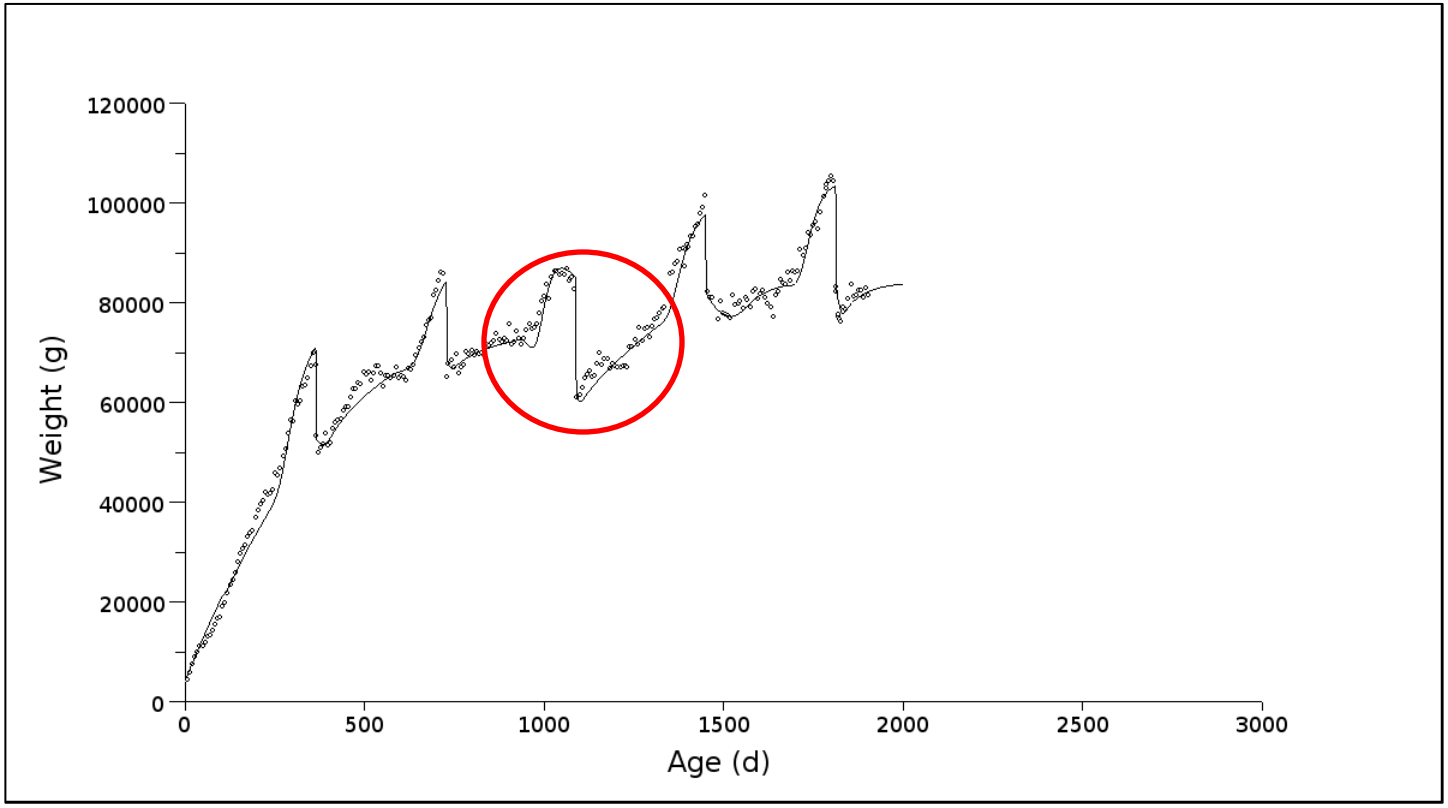
Where we are

- Sequential fitting procedure to optimize !



Where we are

- Thresholds normal/abnormal to define !



What is the next step

- On-farm automation of the fitting algorithm
- Statistical analysis of phenotypic vectors
  - Quantify animal, parity, breed differences
  - Track types of BW trajectories
  - Provide a synthetic view of goats variability
- Application to other performance
  - Milk Yield
  - Dry Matter Intake
    - Correct BW for digestive tract content weight ?

Where we are going

- Develop an alert system for individual management at the MoSAR experimental herd
  - Early detection of deviation from individual benchmarks
  - Virtual goat *vs* Real goat

- Toward virtual herd based management ?

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