Modelling the dynamics of feed intake in growing pigs:

interest for modelling populations of pig

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Growth modelling
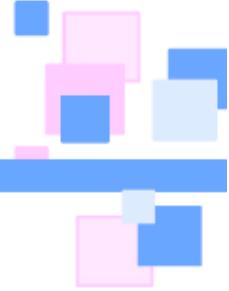
❑ **Growth models:**
  mecanist, dynamic, determinist

- Body weight (BW) = function of Age
- Daily feed intake (FI) = function of BW
- ➔ Description of BW and FI curves

❑ **Simulate an "average pig"**

- Adjustment of average parameters
- Simulation of an average response

➔ Underestimate the nutrient requirements at the batch level
(Brossard et al., 2007)

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Growth modelling
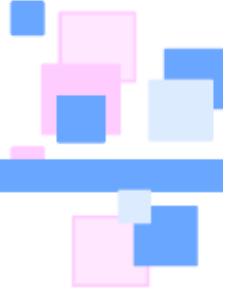
❑ Batch scale / individual scale

- Growth and intake adjusted parameters per pig
- Variability of individual requirements
- ➜ Link between parameters *(Brossard et al., 2009)*

❑ Switching scale issues

- To estimate precisely the individual parameters
- To model the link between ind. parameters within a batch
- ➜ To simulate the response of the batch to nutrient supplies

Growth modelling with InraPorc®
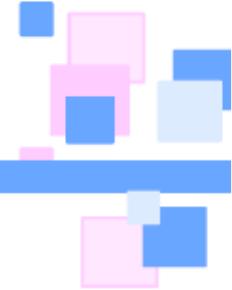
❑ 1 Profile = 8 parameters

Initial BW	kg	BW_i	
Final BW	kg	BW_f	
Initial age	d	AGE_i	Gompertz function
Duration	d	Dur	
Protein deposition	g/d	PD	
Gompertz B coef.		B_{Gomp}	
FI at 50 kg BW	MJ NE	FI50	FI = f(BW)
FI at 100 kg BW	MJ NE	FI100	

Growth modelling with InraPorc®

❑ 4 functions available to describe FI = f(BW)

Legend:
- **Linear**: $aBW+b$
- **Power**: aBW^b
- **Exponential**: $a(1-e^{bBW})$
- **Gamma**: $0.75BW^{0.60}(aBWe^{-bBW}+1)$

Y-axis: Feed intake (MJ NE/d)
X-axis: BW (kg)

Vautier et al., session 17 – paper n°8
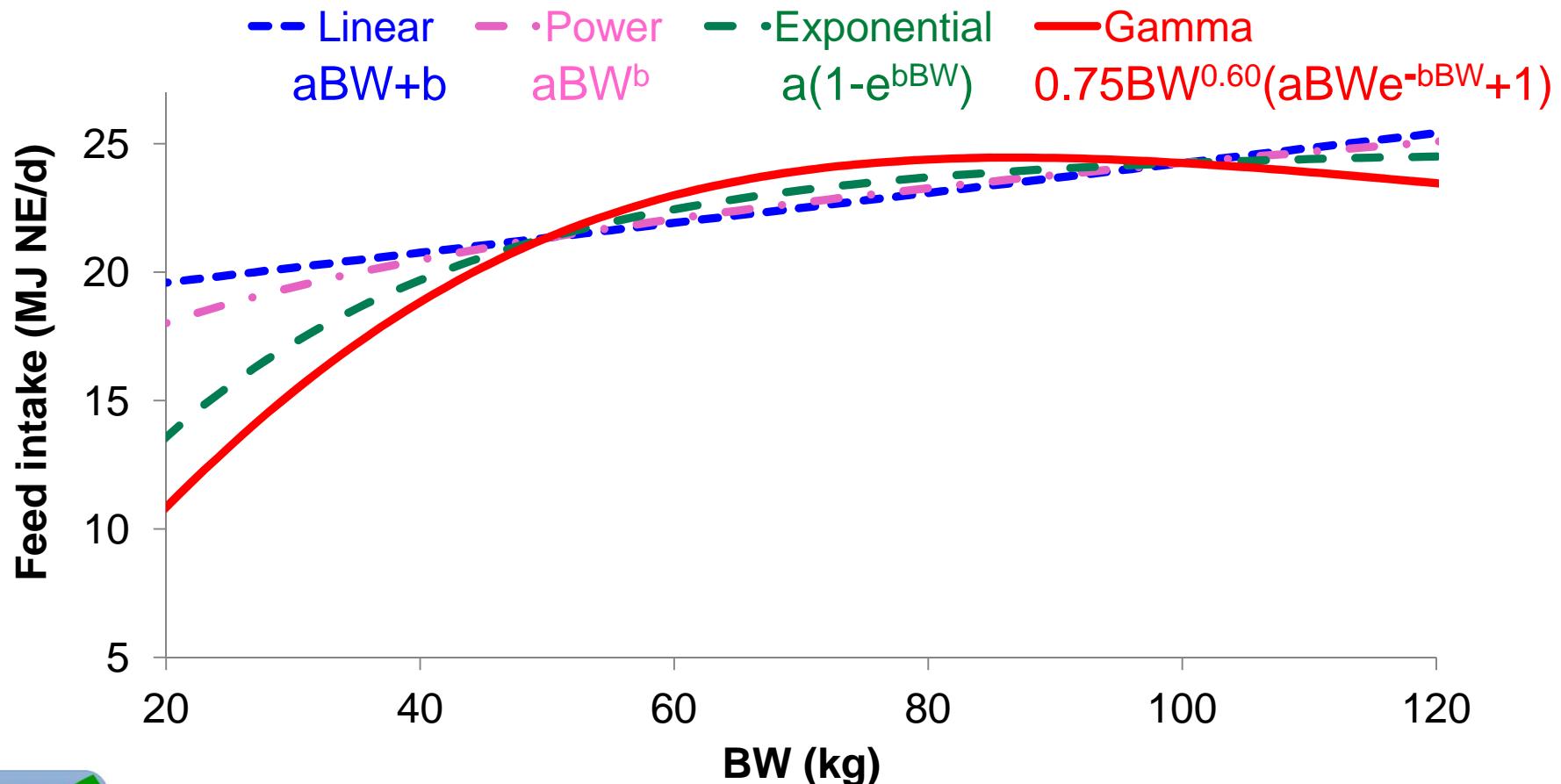
Aim of the study
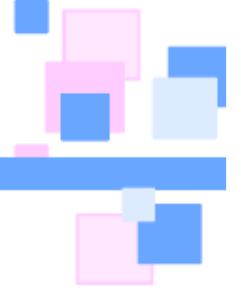
➔ **Which FI equation best fits recorded data?**

➔ **How are the individual profile parameters distributed and linked in pig populations?**

Materials and methods: data collection

❑ Animals:

- 7 batches of 144 barrows and gilts (1008 ind.)
  - ❑ LWxLD sows
  - ❑ 8 sire breeds,
    - half a batch from LWxPP
    - other half from an alternative commercially available breed

❑ *Ad libitum*

❑ Group housed (12 / pen)

❑ Measurements

- Individual FI (automatic feed dispenser)
- BW: x6 over the growing-finishing period

Materials and methods: data processing

❑ **Growth profiles adjusted in InraPorc®:**

- 🗦 BW

- 🗦 FI

❑ **Rejection of profiles**

- 🗦 Health problems

- 🗦 BW loss

➔ **918 animals kept in the database**

Materials and methods: calculations

❏ **Comparison of FI calculated with each of the 4 equations to measured FI**
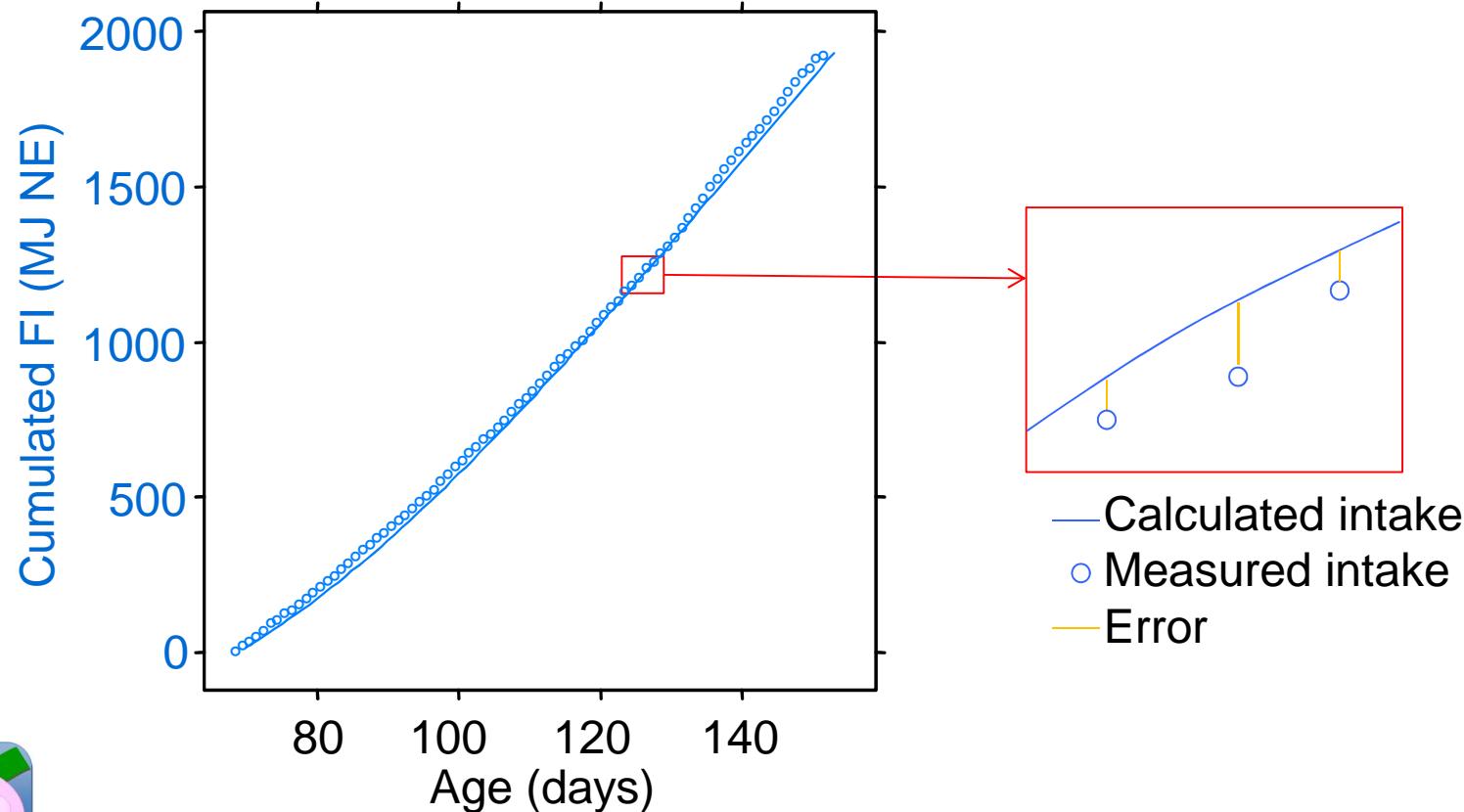
Materials and methods: statistics
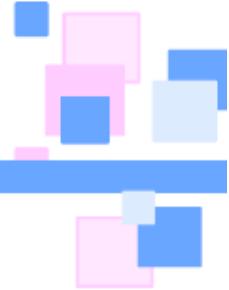
❑ Equations FI = f(BW)

- Error summarized by the Root Mean Square Error of Prediction of every individual profile

$$RMSEP = \sqrt{\sum \frac{(FI_{calculated} - FI_{measured})^2}{duration}}$$

- Statistical analysis with Mixed procedure (SAS v8.01)
  - ❑ Fixed effects: equation, genotype, sex, batch + interactions
  - ❑ Random effect: pen

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Materials and methods: statistics
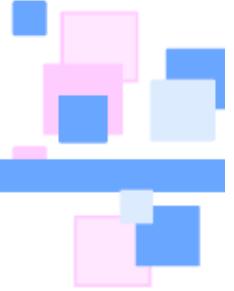
❑ Factors of variation of each profile parameters

- ◼ Mixed procedure (SAS v8.01)
  - ❑ Fixed effects: genotype, sex, batch + interactions
  - ❑ Random effect: pen

❑ Link between profile parameters

- ◼ Principal Component Analysis

Comparison of equations
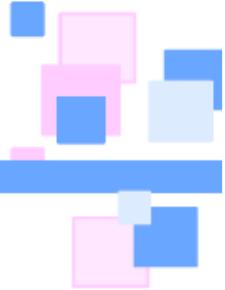
❑ **Equation:** **P<0.001**

Equation	Linear	Power	Expon[tial]	Gamma
Mean RMSEP (MJ NE)	46.1[a]	42.0[b]	37.5[c]	34.5[d]

❑ **Equation x genotype:** **NS**

❑ **Equation x gender:** **NS**

❑ **Equation x batch:** **P<0.001**
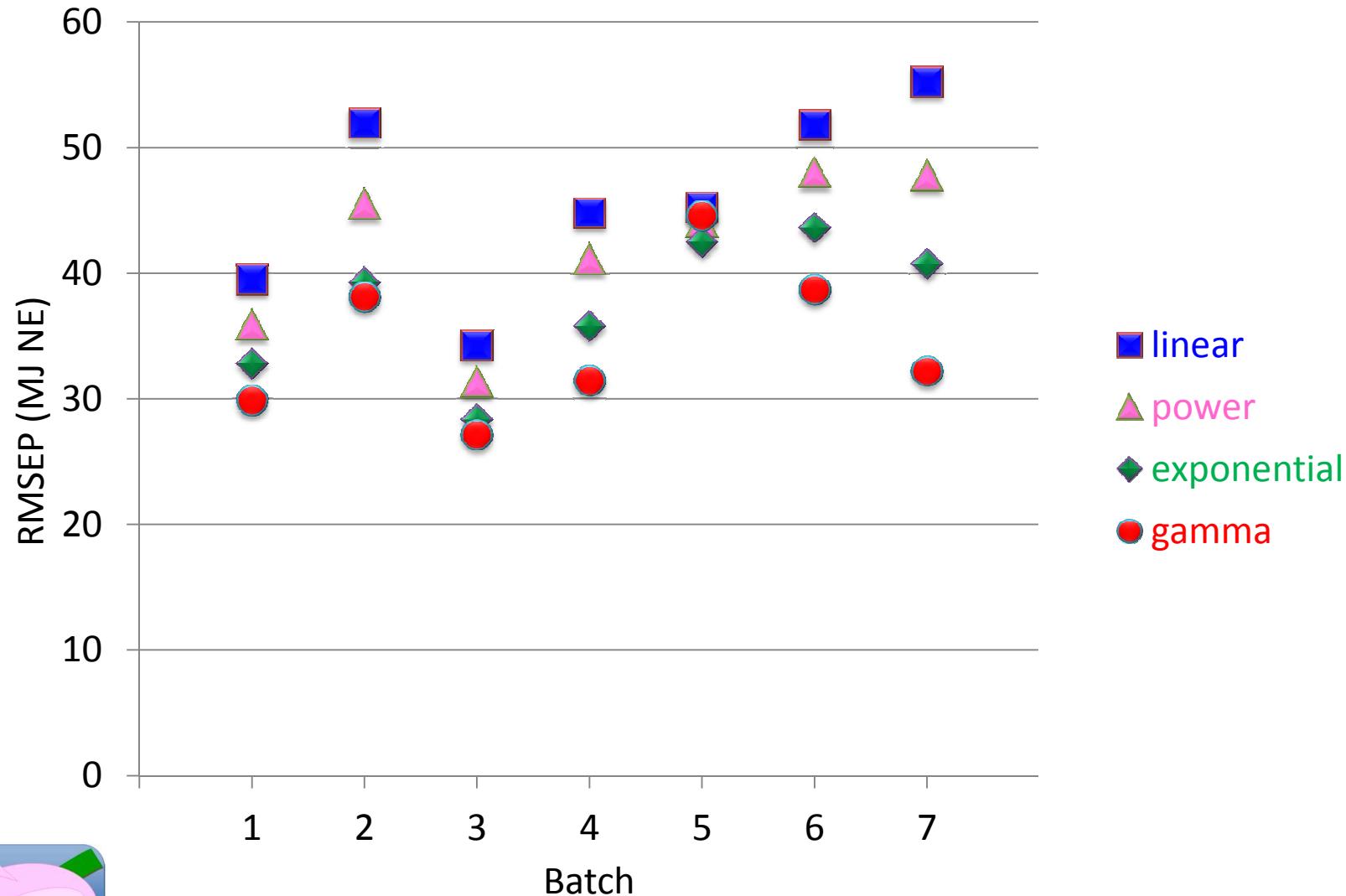
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Equation x batch interaction (P<0.001)

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RMSEP density among equations

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Legend:
- linear
- power
- exponential
- gamma

X-axis: RMSEP (MJ NE)
Y-axis: Density

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RMSEP density among equations

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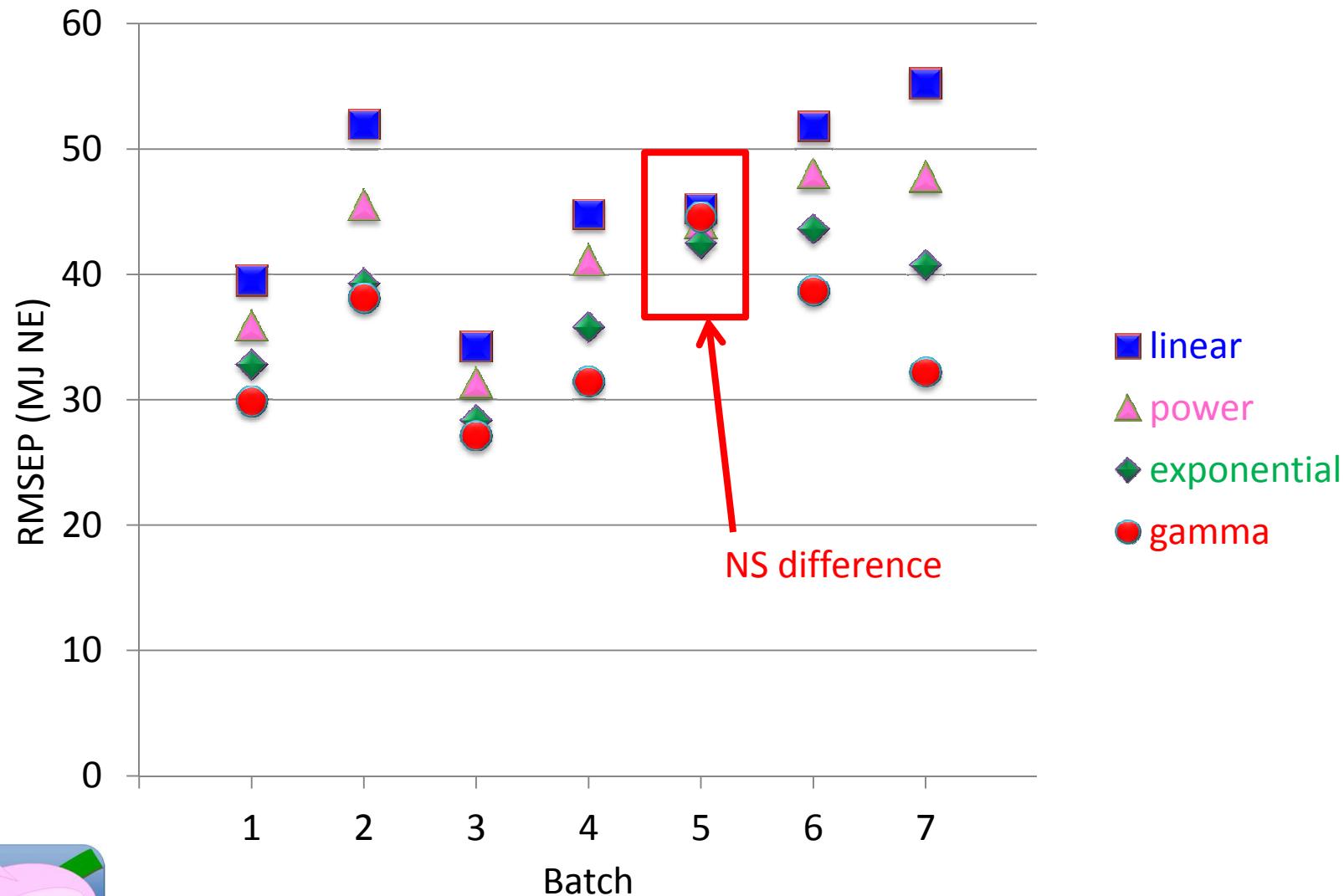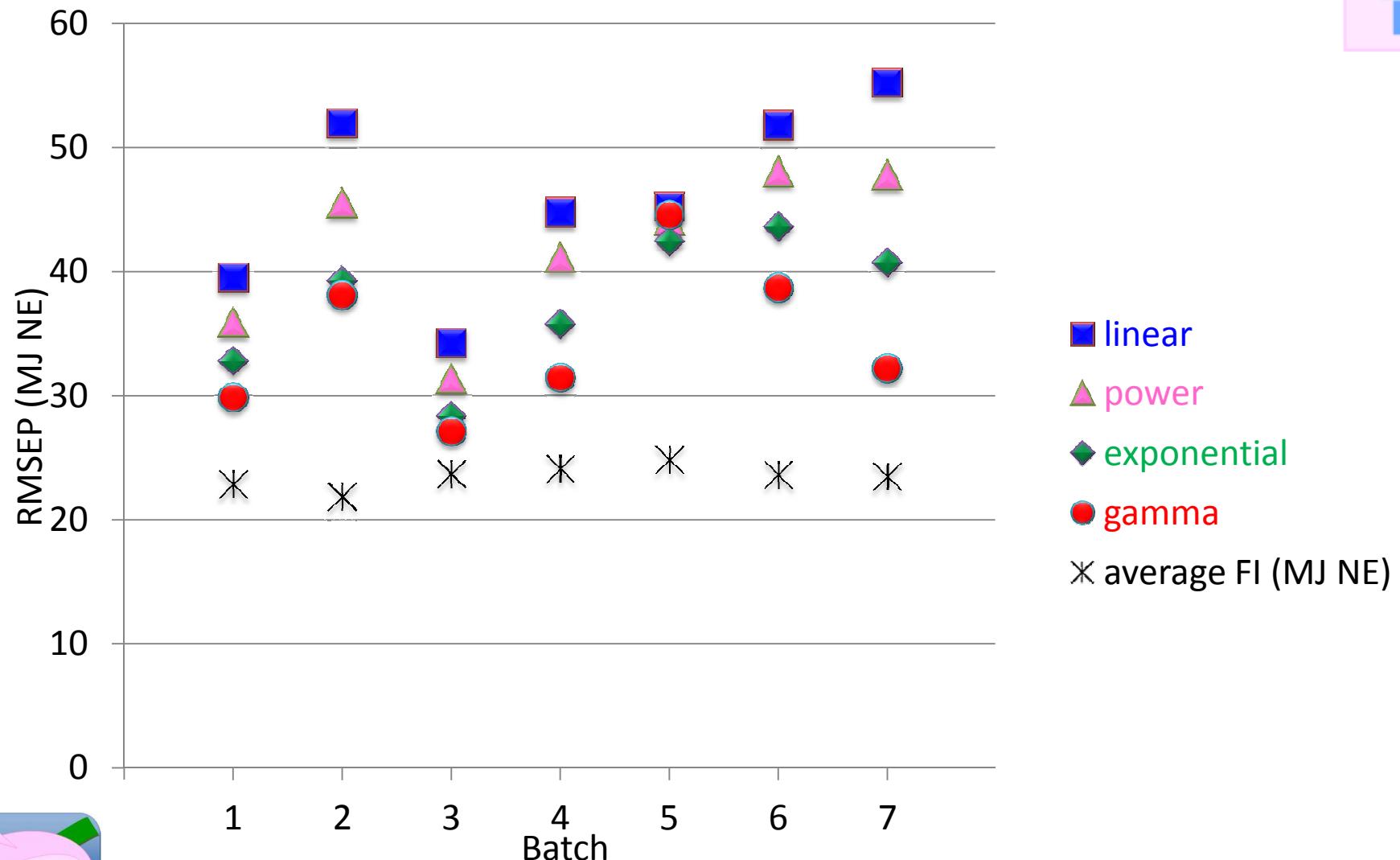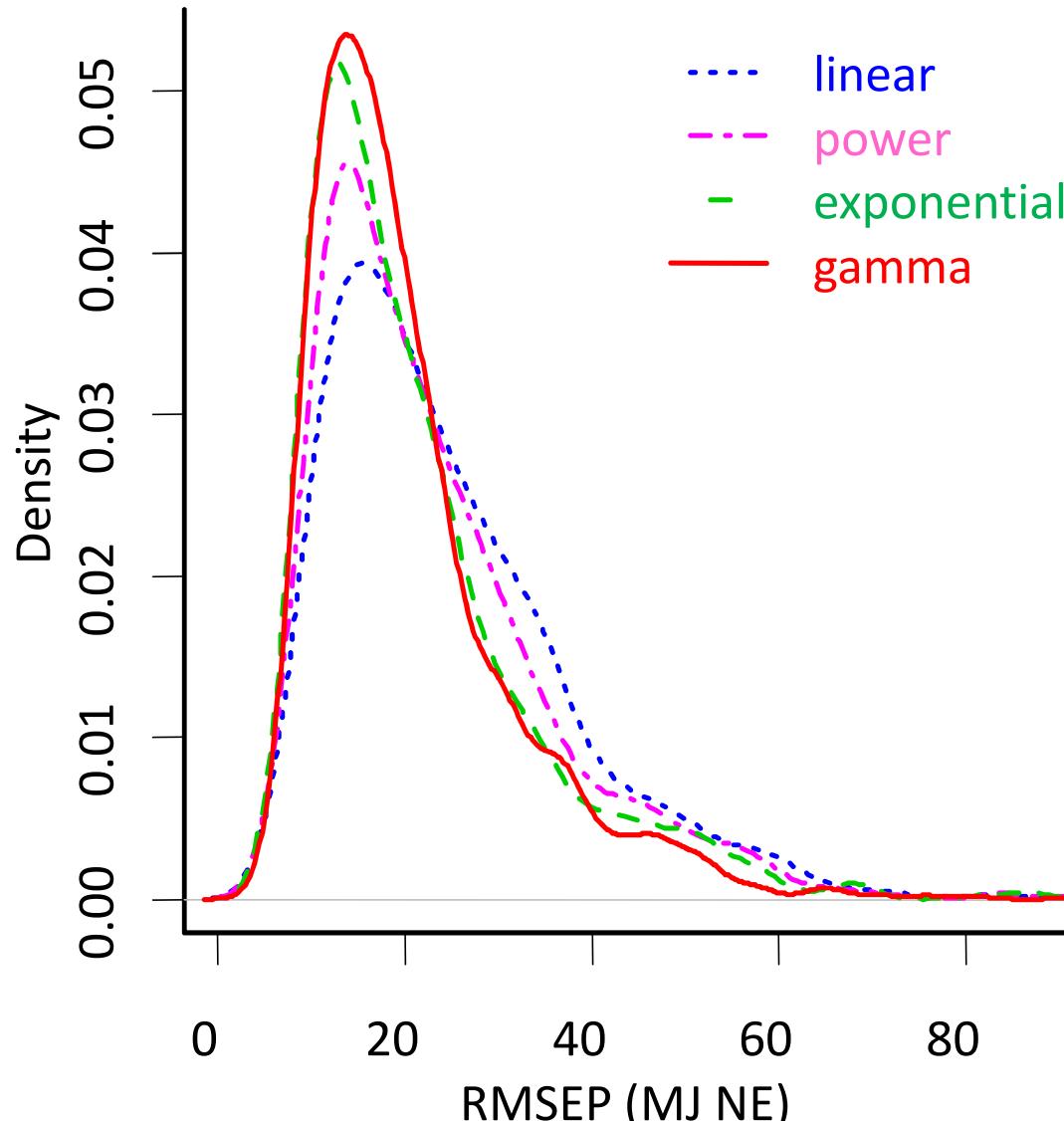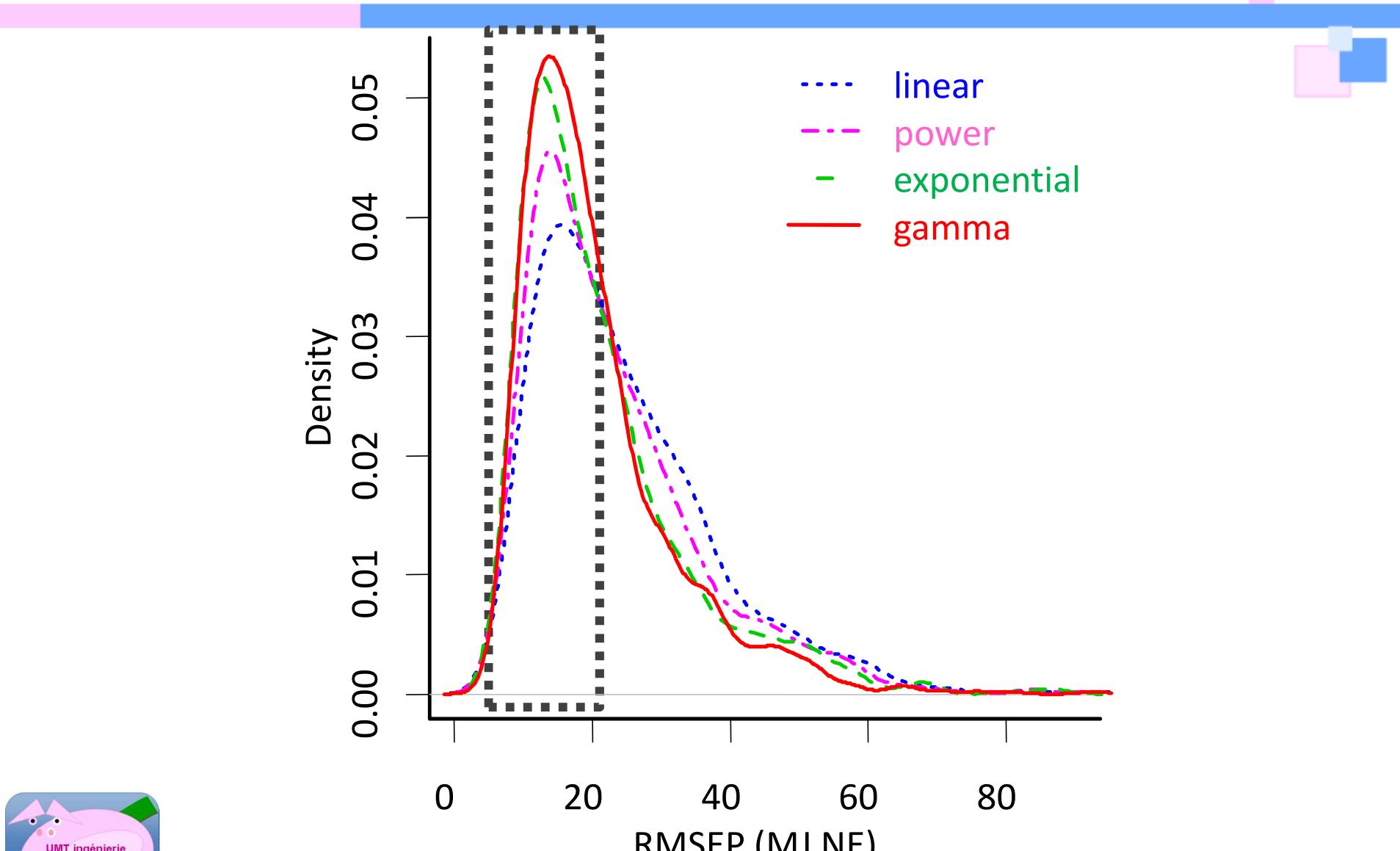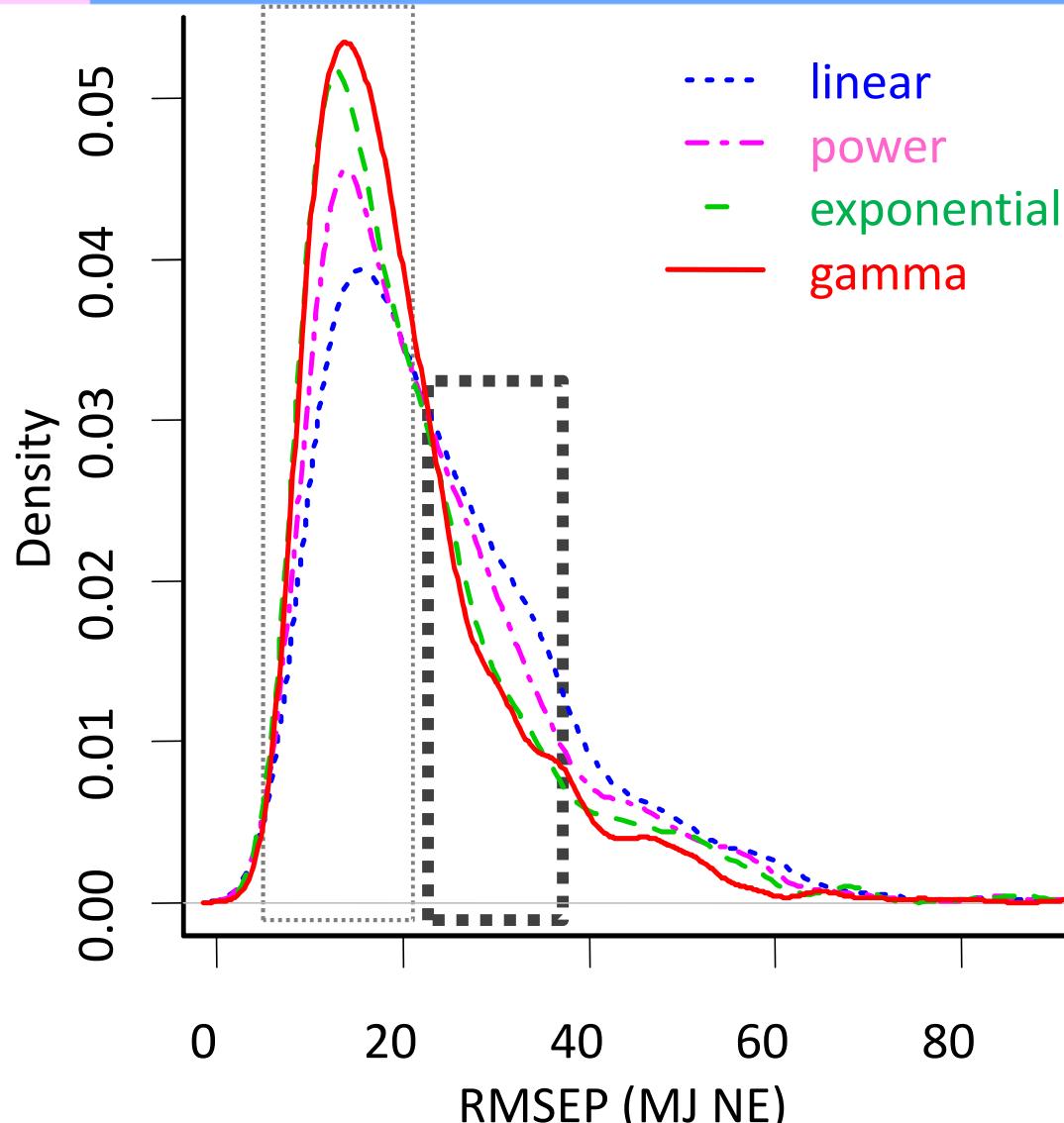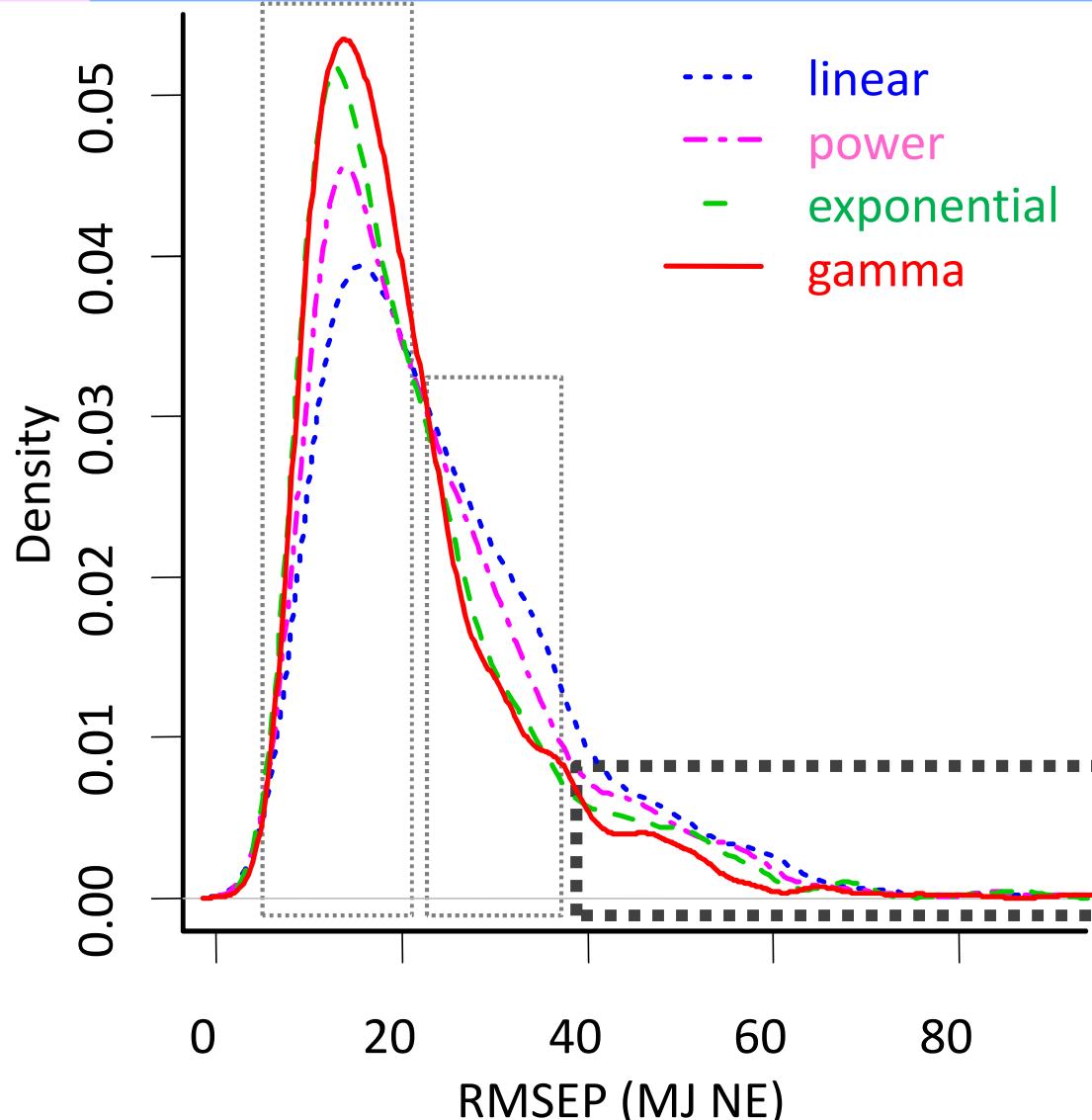
Factors of variation of profile parameters

	Range of values	Significant effects B: batch, G: genotype, S: sex		
Initial BW	19 – 47	B		S	
Final BW	88 – 141	B		S	S x B
Initial age	59 – 79	B	G		
Duration	78 – 120	B		S	S x B
PD	75 – 224	B		S	S x B
Gompertz B coef.	9 – 1505	B		S	
FI50	15 – 37	B		S	
FI100	16 – 44	B		S	S x B
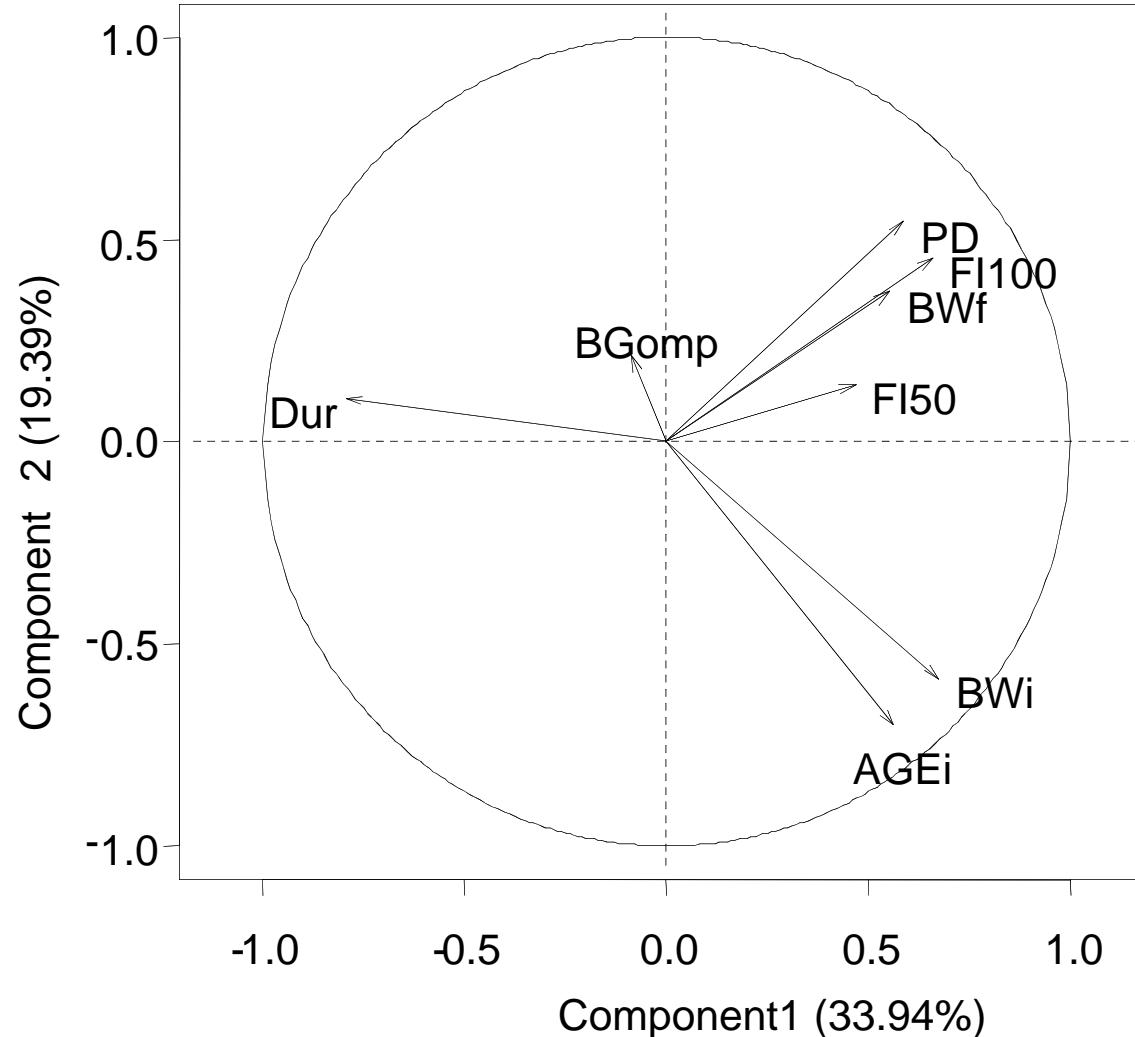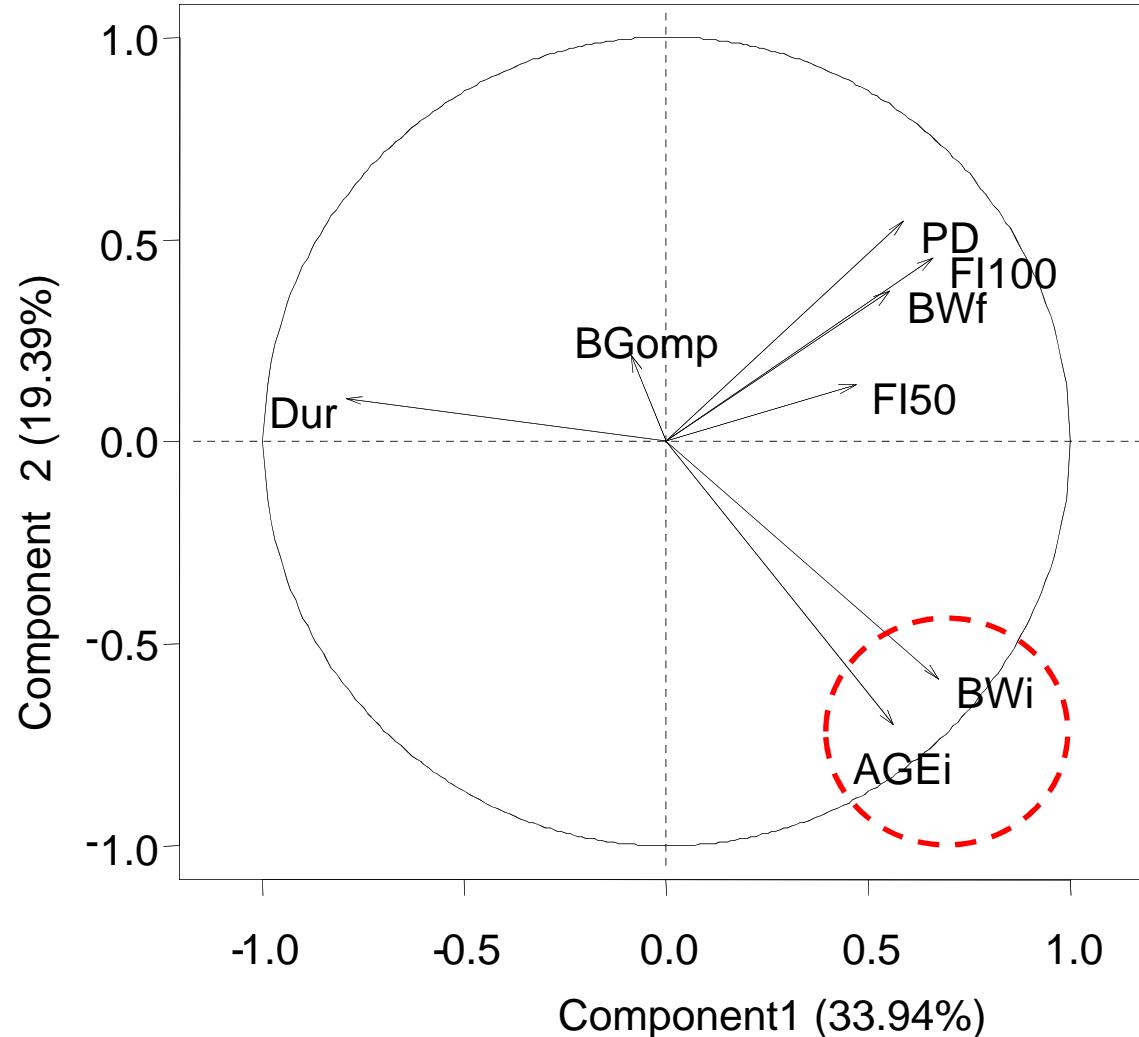
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# Links between profile parameters

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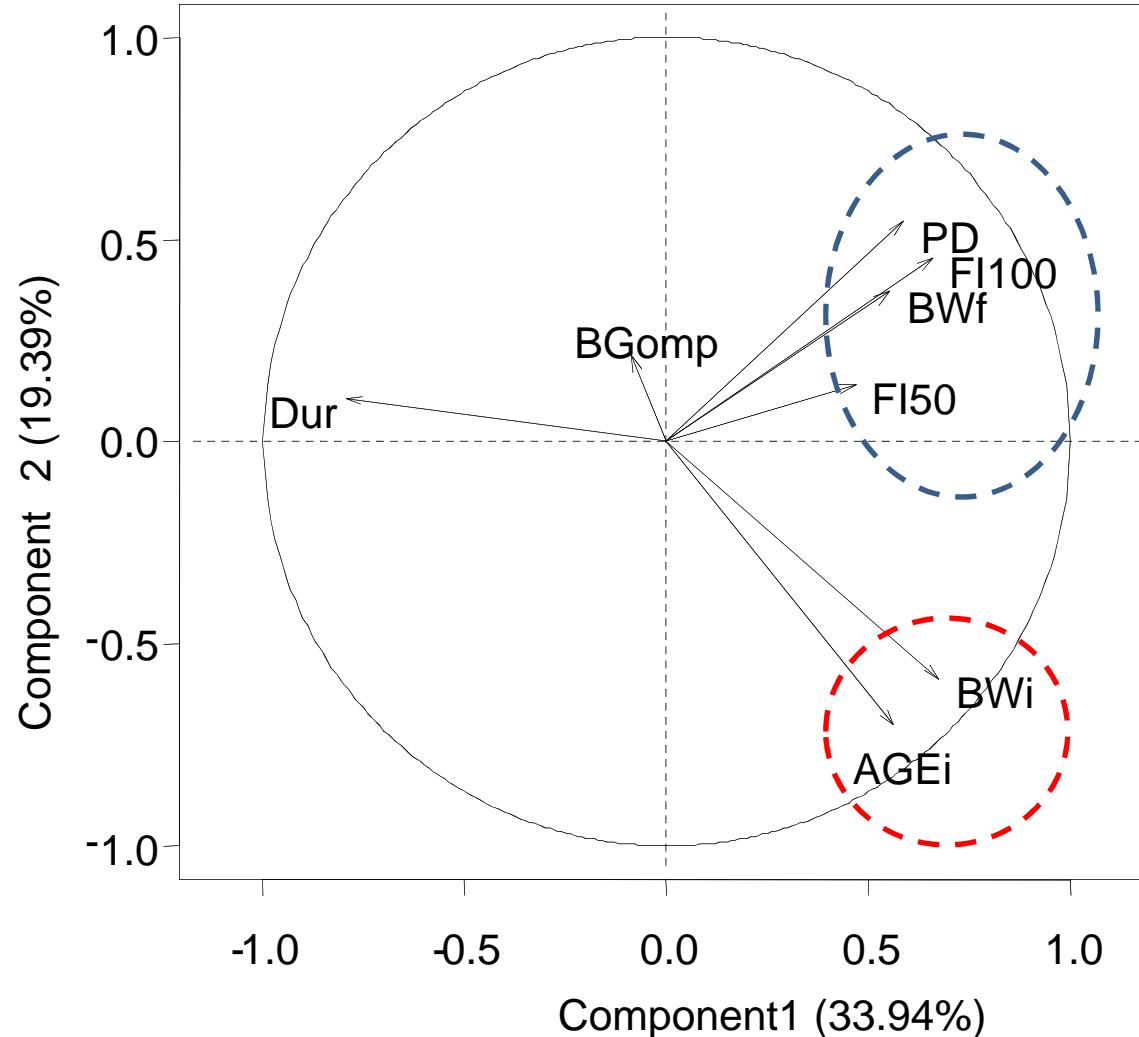
Links between profile parameters
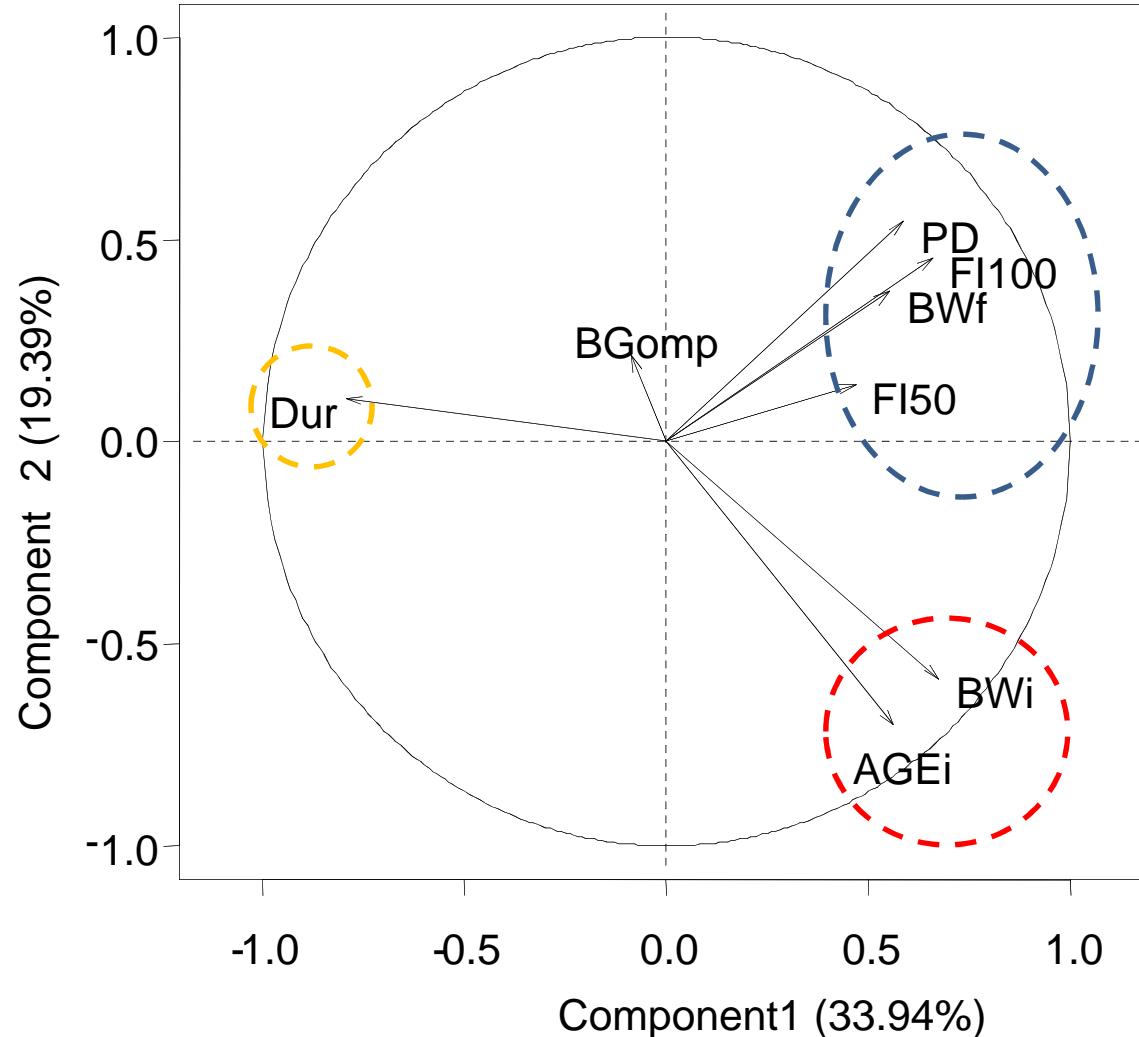
Links between profile parameters

Conclusion
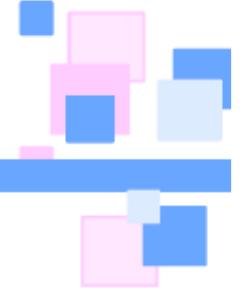
❑ **No interaction between equation and genotype and sex**
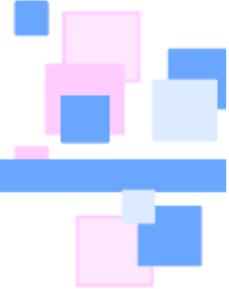
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Conclusion

❑ **No interaction between equation and genotype and sex**

❑ **Gamma function best fits the measured data**

    ❑ Importance of the decrease in FI to maintenance at the end of the fattening period

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Conclusion
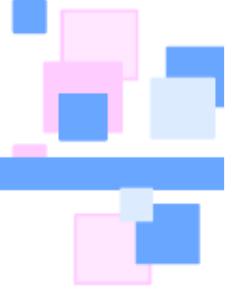
- **No interaction between equation and genotype and sex**
- **Gamma function best fits the measured data**
  - Importance of the decrease in FI to maintenance at the end of the fattening period
- **Links between some profile parameters are confirmed**
- **Further investigation are required**
  - to describe the covariance matrices from different populations of pigs
  - to identify structure(s) to use when generating virtual batches