

➤ UpDown, une méthodologie d'identification
et de caractérisation de perturbations affectant
des données longitudinales

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Vincent Le, Ingrid David & Tom Rohmer,
GenPhySE, INRAE Toulouse, France

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Égalité
Fraternité*

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Plan

Context

UpDown, methodology

 package UpDown



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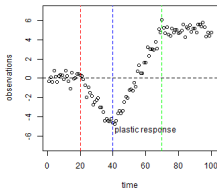
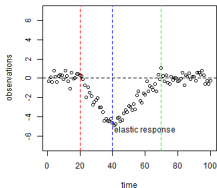
➤ Context: robustness modelling of farm animals

- ▶ Longitudinal data
weight, cumulative feed intake
 - ▶ Data organized in hierarchical levels
in Pig Farming systems: batches, pens, animals
 - ▶ Observations are subject to group disturbances.
contagious disease, heat peak
- ▷ Objective: select 'robust' animals



➤ Elastic, plastic response

- ▶ We assume that the responses to disturbances are elastic or plastic:



- ▶ Disturbance may only affect an (longitudinal) observation
- ▶ Disturbance may affect a group of observations for ex. disease.
 - ▶ All units will be exposed to the disturbance
 - ▶ Not all units will react to the disturbance for ex. in the case of disease, it will depend of the immune capacity of the animal.



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Up-Step: Smoothing

- ▶ We work on trajectories, using a Gaussian kernel smoothing applied on each of the units.
- ▶ For each trajectories, we extract the minimum value of the first derivative of the smoothing curve.

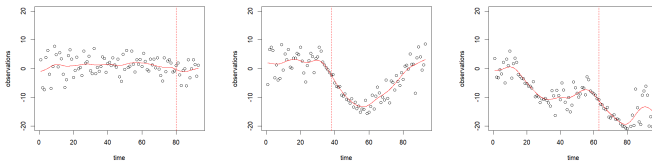
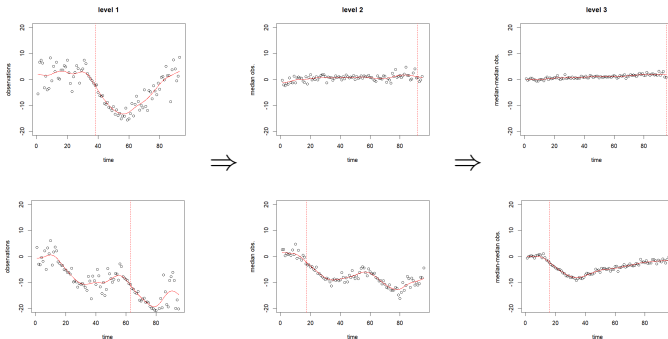


Figure: (left) no disturbance (middle) 1 disturbance (right) 2 disturbances

In the case of individual disturbance, this minimum value is expected to be lower than without disturbance

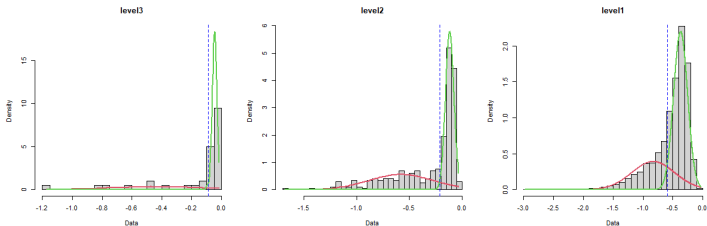
Up-Step: Smoothing

- ▶ To remove individual disturbance, we work on the median (longitudinal) observation at level 2, the median-median (longitudinal) observation at level 3, etc.



Up-Step: Classification

- Mixture Gaussian models on these minimum values are done on each hierarchical levels to classify the disturbed and non disturbed elements (MAP rule)



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- ▶ Else we suppose the disturbance affect the underlying level.



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Analyse of concordances:

- ▶ The overlapping between two considered disturbances are measured to remove redundancy disturbance



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install UpDown:

```
remotes::install_github("TomRohmer/UpDown")  
library(UpDown)
```

data PigFarming:

```
dataPF<-get(data(PigFarming))  
head(dataPF)
```

id	batch	pen	age	time	weight
1	b101	p10101	6	1	22.14
1	b101	p10101	7	2	29.76
1	b101	p10101	8	3	28.84
1	b101	p10101	9	4	24.18
1	b101	p10101	10	5	23.28
1	b101	p10101	11	6	25.20



package UpDown

Using UpDown:

```
levels=c("batch","pen","id")
UD_pig<- UpDown(dataPF,levels=levels, vtime="time",
obs="weight", kappa=0.75,
thr_va=0.5,mixplot=TRUE, correction="age")
```

Output:

```
head(UD_pig$Down$batch)
```

batch	start	end	intensity
b1001	16.49	34.24	0.32
b1002	74.82	82.63	0.17
b104	67.59	84.92	0.84
b401	69.54	76.29	0.47
b504	52.55	68.12	0.43



▶ A Shiny application

UpDownApp(dataPF)

Shiny disturbance Plot median plot

Plot of detected group and individual disturbances

observations

weight

batch

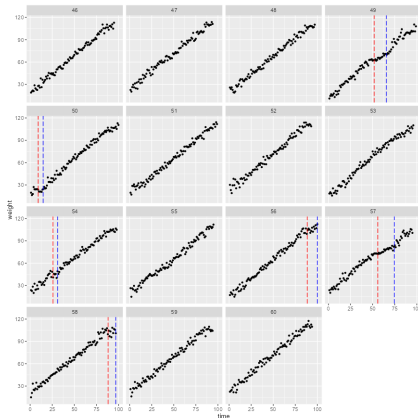
b101

pen

p10104

Use corrected observations?

Original observations



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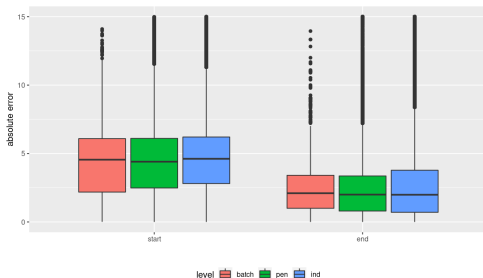
UpDown

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➤ Performances

500 runs of simulations mimicking a Pig Farming system, based on 6000 animals, 400 pens, 40 batches and 20% of disturbed elements by levels (Le et al., 2022)

	level 3	level 2	level 1
sensitivity (%)	0.95	0.80	0.52
specificity (%)	0.99	0.98	0.98



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