

PREDICAL

Connected devices, mathematical methods
and algorithms
for the monitoring of the behavior of isolated persons.

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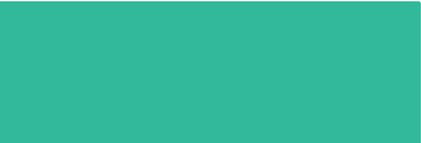
Objectives

- **Adapt the society to aging** with significant growth of the population over 65 years and the desire of the seniors to age at home
- **Fight against the isolation** that is a factor of insecurity for the senior and his family
- **Enable seniors to live longer in their homes** by detecting early fragilities
- **Provide caregivers structures indicators** to get better visibility on their actions and adapt their the time for the senior



PREDICAL solution

- **Detection of a behavioural changes or an abnormal situation** to prevent and anticipate fragility
- It is also possible to add to the solution a **call bracelet for emergencies**



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- It is also possible to add to the solution a **call bracelet for emergencies**
- **A management tool** that allows caregivers structures to prioritize their actions
- **Strengthening social links** between the elder and his family by creating a **network of solidarity** where everyone is an actor

Technological and scientific choices

Learning of the lifestyle in a habitat



Connected Objects

movement sensors installed in
the housing and a data
collection in semi-real time

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Complex Data Statistical Processing

Identifying markers to follow:
sleep, meals, activity ...

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Complex Data Statistical Processing

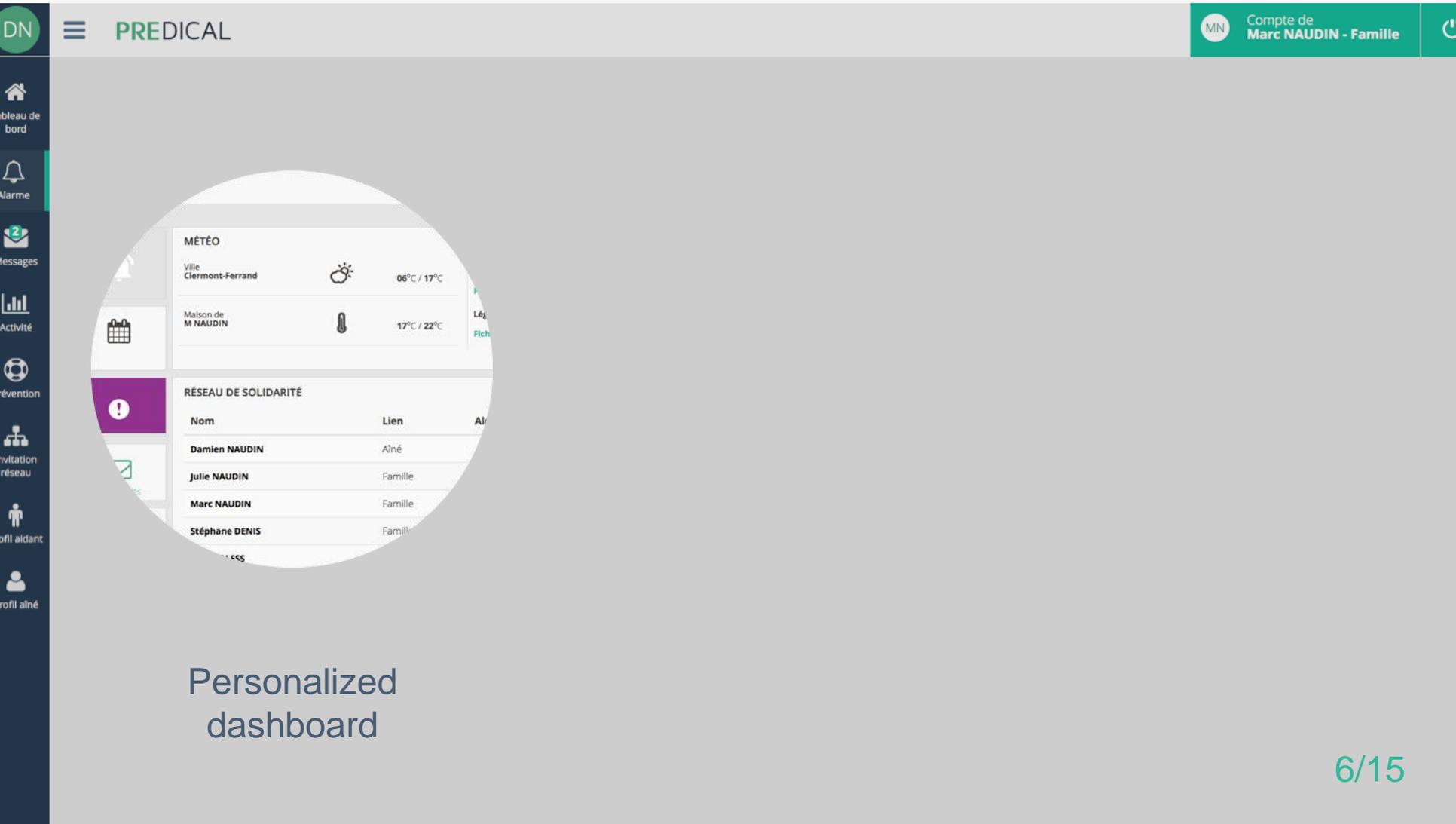
Identifying markers to follow: sleep, meals, activity ...



An application to monitor markers

and manage preventive and reactive alarms

An application for the senior, relatives and caregivers



Personalized dashboard

An application for the senior, relatives and caregivers

- Tableau de bord
- Alarme
- Messages
- Activité
- Prévention
- Invitation réseau
- Profil aidant
- Profil aîné

MÉTÉO
Ville **Clermont-Ferrand** 06°C / 17°C
Maison de **M NAUDIN** 17°C / 22°C

RÉSEAU DE SOLIDARITÉ

Nom	Lien	Al
Damien NAUDIN	Aîné	
Julie NAUDIN	Famille	
Marc NAUDIN	Famille	
Stéphane DENIS	Famille	

Personalized dashboard

4.0 Niveau autonomie

Activité	Etat
Déplacement	☹️ 3.5
Activité	☺️ 3.5
Alimentation	☹️ 4.5
Repos	☹️ 4.5

NIVEAU PRÉVENTION

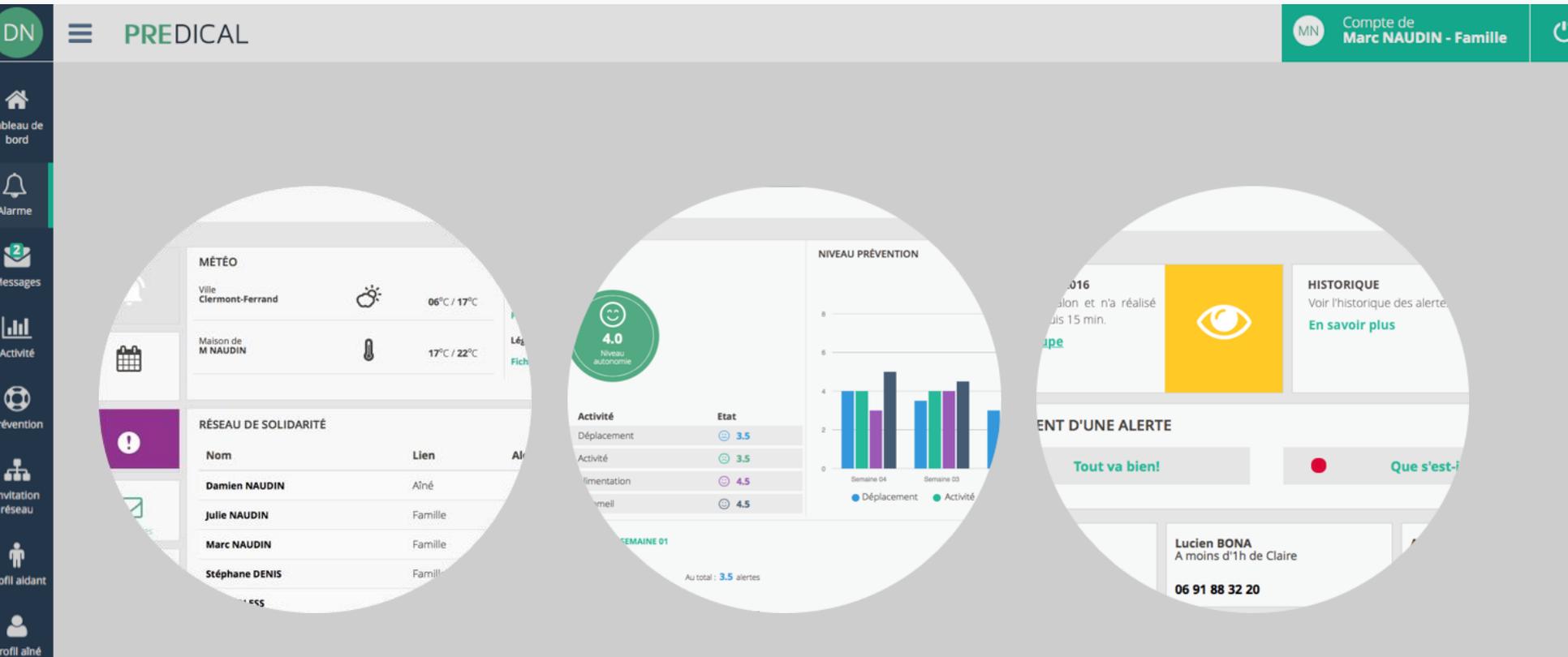
Semaine 04 Semaine 03

● Déplacement ● Activité

Au total : 3.5 alertes

Evolution of the daily indicators

An application for the senior, relatives and caregivers



Personalized dashboard

Evolution of the daily indicators

Management of preventive and reactive alerts

Environment specifications

Installation of motion sensors in the housing rooms,
measuring the activity in semi-real time



From sensors to data

	Raspberry & Fibaro 9 months of use	
Advantages	<ul style="list-style-type: none">- multi-sensors : motion, luminescence, temperature, accelerometer- open-source + Zwave- low cost- lot supplier in home automation area	
Disadvantages	<ul style="list-style-type: none">- need 3G modem- need acquisition protocol- battery consumption not mastered- parametrization not stable	

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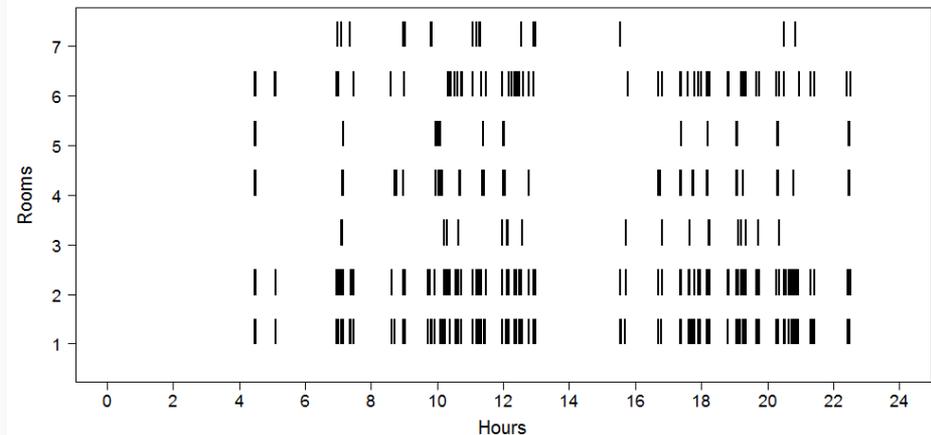
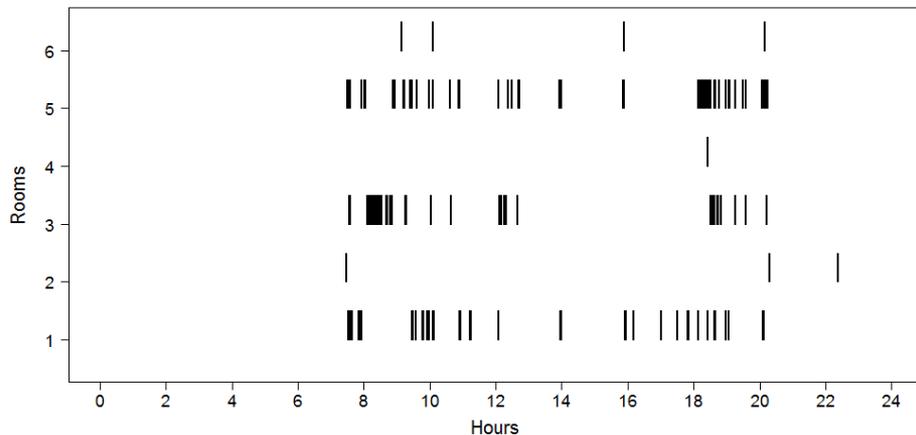
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Available data

Each infrared sensor installed in a room provides event data.



Example of event data on a day for two distinct environments

Statistical approaches



Graphs

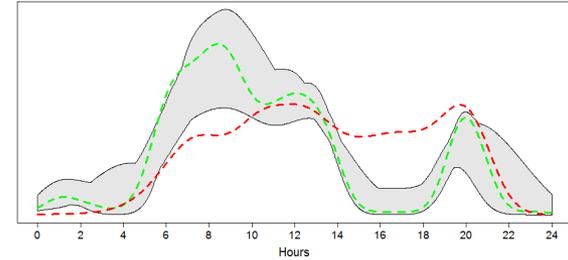
Times and frequencies
of the transitions
between rooms

Statistical approaches



Graphs

Times and frequencies
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Functional data analysis

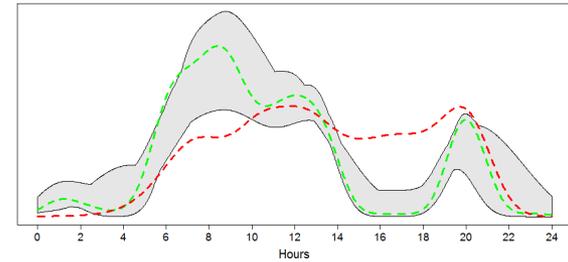
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Statistical approaches



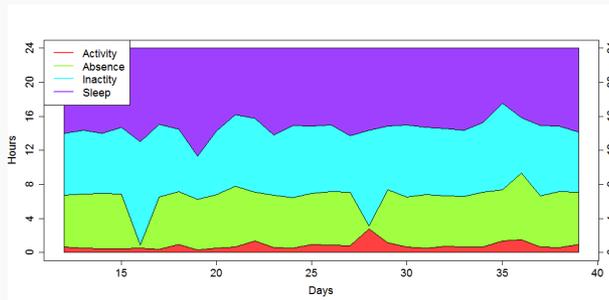
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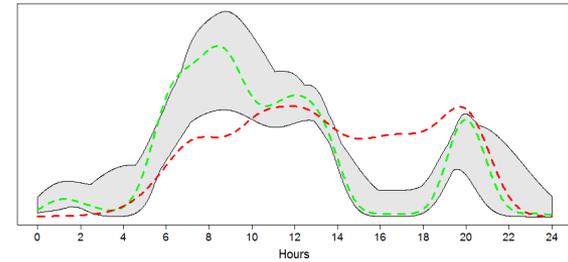
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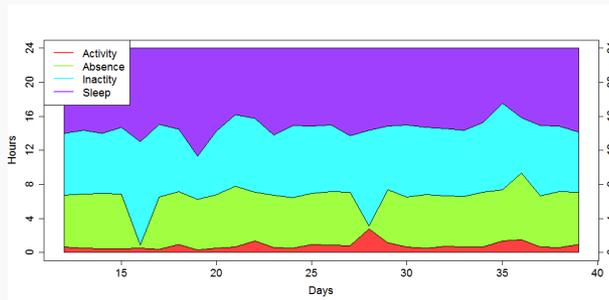
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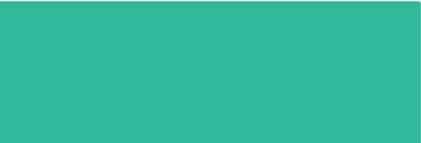
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On this presentation:
the **wake up time** of an isolated
person



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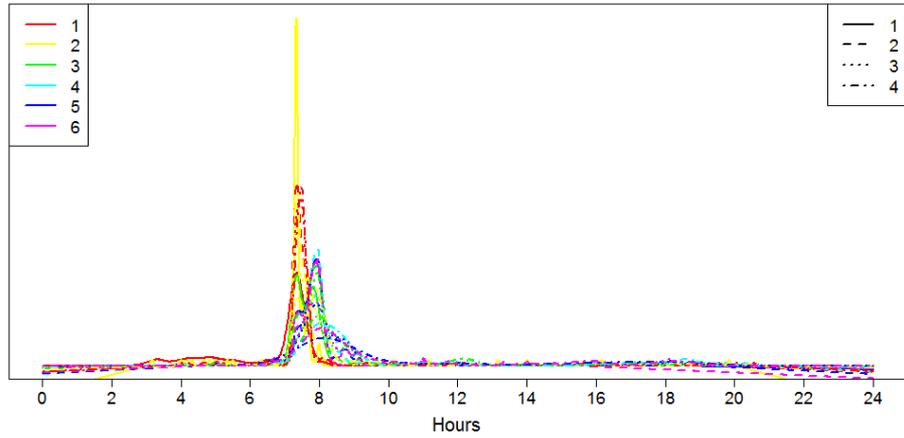
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- 4) We get a **model of parameters (α, β) .**
- 5) After evaluating different parameters, we observe that even **if the seniors have some habits, they don't have the same habits.** So we need an **adaptive approach.**
- 6) We then use the **maximum likelihood estimation (MLE)** method to define a couple of estimators **(α', β') for each environment.**

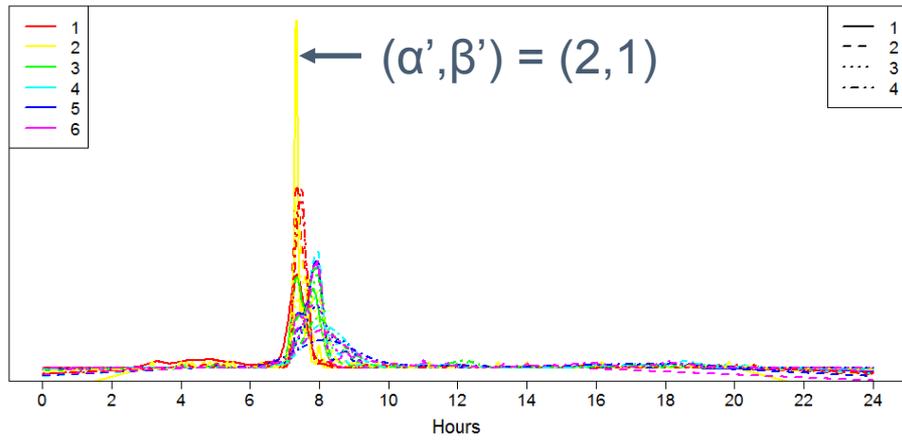
Results

Learning Phase



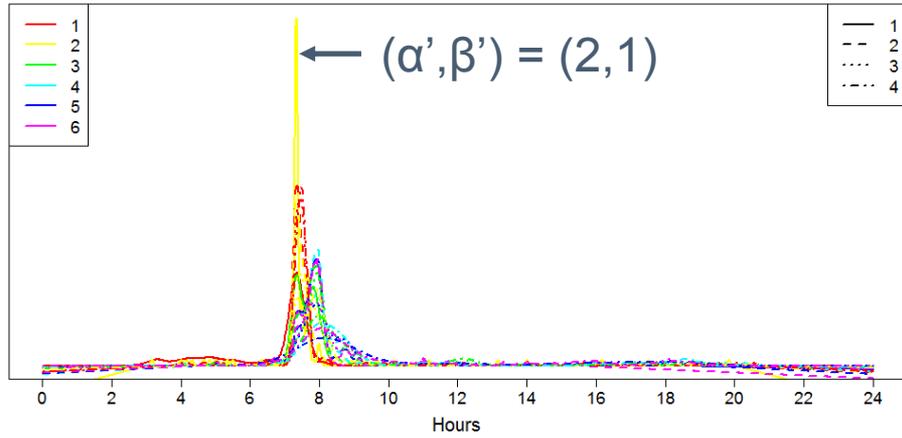
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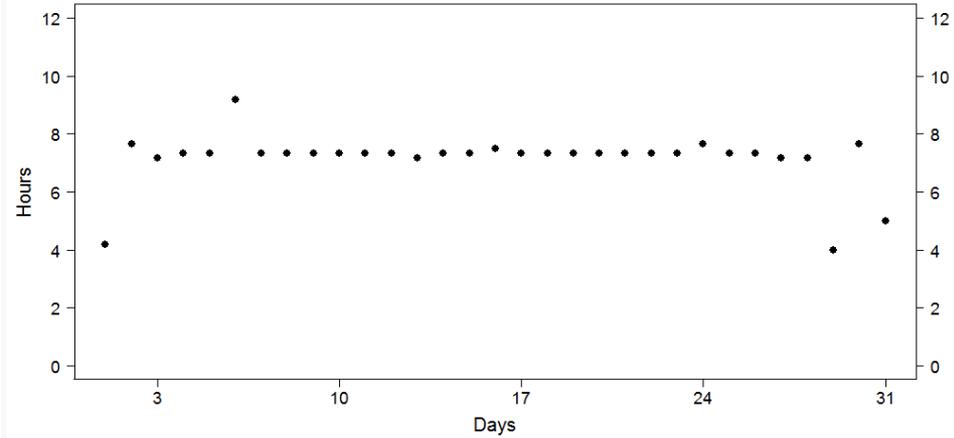


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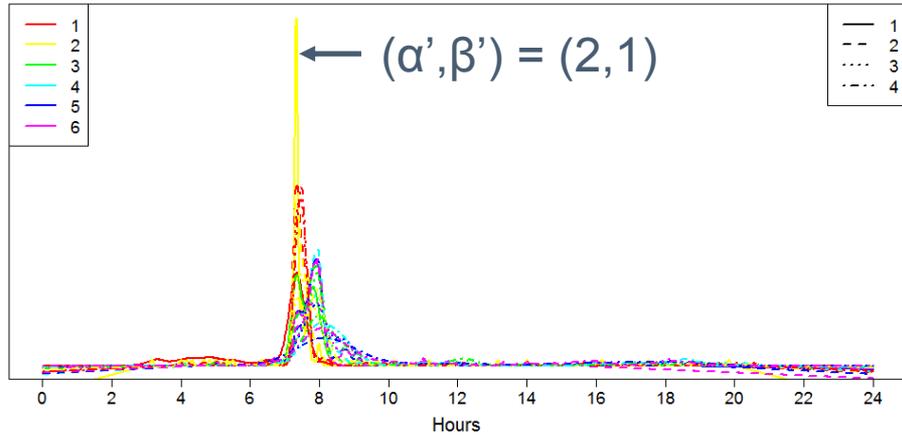


Detection Phase

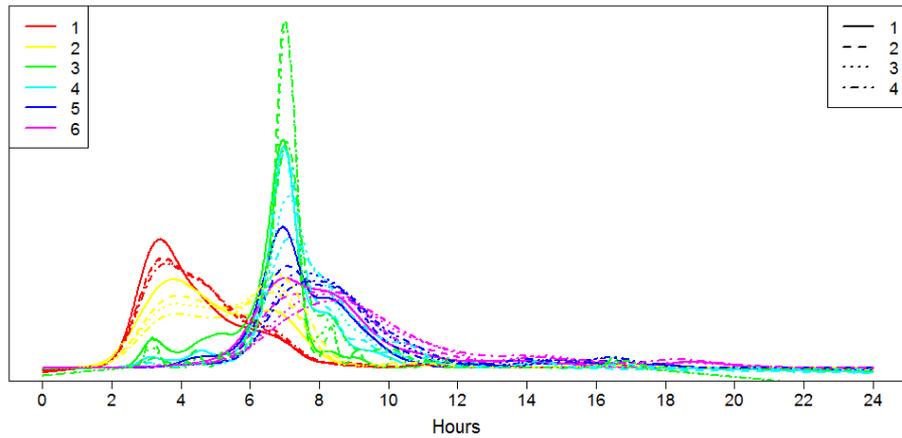
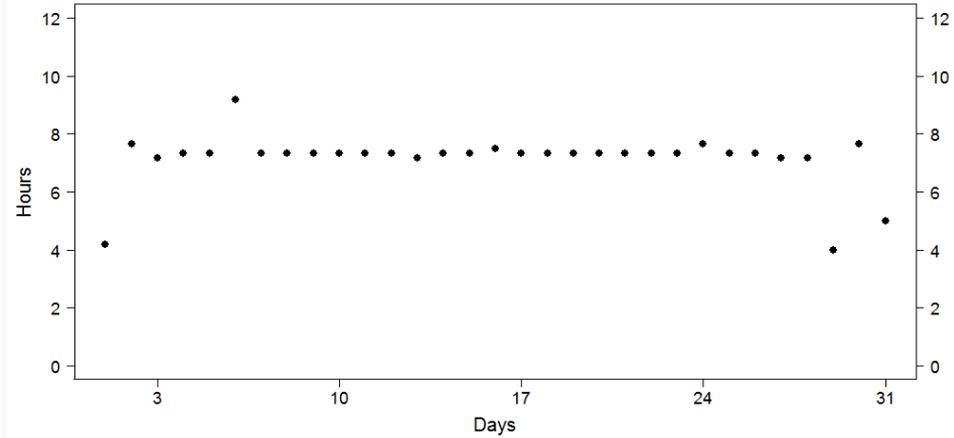


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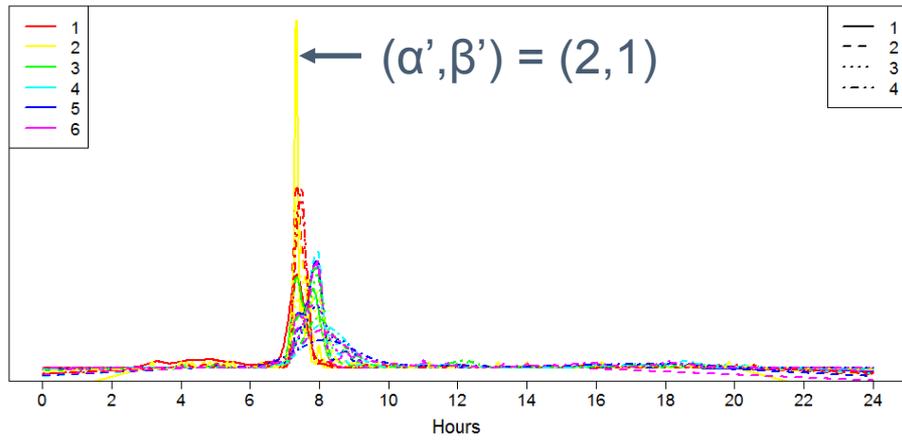


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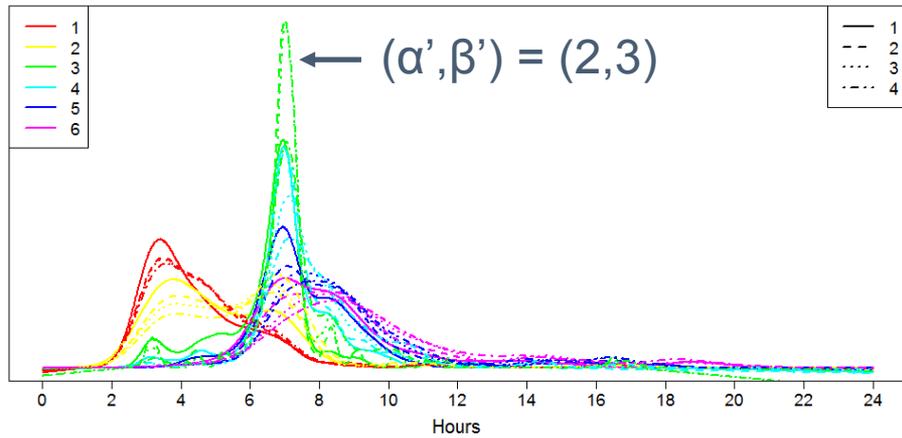
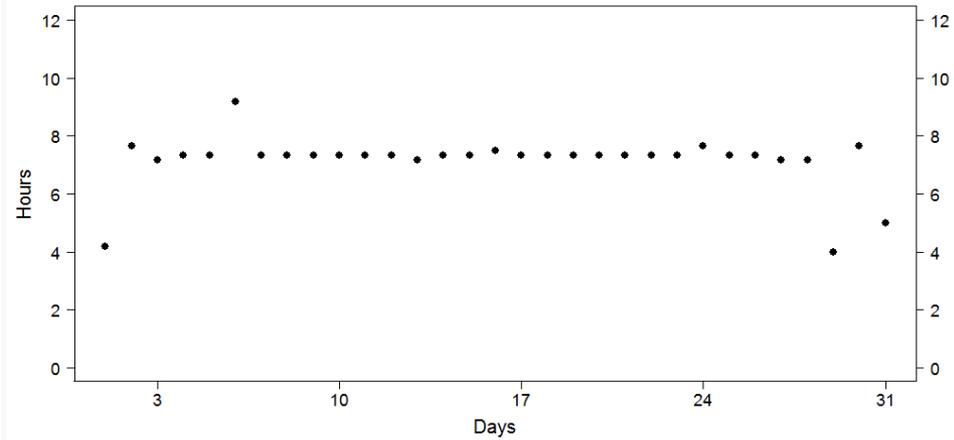


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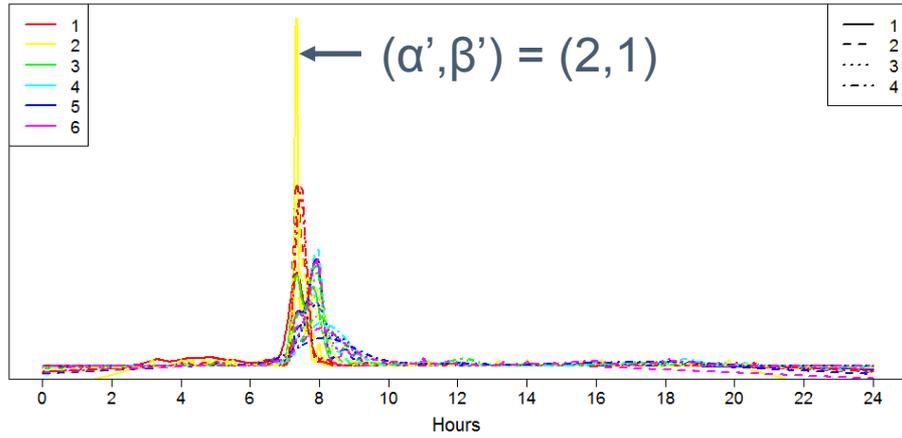


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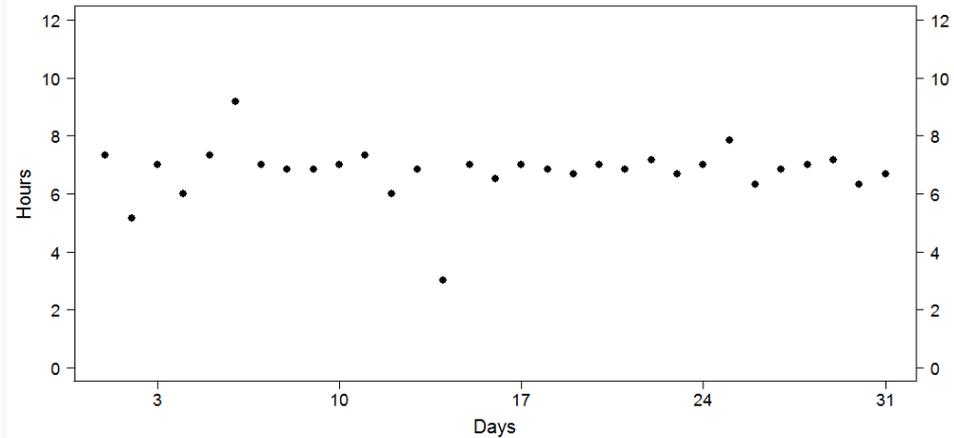
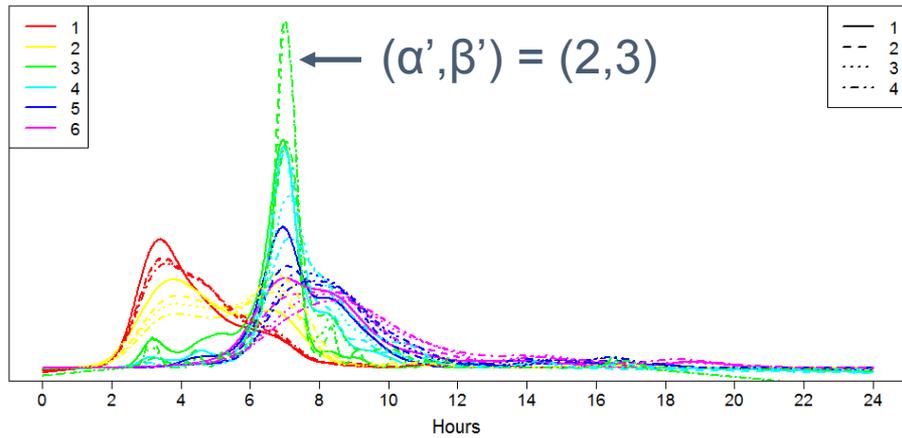
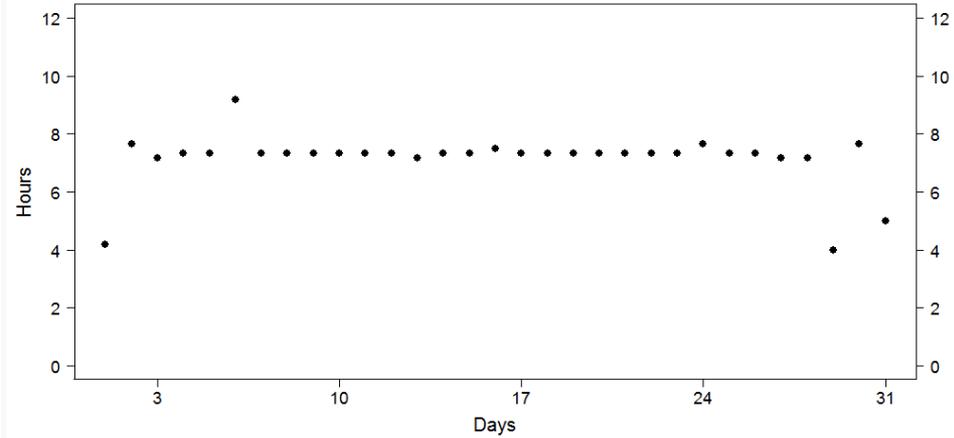


Results

Learning Phase



Detection Phase



Constraints & Questions

Permanent constraints:

- **Only isolated person** in the home can be followed
- **Only the principal rooms** are equipped

Transients changes:

- **Faulty sensors**: misplaced or broken
- **Holidays**
- **Hospitalizations** / day hospitalizations

Difficult and remaining questions:

- What is the **learning period** ?
- What is the **frequency of re-learning** ?

Conclusion & Perspectives

- The V1 of PREDICAL is almost finalized
 - **Actimetry:**
 - wake up time / bed time
 - absence time
 - rest time
 - movement cumulative time
 - **Real time monitoring:**
 - detect the periods of inactivity statistically abnormal
 - awake or not
 - absence or not

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 - **Real time monitoring:**
 - detect the periods of inactivity statistically abnormal
 - awake or not
 - absence or not
- Perspective for the next version
 - **Actimetry:**
 - detect a visit
 - **Prevention:**
 - detect deviant behavior in the time
 - measure a return of hospitalization

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Thank you for your attention.

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