



Statistics and modeling for the microbiological safety of dairy products

F. Tenenhaus-Aziza, V. Michel, H. Souaifi, F. Perrin, M. Sanaa

AGROSTAT, AgroParisTech, 29/02/12-02/03/12

New concepts of food safety regulations

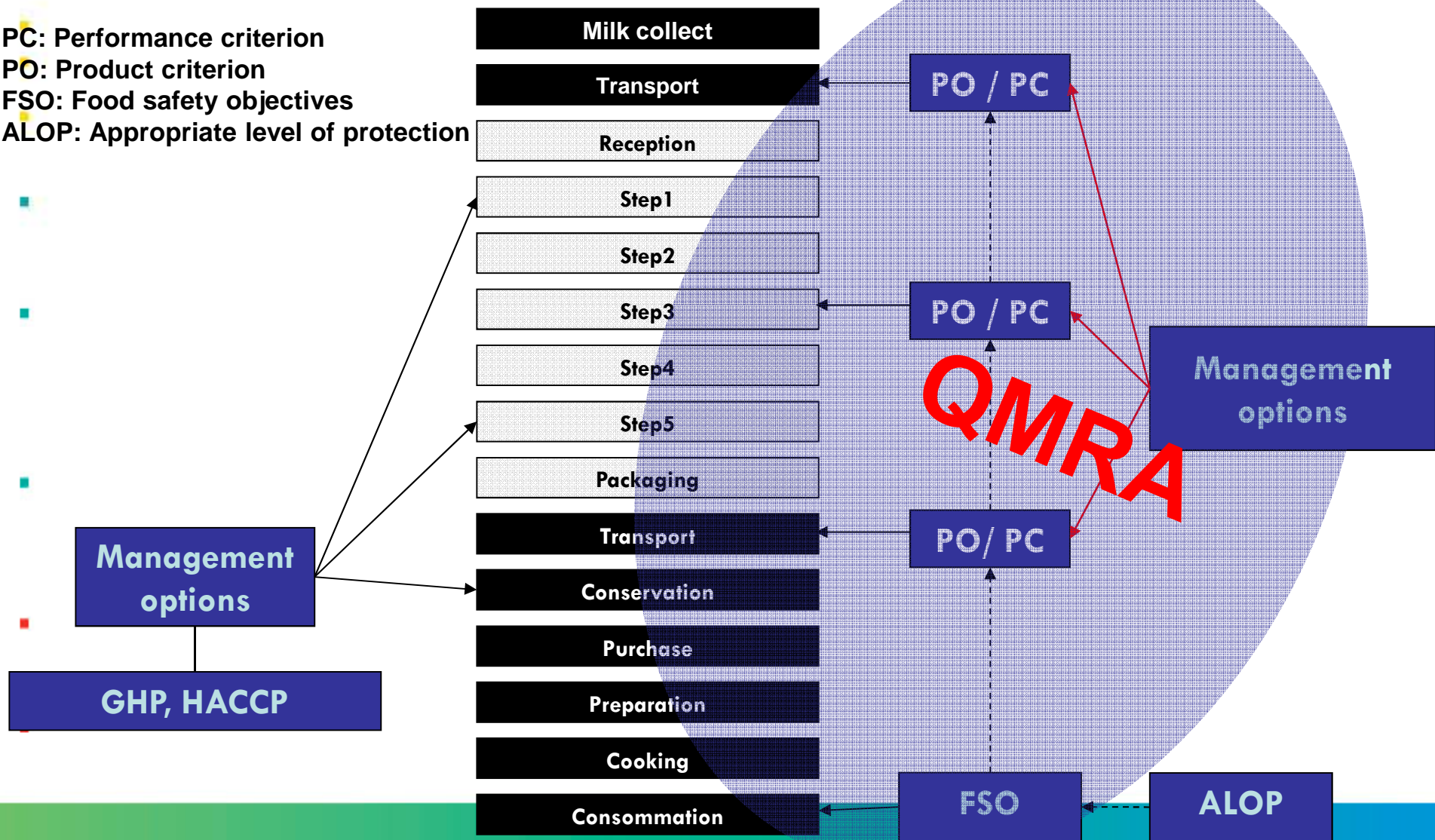


PC: Performance criterion

PO: Product criterion

FSO: Food safety objectives

ALOP: Appropriate level of protection



QMRA in the French dairy sector



⇒ 2003

⇒ Creation at CNIEL of a working group on QMRA

⇒ Objectives

⇒ Developing operational modeling tools for the stakeholders of the sector

⇒ Who ?



⇒ How ?

⇒ Taking part in research projects

⇒ Developing/implementing tools

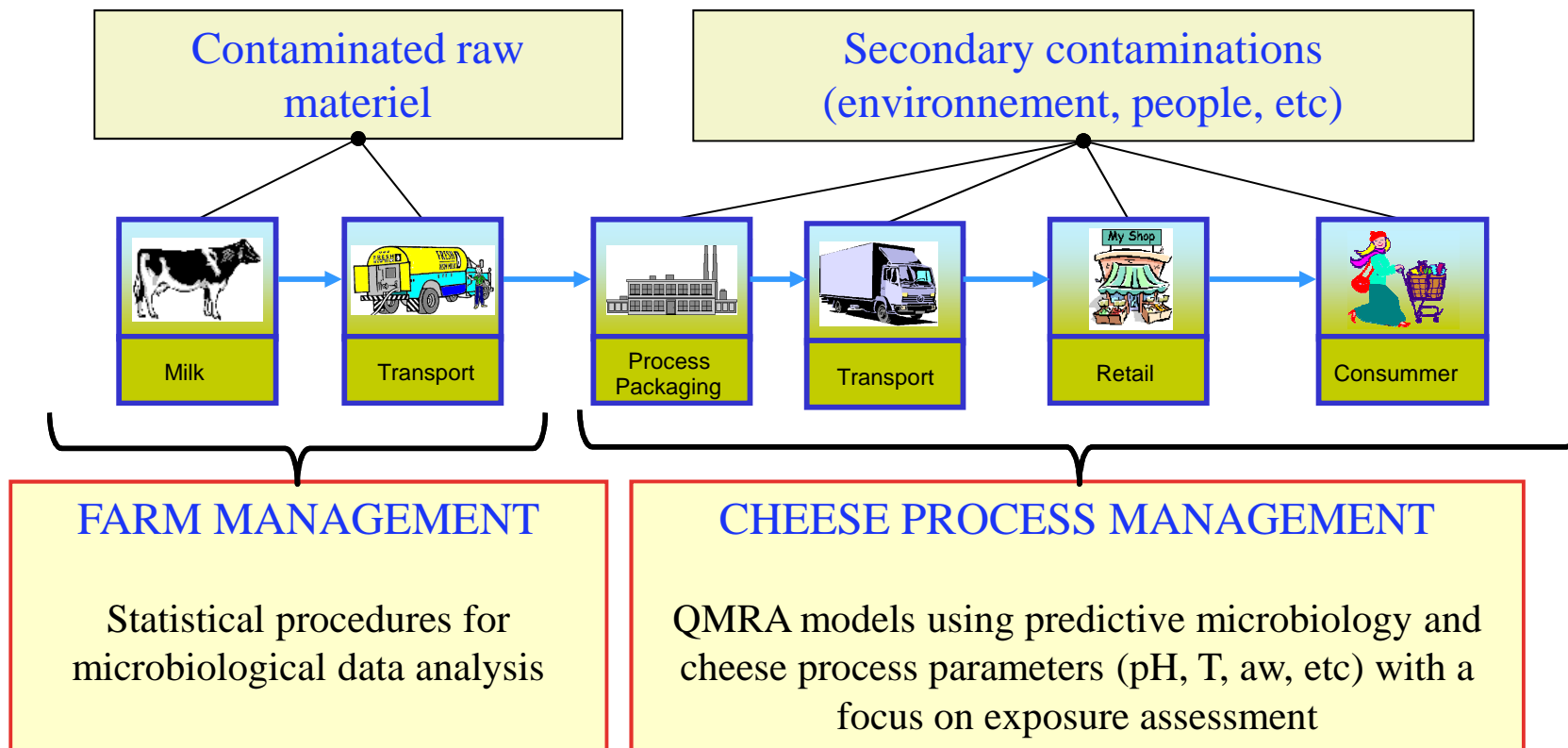
⇒ Communicating on the QMRA approach and the "food law"

⇒ Offering services to dairy manufacturers

Risk management: a modular approach



From the Farm to the Fork



What management options for the safety of raw milk cheeses ?



FARM MANAGEMENT

- ⇒ Evolution of the contamination prevalence during time?
 - ⇒ Impact of management options?
 - ⇒ Seasonality?
- ⇒ Milk sorting efficiency
 - ⇒ Which procedure?
- ⇒ Cross relations between different pathogens ?
 - ⇒ Optimization of control measures
- ⇒ Sampling plan efficiency for detection of non-conforming milk?
- ⇒ DATABASES FROM LABORATORIES IN CHARGE OF ANALYSING MILK FOR QUALITY PAYMENTS

CHEESE PROCESS MANAGEMENT

- ⇒ Probability of contamination and contamination level of the product at the consumption
- ⇒ Management of recontamination
- ⇒ Identification of the process steps and physico-chemical parameters allowing for growth
- ⇒ Sampling plan optimization
- ⇒ Shelf life determination
- ⇒ DATABASES FROM THE DAIRY INDUSTRY (SELF-MONITORING AND PROCESS PARAMETERS)

Farm management tool: data



Cattle	Date	Salmonella	Staph300	E.coli10
100005	200/06/14	0	0	0
100005	2004/06/18	1	0	0
...
100005	2004/07/06	0	0	1
100013	2005/03/10	0	0	0
100013	2005/04/04	0	1	1
100013	2005/04/07	1	0	0
100013	2005/10/07	0	1	1

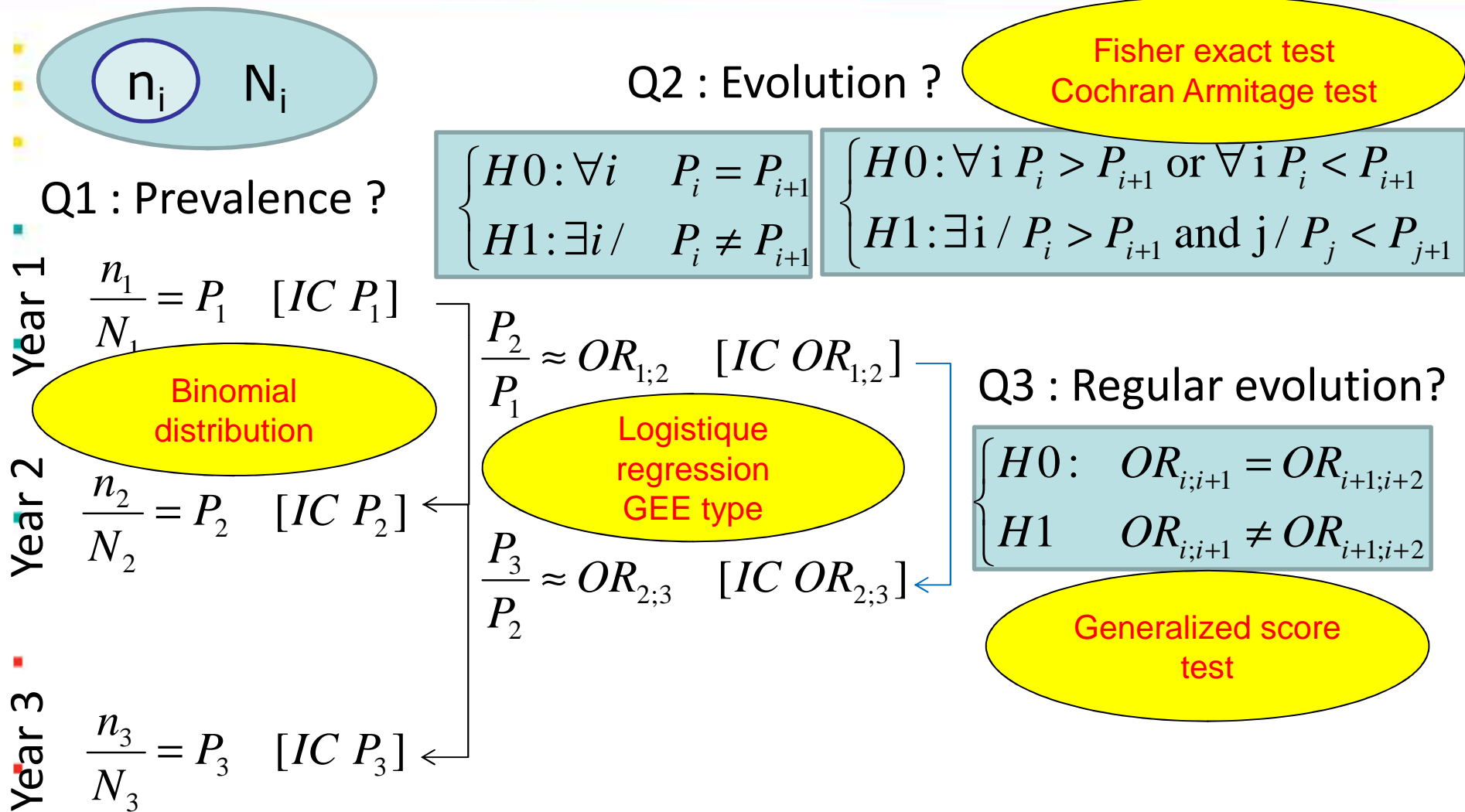
⇒ **Sample fluctuation**

⇒ **Repeated measures in time**

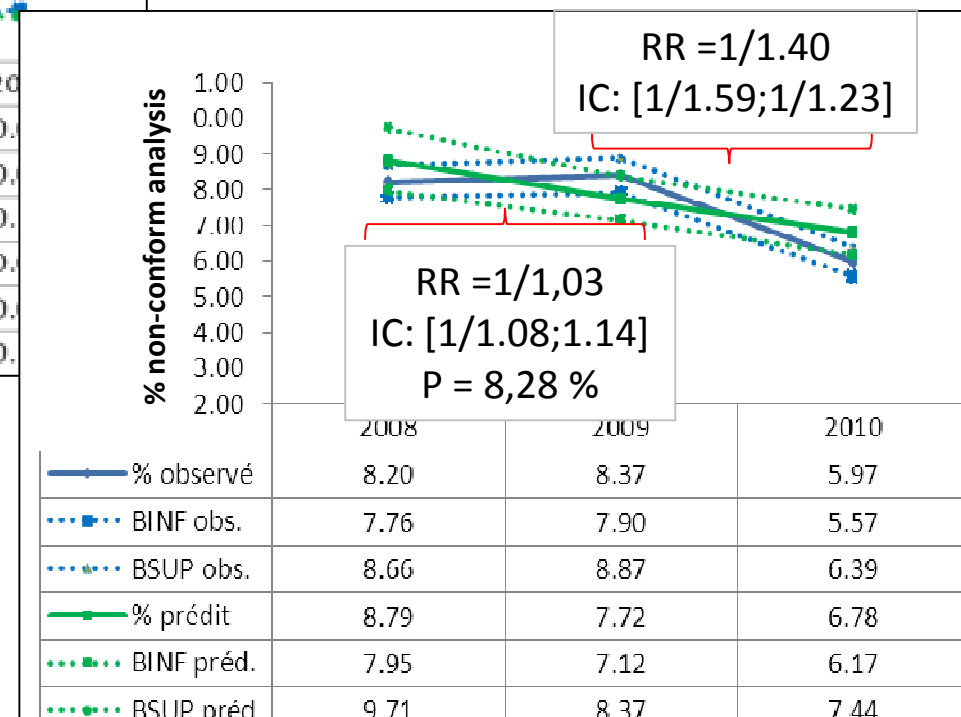
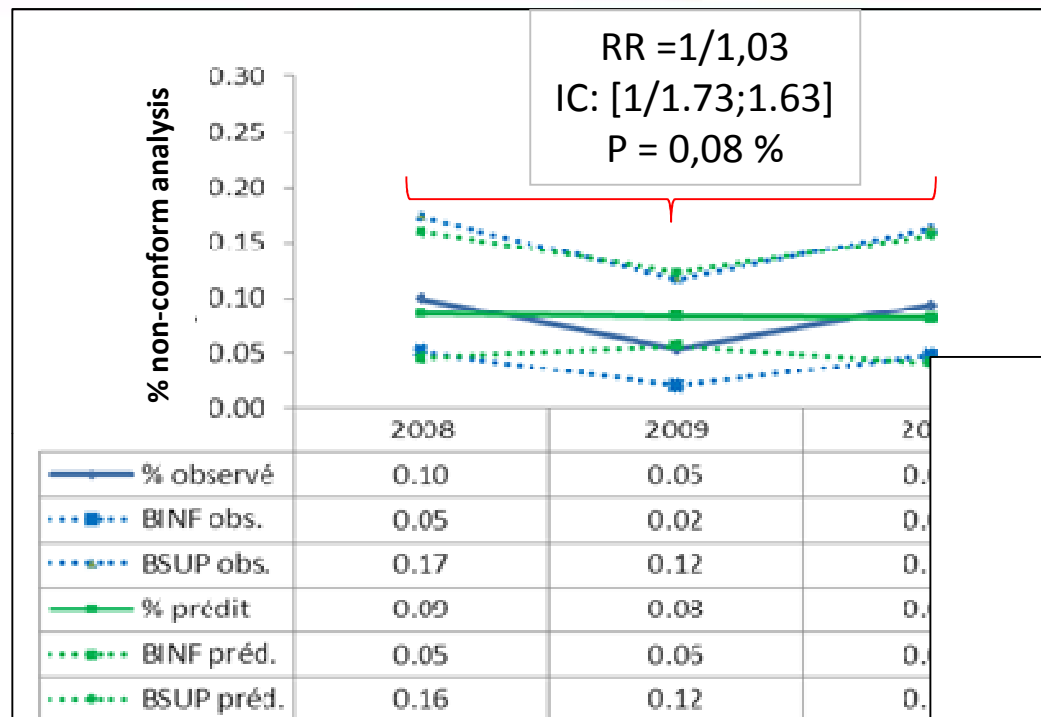
⇒ **Correlated data in space**

⇒ **Objective: Prevalence evolution through the years**

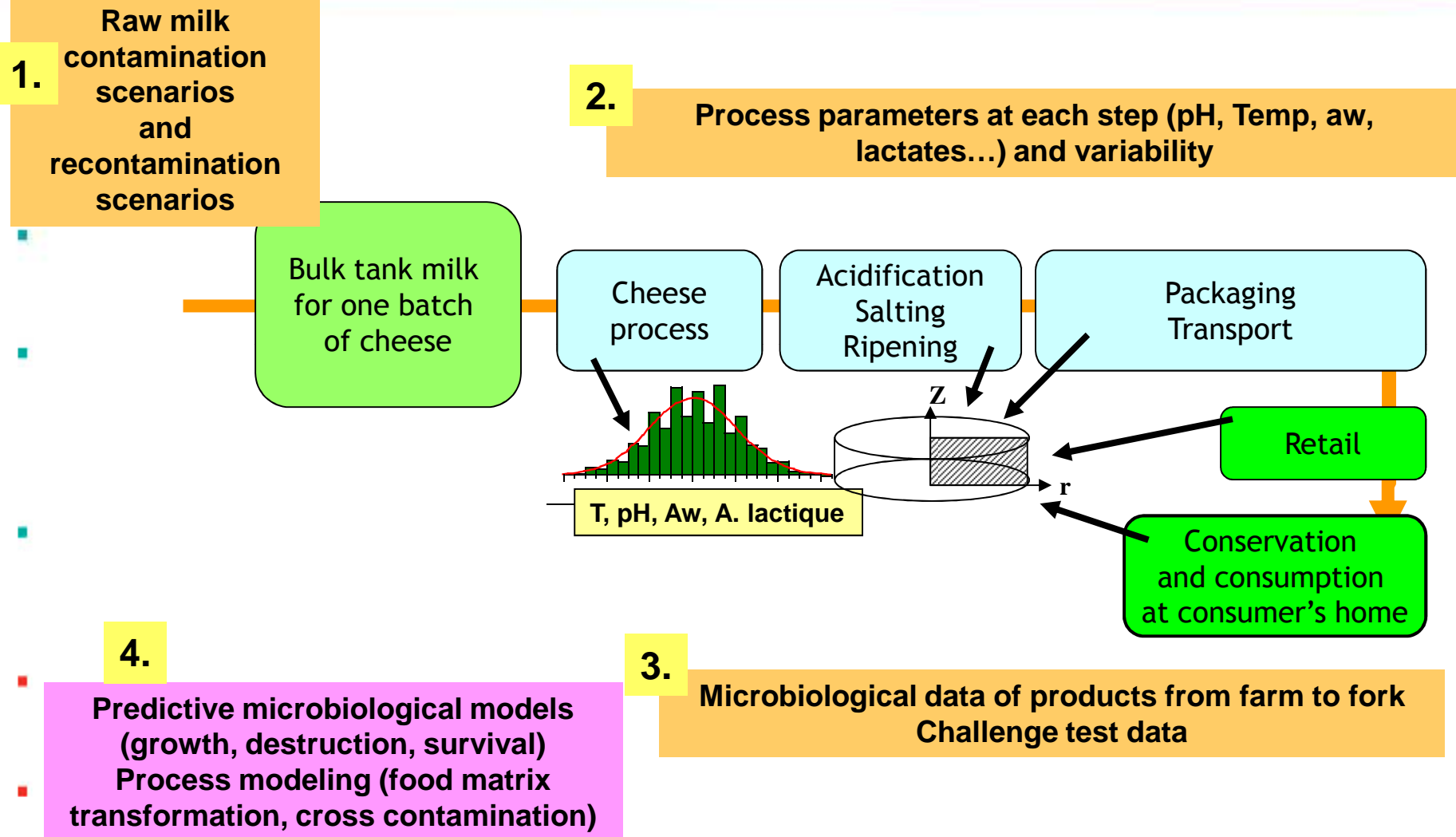
Farm management tool: Statistical procedure



Farm management tool: Results for prevalence evolution

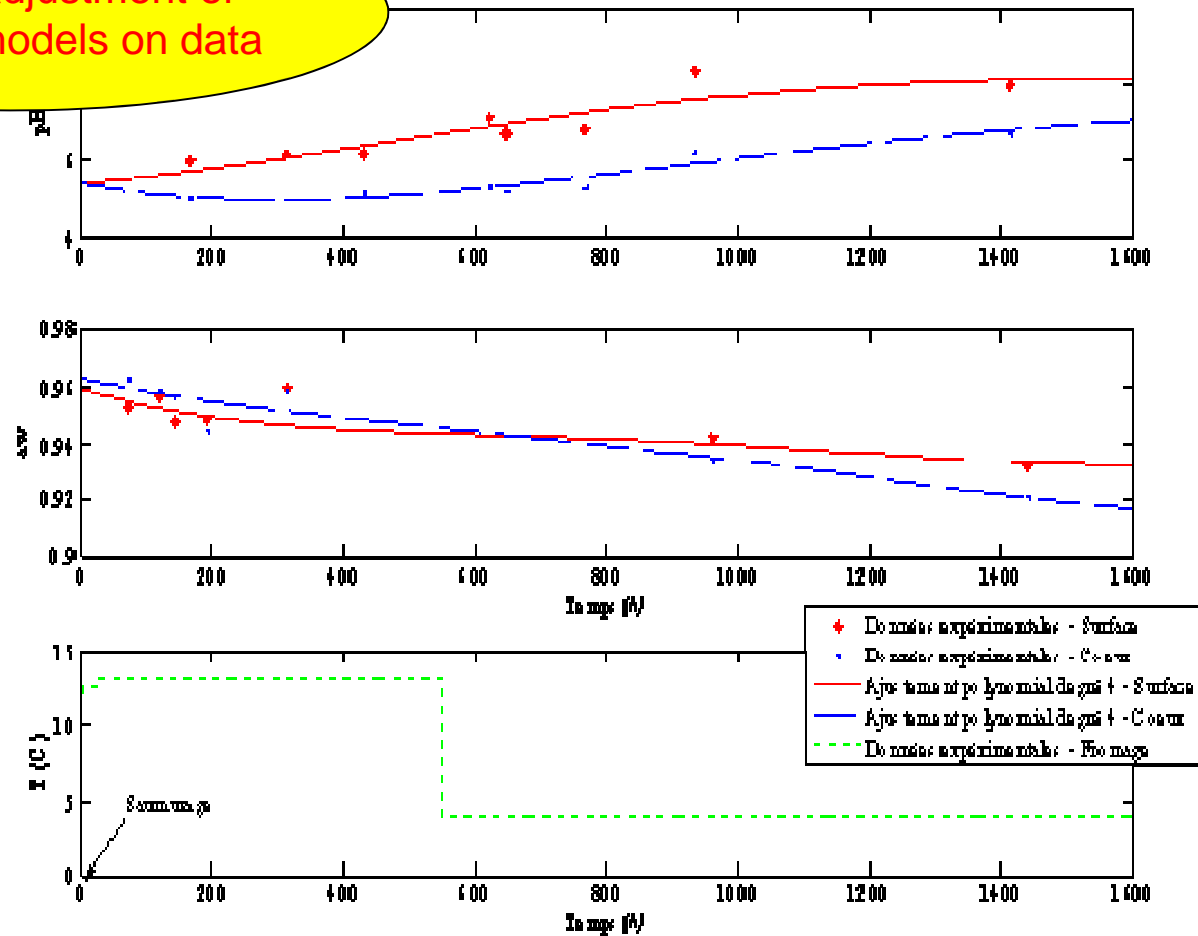


Cheese process management tool: quantitative exposure assessment



Process parameters

Generally adjustment of
polynomial models on data

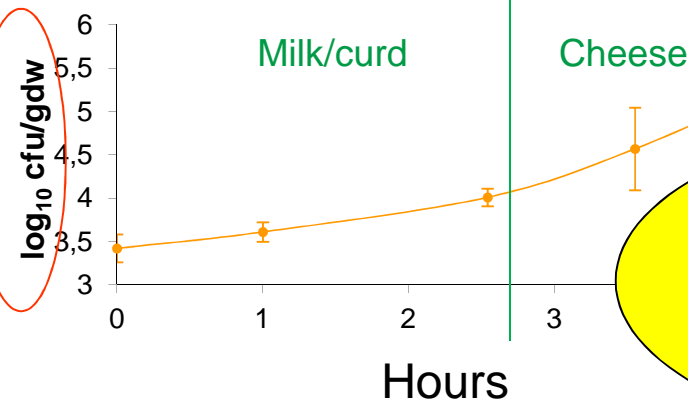


Example of challenge test data

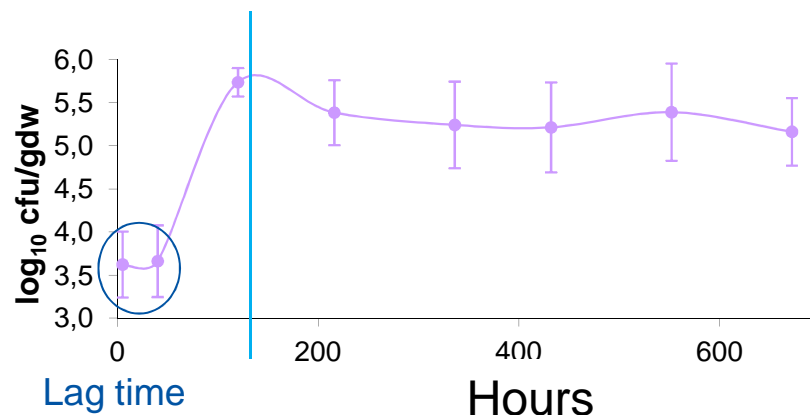


CHEESE MAKING

Concentration in cfu/g of dry matter

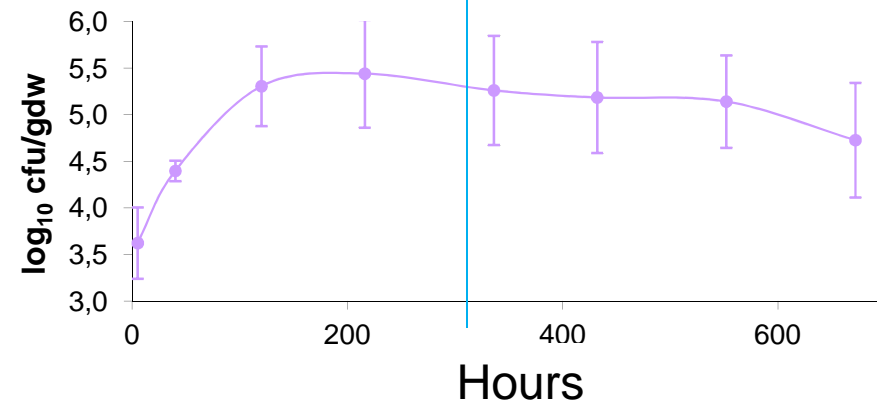


Assessment of an optimal growth rate using the full information maximum likelihood (FIML) estimation method



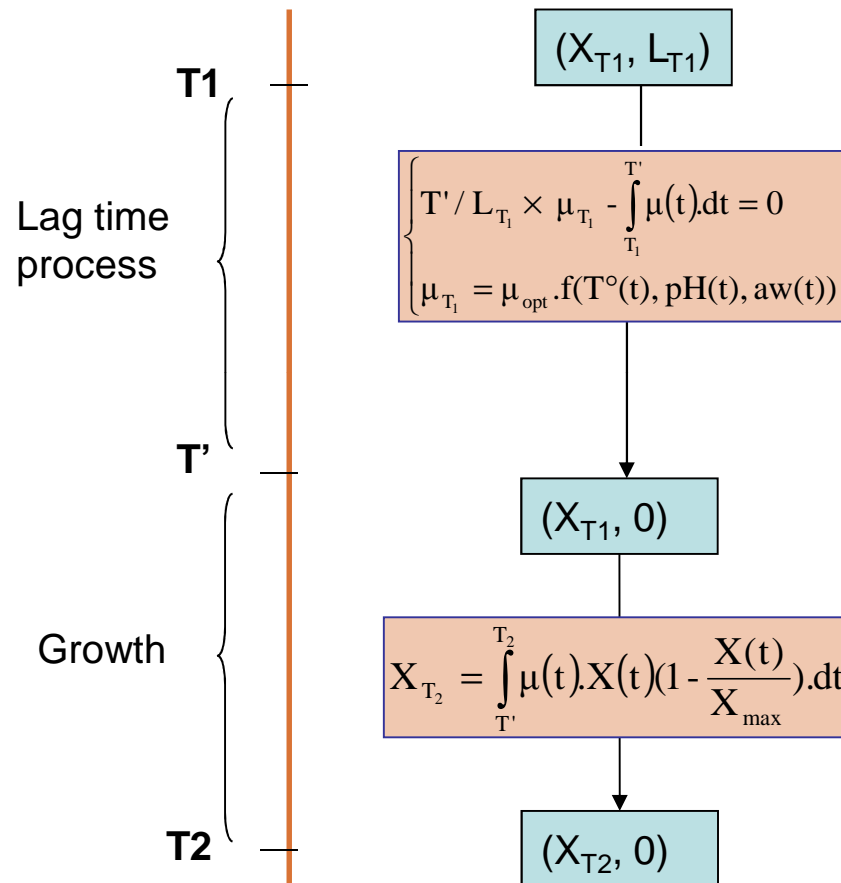
Lag time

RIPENING RIND



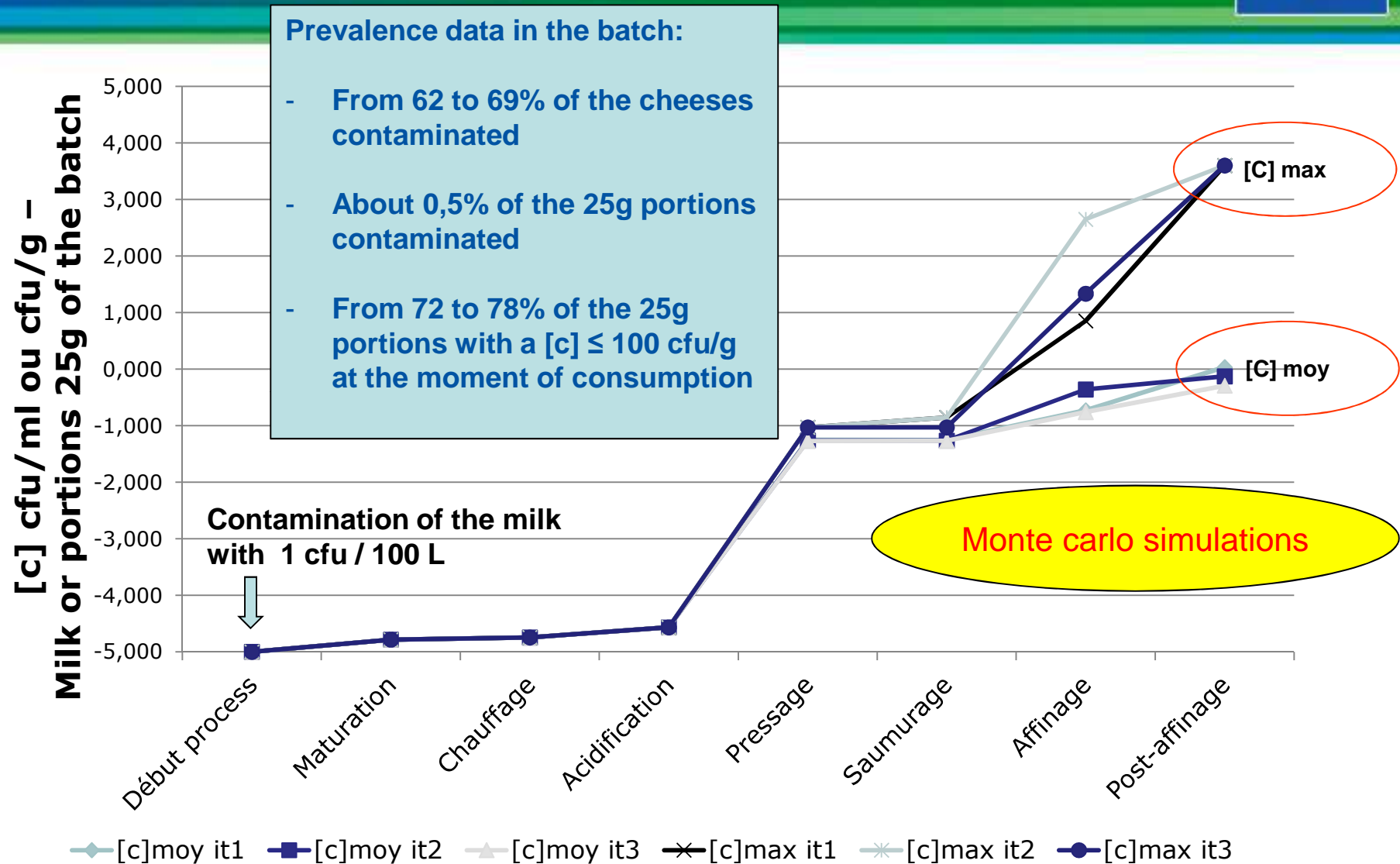
RIPENING CORE

Simulating growth in dynamic conditions



Primary and secondary
cardinal growth models

Example of results for one scenario






INTERFACE DE SIMULATION DES MODÈLES AQR

Espace simulation

dupont

 Déconnexion

 Mon compte

Liste de vos modèles de simulation

Sélectionner

Historique des 1 simulations

Emetteur de la demande	Nom de la simulation	Clé du modèle	Ref.	Date de la demande	Statut	Résultat	Actions
Mr DUPONT	Affinage 11,5°	 Eco_frX_1.00	Eco_frX_1.00_86	13/09/2011	Disponible	 	

Copyright CNIEL 2011 | [Contact](#)
 CNIEL - [Actilait](#)

Web-based user interface

Conclusion



⇒ **QMRA modeling approach**

⇒ **Better know the product and being able to protect it**

⇒ **Consumers**

⇒ **Legislation**

⇒ **Objective, transparent, scientific basis**

⇒ **Simulate new options and decide**

⇒ **New product formulation**

⇒ **New management options**

⇒ **Meet regulatory requirements**

⇒ **Communicate in a pedagogic way**

⇒ **Statistics in general**

⇒ **More and more microbiological data**

⇒ **Databases valorization**

⇒ **Retrospective analyses**

Thanks for your attention



8th International Conference Predictive Modelling of Food Quality and Safety

Paris 2013
September 16-20



$$[y/\theta, n] = C_n^y \theta^y (1 - \theta)^{n-y}$$

$$y_{\text{seuil}} = \frac{C_n^y (a+b+n)}{C_n^y (a+b+n) - 1}$$

$$B = \frac{1}{1 - \frac{1}{n+1}}$$

