Example:
computational tool for evaluating microbiological criterion.

- Bayesian modeling implemented in OpenBUGS.
- Ranta J, Lindqvist R, Hansson I, Tuominen P, Nauta M. *A Bayesian approach to the evaluation of risk-based microbiological criteria for Campylobacter in broiler meat.* The Annals of Applied Statistics 2015, Vol 9., No 3, 1415-1432. (Supplementary material contains model code + example data).

- http://projecteuclid.org/euclid.aoas/1446488745
- http://arxiv.org/abs/1511.01654

- Could be adapted for other modeling for quality control, when data are samples from production ***batches***, and sample based risk reduction actions need to be assessed.

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Modeling problem

- (1) ***Estimation of parameters*** from baseline data
  - Parameters describe campy prevalence and concentrations between and within production batches, per country.
  - Amount and quality of sampling data can vary between countries.

  →statistical model should accommodate various data types.

- (2) Based on uncertainty distribution of parameters, ***predict*** campy in production batches.

- (3) Simulate the selection effect due to microbiological criterions for those batches → ***evaluate risk*** from accepted batches.

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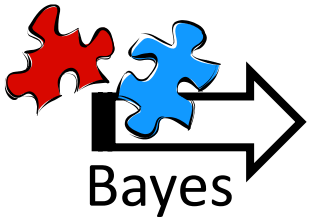
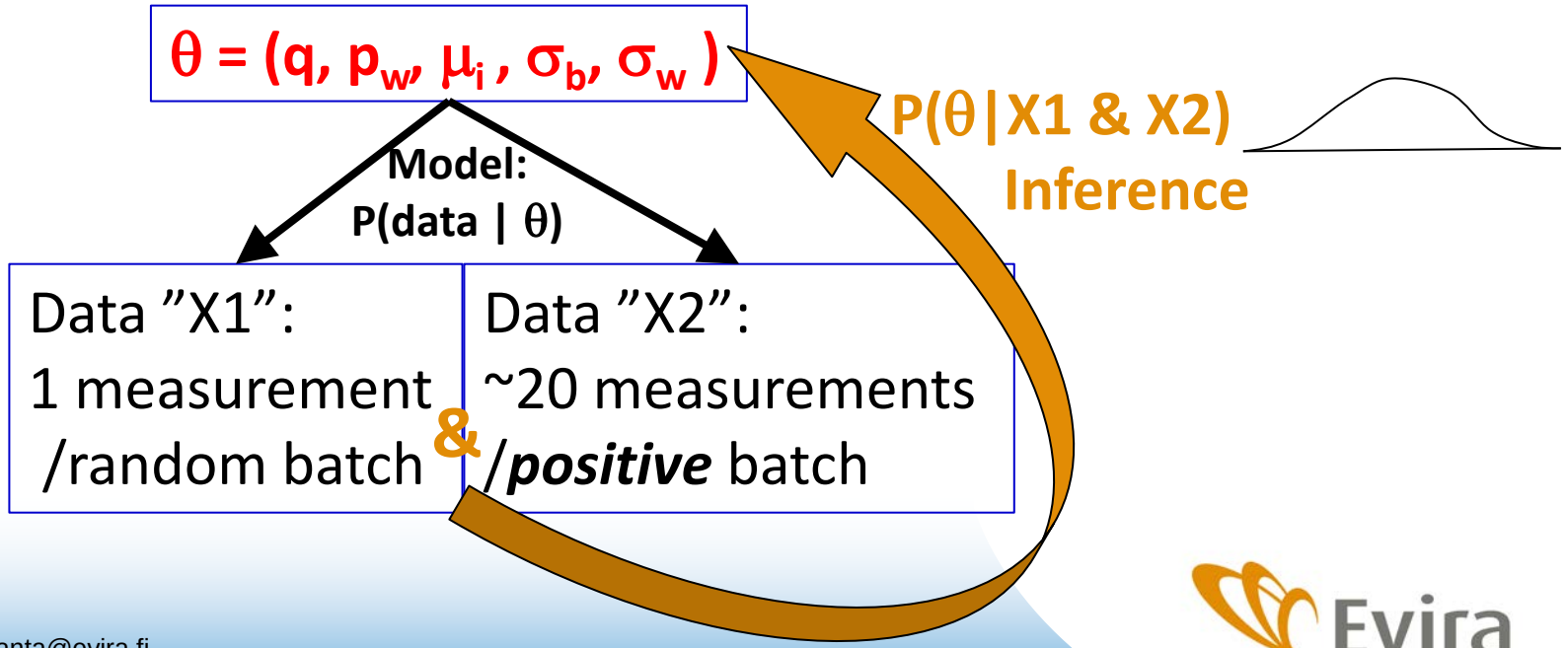
(1) Bayesian inference for model parameters

- Evidence synthesis: ***posterior distribution of parameters***



$$P(\theta \mid X) = \frac{P(X \mid \theta)P(\theta)}{\int_{\Theta} P(X \mid \theta)P(\theta)d\theta}$$

Parameters describing contamination in a country:



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(2) Predicting batches, based on baseline data

- **Compute** posterior predictive distribution for batch parameters for a random new batch.
  - Straightforward to simulate from the posterior distribution of all model parameters (for a country).

  → predicted consumer risk, based on baseline data.

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(3) Update batch prediction according to Microbiological Criterion (MC) outcome

- *Assume MC-outcome was: ”batch is accepted”*
  - ***Question: what does that tell us about the batch?***

  - Evaluate updated parameter distribution for that batch, conditionally on that observation.

  - Evaluate predicted risk according to the *updated* parameter distribution.

(→ Bayesian inference updated)

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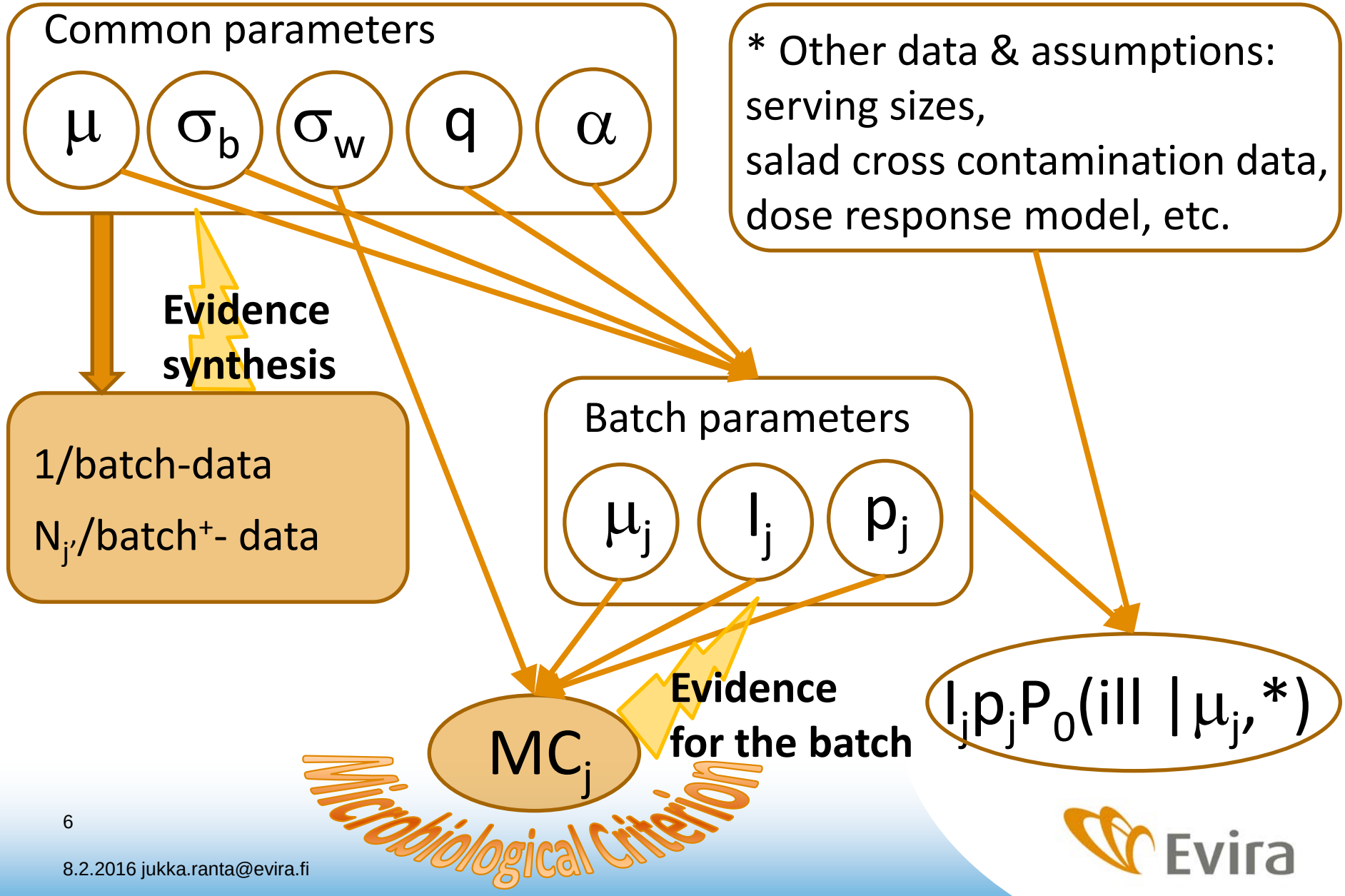
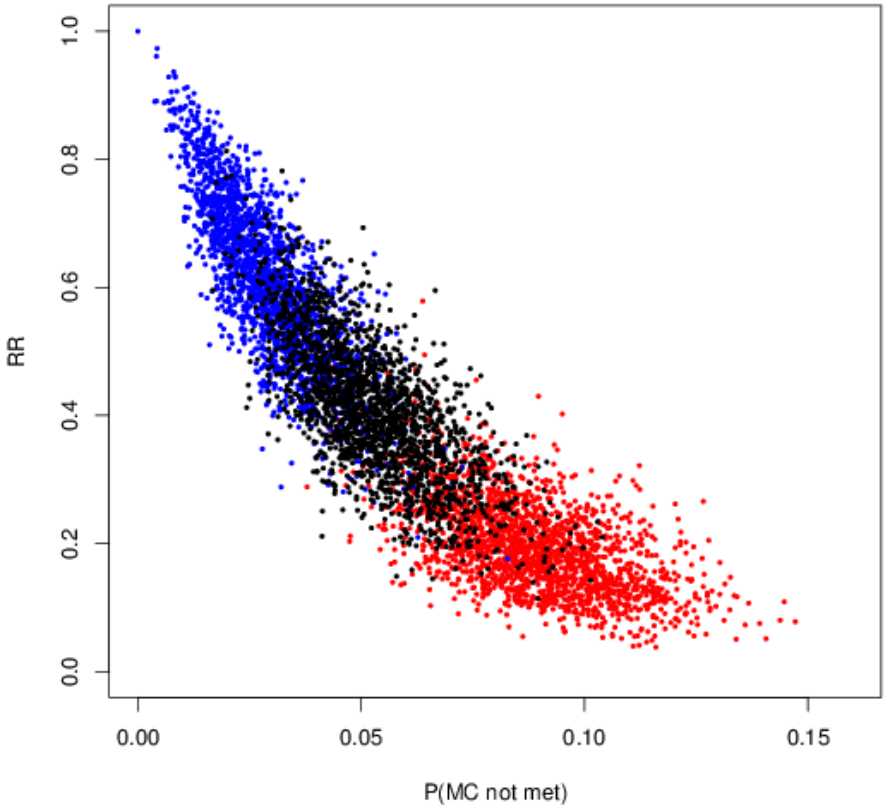
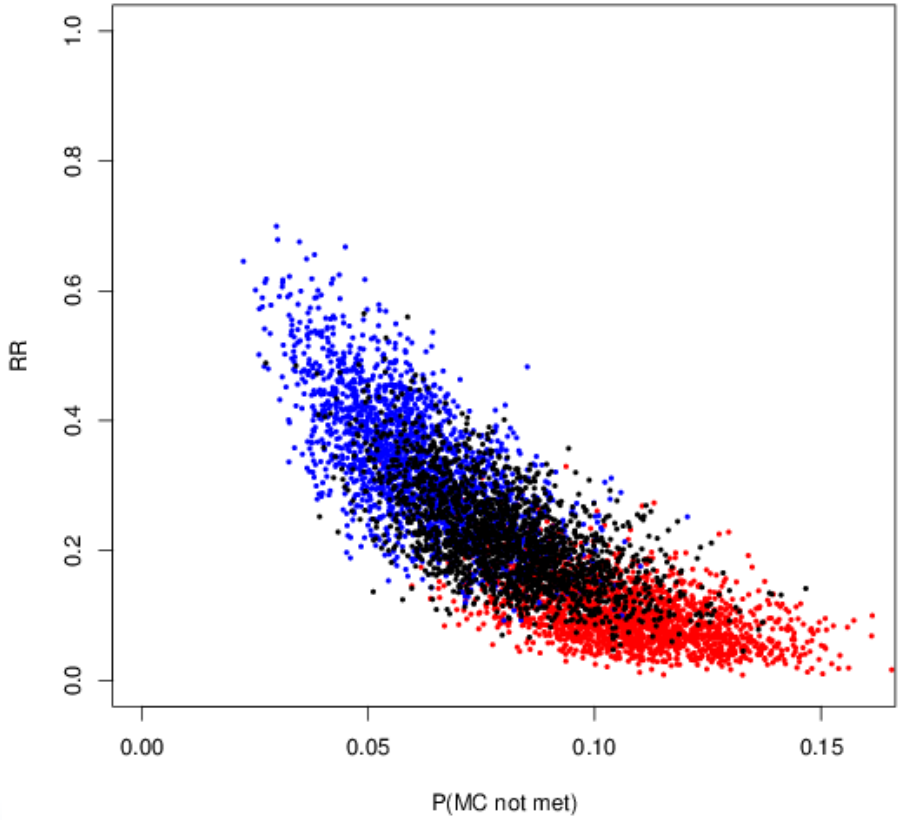

Common parameters
μ
σb
σw
q
α
* Other data & assumptions:
serving sizes,
salad cross contamination data,
dose response model, etc.
Evidence synthesis
1/batch-data
Nj'/batch+- data
Batch parameters
μj
lj
pj
MCj
Evidence for the batch
ljpjP0(ill |μj,*)
Microbiological Criterion

Cost - Benefit?

RR = relative risk = risk from accepted batches / risk from any batch.

P(MC not met) = proportion of rejected batches.





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