Théorie de la décision pour la protection des cultures

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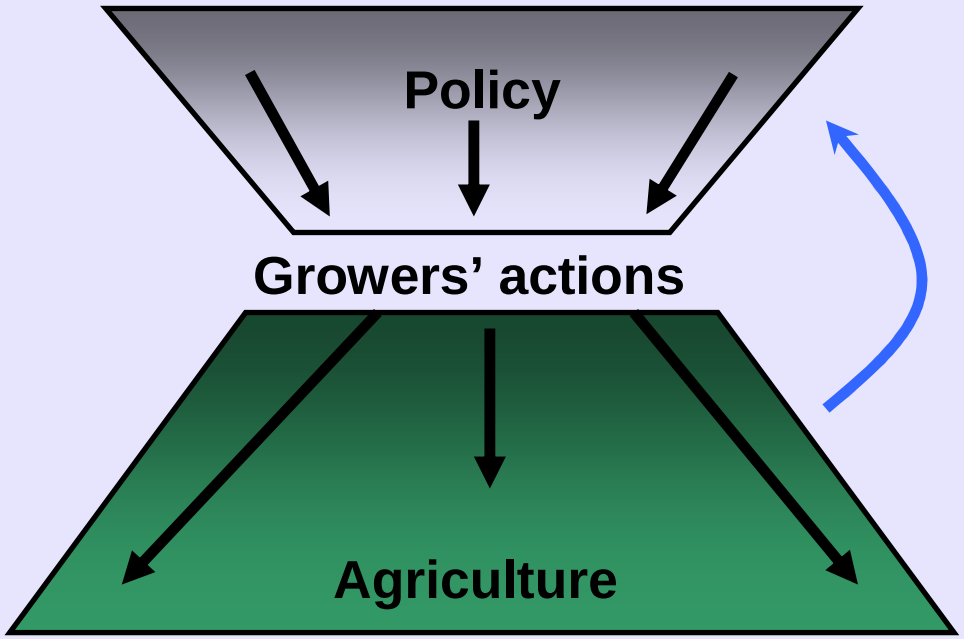
Presentation topics

- Motivations for improving decision making
- Generic structure of the decision problem
- Assessing decision tool fitness for purpose
- The past and the future for decision tools?

Motivations for improving decision making

- All stakeholders in agriculture require it
  - Policy makers; environmental protection
  - **Growers**; economic efficiency, compliance with policy
  - Industry; justify use, quality assurance



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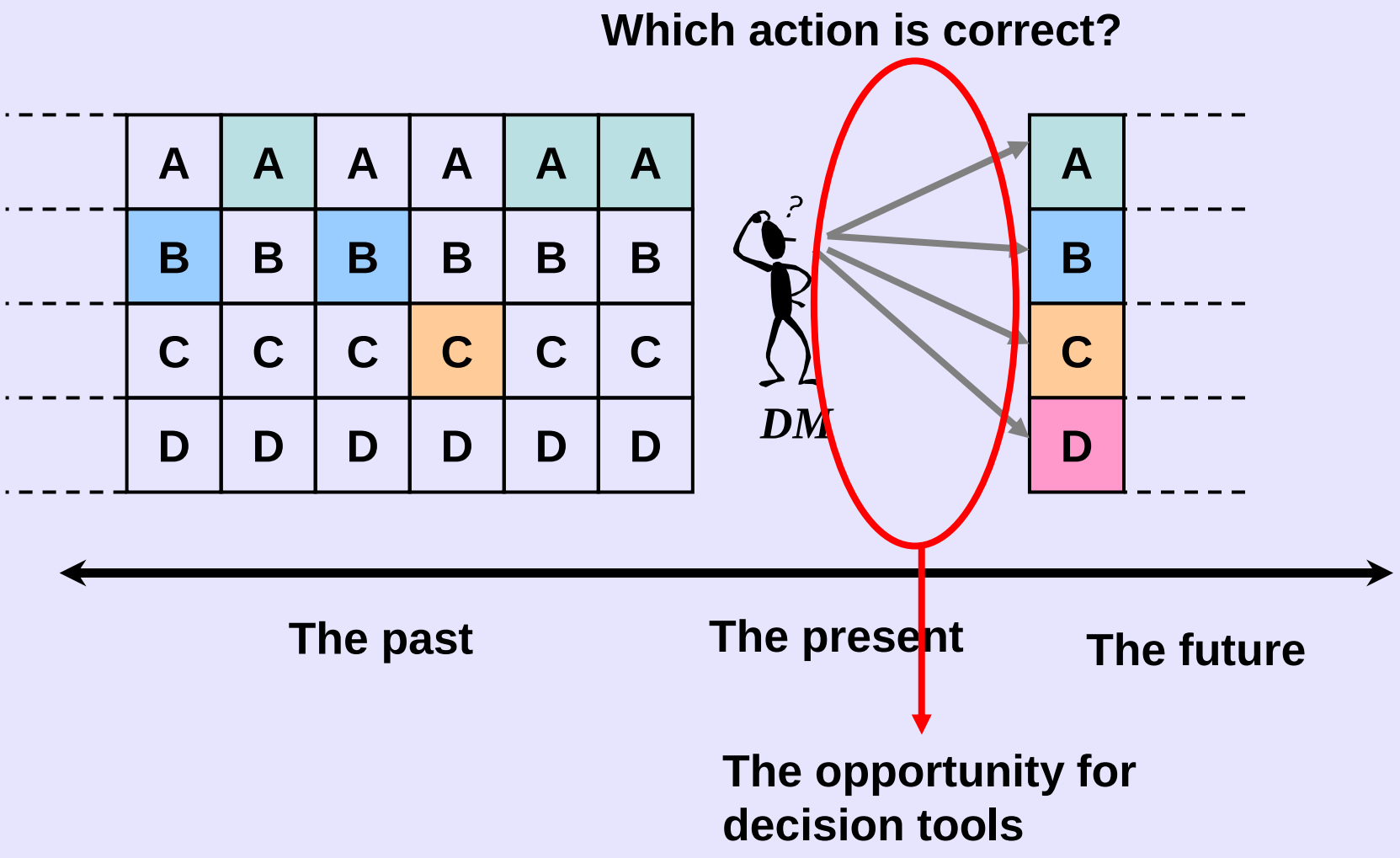
Generic structure of the decision problem

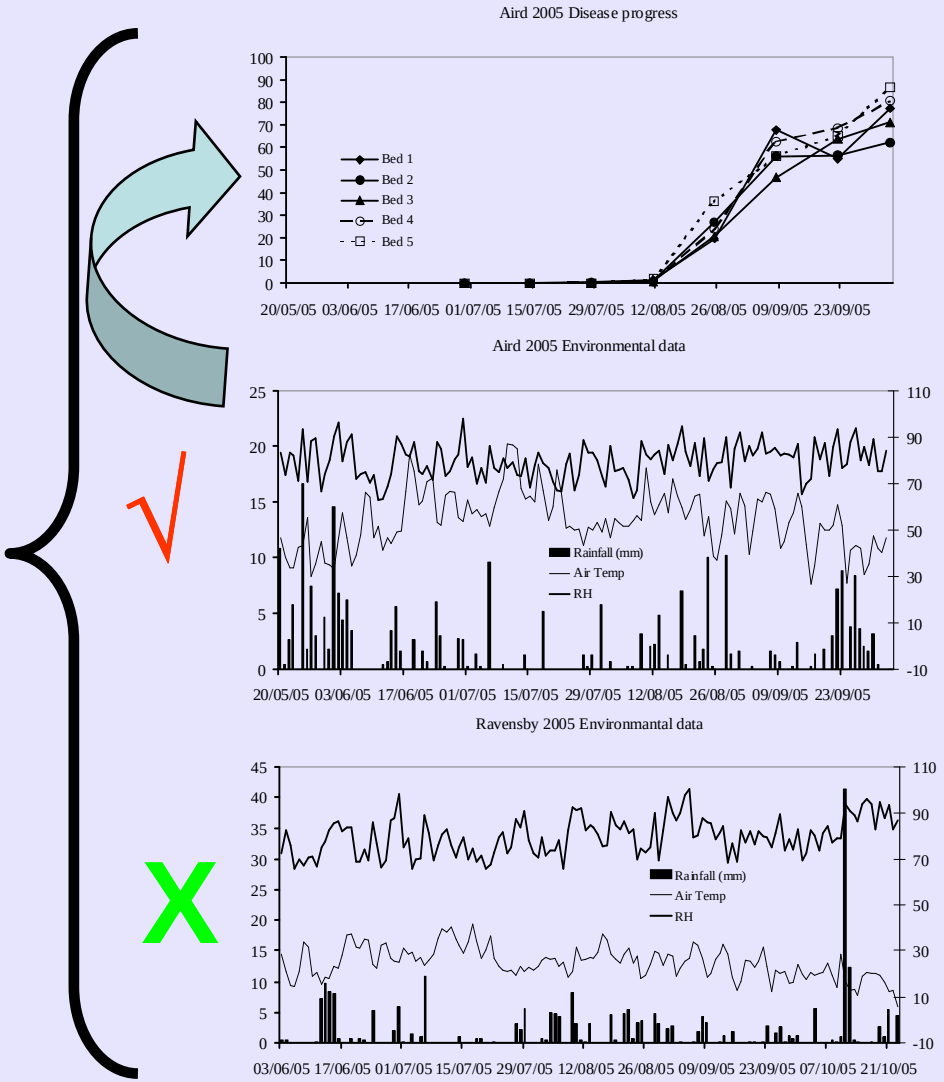


Predicting outcomes from noisy data

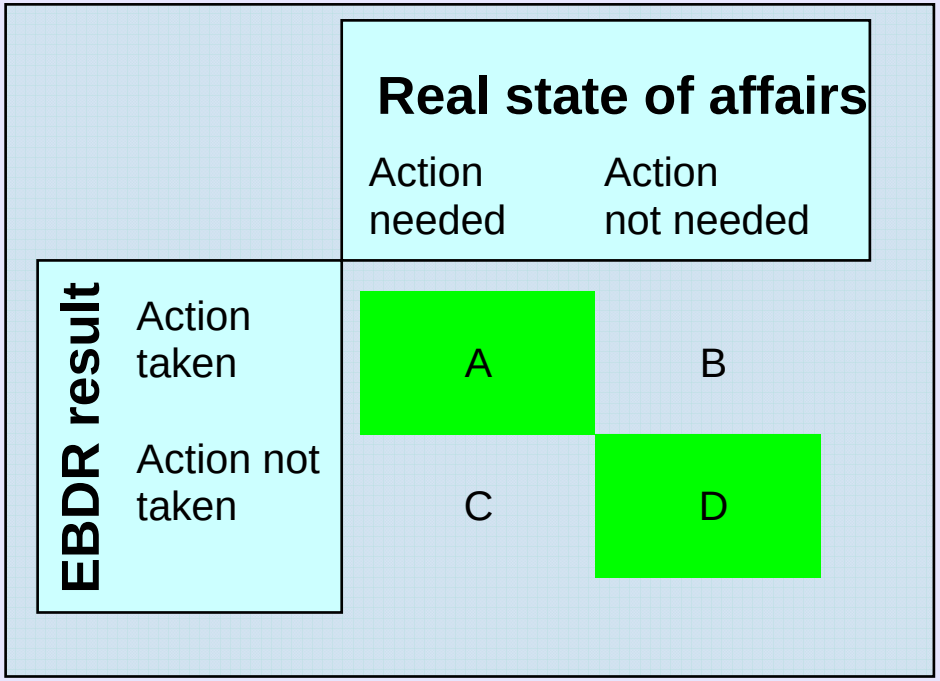
Developing & using decision tools

- Extract evidence-based ***discrimination*** rules (EBDR)
- Use EBDR to ***update*** knowledge & improve decision-making

EBDR can be derived in many ways



Discriminating cases from controls



Likelihood ratios

LR+ Likelihood ratio of a positive prediction of need for action
sensitivity/(1-specificity)

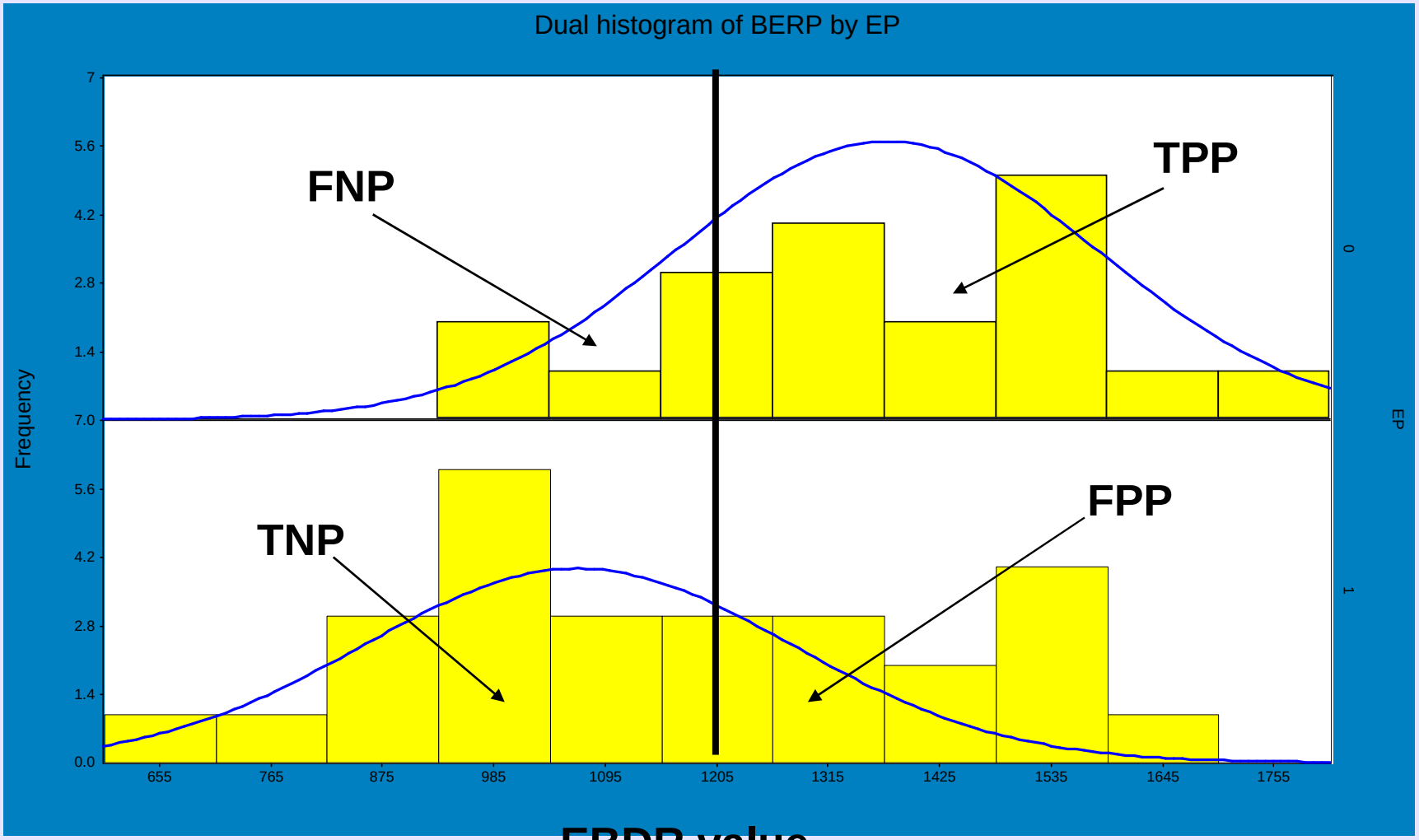
LR- Likelihood ratio of a negative prediction of need for action
(1-sensitivity)/specificity

Sensitivity (TPP) = A/(A+C)

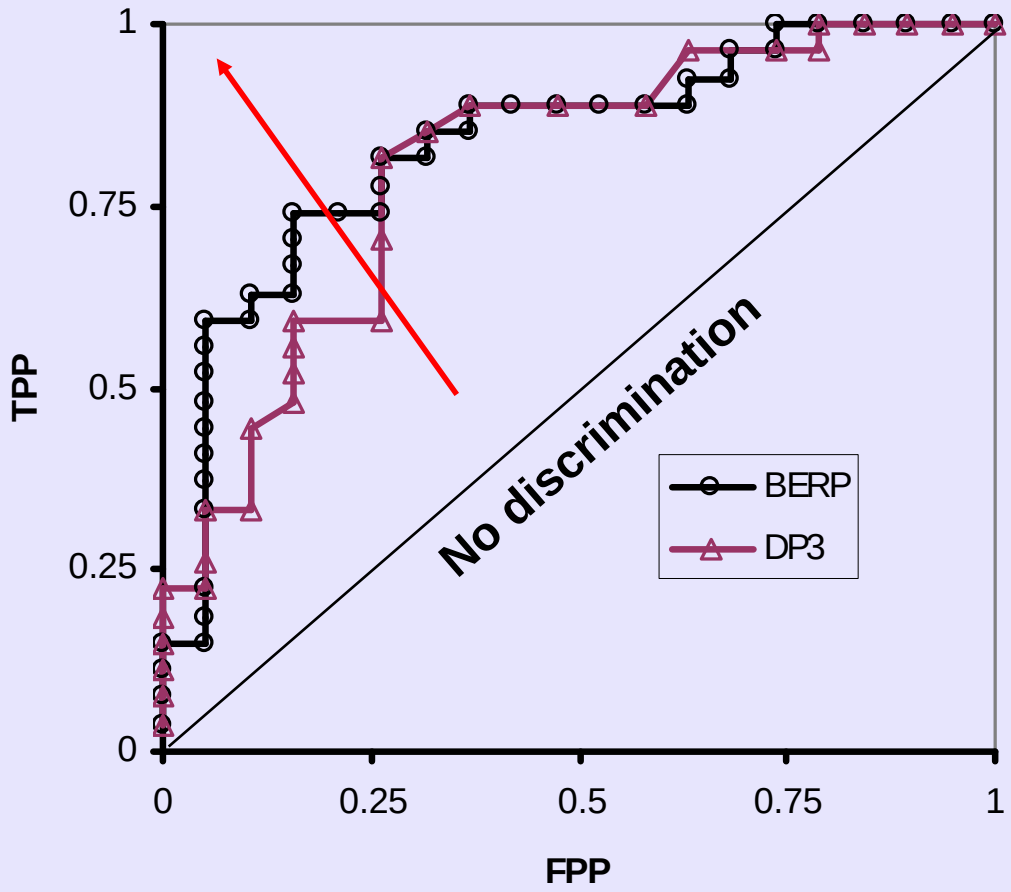
Specificty (1-FPP) = D/(B+D)

} **Of EBDR**

Frequency distributions of “cases” and “controls” on an EBDR scale



ROC Curves for potential epidemic diagnostic

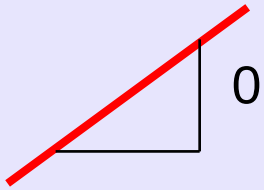


AUROC (BERP) = 0.83

AUROC (DP3) = 0.80

ROC Curve of BERP and DP3 against epidemic classification

LR+

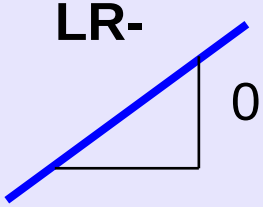


0.5926

0.0526

= 11.27

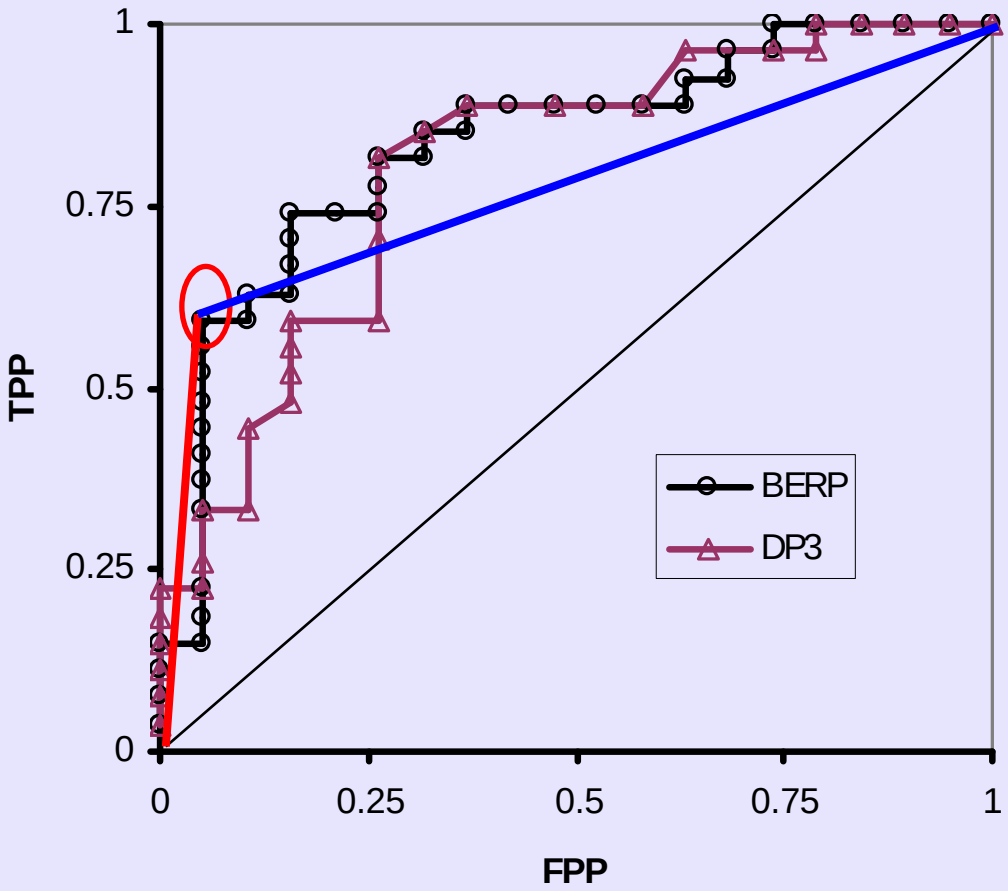
LR-



0.4074

0.9474

= 0.43



Good discrimination allows effective (Bayesian) updating

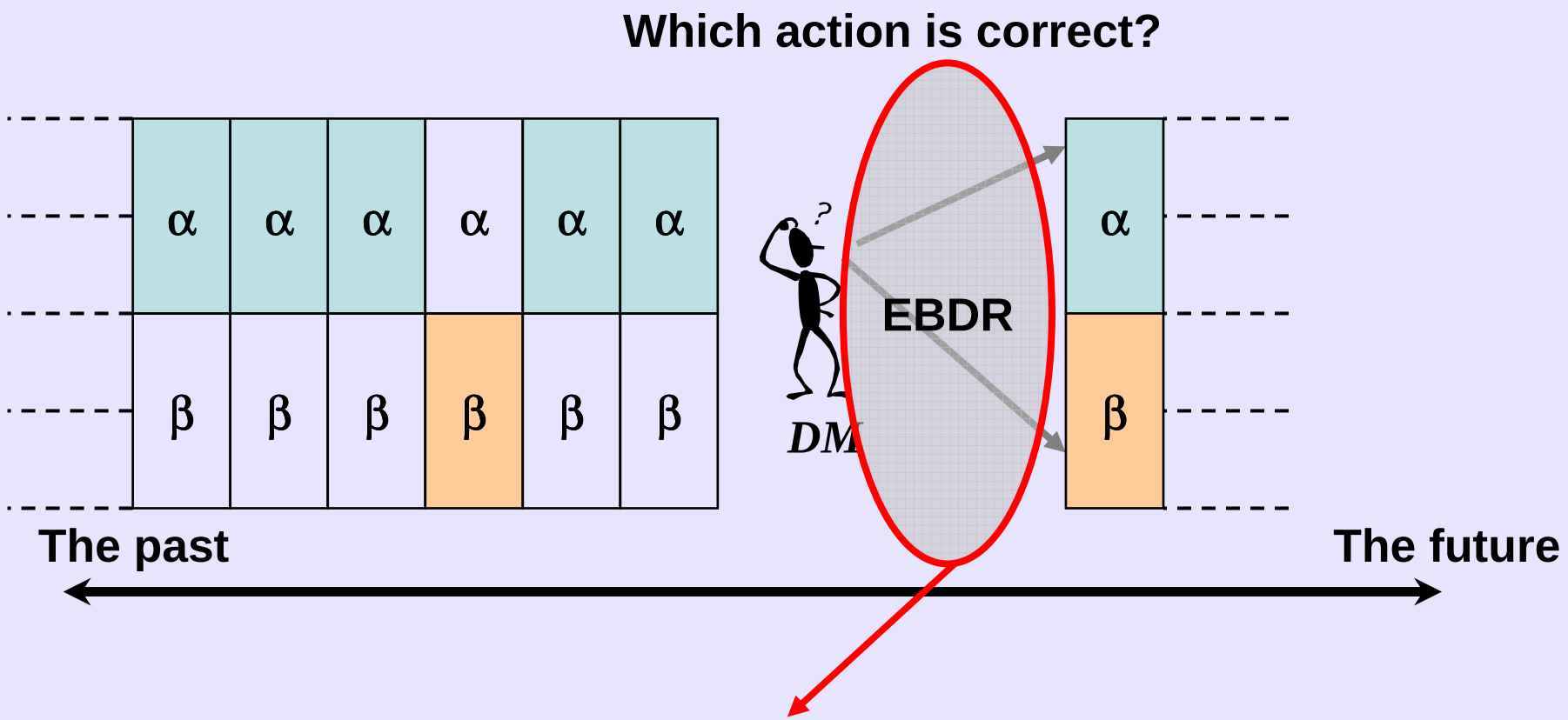
Posterior odds(D+|T+) = LR_+ × Prior odds(D+)

$$\frac{p_{post}}{1-p_{post}} = LR_+ \times \frac{p_{prior}}{1-p_{prior}}$$

Updating (*we hope?*) changes behaviour.

But is the balance of probabilities overwhelming?

Generic structure of the decision problem



$$\text{Prior odds}(D+) \times \boxed{LR_+} = \text{Posterior odds}(D+|T+)$$

What forms a grower's own EBDR?

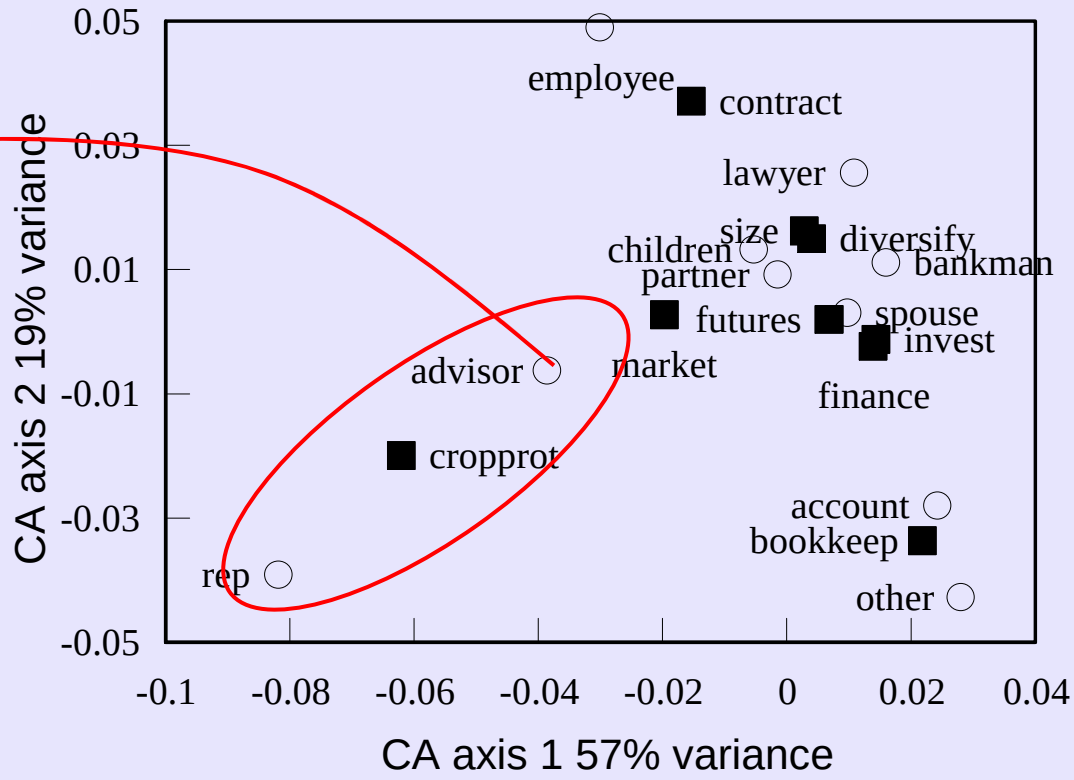
Source of Information	% Highly Important
Own Experience	**93%**
Cornell Recommends	86%
Extension news letters	64%
Grower Meetings	43%
Extension Code-a-phone	21%
Chemical field rep.	14%
Other	14%
Ag. Chemical Handbook	7%

(1998 Survey of New York State wine grape growers)

Scottish arable growers' evidence networks

Correspondence analysis of decisions and decision-makers on Scottish arable farms

State extension service with direct input from SAC and other R&D institutes



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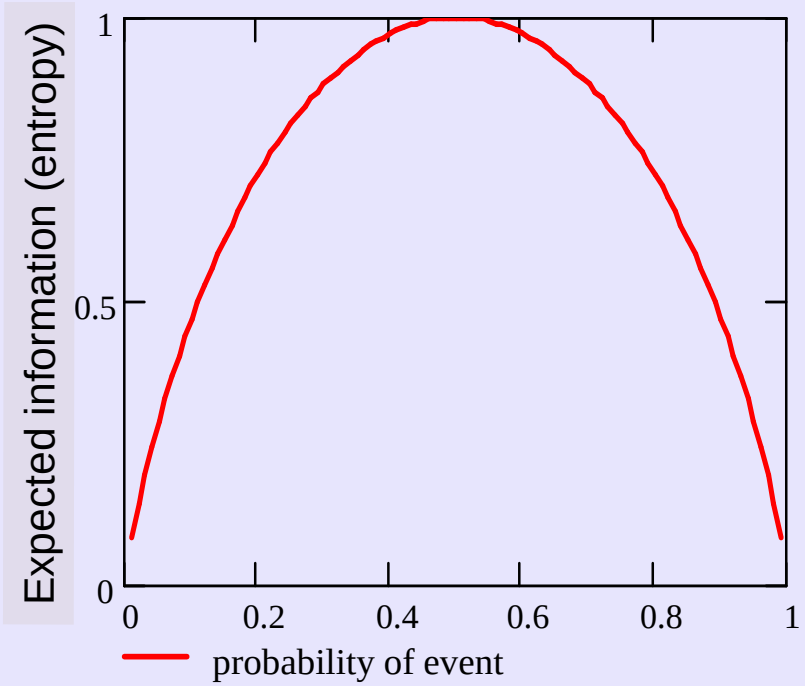
Updating implies supplying and receiving information

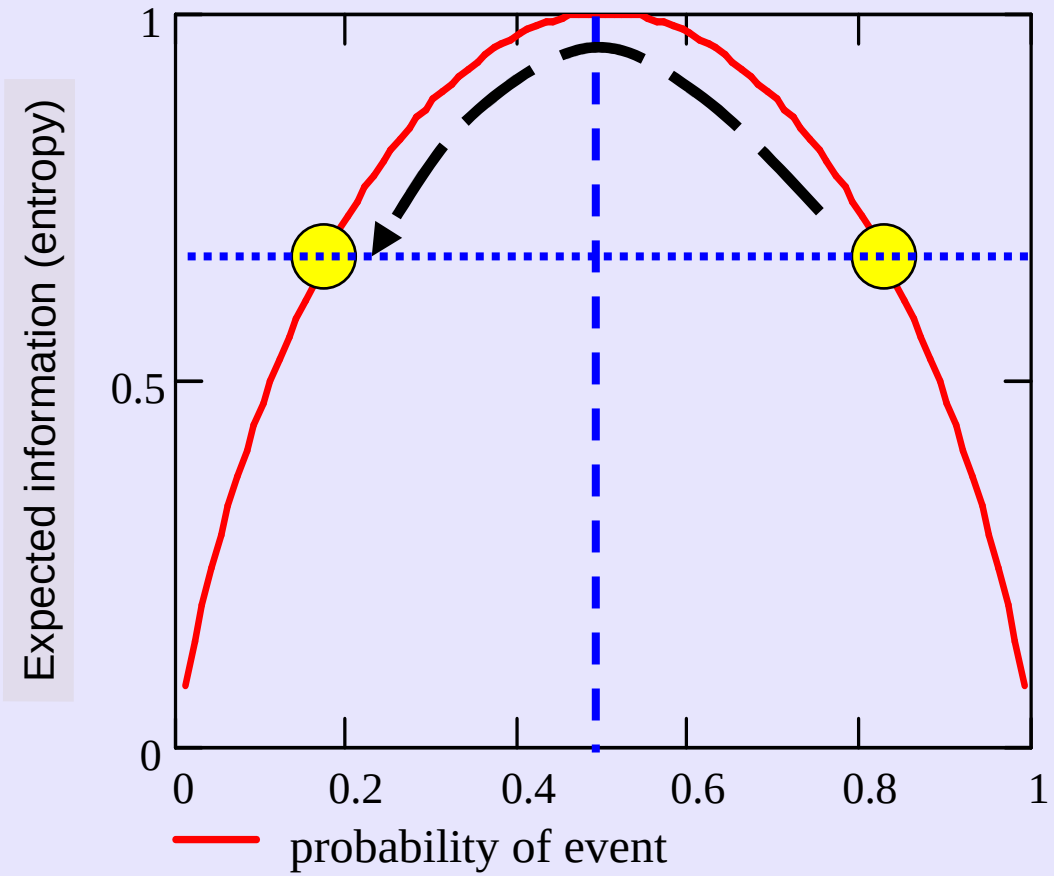
"*For a forecasting system to be successful, it must be adopted and implemented by growers. There must be the* ***perception*** *that the grower can realize specific, tangible benefits from using the forecasting system* ***that could not be realized in its absence***." (Campbell & Madden, 1990, p424.).



Shannon's (1948) entropy equation

$$I = \sum_{i} -p_i \cdot \log_2 \left(p_i \right)$$

Changing a user's balance of probabilities

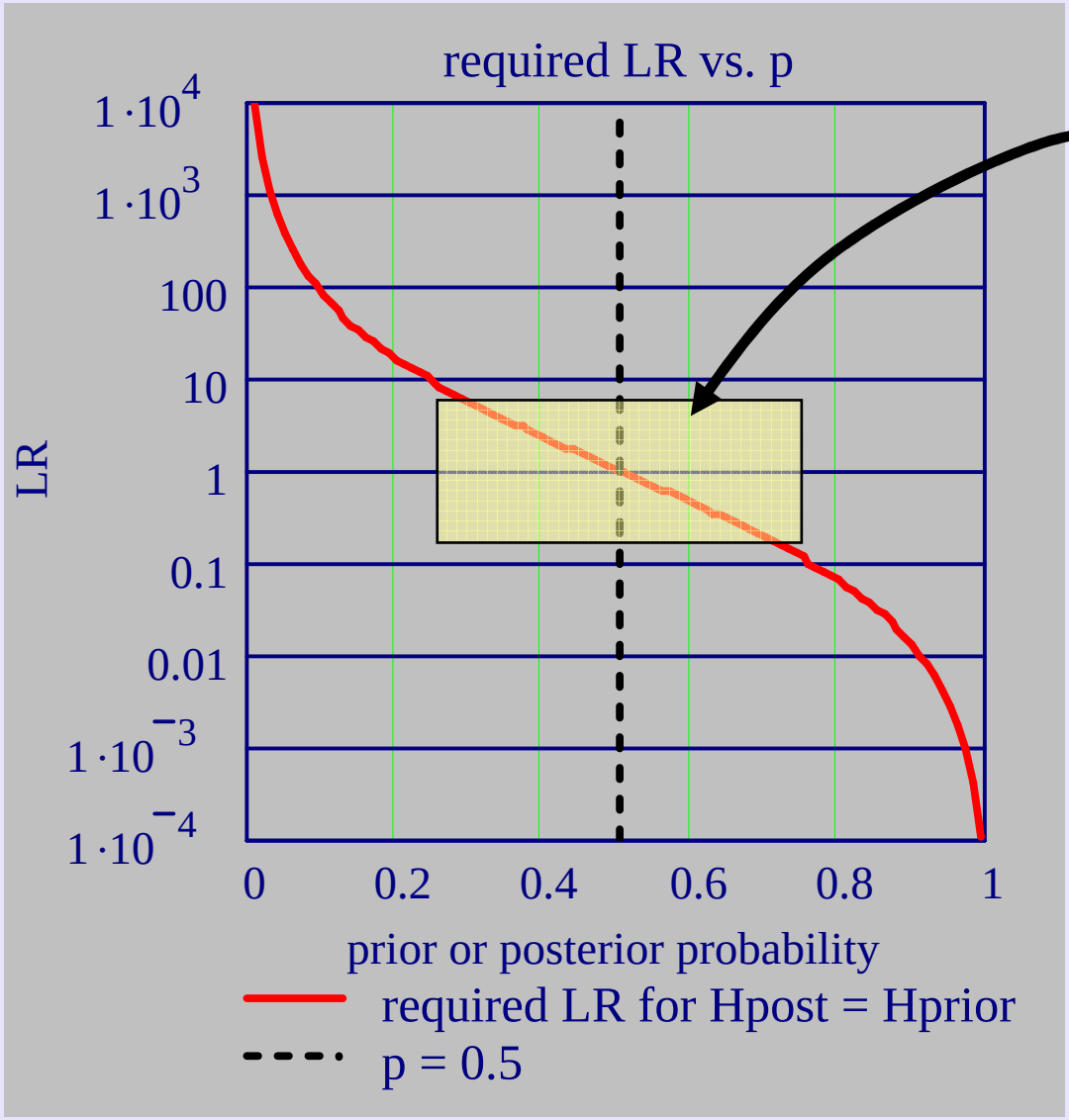


Equal certainty

implies flipping the odds

$$LR_{-req} = \left(\frac{P_{post\_req}(D+)}{1-P_{post\_req}(D+)}\right) \Big/ \left(\frac{P_{prior}(D+)}{1-P_{prior}(D+)}\right)$$

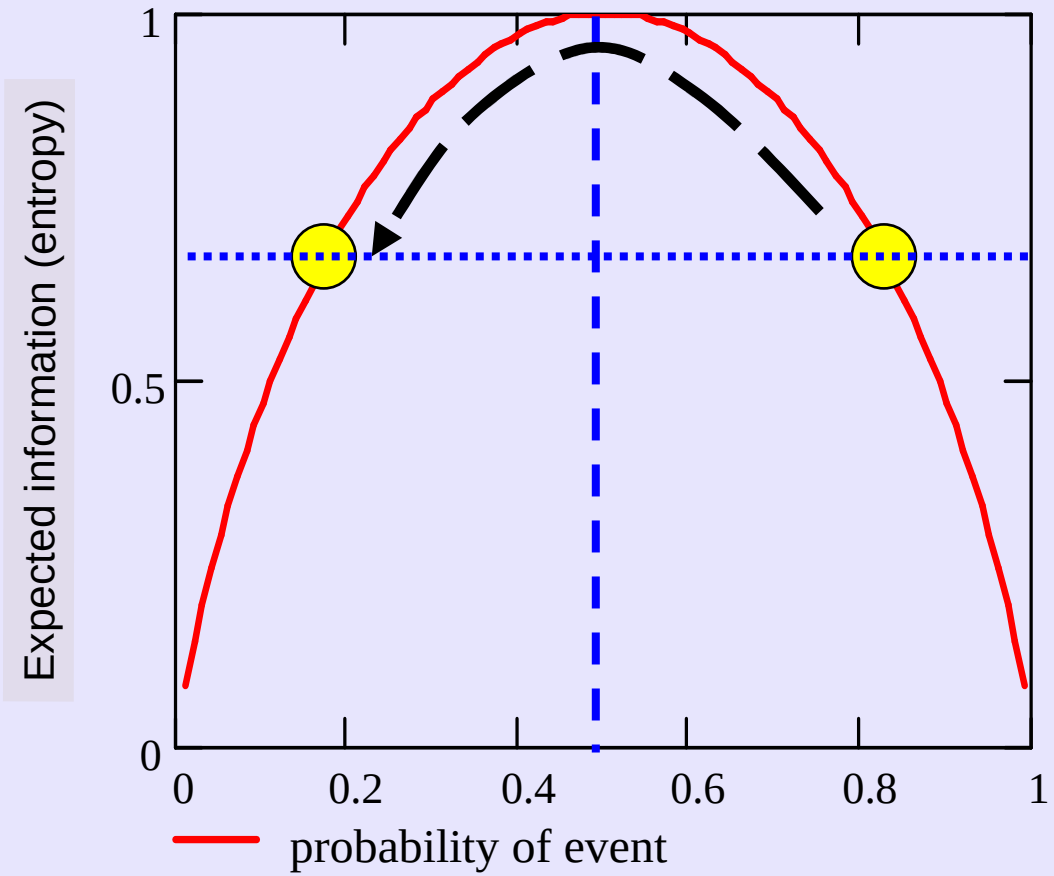
What does the equal uncertainty criterion imply for forecaster performance?



Zone of performance for most current forecasters

Forecasters/tools with LR+≥10, LR-≤0.1 would allow equal uncertainty for most users

Changing a user's balance of probabilities



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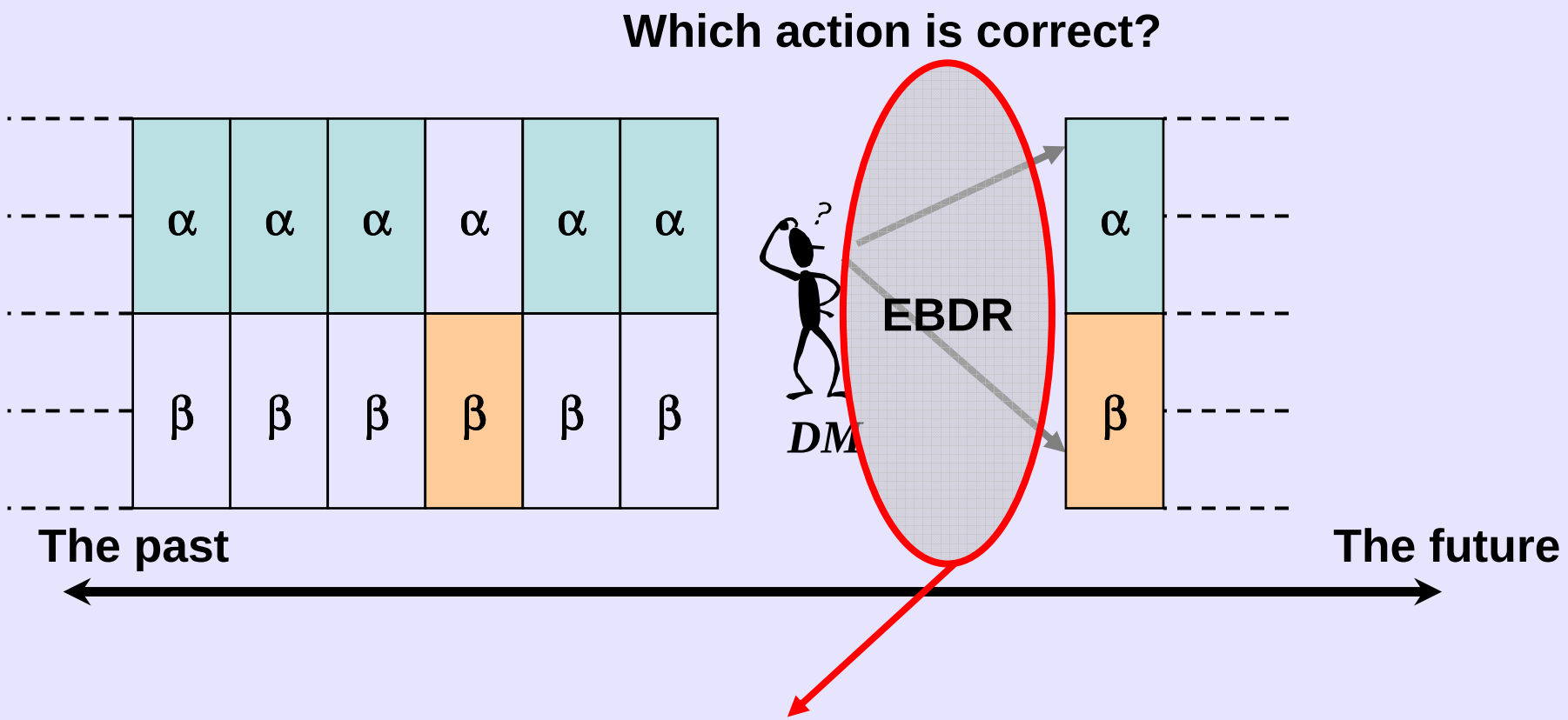
Generic structure of the decision problem



$$\text{Prior odds}(D+) \times \boxed{LR_+} = \text{Posterior odds}(D+|T+)$$

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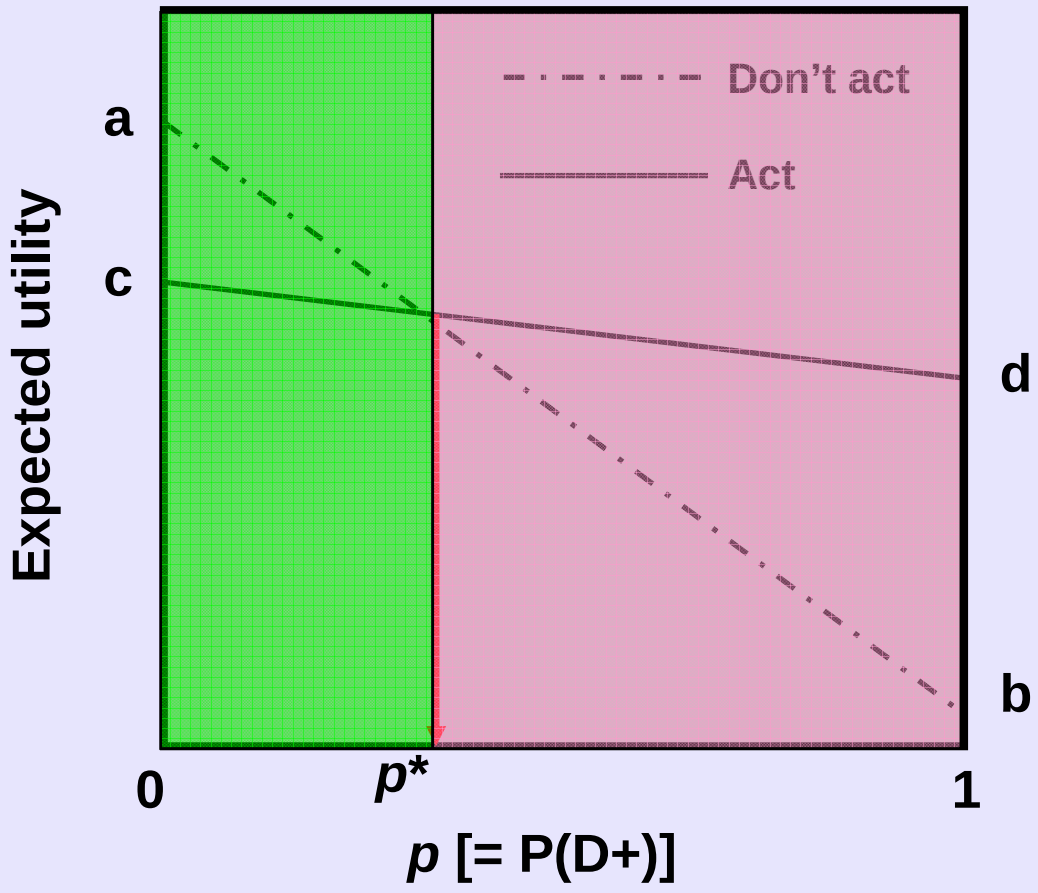
Expected utility (expected regret)

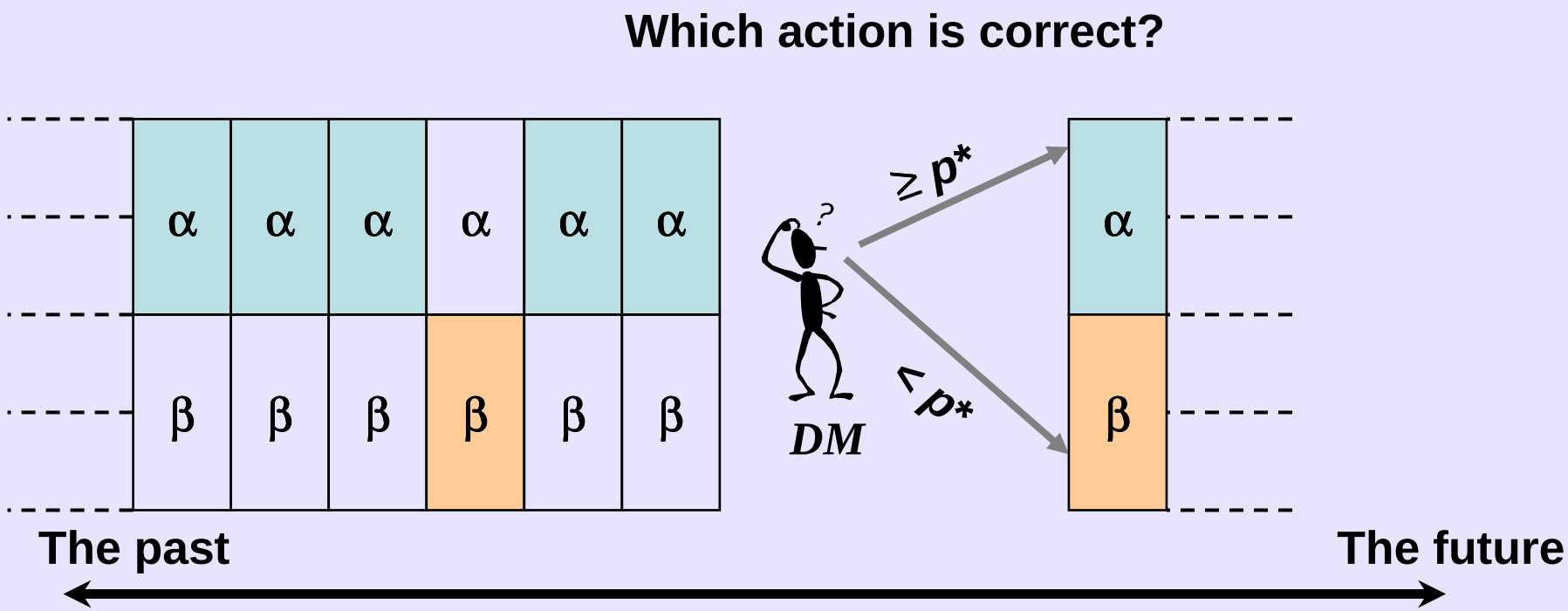


$E(U_A)=pb+((1-p)a)$

$p^*=(a-c)/[(a-b)-(c-d)]$

The Future:
Task for epidemiology is to say what *p is**

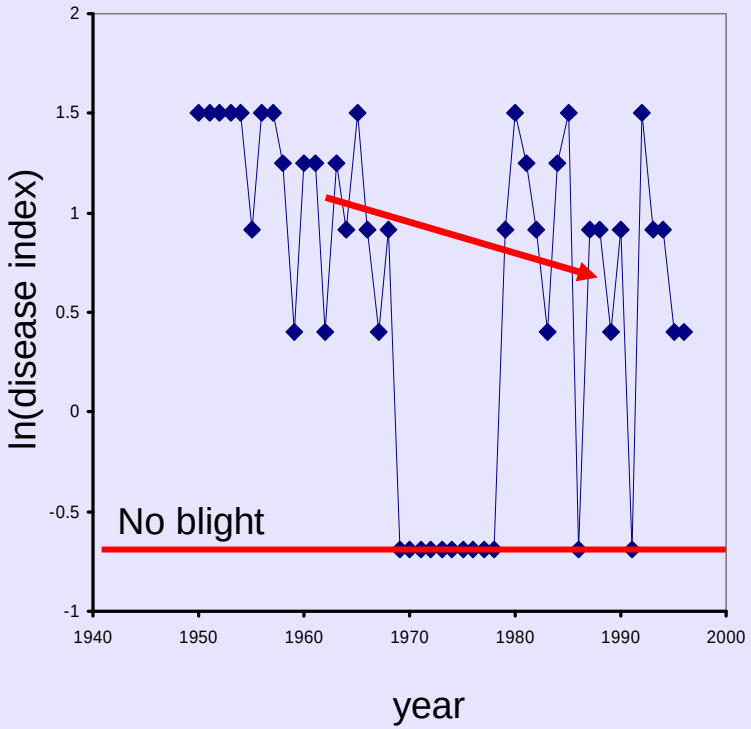
Each DM's experience personalises *p**

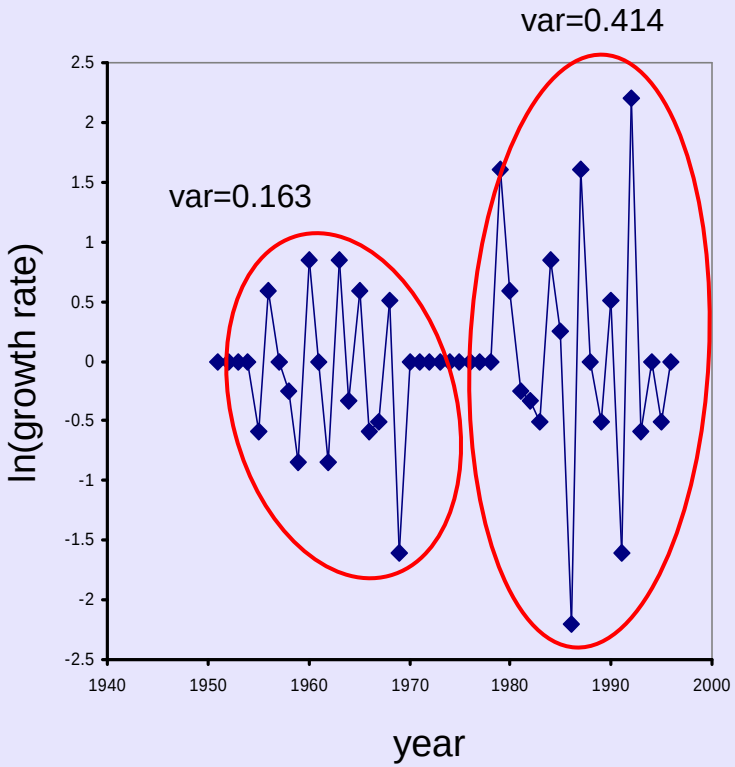


Estimating *p** requires long-term multi-site data

Polyetic disease example: Dutch national late blight epidemics 1950-1996

How is system changing, and why?





Data: Zwankhuizen & Zadoks 2002. *Plant Path*. **51**: 413-423

Does epidemiology have the tools to answer these questions?

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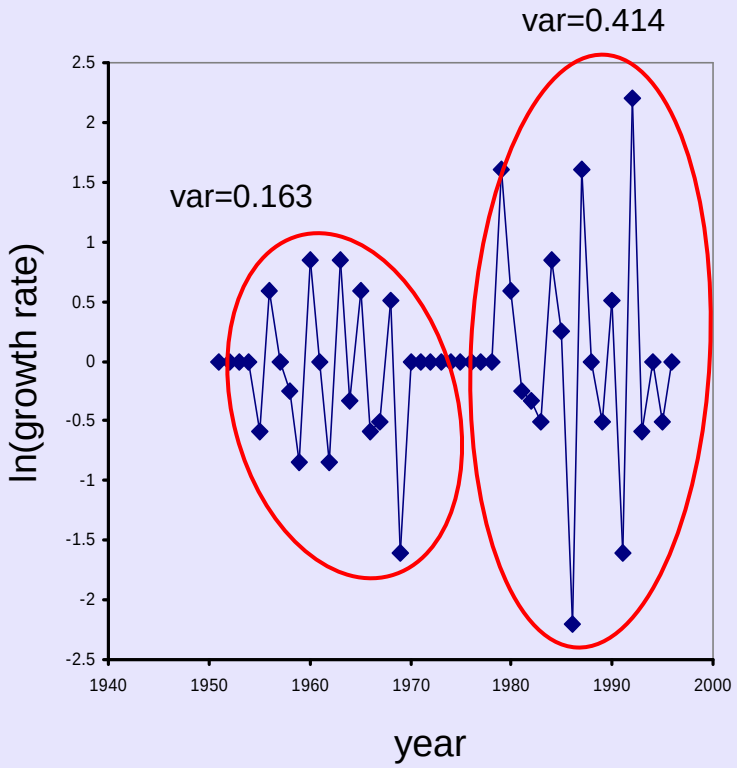
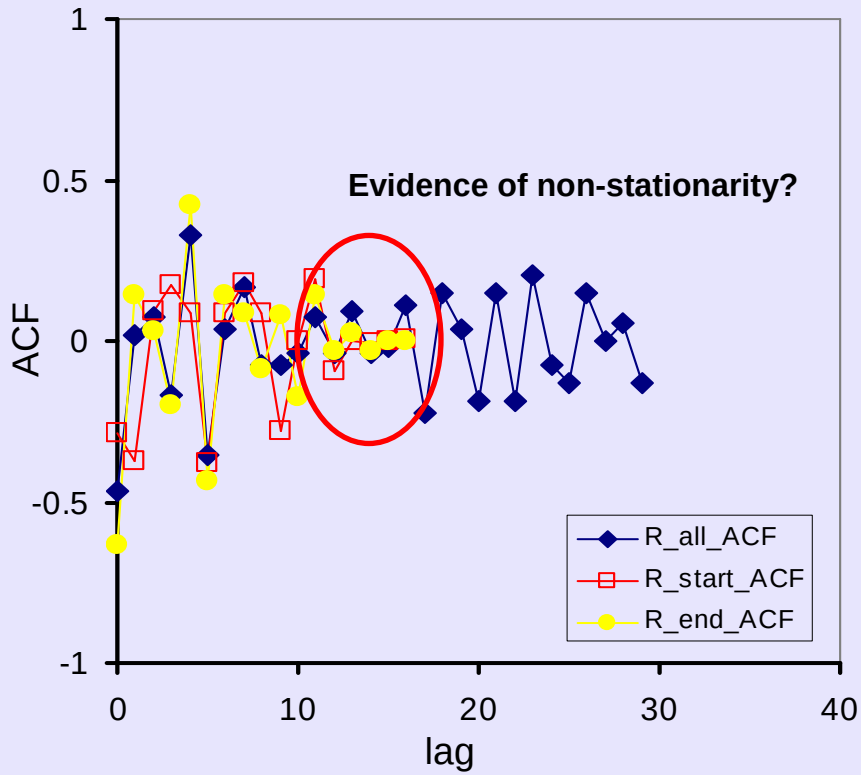
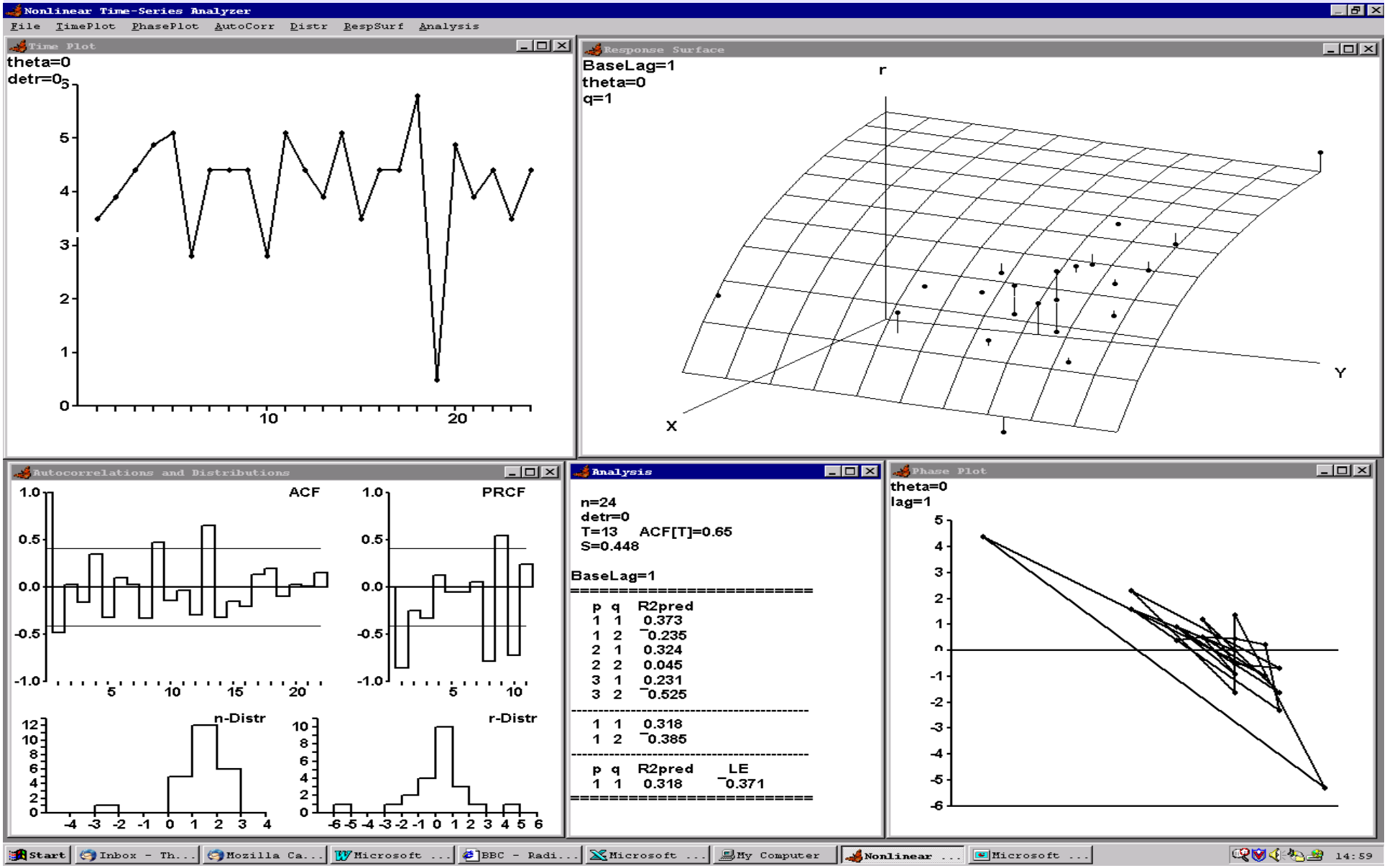




Even with long data series hard to distinguish between: (a) Random walk, (b) transition between 2 equilibria

A new research agenda for epidemiology?



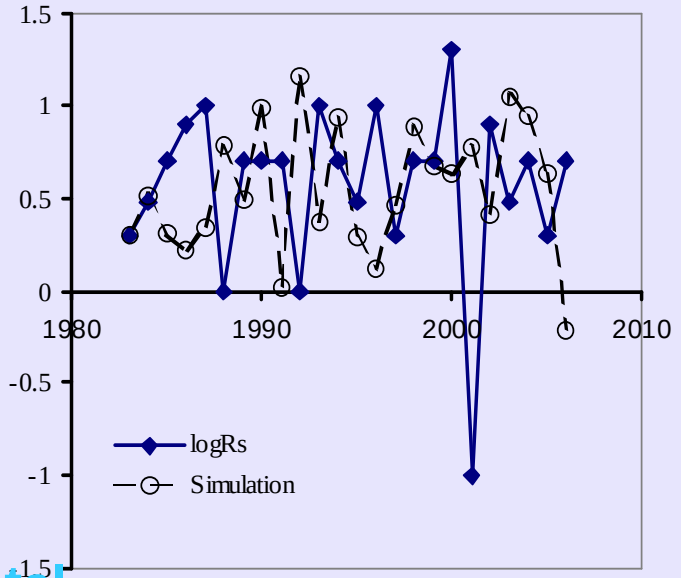
The new agenda addresses the same issues

p = process order (generation lag number for carry-over effects)

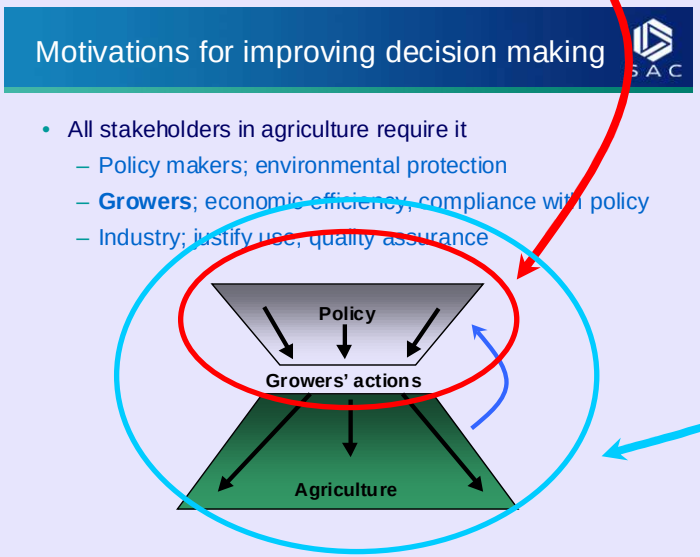
q = polynomial coefficient

$p = 1, q = 1 \Rightarrow N_t = f(N_{t-1})$

$$\log(Nt) = a + (1+b)N_{t-1} + \varepsilon_t$$



The managed past



Environmental noise

Agriculture of the future