Evaluation measures that reflect timeliness in surveillance

A monitoring system for detecting starts and declines of influenza epidemics and other cyclical processes

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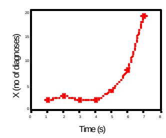
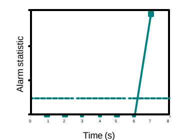
Weekly reports on no of influenza cases

SMI (Swedish Institute for Infectious Disease Control) collect weekly reports on number of suspected influenza cases and number of laboratory confirmed influenza cases.

Detect start of influenza epidemic

By using an alarm system, consisting of an alarm statistic and an alarm limit, we can detect the start of an epidemic.

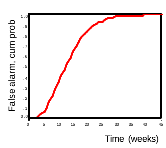




Measures of evaluation

Since timeliness is important, the alarm system should have the property that an epidemic is detected as soon as possible, without too many false alarms.

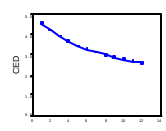
The alarm limit is set to have control over the false alarms



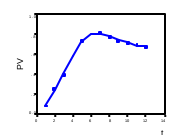
Median Run Length to first false alarm is 12

Other false alarm measures are Average Run Lenght (ARL^0) and Probability of False Alarm (PFA)

A "good" alarm system should indicate the change with short delay. Delay depends on the time of change.
A "good" alarm system should give reliable alarms. The trust you can have in an alarm depends on the time of alarm (information available)



The Conditional Expected Delay of an alarm, if the change occurs at time τ (MRL^0=12).



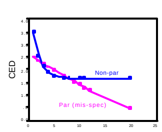
The Predictive Value of an alarm at time t (MRL^0=12)

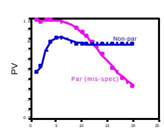
An optimal alarm system

The LR method (likelihood ratio) yields a minimal expected delay (for a fixed false alarm probability)

$LR = f(x_s; C)/f(x_s; D)$ C=μ, given outbreak of influenza
D=μ, given no outbreak

A non-parametric specification of μ can be preferred since there is a large risk for mis-specification of the parametric structure.





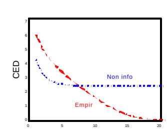
Expected delay and predictive value for miss-specified parametric trend and non-parametric approach (MRL^0=17)

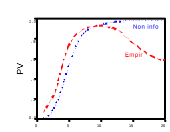
Using prior nformation

Say that during the previous years the epidemic has started 9 weeks after start of monitoring

One example of using prior information in the surveillance is to include information about the intensity of the process.

Compare an informative, empirical prior for the time of change with a non-informative prior





Expected delay and predictive value for empirical and non-informative prior regarding change point (PFA=0.10)

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