

Statistical Tools for Supporting Software Testing

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12th Dutch Testing Day

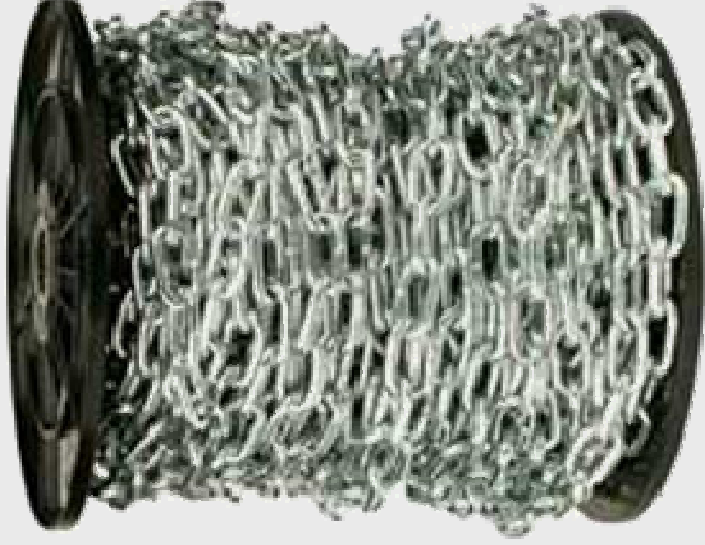
November 17, 2006

! Outline

- Basics of Reliability Analysis
 - Case of Rijkswaterstaat (Dutch Directorate for Public Works and Water Management)
- How to Apply Reliability models
 - Statistical Best Practices
 - Tool by LaQuSo and Refis



! The weakest link?



! The main question:

➤ How to determine the failure probability of software?

! Determine failure probability by

- ▶ Risk analysis
- ▶ Code analysis
- ▶ Testing
- ▶ Reliability analysis

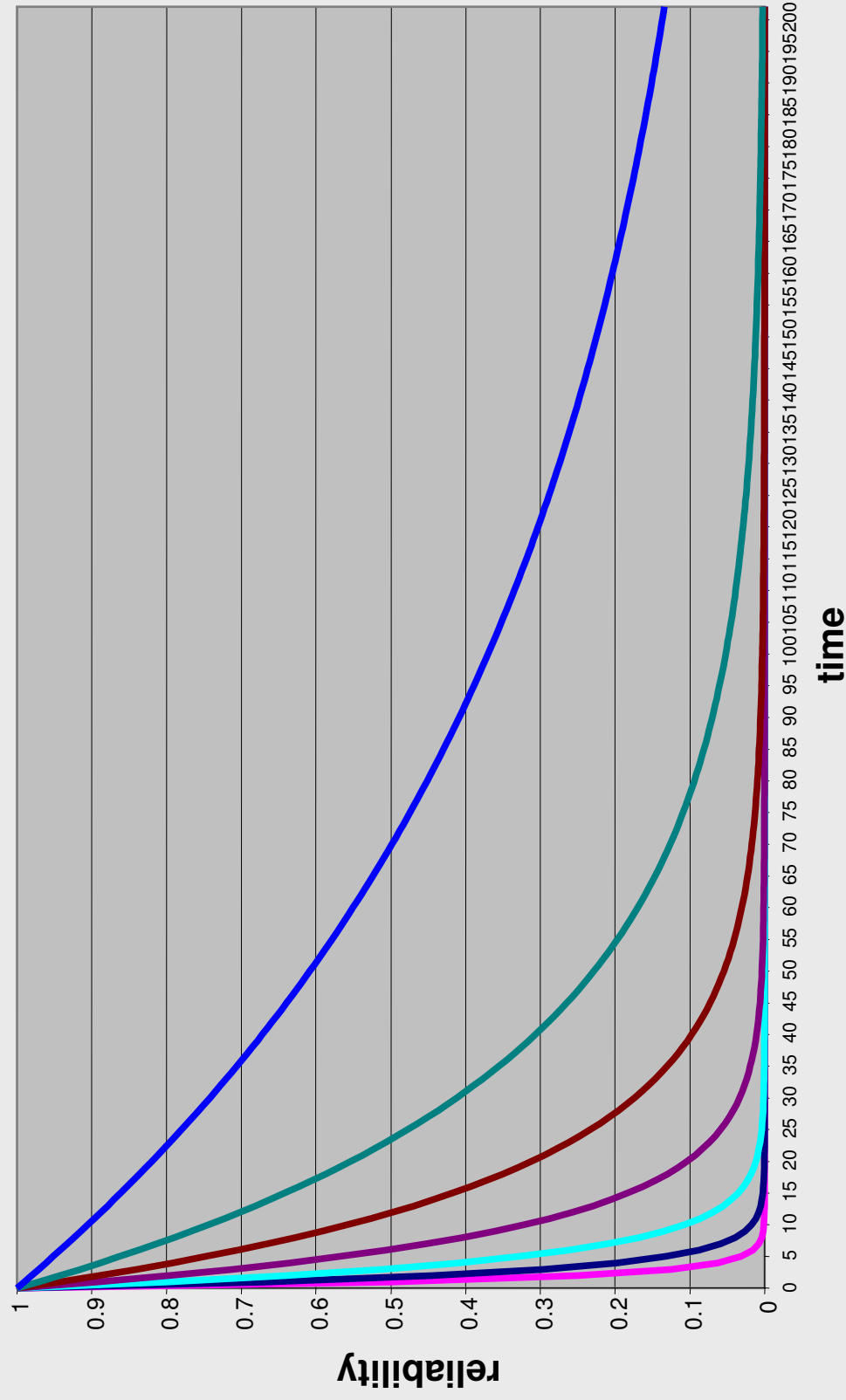
! Test results

- 200 bugs found,
of which
 - 198 solved
 - 1 work around
 - 1 minor bug still open
- 1000 bugs found,
of which
 - 998 solved
 - 1 work around
 - 1 minor bug still open

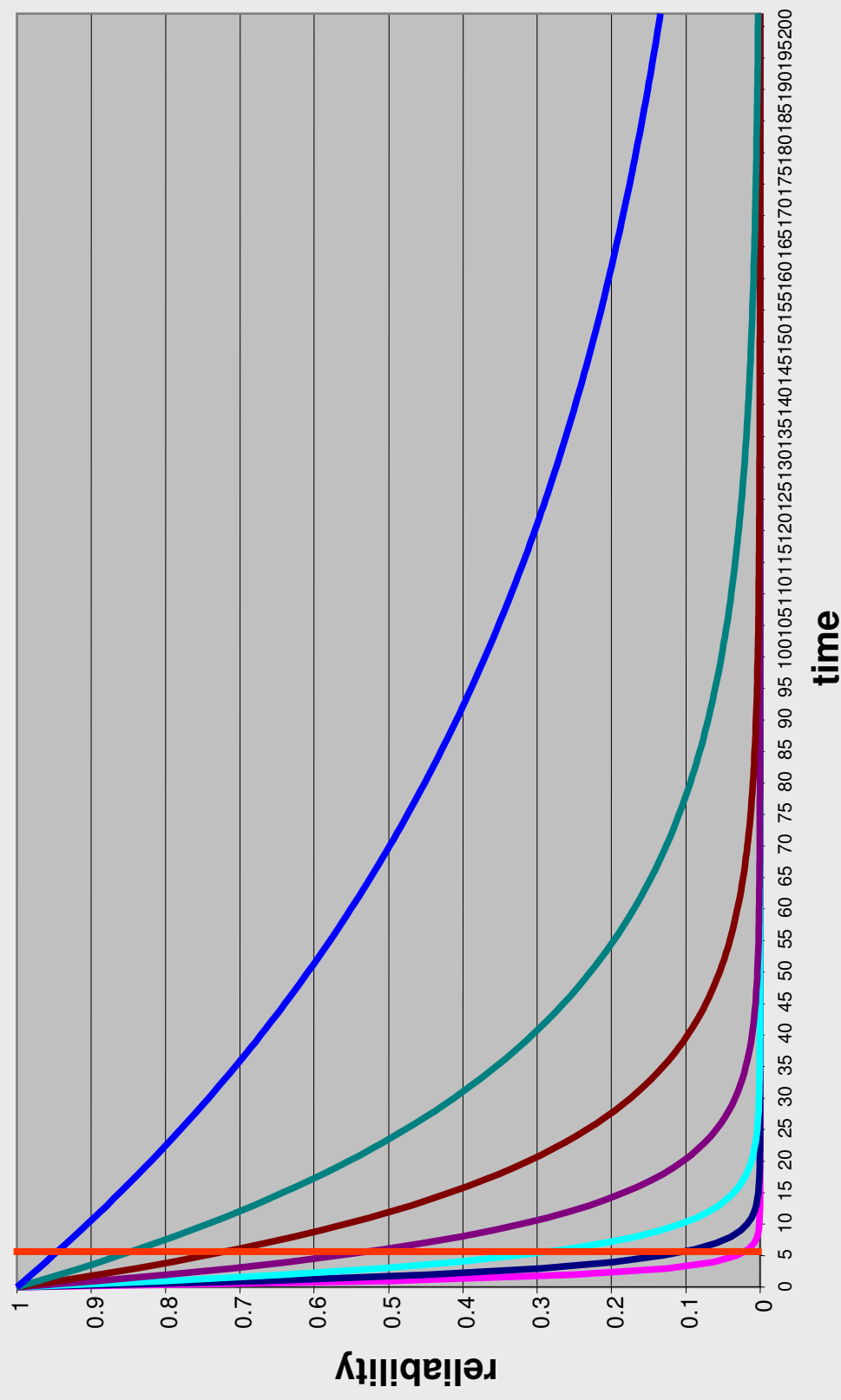
■ Definition of “Reliability”

“The probability that an item will perform a required function without failure under stated conditions for a stated period of time”

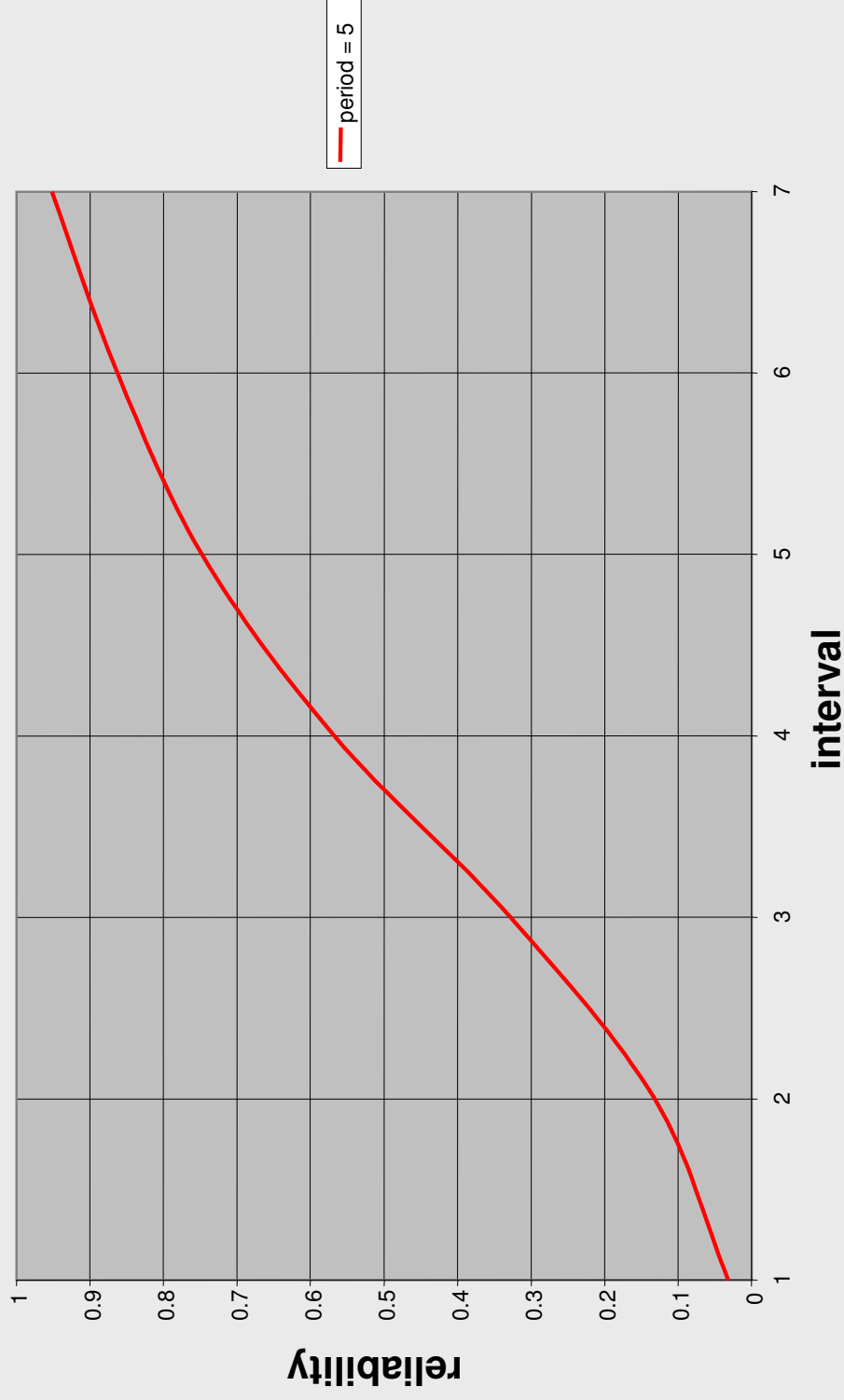
Reliability growth



Reliability growth

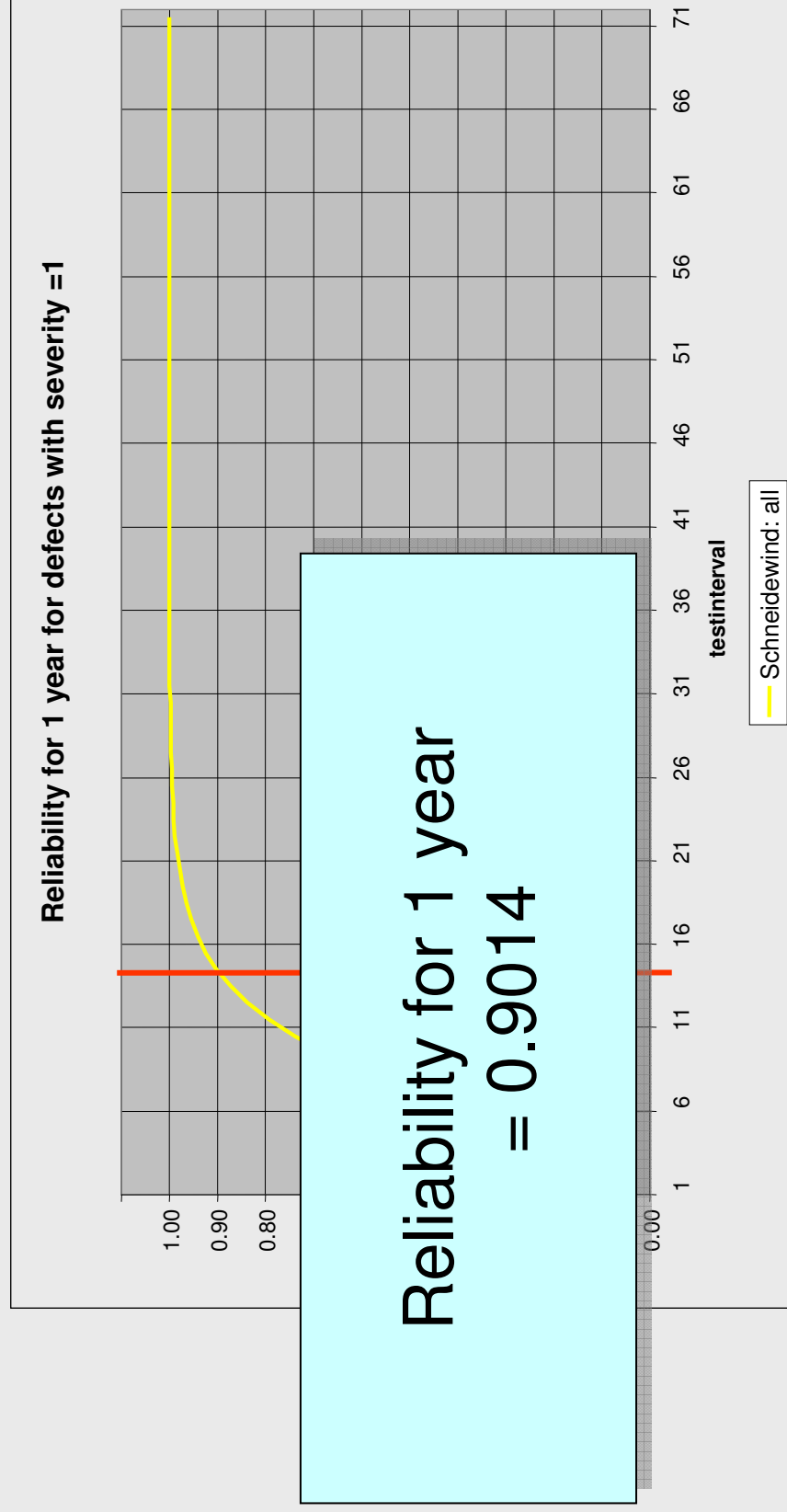


■ Reliability growth curve

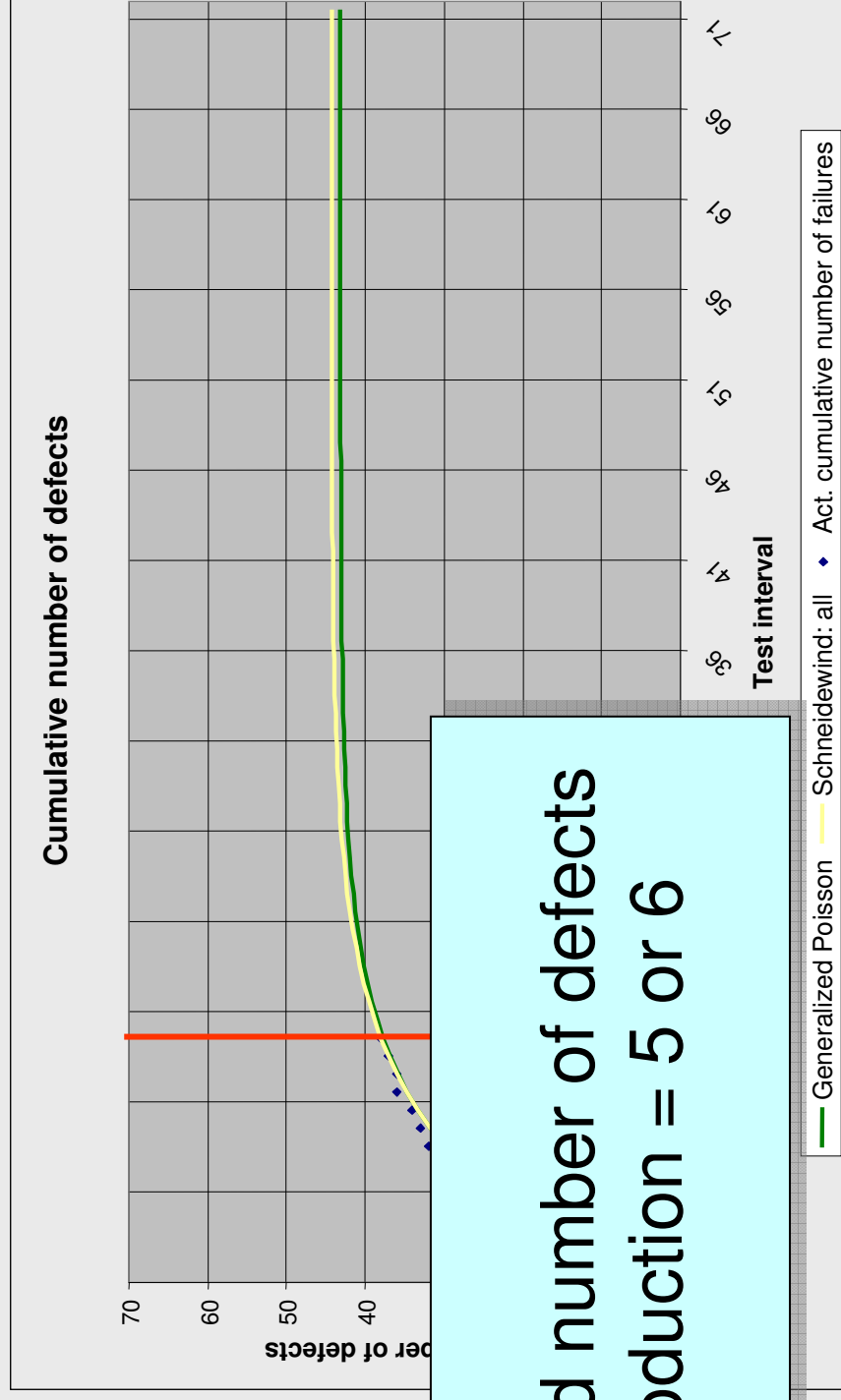


System Reliability Engineering

Results



Results



How to Apply Reliability Models

```
/// <summary>
/// Summary description for CSCodingStandard.
/// </summary>
public class CSCodingStandard Class name
{
    // Property field variable
    private string _fieldOne; Property fieldname

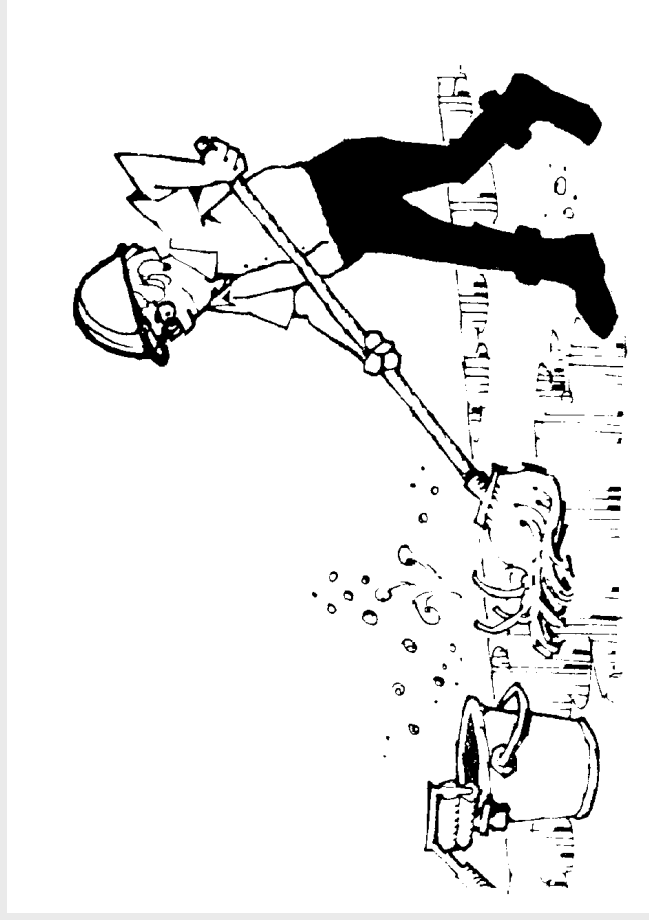
    // Property
    public string FieldOne Property name
    {
        get { return _fieldOne; }
        set { _fieldOne = value; }
    }

    // Constructor
    public CSCodingStandard() Constructor
    {
    }

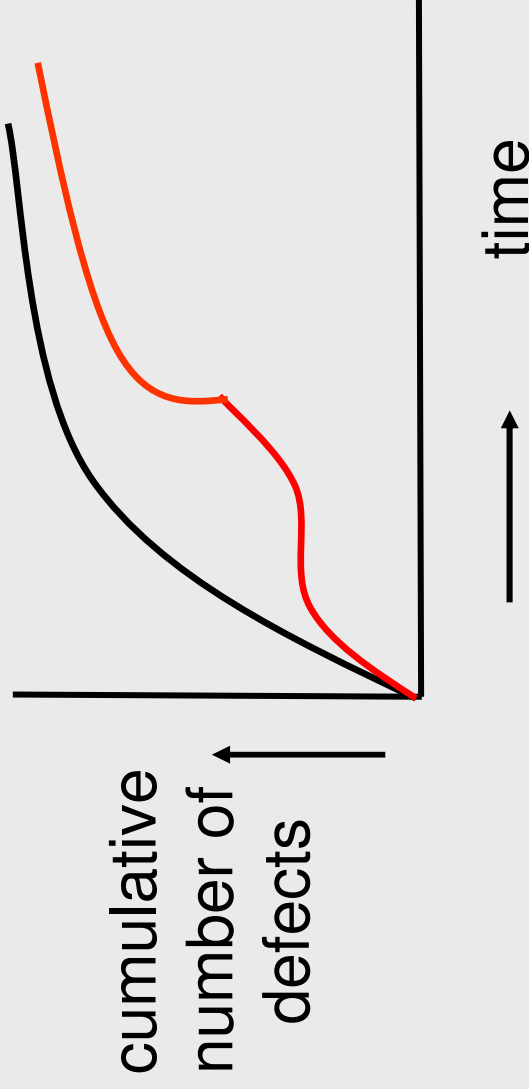
    // Method
    public void DoSomething(string parameter) Method parameter
    {
        // Do something
    }
}
```

■ Step 1: Data collection

- ▲ document data sources
- ▲ record data collection procedures
- ▲ clean-up data

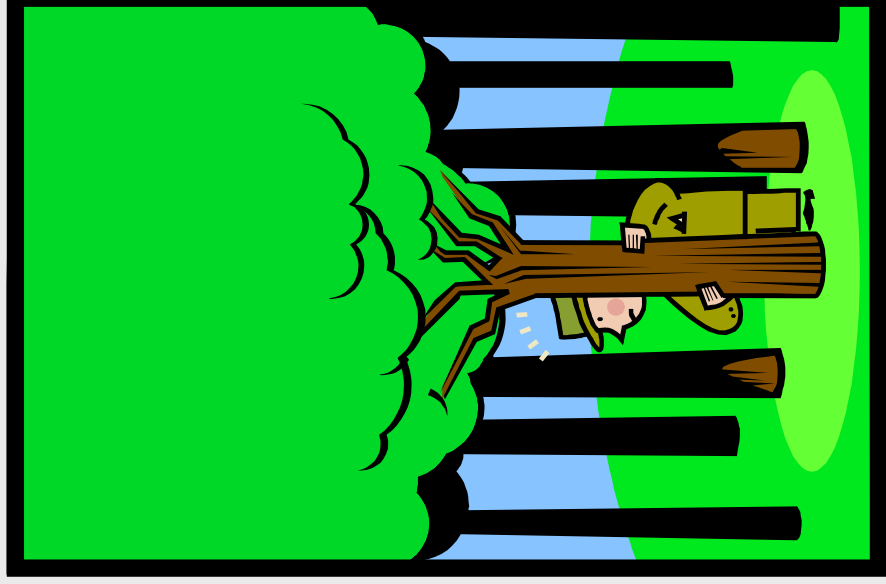


Step 2: Determine Growth

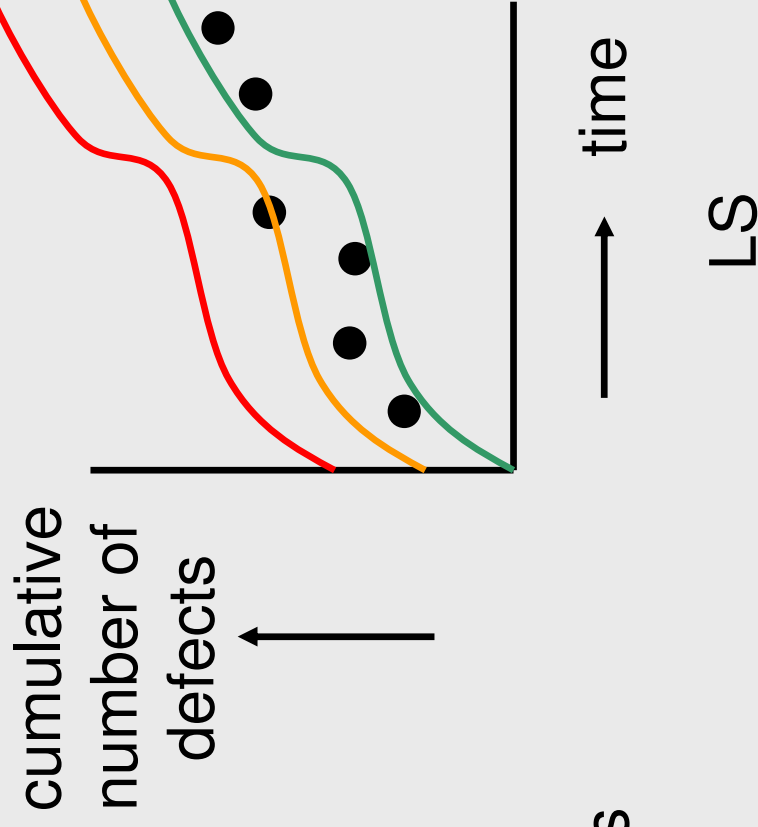
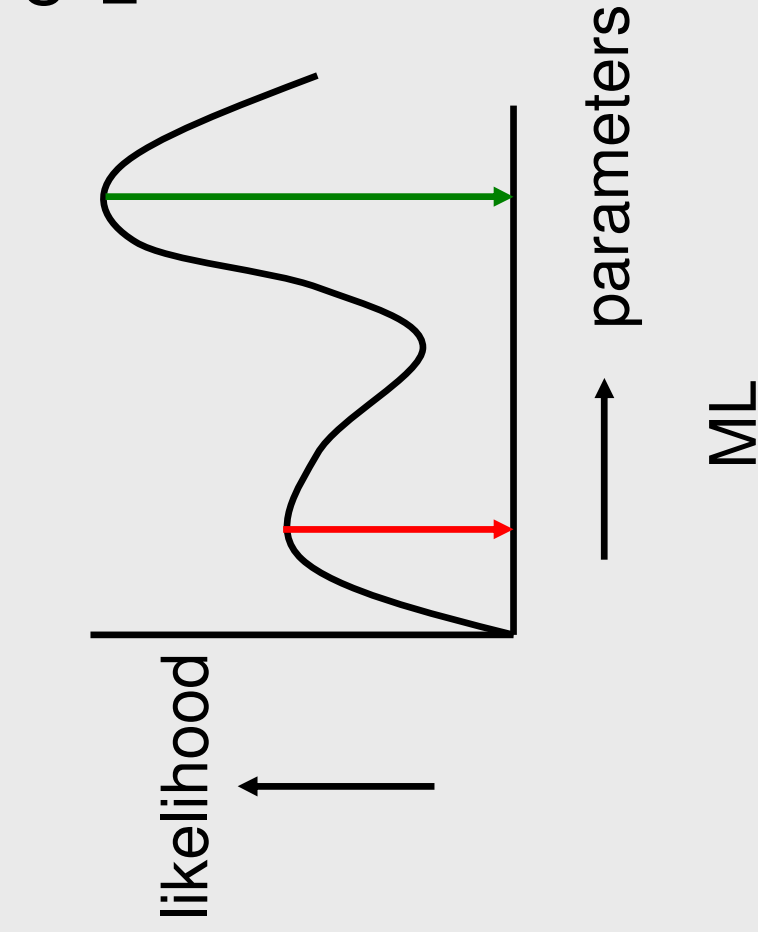


formal tests (Laplace, MIL-HB, LRT, ...)

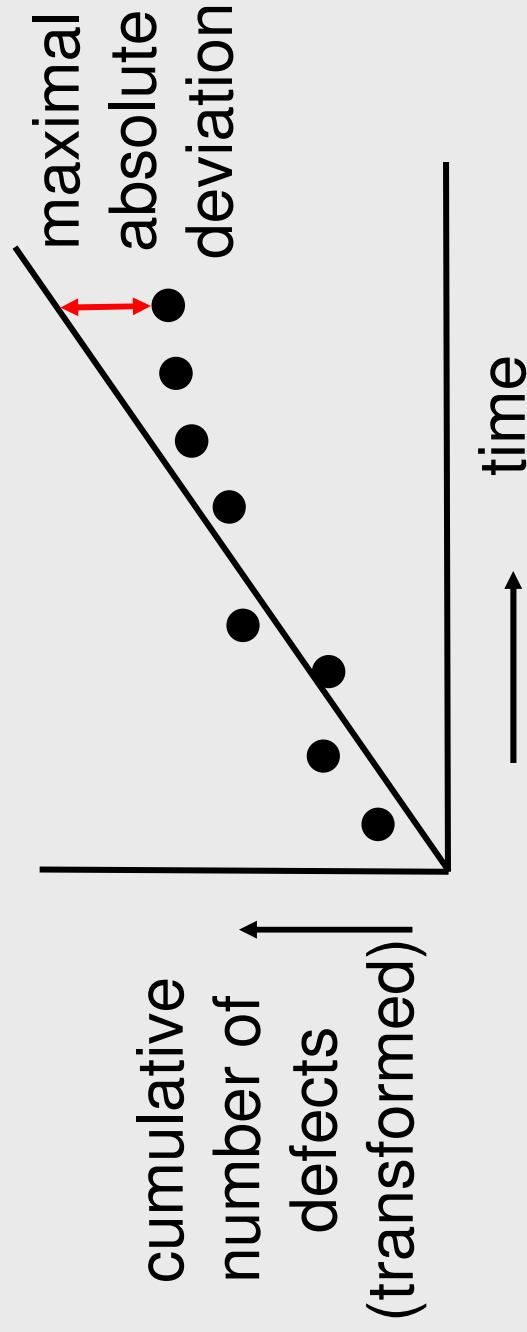
■ Step 3: Initial Model Selection



Step 4: Estimate Models

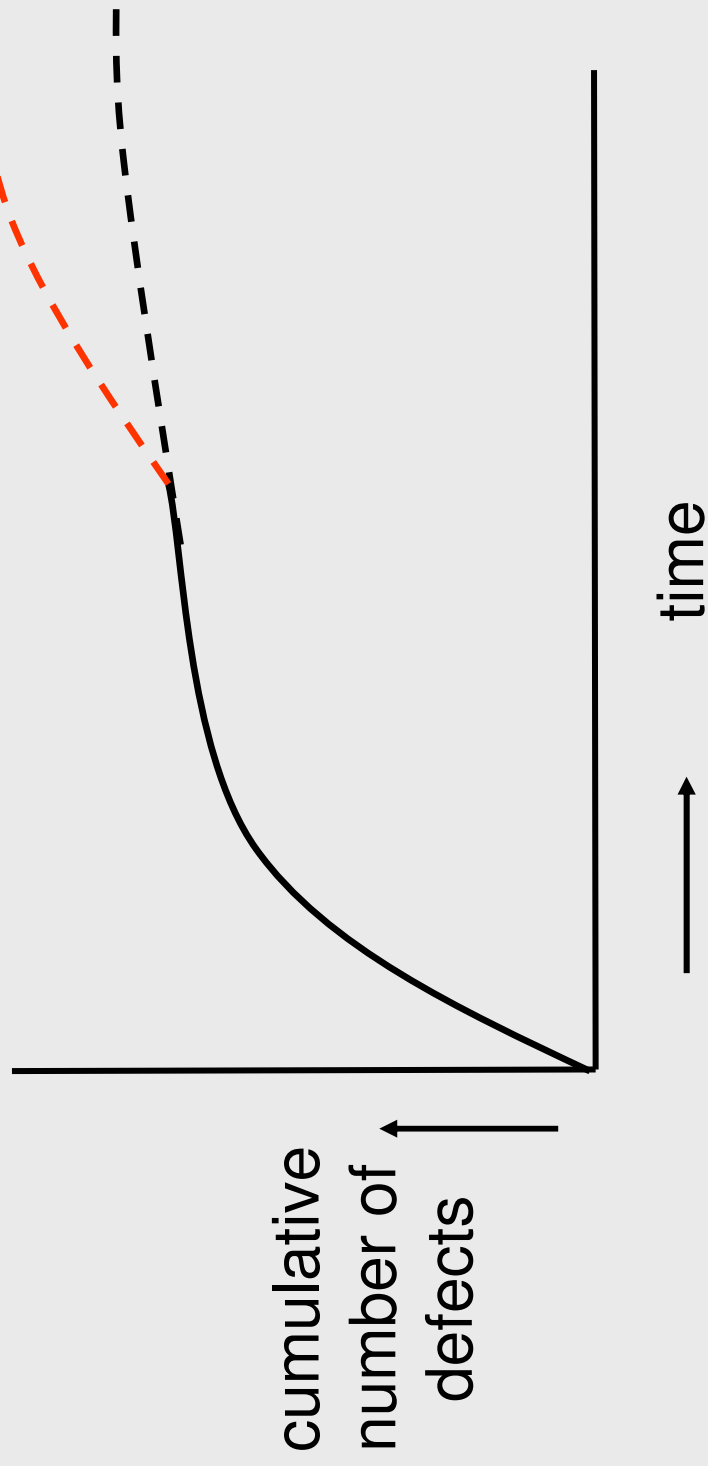


Step 5: Validate Model



- goodness-of-fit plots (TTT-plot, u-plot, QQ-plot, residual plots)
- goodness-of-fit tests (Kolmogorov, Cramer-von Mises,...)

Step 6: Interpret Model



👉 use confidence bounds to learn about precision

Refis LaQuSo Tool



! Conclusions

- statistics can be a useful additional method to evaluate software reliability
- a tool is being developed for software reliability analyses that incorporates best practices (“coding standards”) from statistics

