

Analysis of Defect (and other) Data

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Uses of Defect Data:

- **Defect counts derived from QC activity and combined with other data is an irresistible subject for analysis**
- **Radice (2000) identified minimal set of data types:**
 - **LOC (or other size measure)**
 - **Defects**
 - **Engineer months**
 - **Calendar months**
 - **Cost**
 - **Test progress**
- **Can investigate: rework, schedule, quality, predicted quality, working practices....**
- **Defect data are software engineering's 'lab rat'**

Statistical Process Control¹:...

- **SPC is a set of techniques that have been promoted**
- **It is attractive to software process engineers**
 - Its an engineer's analytical tool – legitimises software development as 'engineering'
 - Data appears to be appropriate
- **Controls chart types**
 - Two principal families of control charts – for variables and attributes
 - Neither are appropriate 'as is' for software – can lead to misuse and ad hoc modifications.
- **Raises numerous questions that must be answered to avoid 'jumping to conclusions'...**

1 – Many techniques but centred on run and control charts.

...Statistical Process Control:

- For example:
 - What type of control chart should be used
 - What types or classes of QC should be included
 - What types or classes of artefacts can be included
 - What are the allowable relationships between artefacts
 - What determines the sequence of the plots
 - What evidence is required to demonstrate parametric distribution
 - What is required to demonstrate linear relationship for normalized data
 - What significance have the +/- 3 sigma control limits for software
 - What do deviations from 'norm' mean?
 - etc...

 - What is the control chart for?

- Difficult to answer because software is product of a design process that only approximates to a manufacturing/replication process – the data does not behave.

Software Development:

- **Development (and inspection) of a software artefact is a unique event**
 - **Different people, skills, and priorities**
- **The artefact is unique too**
 - **Variation in size and complexity can affect relative defect levels**
- **There are similarities of course – but fundamentally different to hardware replication**
 - **E.g. ‘norms’ and conformance are not the essence of software development.**
- **To reiterate - what does a deviation from ‘norm’ mean?**
 - **Interesting**
 - **Prompts investigation**
 - **Exploratory data – *not* control data**

Production Data and Development Data:

- **Software development data (including defect counts) can be subject to SPC – but should it?**
- **Process control has particular needs**
 - **But control data is specialized and conceals more than it reveals**
- **Process control data has particular characteristics and constraints**
 - **Well characterized**
 - **Needs to be demonstrated – no jumping to conclusions**
 - **(and it usually cannot)**
- **So what analyses should be used?**

Analytical Techniques for Software and Software Development:

- **Well know**
- **Simple**
- **Robust**
- **Look to Production Engineering and TQC**

TQC:

- **Seven Tools:**
 - **Process chart**
 - **Pareto analysis**
 - **Ishikawa diagram**
 - **Histogram**
 - **Scatter diagram**
 - **Control chart**
 - **Check sheets**
- **In particular - the Histogram and the Scatter diagram**
 - **Familiar and often overlooked**
 - **Tukey's Exploratory Data Analysis**

Compare the use of control charts and histograms:

Control chart:

- Establish criteria for inclusion of data
 - Normalized, parametric data
 - Select chart type (standardized C chart?)
 - Calculate sample size to set control limits (+/- 3 sigma?)
 - Revise control limits?
 - plot data
 - Then...?
-
- **Histogram and Scattergram:**
 - Plot number of defects found for each artefact inspected
 - Plot scattergram of artefact size and number of defects.

 - **Histogram and scattergram are simpler, less error prone and more useful**

Further graphical analyses:

- **Box plots**
 - For groups of data
- **Other possibilities – e.g. Jeremy Dick's fault grid**
 - Defect 'containment'
- **Integrate symbolic diagrams and metrics to make 'pictures'**
 - Draw planned as well as display actual
 - And animate them?

Additional Data from Inspections?:

- **Inspections are the primary software quality control**
- **Derived from production engineering**
- **But software development is not replication - it is design**
- **And inspection is an aware process performed by intelligent people**
- **Identify record and analyses design excellence too?**
- **Potential is not bounded by a lower limit**

Envoi:

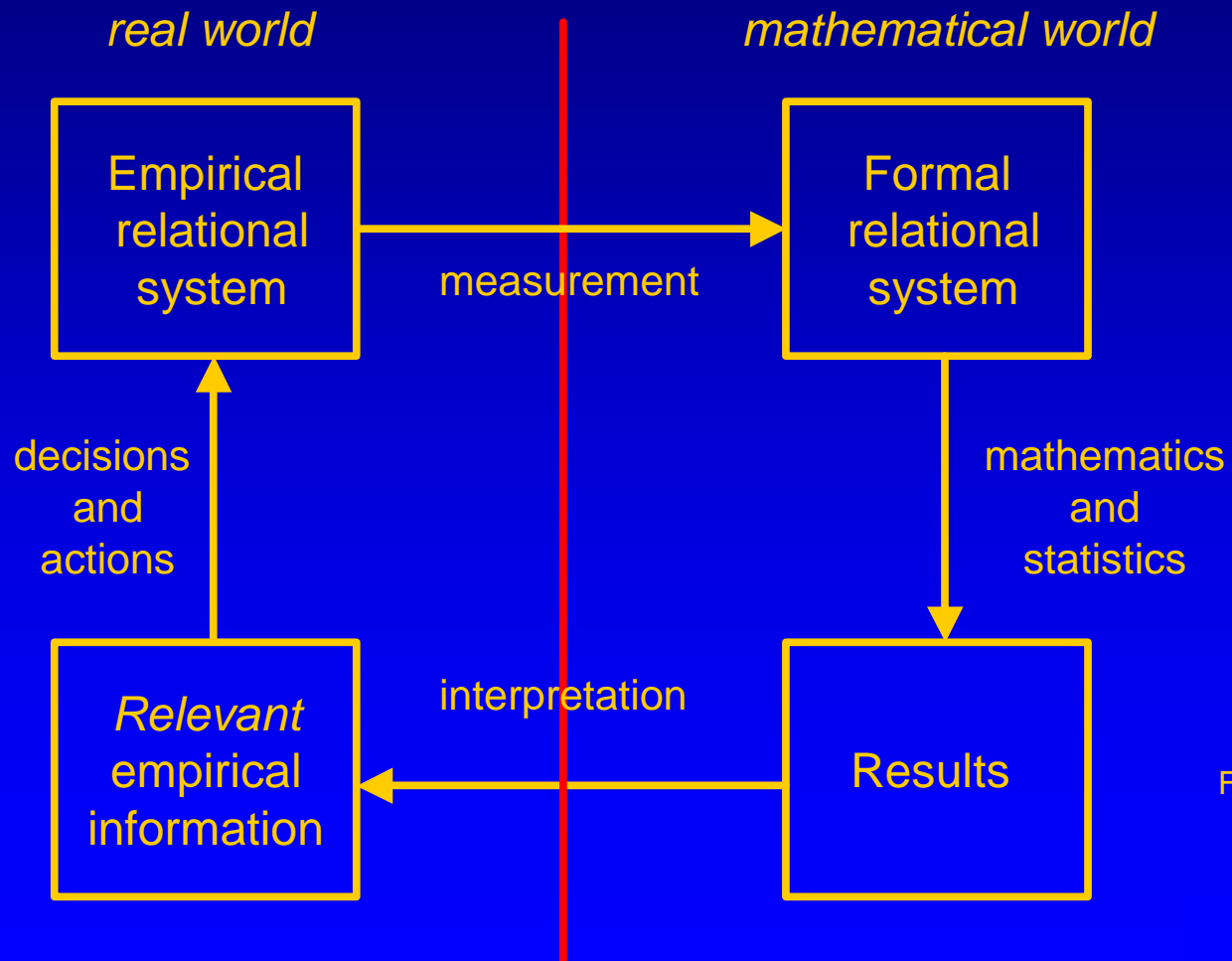
- **Software 'Engineering' is (or will become) an engineering discipline²**
- **It has a debt to other engineering disciplines**
- **This will be repaid when it is recognized that it is a *design* discipline not a manufacturing (replication) discipline - and develops its analytical tools accordingly**

2 – When we stop reinventing, acknowledge prior work and build on it.

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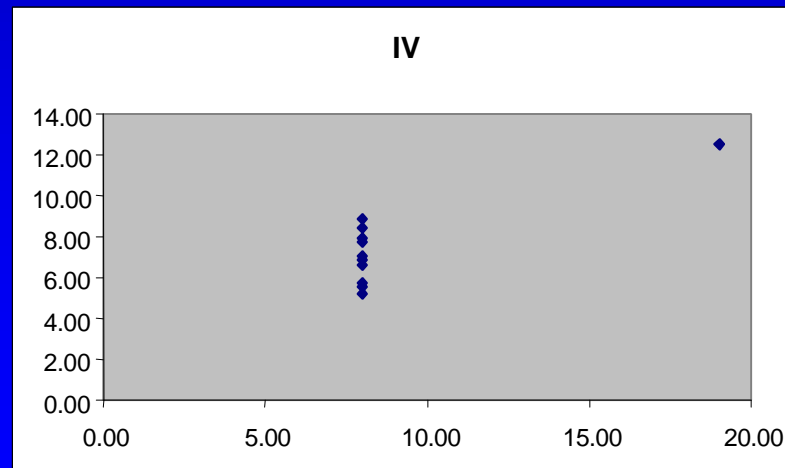
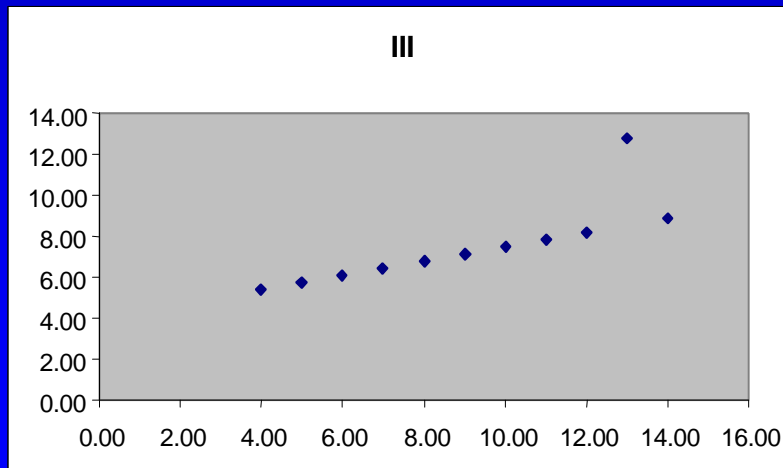
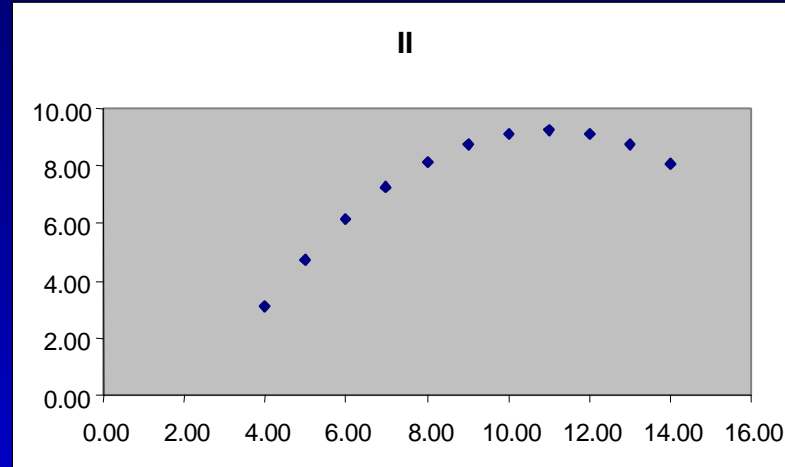
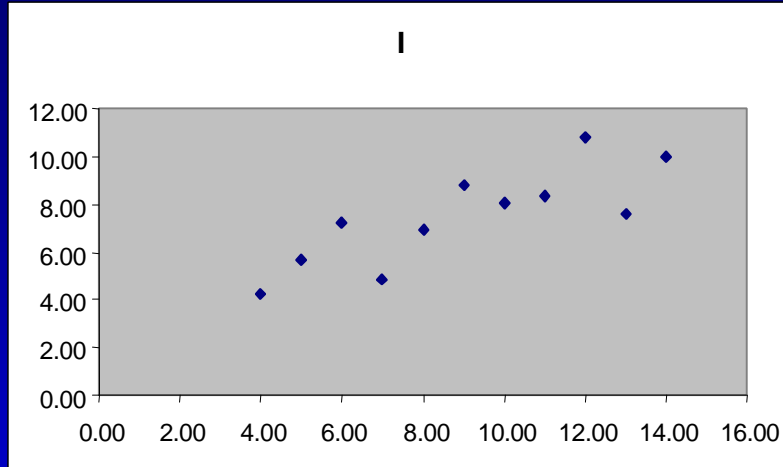
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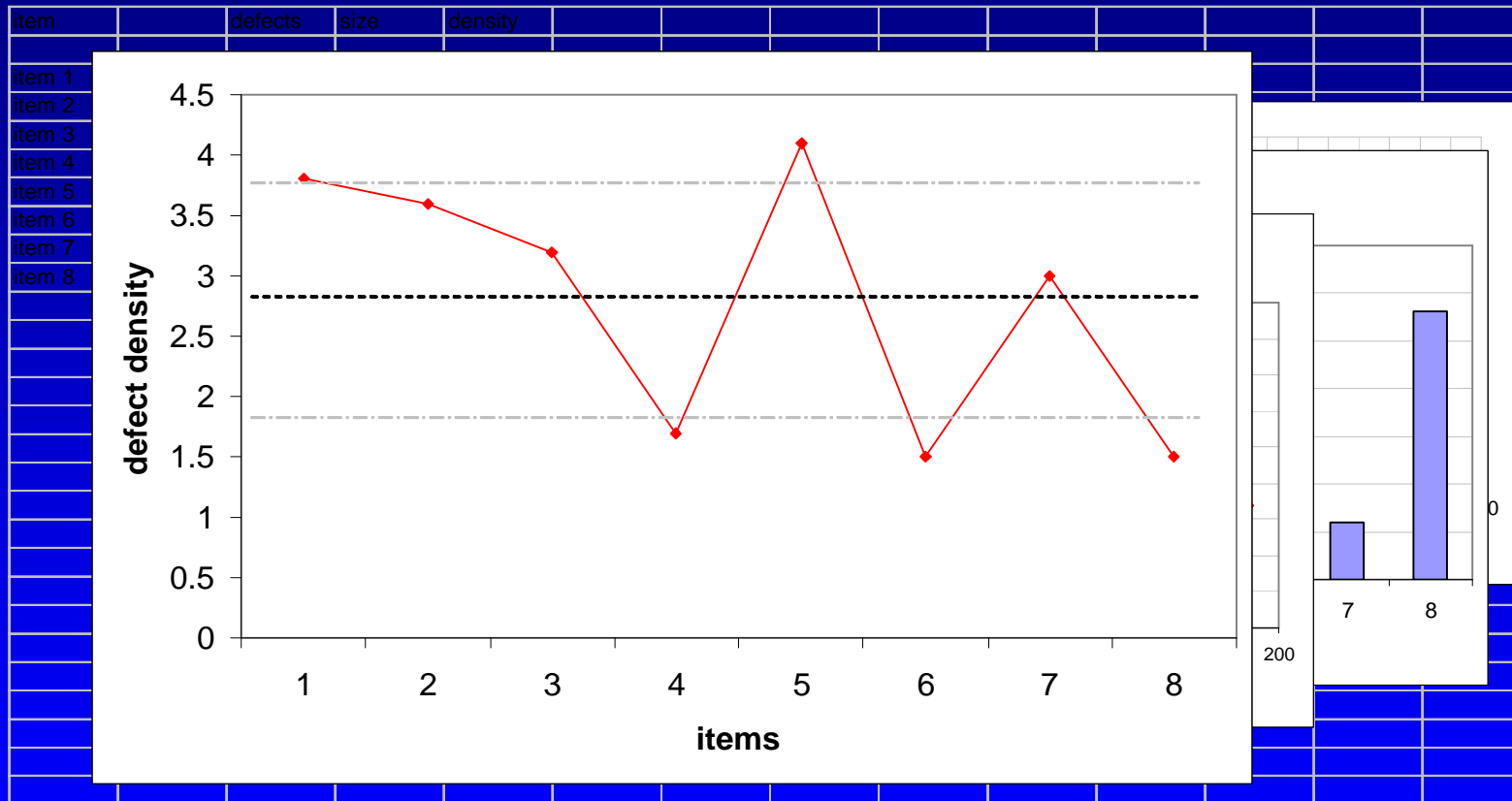


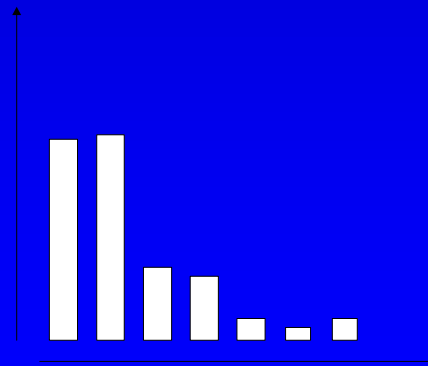
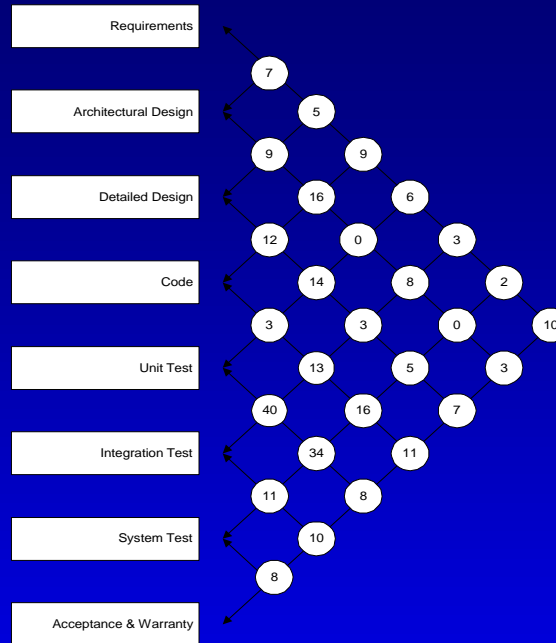
From Pfleeger 1998

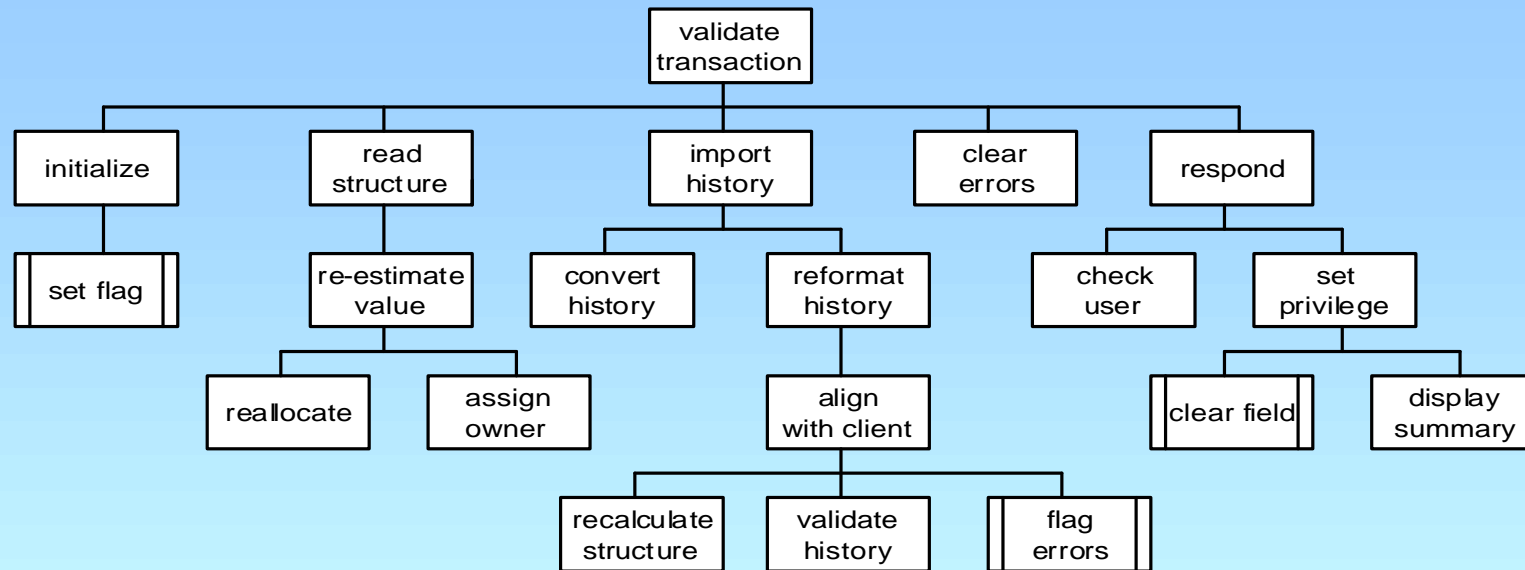
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11.00	8.33	11.00	9.26	11.00	7.81	8.00	8.47
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6.00	7.24	6.00	6.13	6.00	6.08	8.00	5.25
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12.00	10.84	12.00	9.13	12.00	8.15	8.00	5.56
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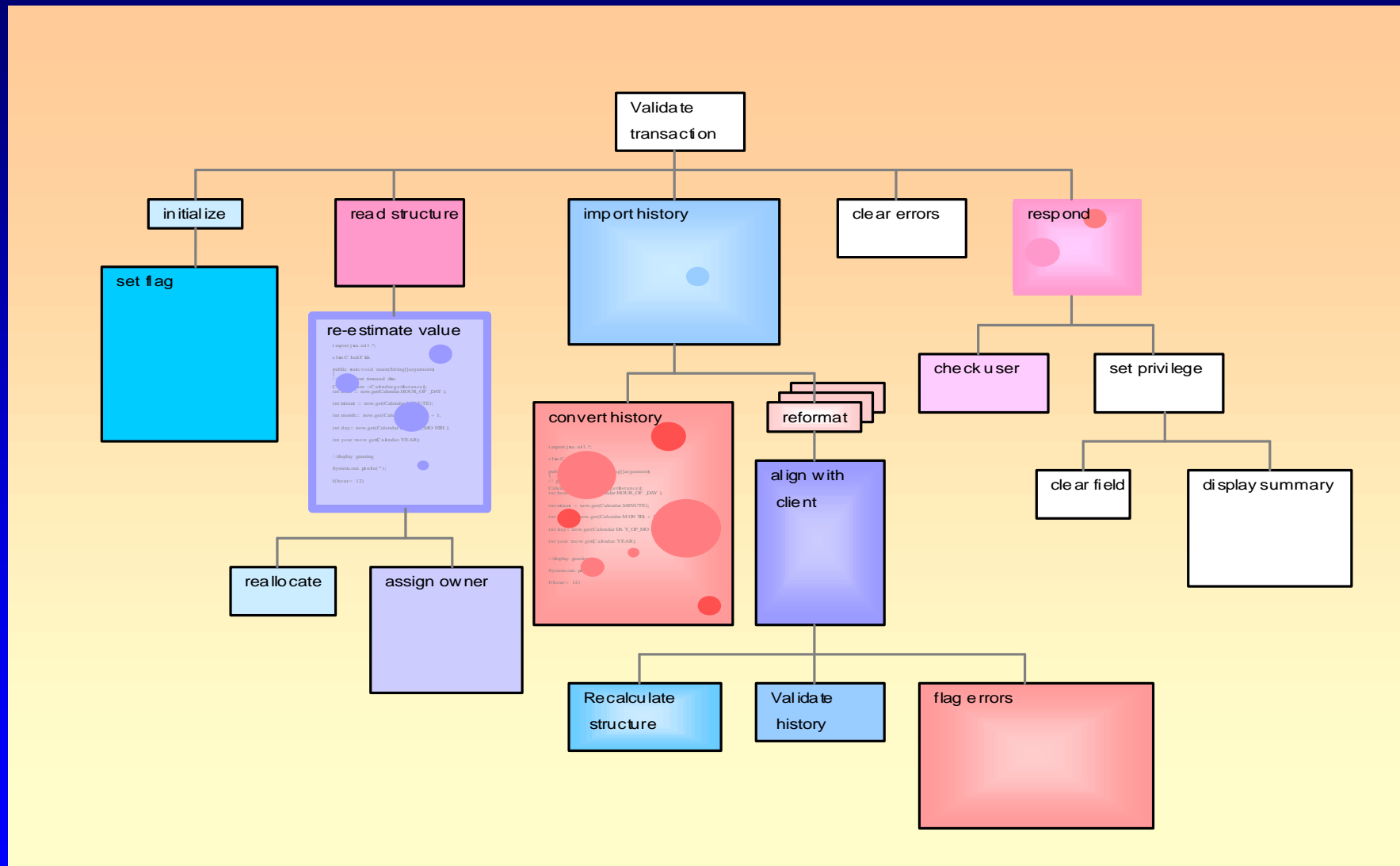
'Anscombe's quartet'











- **Validating Measurements**

- do the data reveal the truth?
- is the representation accurate?
- are the data carefully documented?
- do the methods of display avoid spurious reading of the data?
- are appropriate contexts and comparisons shown?

– From Tufte

