Furthering modelling by conducting tests

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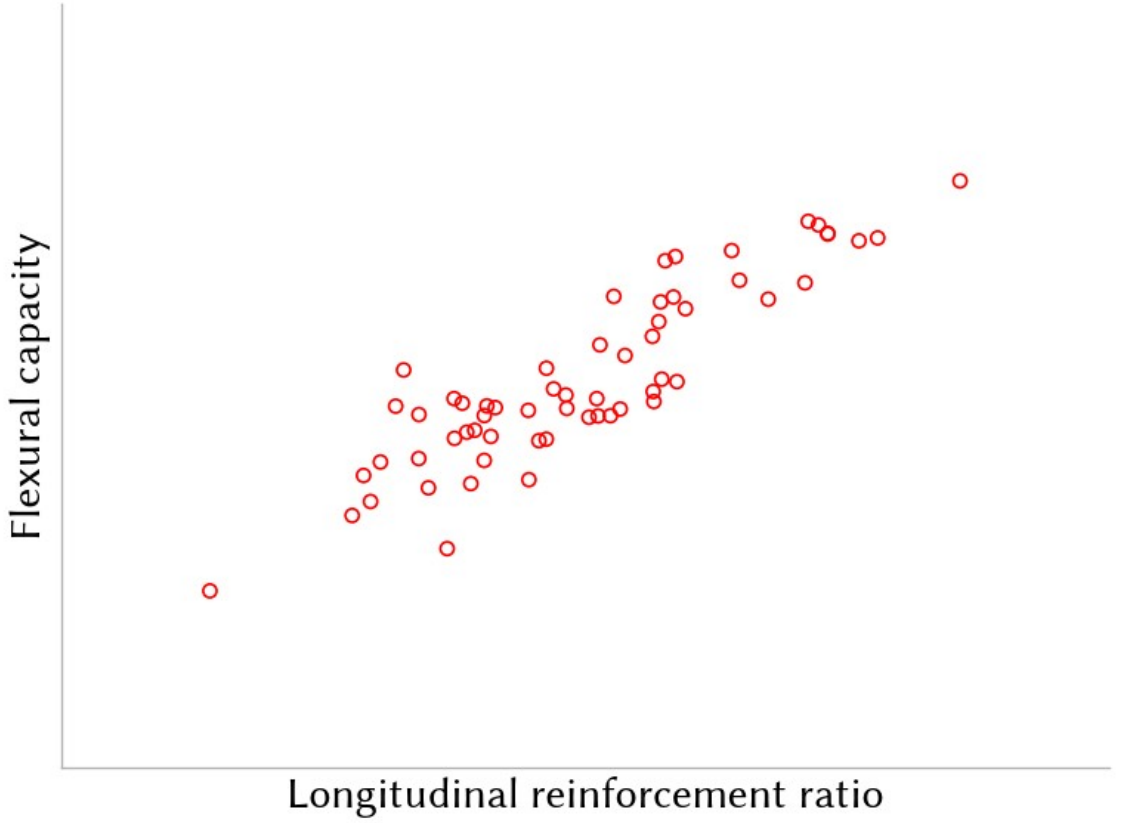
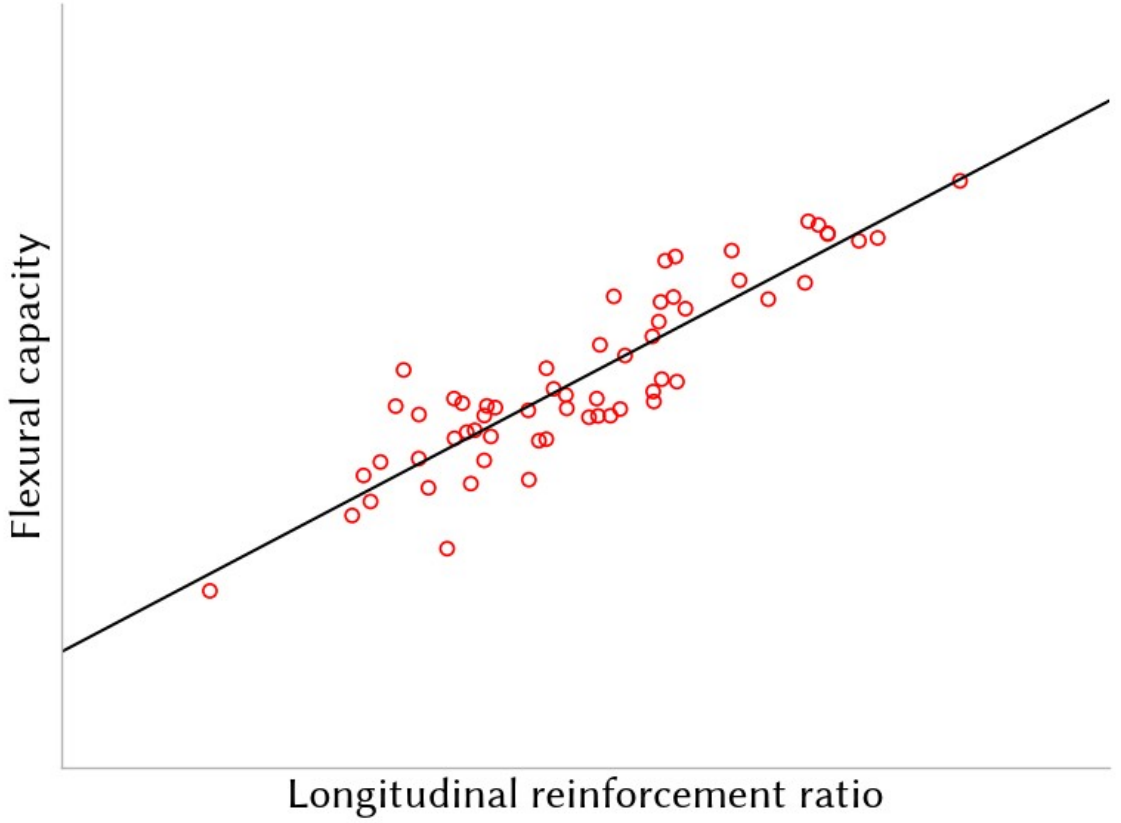
Testing vs. modelling



- Tests provide useful insights into structural behaviour
- But testing cannot be an end in itself
- Tests are most useful when they aid model development for forward prediction

Testing vs. modelling



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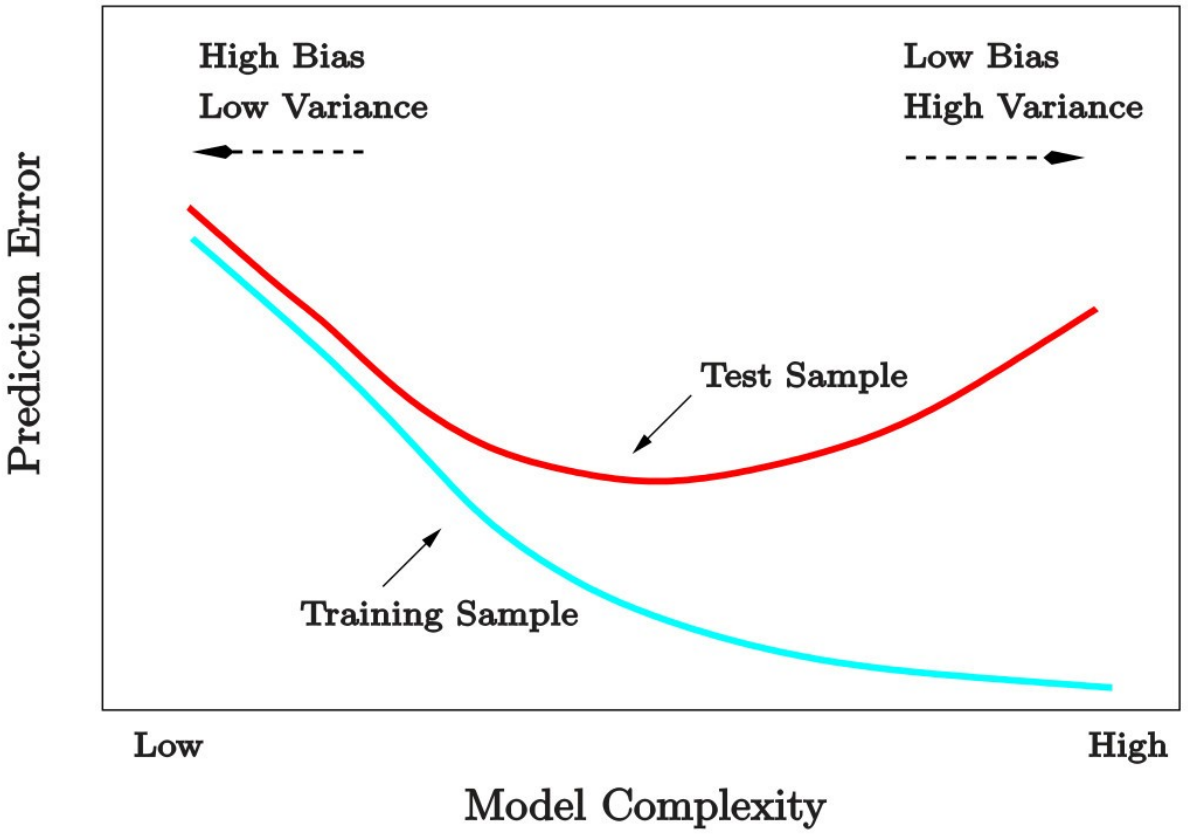
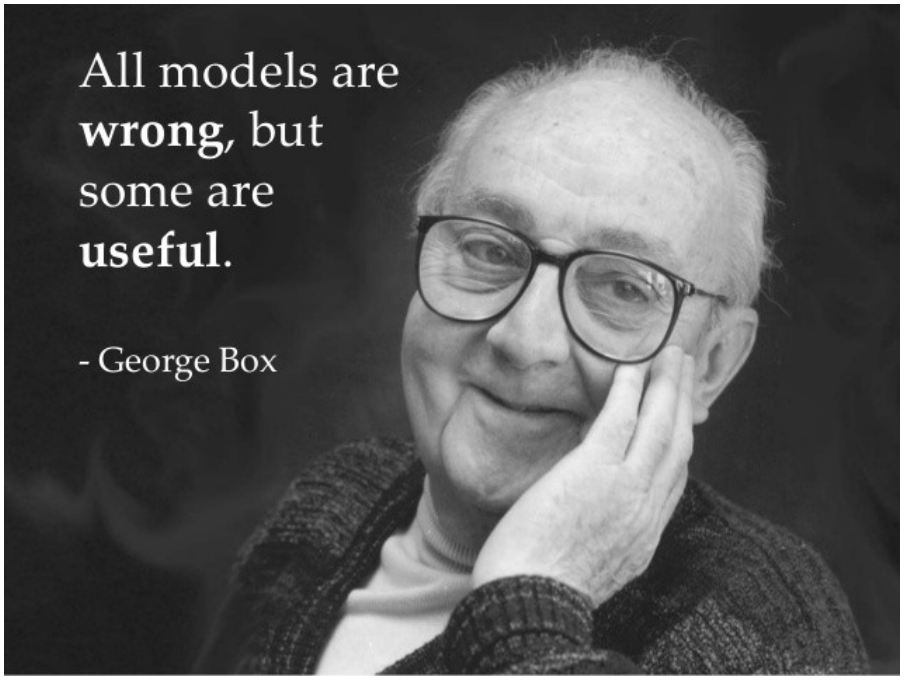
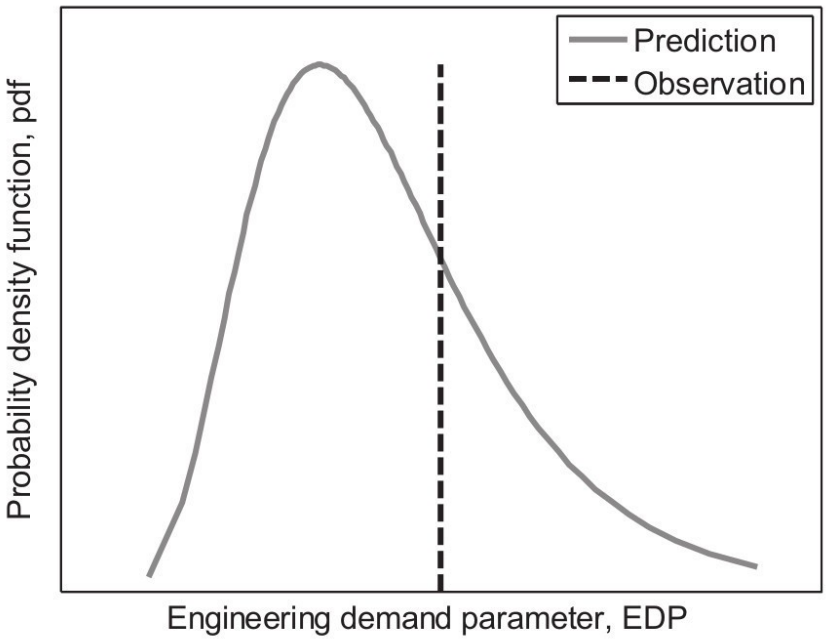
Bias-variance tradeoff



- The most complex model is not always the best model!

Model validation

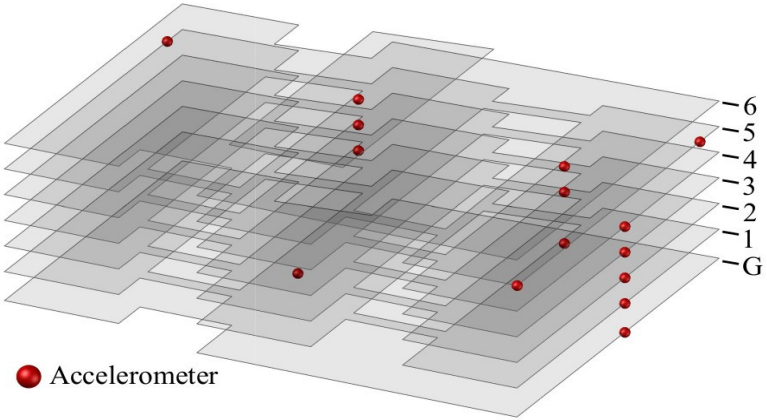




- Geotechnical engineers have initiated projects like PRENOLIN and LEAP recognising the need to verify and validate their models
- Structural engineers deal with relatively lesser uncertainty, but have still focussed very little effort in attempting to quantify it
- No model is exact, but it is helpful to know how accurate and precise they are

Field data

- Field data is probably best suited for validating structural models
- Unfortunately, field data is scarce
  - Earthquakes don't occur very frequently
  - Most earthquakes don't occur near populated cities
  - Not many buildings are instrumented
  - Instrumentation density is often sparse
- Available field data is often difficult to access and use
  - Hard to access due to privacy concerns
  - Structural metadata is often sketchy
  - Double-integration of acceleration data to infer displacements is error-prone
  - Records can often be noisy



Experimental test data

- Small-scale tests are suitable for validating component and sub-assembly models
- But structural models are more than mere assemblages of hysteretic component models
  - Boundary conditions
  - Damping
  - Mass distribution
  - Nonstructural components
- Designing tests to facilitate model validation
  - Record the sequence of models developed preceding the test
  - Record the process of calibrating the models after acquiring the test data
  - Quantify the uncertainty in the developed models at different stages
  - Analyse and publish the evolution of the developed models
  - Blind prediction contests are helpful, but can produce misleading conclusions if interpreted at face-value