

Golem of Prague

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Introduction

- Most of the statistics we use were designed for simple systems. The questions we are trying to answer nowadays regard much more complex phenomena and behaviour
- Statistical models are like small robots: they are not clever, they just follow instructions. It's important to keep this in mind when doing science: we need to use the right models to answer the right questions.
- We should use 'robots' for the things we are not really good at
- Another mythology for robot is a Golem: a clay figure brought to life by magic.
- Most notably: The Golem of Prague. Legend has it, a Rabbi created a Golem to protect the Jews in Prague from persecution. But because the Golem took instructions so literally, it ended harming people instead of saving them. We need to be careful of the types of models we build so that they do not 'harm' anyone. | Golem | Model | |——|——| |Made of Clay | Made of Silicon| |Animated by "truth" | Animated by "truth"| |Powerful | Hopefully powerful | | Blind to creator's intent | Blind to creator's intent | |Easy to misuse| Easy to misuse | |Fictional | Not even false |
- Models are as false as hammers are. They are not.
- "Some models are false, but some of them are useful"
- This course is not about building statisticians: lots of coding, none of the problems we are looking at are solvable analytically.
- What we do for a living: being confused, but trying to be less confused every day.

Updates to the 2nd Edition

- Lots of predictive simulation, Causal Inference (DAGs, Colliders, Instrumental Variables), `map` becomes `quap`, `map2stan` replaced by `ulam`, New examples.

We should all be against tests

- Statistical tests are like specialised, pre-made golem procedures. We should be able to make our own golems that fit our needs!
- Developed in the 20th century
- Disguised as not golems
- The concept of falsifying a *null* model is not sufficient
- Ultimately, inference is not decision
- Statistical models are not hypothesis
- Example:

... H₀ Evolution is Neutral. We pass this idea through different methodologies, and we analyse a 'cut' of the data through a statistical model. But what if evolution is not neutral, how do we test that? ... We cannot falsify one hypothesis with only one model, so how do we do this properly? ... The process looks

something like this | Hypothesis | Model | Statistical test | | | | H0 | Model 1 |
 Resulting data: test T1: Conclusion 1 | H0 | Model 1 | Resulting data: test T2: Conclusion 2 | H1 | Model 2 |
 Resulting data: test T1: Conclusion 1 | We need to think about these models clearly.

- Failure of falsification. Karl Popper. ... Evidence requires building several models that are consistent with a theory. With current statistical tests, researchers are not trying to test their research hypothesis, but rather uninteresting hypothesis to show that nothing is going on. ... Try to come up with a model that predicts that something is happening, and try to falsify that!
- What (which kinds of models) we are going to build: – Bayesian Data Analysis – Multilevel Modelling – Model Comparison