

Prediction

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Example: linear regression

Polynomial regression

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Running models forward

Suppose you have parameterized a model $y(t|\theta)$ with parameters θ and calibrated it to some time range $[0, T]$. Prediction means projecting $y(t)$ for $t > T$.

Sometimes people call this “out of sample prediction”.

When the model holds outside the support of the data, then it works well.

When the model does not hold, then it doesn't.

Example: linear regression

Polynomial regression

Causal inference

These questions suggest a formal view of out-of-sample prediction.

What-if scenarios - What if everyone got the same treatment? -

What if we implement the program? - What if we eliminate the program?

Crash course in causal inference using models

You observe some data for outcomes under certain circumstances.

You want to know what *would have happened, had circumstances been different*. To do this, you need to reason about counterfactual outcomes. When can you do this using models?

Suppose you believe a linear model for the potential outcome

$$Y(x) = \alpha + \beta x + \epsilon$$

changing x one unit gives a change of β in the outcome.

$$ATE = Y(1) - Y(0) = \beta$$

Easy!

Modeler beware: spurious associations

sources of apparent dependence in variables (see figure) causation
reverse causation confounding selection

Using evidence from trials, surveillance, and observational studies to calibrate mechanistic models.

Difficulties: many studies report composite or marginal measures like odds ratios. How to use these properly?

Making good decisions

See appendices of Manski public policy book See Basu book

Borrow some of Gregg's books

References