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Strategic Statistical Models in R

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Abstract

We don't really have one yet.

Keywords:˜bear, moose, pizza.

1. Introduction

The **strat** package provides functions for the estimation and analysis of statistical models derived from game theory.

Gauss (**?**).

2. Strategic statistical models

(talk about strategic models in general)

2.1. Discrete-choice extensive form games

The simplest example of a strategic statistical model is a two-player game with three potential outcomes, which corresponds to the game trees in Figure˜**??**.

We will use the following notation throughout the rest of the section:

The equilibrium of the model depends on

2.2. The statistical ultimatum game

3. Estimating strategic models with strat

(anything else common to all models?)

Since each utility value is modeled as a function of (possibly) different regressors, it is necessary to deal with multiple model formulas. To construct a model frame from a formula with multiple right-hand sides, we use the `Formula` class from the **Formula** package (**?**). The first argument of each estimation function is `formulas`, where the right-hand side should contain as many formulas as there are utilities (other than those fixed at 0) in the model. In `strat12`, there are four right-hand formulas, corresponding to U_{11}, U_{13}, U_{14}, and U_{24} respectively. Consider the following specification of utilities:

$$\begin{aligned} U_{11} &= \beta_{10} + \beta_{11} X_1 \\ U_{13} &= \beta_{30} \\ U_{14} &= \beta_{41} X_1 + \beta_{42} X_2 \\ U_{24} &= \gamma_{40} + \gamma_{42} X_2 + \gamma_{43} X_3 \end{aligned}$$

This would be specified in the `formulas` argument as follows:

```
m1 <- strat12(formulas = y ~ X1 | 1 | X1 + X2 - 1 | X2 + X3, ...)
```

Similarly, there must be six right-hand formulas in a call to `strat122`, corresponding to U_{11}, U_{12}, U_{13}, U_{14}, U_{22}, and U_{24} respectively. An `ultimatum` model has two right-hand sides: R_1 and R_2.

(talk about estimation via BFGS and maxLik)

3.1. Discrete models

For the discrete models discussed in Section˜2.1, the response variables may be specified in terms of either outcomes or actions. For example, in the `strat12` model, one could represent the outcome as which of the three terminal nodes is reached (outcomes); or as whether Player 1 chose a_1 or a_2, and Player 2's choice of a_3 or a_4 if Player 1 chose a_2 (actions). The estimation functions in **strat** allow for the response to be specified in either way. For outcomes, use `y ~ u11 | u13 | u14 | u24`, where `y` is an `integer` or `factor` variable whose values/levels correspond (in order) to outcome 1, 3, or 4 being reached. For actions, use `y1 + y2 ~ u11 | u13 | u14 | u24`, where `y1` is a dummy variable for whether Player 1 chose a_2, and `y2` is a dummy variable for whether Player 2 (if her move was reached) chose a_4. The following data frame provides an example of equivalent outcome and action variables:

```
  outcome action1 action2
1       1       0       0
2       3       1       1
3       2       1       0
4       2       1       0
5       1       0       0
6       3       1       1
```

Note that the value of `y2` when `y1 == 0` (i.e., Player 2's move was not reached) does not matter. However, to avoid errors, such values of `y2` must be set to 0 or 1, rather than `NA` or another numeric value.

3.2. Ultimatum game

(talk about the two different log-likelihoods, referring to equations from earlier)

4. Interpreting estimation results

As with most nonlinear models, the interpretation of raw numeric results from a strategic model is not straightforward. To facilitate meaningful analysis, such as the marginal effect of a regressor on the probability of a particular outcome, we provide the `predProbs` function.

(mention similarity to **gam** (**?**))

5. Examples

(go through three things: basic estimation with war1800, estimation of an experiment, and use of ultimatum)

(demonstrate latextable)

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