



*E*conomics of *H*uman *C*apital

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grmpy Tutorial

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Introduction

grmpy

`grmpy` is an open-source Python package for the simulation and estimation of generalized Roy model. Its main purpose is to serve as a teaching tool to promote the conceptual framework provided by the generalized Roy model to illustrate a variety of issues in the econometrics of policy evaluation.

- ▶ ***grmpy*** is ...
 - ▶ ...an open-source Python Package for the simulation and estimation of the generalized Roy model.
 - ▶ ...intended as a useful device to support and improve the understanding of the framework by providing the opportunity to experience the effect of particular specifications directly.

Setup

Setup

- ▶ Normal linear-in-parameters version of the generalized Roy model.

Potential Outcomes

$$Y_1 = \beta_1 X + U_1$$

$$Y_0 = \beta_0 X + U_0$$

Cost

$$C = \gamma Z + U_C$$

Observed Outcomes

$$Y = DY_1 + (1 - D)Y_0$$

Choice

$$S = Y_1 - Y_0 - C$$

$$D = I[S > 0]$$

Features

Features

- ▶ *grmpy* is currently capable of the following features:
 - ▶ Simulating a dataset based on your own specifications.
 - ▶ Providing some useful information about the simulated dataset for instance:
 - ▶ Distributional outcome characteristics
 - ▶ ATE, TT, TUT
 - ▶ MTE by ventile
 - ▶ Estimating the coefficients of interest given a dataset (of a specific form).

Install the package

- ▶ OS, Linux : Use the pip install manager (*pip install grmpy*) or download the package via [GitHub](#) and install it manually.
- ▶ Windows: The same procedure as for Linux, OS but you have to verify that the numpy package is already installed on your machine.

Initialization file

- ▶ The initialization file provides the user with the opportunity to specify all parameters of his/her model, for instance:
 - ▶ Simulation parameters (number of observations, name of the output files)
 - ▶ Estimation parameters (optimization algorithm, start values)
 - ▶ Optimization parameters
 - ▶ Coefficients and covariance parameters, dummy variables...
- ▶ Example
- ▶ for a detailed explanation see: [grmpy-documentation](#)

Simulation

- ▶ *grmpy.simulate()*:
 - ▶ Input: path of the initialization file.
 - ▶ The function returns a data frame based on your specifications and different output files.
 - ▶ The data set as a pickle and a txt file.
 - ▶ An [Info file](#) that provides the distributional characteristics of the data as well as information about the different treatment effects.

Estimation

- ▶ *grmpy.estimate()*:
 - ▶ Input: path of the initialization file.
 - ▶ At the moment the estimation process is only capable of two different optimization algorithms:
 - ▶ Broyden Fletcher Goldfarb Shanno (BFGS) algorithm
 - ▶ Powell's conjugate direction method

- ▶ There are two different options for the start values that could be set in the initialization file:
 - ▶ *init*: The estimation process uses the coefficient values specified in the initialization file as the start values for the estimation process.
 - ▶ *auto*: The start values are determined via a simple OLS followed by a Probit regression for the choice indicator.
- ▶ The estimation results are printed to an **output file**

Test battery

- ▶ We also provide a test battery that includes several tests to ensure that the processes perform as intended.
 - ▶ Property-based testing
 - ▶ Reliability testing
 - ▶ Regression testing

What's yet to come?

- ▶ Partial replication of Carneiro, Heckman, and Vytlacil (2011) (very soon!)
- ▶ Addition of marginal surplus and marginal cost parameters
- ▶ Implementation of polynomial and local instrumental variable estimation
- ▶ Exploration of alternative optimization algorithms to address large estimation tasks

Application Example

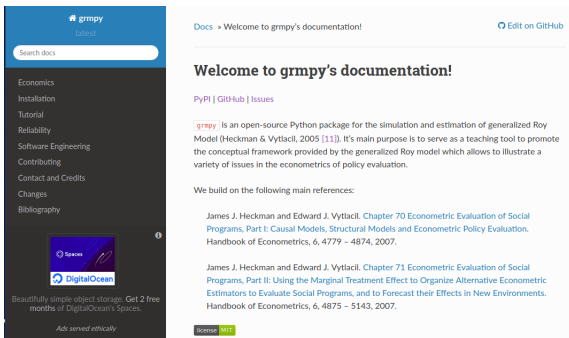
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grmpy is an open-source Python package for the simulation and estimation of generalized Roy Model (Heckman & Vytlacil, 2005 [1]). Its main purpose is to serve as a teaching tool to promote the conceptual framework provided by the generalized Roy model which allows to illustrate a variety of issues in the econometrics of policy evaluation.

We build on the following main references:

James J. Heckman and Edward J. Vytlacil. Chapter 70 Econometric Evaluation of Social Programs, Part I: Causal Models, Structural Models and Econometric Policy Evaluation. Handbook of Econometrics, 6, 4779 – 4874, 2007.

James J. Heckman and Edward J. Vytlacil. Chapter 71 Econometric Evaluation of Social Programs, Part II: Using the Marginal Treatment Effect to Organize Alternative Econometric Estimators to Evaluate Social Programs, and to Forecast their Effects in New Environments. Handbook of Econometrics, 6, 4875 – 5143, 2007.

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Appendix

References

Becker, G. S. (1964). *Human capital* (1st ed.). New York City, NY: Columbia University Press.

Carneiro, P., Heckman, J. J., & Vytlačil, E. J. (2011). Estimating marginal returns to education. *American Economic Review*, 101(6), 2754–2781.