# Econometrics of Human Capital

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# *grmpy* Tutorial

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# Introduction

## *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 | Cost |
|---|---|
| $Y_1 = \beta_1 X + U_1$ | $C = \gamma Z + U_C$ |
| $Y_0 = \beta_0 X + U_0$ | |

| Observed Outcomes | Choice |
|---|---|
| $Y = DY_1 + (1-D)Y_0$ | $S = Y_1 - Y_0 - C$ |
| | $D = \mathrm{I}[S > 0]$ |

# 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

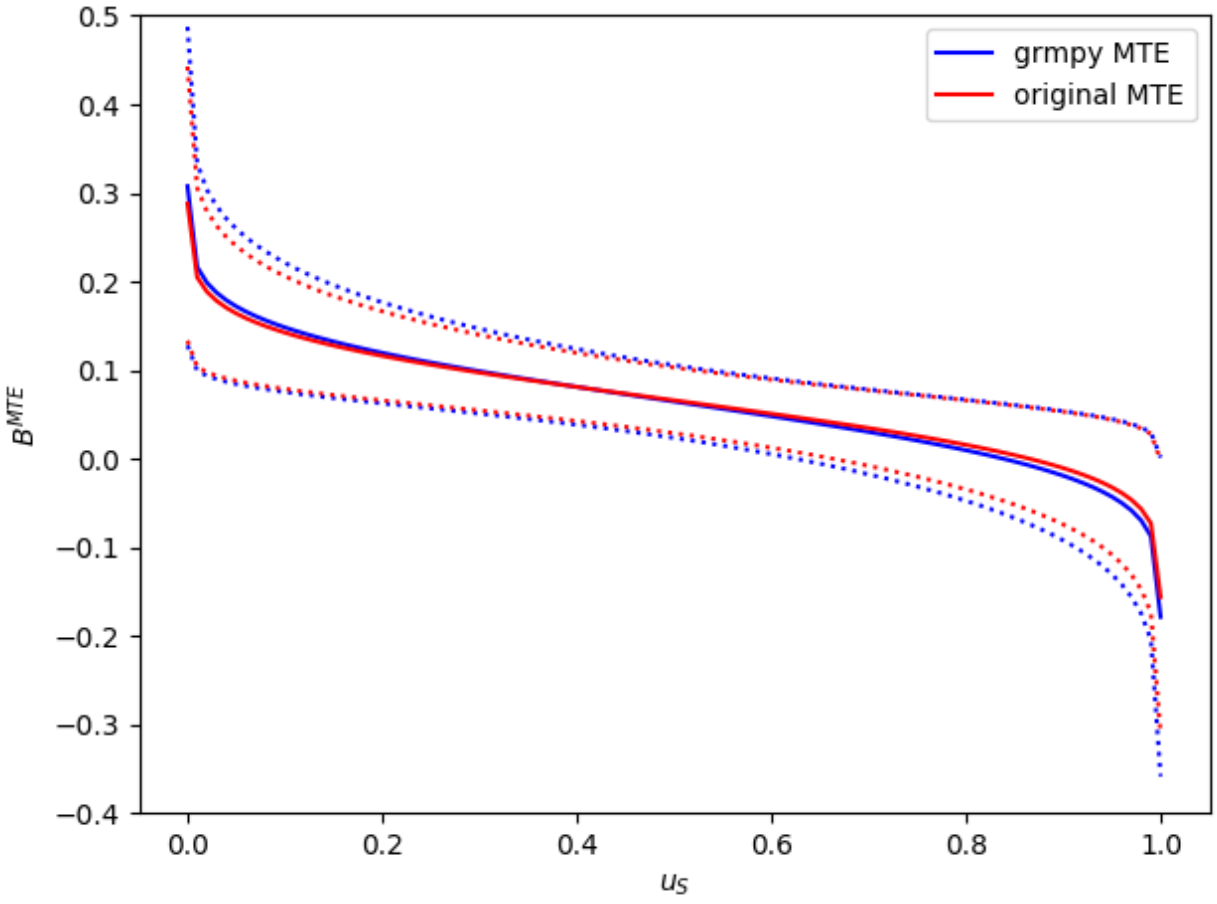
- There are two different options for the start values that could be set in the initialization file:
  - *init:* The estimation process uses the coefficient values specified in the initialization file as the start values for the estimation process.
  - *auto:* The start values are determined via a simple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

## Test battery

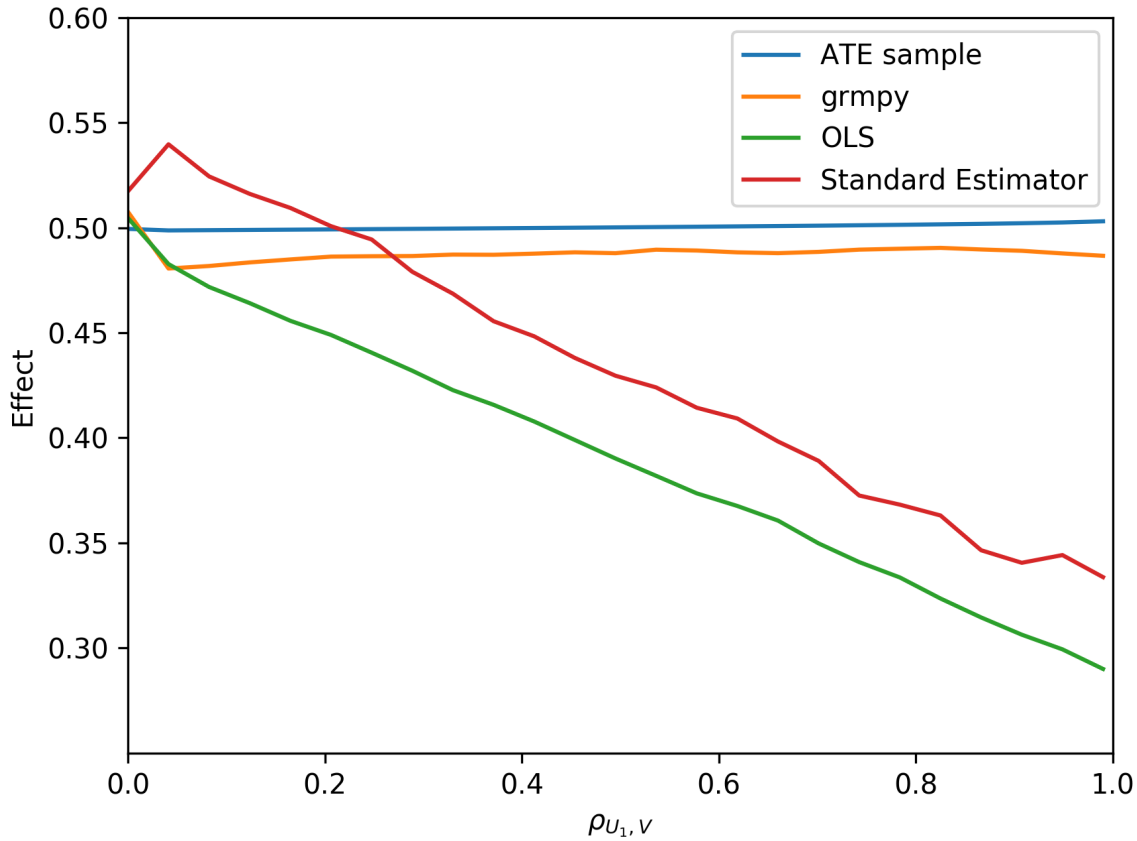
- We also provide a test battery that includes several tests to ensure that the processes perform as intended.
  - Property-based testing
  - Reliability testing
  - Regression testing

# What’s new?

# Replication Carneiro (2011)



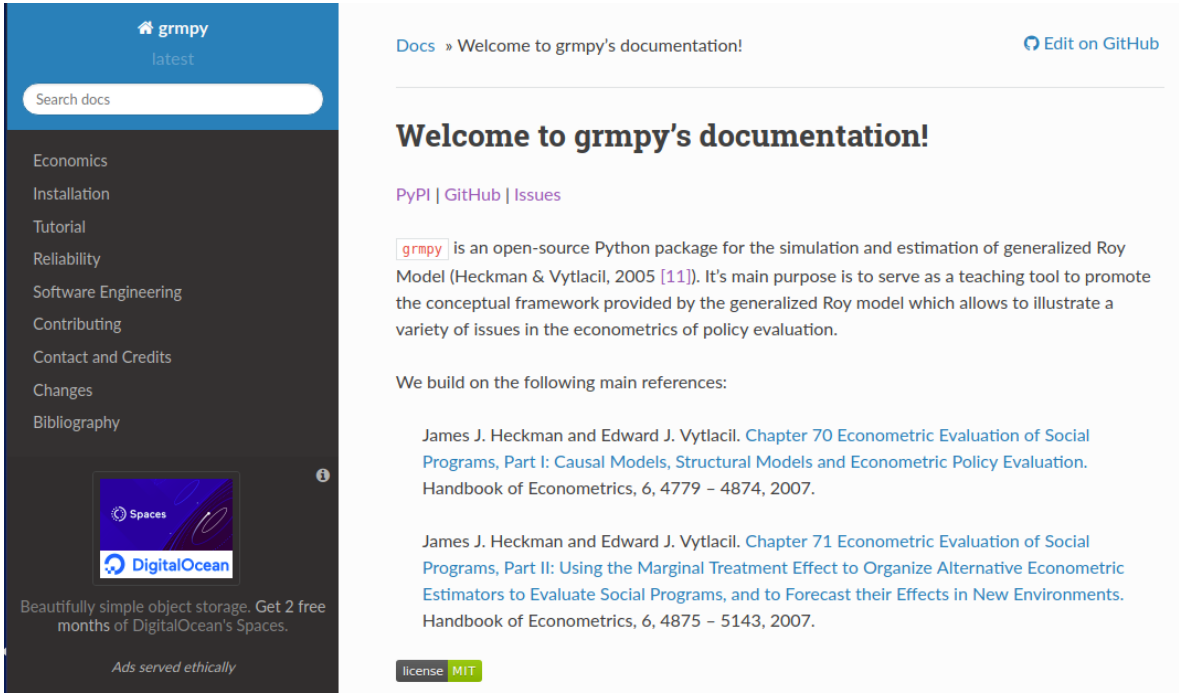
# Performance comparison



## Implementation of standard errors and adjustments on the output files

See: Example

# Online documentation



# Appendix

# *References*

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Heckman, J. J., & Vytlacil, E. J. (2007a). Econometric evaluation of social programs, part I: Causal effects, structural models and econometric policy evaluation. In J. J. Heckman & E. E. Leamer (Eds.), *Handbook of econometrics* (Vol. 6B, pp. 4779–4874). Amsterdam, Netherlands: Elsevier Science.

Heckman, J. J., & Vytlacil, E. J. (2007b). Econometric evaluation of social programs, part II: Using the marginal treatment effect to organize alternative economic estimators to evaluate social programs and to forecast their effects in new environments. In J. J. Heckman & E. E. Leamer (Eds.), *Handbook*

*of econometrics* (Vol. 6B, pp. 4875–5144). Amsterdam, Netherlands: Elsevier Science.