Package 'RCT'

February 1, 2021

Title Assign Treatments, Power Calculations, Balances, Impact Evaluation of Experiments

Version 1.1

Description Assists in the whole process of designing and evaluating Randomized Control Trials.
Robust treatment assignment by strata/blocks, that handles misfits;
Power calculations of the minimum detectable treatment effect or minimum populations;
Balance tables of T-test of covariates;
Balance Regression: (treatment ~ all x variables) with F-test of null model;
Impact_evaluation: Impact evaluation regressions. This function
gives you the option to include control_vars, fixed effect variables,
cluster variables (for robust SE), multiple endogenous variables and
multiple heterogeneous variables (to test treatment effect heterogeneity)
summary_statistics: Function that creates a summary statistics table with statistics
rank observations in n groups: Creates a factor variable with n groups. Each group has
a min and max label attach to each category.
Athey, Susan, and Guido W. Imbens (2017) <arXiv:1607.00698>.

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Encoding UTF-8

LazyData true

Imports dplyr, purrr, glue, rlang, tidyr, stringr, MASS, pracma, lfe, broom, forcats, magrittr, ggplot2, utils, tidyselect (>= 1.0.0)

Suggests knitr, rmarkdown, testthat, qpdf

RoxygenNote 7.1.1

VignetteBuilder knitr

NeedsCompilation no

Author Isidoro Garcia-Urquieta [aut, cre]

Maintainer Isidoro Garcia-Urquieta <isidoro.gu@gmail.com>

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R topics documented:

`balance_regression` *balance_regression() Runs a LPM of treatment status against all covariates (treatment~X'B).*

Description

balance_regression() Runs a LPM of treatment status against all covariates (treatment~X'B).

Usage

```
balance_regression(data, treatment)
```

Arguments

`data`	A data.frame, tibble or data.table
`treatment`	a string with treatment status column

Details

This functions runs a Linear Probability model of each treatment group & control on all the columns in data. For instance, if treatment column has values of (0,1,2), balance_regression will run two models: 1) LPM(treatment(0,1)~X'b) and 2) LPM(treatment(0,2)~X'b). The value are the regression tables and details of the F_test of these models.

Value

A list: regression_tables = regression output of treatment against all covariates, F_test = table with the F tests of each regression

Examples

```
data <-data.frame(x1 = rnorm(n = 100, mean = 100, sd = 15), x2= rnorm(n = 100, mean = 65),
treat = rep(c(0,1,2,3,4), each = 20))
balance_regression(data = data, treatment = "treat")
```

balance_table *Creates balance table for the X variables across treatment status*

Description

Creates balance table for the X variables across treatment status

Usage

```
balance_table(data, treatment)
```

Arguments

data	A data.frame, tibble or data.table
treatment	a string with treatment status column

Details

balance_table() performs t.test(X~treatment) for each X column in data. Every value of treatment i.e 1,2,3,...N is compared against control value (0) or the first value of the treatment column. For instance, If treatment column has values of (0,1,2,3), balance_table will return: the mean value of each treatment (for all X's), and the p_values of the t.test of (1,2,3) against treatment = 0.

Value

A tibble with Mean_value of each treatment status and p_values

Examples

```
data <-data.frame(x1 = rnorm(n = 100, mean = 100, sd = 15),
                  x2=rnorm(n = 100, mean = 65),
                  treatment = rep(c(0,1,2,3,4), each = 20))
balance_table(data, "treatment")
```

impact_eval *Impact Evaluation of Treatment Effects*

Description

Impact Evaluation of Treatment Effects

Usage

```
impact_eval(
  data,
  endogenous_vars,
  treatment,
  heterogenous_vars,
  cluster_vars = "0",
  fixed_effect_vars = "0",
  control_vars
)
```

Arguments

data	A data.frame, tibble or data.table
endogenous_vars	Vector of Y's on which treatment effects will be evaluated
treatment	Variable indicating the treatment status
heterogenous_vars	Vector of variables for which you wish to assess treatment distributions/heterogeneities.
cluster_vars	Vector of variables to cluster the standard errors. Default is without clustered std errors
fixed_effect_vars	Vector of variables to add as fixed effects. Default is without fixed effects
control_vars	Vector of variables to control for in the evaluation. Default is without controls

Details

This function carries out the evaluation of treatment effects on endogenous variables. It automatically runs the regressions of all the endogenous_vars supplied & all the combinations of endogenous_vars and heterogenous_vars. Additionally, the function has the option of include fixed_effects, controls and cluster variables for clustered std errors.

Value

impact_eval() returns a list of regression tables. The names of the list are the same as the endogenous variables. for heterogeneities the names are endogenous_var_heterogenous_var

Examples

```
data <- data.frame(y_1 = rnorm(n = 100, mean = 100, sd = 15),
                   y_2 = rnorm(n = 100, mean = 8, sd = 2),
                   treat = rep(c(0,1,2,3), each = 25),
                  heterogenous_var1 = rep(c("X_Q1", "X_Q2", "X_Q3", "X_Q4"), times = 25),
                   cluster_var1 = rep(c(1:5), times = 20),
                   fixed_effect_var1 = rep(c(1,2), times = 50),
                   control_var1 = rnorm(n = 100, mean = 20, sd = 1))

evaluation<-impact_eval(data = data,
```

```
        endogenous_vars = c("y_1", "y_2"),
        treatment = "treat",
        heterogenous_vars = c("heterogenous_var1"),
cluster_vars = "cluster_var1", fixed_effect_vars = c("fixed_effect_var1"),
        control_vars = c("control_var1"))
```

`ntile_label` *ntile_label() ranks observations in n groups, with labels*

Description

ntile_label() ranks observations in n groups, with labels

Usage

```
ntile_label(var, n, digits = 0)
```

Arguments

`var`	The variable wished to be ntile_label
`n`	rank the variable in n groups
`digits`	How many digits to include in the label

Details

n_tile_label is very similar to ntile from dplyr. But n_tile_label creates the n groups and then labels them. For each group i, the value of the ntile_label is [min(i) - max(i)].

Value

A ordered factor vector of each n group. The value has the form of [min(n_i) - max(n_i)]

Examples

```
data <- data.frame(y_1 = rbinom(n = 100, size = 1, prob = 0.3),
                   y_2 = rnorm(n = 100, mean = 8, sd = 2))
data$y_1_2 <- ntile_label(data$y_1, n = 2, digits = 0)
data$y_2_4 <- ntile_label(data$y_2, n = 4, digits = 1)
```

N_min *N_min() computes the minimum population needed to detect difference between control group and each treatment, given a target minimum detectable effect*

Description

N_min() computes the minimum population needed to detect difference between control group and each treatment, given a target minimum detectable effect

Usage

```
N_min(
  outcome_var,
  tau_min,
  power = 0.8,
  significance = 0.05,
  share_control,
  n_groups = 2
)
```

Arguments

outcome_var	the variable for which you wish to test the impact of treatment
tau_min	the target detectable effect (in outcome_var units)
power	The level of power of the test (1 - Pr(Reject H_0 | H_0 True)). Default is 0.8
significance	The level of significance of the test Pr(Reject H_0 | H_0 False). Default is 0.05
share_control	The share of observations in N assigned to control. This argument allows for sequences (i.e. seq(0,1,0.1))
n_groups	Number of groups (control + # treatment groups)

Details

This function calculates the minimum experiment's population needed in order to detect at least a difference of tau_min statistically significantly. This is between any two given groups (e.g. control vs each treatment), given the outcome variable, power and significance

Value

A tibble with the share_control and N observations in control group (N_control), the share and N of each treatment c(share_ti, N_ti), total share of treatment rows and N treated (share_treat, N_treat), N, the minimum detectable difference between control and all treatments together (tau_min_global), the minimum detectable difference between control and each treatment (tau_min_each_treat)

Examples

```
data <- data.frame(y_1 = rbinom(n = 100, size = 1, prob = 0.3),
                   y_2 = rnorm(n = 100, mean = 8, sd = 2))
N_min(data$y_1, tau_min = 0.01, share_control = seq(0,1,0.1), n_groups = 3)
```

RCT *Designing, random assigning and evaluating Randomized Control Trials*

Description

RCT provides three important group of functions: a) functions for pre-processing the design of the RCT b) Functions for assigning treatment status and checking for balances c) Function for evaluating the impact of the RCT

Details

RCT helps you focus on the statistics of the randomized control trials, rather than the heavy programming lifting. RCT helps you in the whole process of designing and evaluating a RCT. 1. Clean and summarise the data in which you want to randomly assign treatment 2. Decide the share of observations that will go to control group 3. Decide which variables to use for strata building 4. Robust Random Assignment by strata/blocks 5 Impact evaluation of all y's and heterogeneities To lean more about RCT, start with the vignette: browseVignettes(package = "RCT")

RCT functions

treatment_assign: Robust treatment assign by strata/blocks

impact_eval: Automatized impact evaluation with heterogeneous treatment effects

balance_table: Balance tables for any length of covariates

balance_regression: LPM of treatment status against covariates with F-test

tau_min: Computation of the minimum detectable effect between control & treatment units

tau_min_probability: Computation of the minimum detectable effect between control & treatment units for dicotomical y-vars

summary_statistics: Summary statistics of all numeric columns in your data

ntile_label: Rank and divide observations in n groups, with label

Author(s)

Isidoro Garcia Urquieta, isidoro.gu@gmail.com

References

Athey, Susan, and Guido W. Imbens (2017) "The Econometrics Randomized Experiments". Handbook of economic field experiments. https://arxiv.org/abs/1607.00698

See Also

Useful links: https://github.com/isidorogu/RCT Report bugs at https://github.com/isidorogu/RCT/issues

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`summary_statistics` *summary_statistics() Creates summary statistics table of all numeric variables in data*

Description

summary_statistics() Creates summary statistics table of all numeric variables in data

Usage

```
summary_statistics(
  data,
  probs = c(0, 0.05, 0.1, 0.25, 0.5, 0.75, 0.9, 0.95, 1),
  na.rm = T
)
```

Arguments

`data`	A data.frame, tibble or data.table
`probs`	The quantiles to compute. Default is c(0, 0.05, 0.1, 0.25, 0.5, 0.75, 0.9, 0.95, 1)
`na.rm`	whether to exclude NA's from calculations

Details

This function computes the selected quantiles, mean and N values of all the numeric columns of data.

Value

A tibble with the Mean, N (not NA) and probs selects for each numeric column

Examples

```
data <-data.frame(x = c(1:5), y = c(100, 200, 300, 410, 540), z = rep("c", 5))
summary_statistics(data)
```

tau_min *tau_min() computes the minimum detectable difference between control group and each treatment*

Description

tau_min() computes the minimum detectable difference between control group and each treatment

Usage

```
tau_min(
  outcome_var,
  N,
  power = 0.8,
  significance = 0.05,
  share_control,
  n_groups = 2
)
```

Arguments

outcome_var	the variable for which you wish to test the impact of treatment
N	number of observations in the RCT, usually nrow(data)
power	The level of power of the test (1 - Pr(Reject H_0 | H_0 True)). Default is 0.8
significance	The level of significance of the test Pr(Reject H_0 | H_0 False). Default is 0.05
share_control	The share of observations in N assigned to control. This argument allows for sequences (i.e. seq(0,1,0.1))
n_groups	Number of groups (control + # treatment groups)

Details

This function calculates the minimum difference that could show significant E[Y(1)-Y(0)] = tau, between any two given groups (e.g. control vs each treatment), given the population size (N), the outcome variable, power and significance

Value

A tibble with the share_control and N observations in control group (N_control), the share and N of each treatment c(share_ti, N_ti), total share of treatment rows and N treated (share_treat, N_treat), N, the minimum detectable difference between control and all treatments together (tau_min_global), the minimum detectable difference between control and each treatment (tau_min_each_treat)

Examples

```
data <- data.frame(y_1 = rbinom(n = 100, size = 1, prob = 0.3),
                   y_2 = rnorm(n = 100, mean = 8, sd = 2))
tau_min(data$y_1, N = nrow(data), share_control = seq(0,1,0.1), n_groups = 3)
```

`tau_min_probability` *tau_min_probability() computes the minimum detectable difference between control group and each treatment for a dicotomical variable*

Description

tau_min_probability() computes the minimum detectable difference between control group and each treatment for a dicotomical variable

Usage

```
tau_min_probability(
  prior,
  N,
  power = 0.8,
  significance = 0.05,
  share_control,
  n_groups = 2
)
```

Arguments

`prior`	Pr(Y=1).
`N`	number of observations in the RCT, usually nrow(data)
`power`	The level of power of the test (1 - Pr(Reject H_0 | H_0 True)). Default is 0.8
`significance`	The level of significance of the test Pr(Reject H_0 | H_0 False). Default is 0.05
`share_control`	The share of observations in N assigned to control. This argument allows for sequences (i.e. seq(0,1,0.1))
`n_groups`	Number of groups (control + # treatment groups)

Details

This function calculates the minimum difference that could show significant Pr[Y(1)-Y(0)] = tau, between any two given groups (e.g. control vs each treatment), given the population size (N), the outcome variable, power and significance

Value

A tibble with the share_control and N observations in control group (N_control), the share and N of each treatment c(share_ti, N_ti), total share of treatment rows and N treated (share_treat, N_treat), N, the minimum detectable difference between control and all treatments together (tau_min_global), the minimum detectable difference between control and each treatment (tau_min_each_treat)

Examples

```
tau_min_probability(0.4, N = 1000, share_control = seq(0,1,0.1), n_groups = 3)
```

`treatment_assign` *treatment_assign() carries out robust treatment assignment by strata/blocks*

Description

treatment_assign() carries out robust treatment assignment by strata/blocks

Usage

```
treatment_assign(
  data,
  share_control,
  n_t = 2,
  strata_varlist,
  missfits = c("global", "NA", "strata"),
  seed = 1990,
  share_ti = rep(1/n_t - share_control/n_t, times = n_t),
  key
)
```

Arguments

`data`	A data.frame, tibble or data.table
`share_control`	share of the observations assigned to control group
`n_t`	Number of treatments groups
`strata_varlist`	vector of categorical variables to form the strata/blocks for random assignment. Should be in the form of vars(var1, var2, ...)
`missfits`	How to handle the misfits. Default is "global". See Carril (2016) for details.
`seed`	A number used to set.seed().
`share_ti`	The share of each treatment group. If NULL (Default), each treatment group will have equal share.
`key`	The key identifier column of data.

Details

This function creates a variable that indicates the treatment status. The random assignment is made by strata/blocks. It can handle equal or unequal treatment shares. Finally, it has three methods available to handle misfits (same as randtreat in STATA): "global": assigning the observations that couldn't be randomly assigned globally, "strata": assigning the observations that couldn't be randomly assigned by strata, "NA": set the the treat observations that couldn't be randomly assigned to NA.

Value

A list: "data" = the data with key, treat, strata, misfit column., "summary_strata" = A summary tibble with the membership of each strata and its size.

Examples

```
data<-data.frame(key = c(1:1000),
                 ing_quartile = rep(c("Q1", "Q2", "Q3", "Q4"), each = 250),
                 age_quartile = rep(c("Q1", "Q2", "Q3", "Q4"), times = 250))
assigment<-treatment_assign(data = data, share_control = 0.1, n_t = 3,
                            strata_varlist = dplyr::vars(ing_quartile,
                            age_quartile), missfits = "strata",
                            seed = 1990, key = "key")
table(data$treat, useNA = "ifany")
prop.table(table(data$treat, useNA = "ifany"))
```

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