Package ‘RCT’

February 21, 2024

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

Version 1.2

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.


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

Suggests knitr, rmarkdown, testthat

RoxygenNote 7.3.1

VignetteBuilder knitr

NeedsCompilation no

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Repository CRAN

Date/Publication 2024-02-21 01:10:02 UTC
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 function 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

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,
  fixed_effect_vars = NULL,
  control_vars,
  cluster_var
)

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.
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
cluster_var String of cluster variable the standard errors. Default is without clustered std errors

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,
ntile_label

ntile_label = c("y_1", "y_2"),
treatment = "treat",
heterogenous_vars = c("heterogenous_var1"),
cluster_var = "cluster_var1", fixed_effect_vars = c("fixed_effect_var1"),
control_vars = c("control_var1")

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

ntile_label is very similar to ntile from dplyr. But ntile_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)
\textbf{N\_min} \textit{N\_min() computes the minimum population needed to detect difference between control group and each treatment, given a target minimum detectable effect}

\textbf{Description}

\textit{N\_min()} computes the minimum population needed to detect difference between control group and each treatment, given a target minimum detectable effect

\textbf{Usage}

\texttt{N\_min(outcome\_var, tau\_min, power = 0.8, significance = 0.05, share\_control, n\_groups = 2)}

\textbf{Arguments}

\begin{itemize}
  \item \texttt{outcome\_var} the variable for which you wish to test the impact of treatment
  \item \texttt{tau\_min} the target detectable effect (in outcome\_var units)
  \item \texttt{power} The level of power of the test (1 - Pr(Reject H\_0 | H\_0 True) ). Default is 0.8
  \item \texttt{significance} The level of significance of the test Pr(Reject H\_0 | H\_0 False). Default is 0.05
  \item \texttt{share\_control} The share of observations in N assigned to control. This argument allows for sequences (i.e. seq(0,1,0.1))
  \item \texttt{n\_groups} Number of groups (control + \# treatment groups)
\end{itemize}

\textbf{Details}

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

\textbf{Value}

A tibble with the \texttt{share\_control} and \texttt{N} observations in control group (\texttt{N\_control}), the share and \texttt{N} of each treatment c(\texttt{share\_ti, N\_ti}), total share of treatment rows and \texttt{N} treated (\texttt{share\_treat, N\_treat}), \texttt{N}, the minimum detectable difference between control and all treatments together (\texttt{tau\_min\_global}), the minimum detectable difference between control and each treatment (\texttt{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)

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 pro-
gramming 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 dichotomous y-vars
summary_statistics: Summary statistics of all numeric columns in your data
ntile_label: Rank and divide observations in n groups, with label

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References

Athey, Susan, and Guido W. Imbens (2017) “The Econometrics Randomized Experiments”. Hand-
summary_statistics

See Also


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)
Description

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

Usage

```r
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

```r
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() computes the minimum detectable difference between control group and each treatment for a dichotomous variable

Description

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