Package ‘icsw’

May 17, 2018

Type Package
Title Inverse Compliance Score Weighting
Version 1.0.0
Date 2018-05-16
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Description Provides the necessary tools to estimate average treatment effects with an instrumental variable by re-weighting observations using a model of compliance.
Depends R (>= 3.0.0)
Imports stats
Suggests rgenoud, minqa
License MIT + file LICENSE
LazyLoad yes
RoxygenNote 6.0.1
NeedsCompilation no
Repository CRAN
Date/Publication 2018-05-16 22:44:58 UTC

R topics documented:

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Description

Inverse compliance score weighting is a tool for estimating average treatment effects from local average treatment effects by weighting units using inverse probabilities of complying with an encouragement (instrument).

Details

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References


Replace probabilities below threshold with threshold value
Description

Return the provided vector with values smaller than the provided threshold replaced with that threshold (i.e., clip the probabilities below a certain value). If the threshold is chosen to match an empirical quantile then this can be used to implement Winsorizing probabilities from below. If no threshold is provided, the smallest value greater than zero is used.

Usage

clip.small.probs(x, min.prob = NULL)

Arguments

x
Vector of probabilities.

min.prob
Threshold. Values smaller than min.prob are replaced with min.prob. If not provided, set to the smallest value in x greater than 0.

Details

Used to avoid small probabilities blowing up in inverse probability weighting.

Produces warnings whenever values are actually replaced.

Value

Vector the same length as x with, possibly, some entries replaced.

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Examples

probs <- seq(0, .01, by = .001)
min(clip.small.probs(probs, .05))

# without min.prob, uses smallest value > 0
min(clip.small.probs(probs))
compliance.score

Estimate compliance scores using covariates.

Description

Estimate probability that units are compliers using generalized linear models for probability of being a complier or always-taker and for being an always-taker conditional on being a complier or always-taker. These compliance scores can be used in inverse probability weighting to estimate average treatment effects. In the case of one-sided non-compliance, this estimation is considerably simpler.

Usage

```r
compliance.score(D, Z, W, weights = NULL,
                   link = qnorm, inv.link = pnorm, genoud = TRUE,
                   num.iter = ifelse(genoud, 200, 10000),
                   one.sided = FALSE)
```

Arguments

- **D**: Binary treatment of interest.
- **Z**: Binary instrument.
- **W**: Matrix of covariates for compliance model.
- **weights**: Observation weights.
- **link**: Link function applied for linear models. Defaults to probit link function.
- **inv.link**: Inverse link function (i.e., mean function) applied for linear models. Defaults to probit mean function.
- **genoud**: Whether to use global optimization via genetic optimization from package rgenoud. Default, and highly recommended because the likelihood need not be concave. Otherwise, use the BOBYQA algorithm for constrained optimization from package minqa.
- **num.iter**: Number of iterations of optimization routine.
- **one.sided**: Whether non-compliance is one-sided (logical). When compliance is one-sided, the previous four arguments are ignored, and the compliance scores are estimated with probit regression.

Details

A unit $i$ is a complier if $D_{i1} > D_{i0}$, where $D_{i1}$ and $D_{i0}$ are the potential treatments for unit $i$ when $Z$ is set to 1 and 0. This is a latent (unobserved) characteristic of individual units, since each unit is only observed with one value of $Z$.

By default this function uses genetic optimization via genoud because the loss function for the complier scores is not necessarily convex.
Value

Vector of estimated probabilities of being a complier (i.e., compliance scores).

Note

Requires \texttt{rgenoud} package if genoud = TRUE. Requires \texttt{minqa} package if genoud = FALSE.

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References


See Also

Used by \texttt{icsw.tlsls}.

Examples

```r
# Load example dataset, see help(FoxDebate) for details
data(FoxDebate)

# Matrix of covariates
covmat <- with(FoxDebate, cbind(partyid, pnintst, watchnat, educad, readnews, gender, income, white))

# Estimate compliance scores with covariates, assuming (default) # case of two-sided non-compliance
cscoreout <- with(FoxDebate, compliance.score(D = watchpro, Z = conditn, W = covmat))

# Extract vector of estimated compliance scores
cscore <- cscoreout$C.score
summary(cscore)
```

---

FoxDebate  

The effects of watching a Fox debate on Proposition 209.
Description

The data set (n=507) contains findings from the experiment described in Albertson and Lawrence (2009) in which a representative sample of survey respondents in Orange County, California, were randomly assigned to receive encouragement to view a Fox debate on affirmative action, which would take place on the eve of the 1996 presidential election. Shortly after the election, these respondents were reinterviewed. The postelection questionnaire asked respondents whether they viewed the debate, whether they supported a California proposition (209) to eliminate affirmative action (support), and how informed they felt about the proposition (infopro). The dataset can be used to reproduce Table 2 in Aronow and Carnegie (2013). Note that mean imputation was used to handle missing data so non-integer values are imputed. support and infopro are excepted and include missing values.

Usage

data(FoxDebate)

Format

A data frame with 507 observations on the following 11 variables:

- **partyid** An 11 point scale from “strong Republican” to “strong Democrat”.
- **pnintst** Respondent interest in politics and national affairs. Coded 1 = "very interested", 2 = "somewhat interested", 3 = "only slightly interested", 4 = "not interested at all".
- **watchnat** Frequency of national television news consumption. Coded 1 = "never", 2 = "less than once a month", 3 = "once a month", 4 = "several times a month", 5 = "once a week", 6 = "several times a week", 7 = "every day".
- **educad** Education level of respondent. Coded 1 = "eighth grade or less", 2 = "beyond eighth grade, not high school", 3 = "ged", 4 = "high school", 5 = "less than one year vocational school", 6 = "one to two year vocational school", 7 = "two years or more vocational school", 8 = "less than two years of college", 9 = "two or more years of college", 10 = "finished a two-year college program", 11 = "finished a four-year college program", 12 = "master degree or equivalent", 13 = "ph.d., m.d., or other advance degree".
- **readnews** How often respondent reads political news. Coded 1 = "never", 2 = "less than once a month", 3 = "once a month", 4 = "several times a month", 5 = "once a week", 6 = "several times a week", 7 = "every day".
- **gender** Respondent gender. Coded 1 for female and 0 for male.
- **income** Family income from all sources. Coded 1 = "under $10,000", 2 = "between $10,000 and $20,000", 3 = "between $20,000 and $30,000", 4 = "between $30,000 and $40,000", 5 = "between $40,000 and $50,000", 6 = "between $50,000 and $60,000", 7 = "between $60,000 and $70,000", 8 = "between $70,000 and $80,000", 9 = "between $80,000 and $90,000", 10 = "between $90,000 and $100,000", 11 = "$100,000 or more".
- **white** Binary indicator coded 1 if subject is white and 0 otherwise.
- **support** Support for Proposition 209. Coded 1 if subject voted against or opposed and 0 if subject voted for or favored
- **infopro** Information on Proposition 209. Coded from 1 to 4, with 4 meaning respondents had a great deal of information about Proposition 209 prior to the election, and 1 meaning respondents reported no information about the proposition before the election.
watchpro  Binary indicator coded 1 if subject watched the Fox Debate about affirmative action and 0 otherwise. This is the outcome ("treatment") of interest.

conditn Binary indicator coded 1 if subject was (randomly) prompted to watch the Fox Debate about affirmative action. This is the encouragement (instrumental) variable.

References


icsw.tls  Two-stage least squares with inverse complier score weighting

Description

Estimate average treatment effects using two-stage least squares with a binary instrument and binary treatment and weighting with inverse complier scores (probabilities of compliance). Optionally, bootstrap the entire estimation process for the purpose of hypothesis testing and constructing confidence intervals.

Usage

icsw.tls(D, X, Y, Z, W, weights = NULL,  
R = 0, estimand = c("ATE", "ATT"),  
min.prob.quantile = NULL,  
min.prob = NULL, ...)  

icsw.tls.fit(D, X, Y, Z, W, weights,  
estimand = c("ATE", "ATT"),  
min.prob.quantile = NULL,  
min.prob = NULL, ...)

Arguments

D  Binary treatment of interest.
X  Matrix of covariates for two-stage least squares. Add a constant if desired (see examples).
Y  Outcome.
Z  Binary instrument.
Matrix of covariates for compliance model.

Observation weights.

Number of bootstrap replicates.

Whether to estimate average treatment effect (default) or average treatment effect on the treated.

Compliance scores are truncated to this quantile of positive compliance scores.

Compliance scores are truncated to this value.

Additional arguments to compliance.score.

If R = 0 or icsw.tsls.fit is called directly, a model fit, as described in lm.wfit.

If R > 0, a list with elements

A model fit, as returned by lm.wfit.

p by R matrix of model coefficients for each of R bootstrap replicates.

Vector of standard deviations of coefficients under bootstrap resampling (i.e., bootstrap standard errors).

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compliance.score for calculating compliance scores used in example.

tsls.wfit for regression via 2SLS with weights.

# Load example dataset, see help(FoxDebate) for details
data(FoxDebate)

# IPW reweighting step Aronow and Carnegie (2013) use for missing data
covmat <- with(FoxDebate, cbind(partyid, pnintst, watchnat, educad, readnews, gender, income, white))

# IPW reweighting step Aronow and Carnegie (2013) use for missing data
Ymis <- is.na(FoxDebate[, "infopro"])
tsls.wfit

Fit instrumental variables model via two-stage least squares, with weights.

Description

Fits linear first- and second-stage models using weighted linear regression.

Usage

tsls.wfit(X, Y, Z, weights, ...)

Arguments

X  Matrix of covariates and treatment, including constant if intercept is desired.
Y  Vector outcome.
Z  Matrix of covariates and instrument, including constant if intercept is desired.
weights  Observation weights.
... Additional arguments to lm.wfit.
Value

A list with the second stage model fit, as returned by \texttt{lm.wfit}.

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References


See Also

\texttt{lm.wfit}.

\texttt{compliance.score} for calculating compliance scores used in example.

Examples

\begin{verbatim}
# Load example dataset, see help(FoxDebate) for details
data(FoxDebate)

# Estimate compliance scores with covariates, assuming (default) # case of two-sided non-compliance.
covmat <- with(FoxDebate, cbind(partyid, pnintst, watchnat, educad, readnews, gender, income, white))

cscoreout <- with(FoxDebate, compliance.score(D = watchpro, Z = conditn, 
                     W = covmat))

# Extract vector of estimated compliance scores
cscore <- cscoreout$C.score

# Winsorising as described in Aronow and Carnegie (2013)
N <- length(FoxDebate[, "infopro"])
alpha <- 0.275
qcscore <- quantile(cscore, 1 / (N*alpha))
cscore[cscore < qcscore] <- qcscore

# IPW reweighting step Aronow and Carnegie (2013) use for missing data
Ymis <- is.na(FoxDebate[,"infopro"])

IPWweight <- 1 / (1 - predict(glm(Ymis ~ covmat, family = binomial(link = "probit"), 
                                      type = "response")))
IPWweight[Ymis] <- 0

# Compute LATE via 2SLS with IPW weights. This replicates # Table 2 Column 1 in Aronow and Carnegie (2013)
outputTSLS <- with(FoxDebate, tsls.wfit(X = cbind(1, covmat, watchpro), Y = infopro, 
                                    Z = cbind(1, covmat, conditn), weights = IPWweight))
round(outputTSLS$coefficients, 2)
\end{verbatim}
# Compute ATE via 2SLS with (IPW weights / compliance scores). This
# replicates Table 2 Column 2 in Aronow and Carnegie (2013)
outputICSW <- with(FoxDebate, tsls.wfit(cbind(1, watchpro, covmat), infopro,
                      cbind(1, condtn, covmat), w = IPWweight / cscore))
round(outputICSW$coefficients, 2)
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