Package: npDoseResponse (via r-universe)

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Type Package

Title Nonparametric Estimation and Inference on Dose-Response Curves

Version 0.1

Description A novel integral estimator for estimating the causal effects with continuous treatments (or dose-response curves) and a localized derivative estimator for estimating the derivative effects. The inference on the dose-response curve and its derivative is conducted via nonparametric bootstrap. The reference paper is Zhang, Chen, and Giessing (2024) <doi:10.48550/arXiv.2405.09003>.

URL https://github.com/zhangyk8/npDoseResponse/

BugReports https://github.com/zhangyk8/npDoseResponse/issues

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RoxygenNote 7.2.3

Imports parallel, stats

Suggests locpol

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Contents

`DerivEffect` *The proposed localized derivative estimator.*

Description

This function implements our proposed estimator for estimating the derivative of a dose-response curve via Nadaraya-Watson conditional CDF estimator.

Usage

```
DerivEffect(
  Y,
  X,
  t_eval = NULL,
  h_bar = NULL,
  kernT_bar = "gaussian",
  h = NULL,
  b = NULL,
  C_h = 7,
  C_b = 3,
  print_bw = TRUE,
  degree = 2,
  deriv_ord = 1,
  kernT = "epanechnikov",
  kernS = "epanechnikov",
  parallel = TRUE,
  cores = 6
)
```

Arguments

Y	The input n-dimensional outcome variable vector.
X	The input n*(d+1) matrix. The first column of X stores the treatment/exposure variables, while the other d columns are confounding variables.

t_eval	The m-dimensional vector for evaluating the derivative. (Default: t_eval = NULL. Then, t_eval = X[,1], which consists of the observed treatment variables.)
h_bar	The bandwidth parameter for the Nadaraya-Watson conditional CDF estimator. (Default: h_bar = NULL. Then, the Silverman's rule of thumb is applied. See Chen et al. (2016) for details.)
kernT_bar	The name of the kernel function for the Nadaraya-Watson conditional CDF estimator. (Default: "gaussian".)
h, b	The bandwidth parameters for the treatment/exposure variable and confounding variables in the local polynomial regression. (Default: h = NULL, b = NULL. Then, the rule-of-thumb bandwidth selector in Eq. (A1) of Yang and Tschernig (1999) is used with additional scaling factors C_h and C_b, respectively.)
C_h, C_b	The scaling factors for the rule-of-thumb bandwidth parameters.
print_bw	The indicator of whether the current bandwidth parameters should be printed to the console. (Default: print_bw = TRUE.)
degree	Degree of local polynomials. (Default: degree = 2.)
deriv_ord	The order of the estimated derivative of the conditional mean outcome function. (Default: deriv_ord = 1. It shouldn't be changed in most cases.)
kernT, kernS	The names of kernel functions for the treatment/exposure variable and confounding variables. (Default: kernT = "epanechnikov", kernS = "epanechnikov".)
parallel	The indicator of whether the function should be parallel executed. (Default: parallel = TRUE.)
cores	The number of cores for parallel execution. (Default: cores = 6.)

Value

The estimated derivative of the dose-response curve evaluated at points `t_eval`.

Author(s)

Yikun Zhang, <yikunzhang@foxmail.com>

References

Zhang, Y., Chen, Y.-C., and Giessing, A. (2024) *Nonparametric Inference on Dose-Response Curves Without the Positivity Condition.* https://arxiv.org/abs/2405.09003.

Hall, P., Wolff, R. C., and Yao, Q. (1999) *Methods for Estimating A Conditional Distribution Function. Journal of the American Statistical Association, 94 (445): 154-163.*

Examples

```
library(parallel)
set.seed(123)
n <- 300

S2 <- cbind(2 * runif(n) - 1, 2 * runif(n) - 1)
```

```
Z2 <- 4 * S2[, 1] + S2[, 2]
E2 <- 0.2 * runif(n) - 0.1
T2 <- cos(pi * Z2^3) + Z2 / 4 + E2
Y2 <- T2^2 + T2 + 10 * Z2 + rnorm(n, mean = 0, sd = 1)
X2 <- cbind(T2, S2)

t_qry2 = seq(min(T2) + 0.01, max(T2) - 0.01, length.out = 100)
chk <- Sys.getenv("_R_CHECK_LIMIT_CORES_", "")
if (nzchar(chk) && chk == "TRUE") {
  # use 2 cores in CRAN/Travis/AppVeyor
  num_workers <- 2L
} else {
  # use all cores in devtools::test()
  num_workers <- parallel::detectCores()
}
theta_est2 = DerivEffect(Y2, X2, t_eval = t_qry2, h_bar = NULL,
                         kernT_bar = "gaussian", h = NULL, b = NULL,
                         C_h = 7, C_b = 3, print_bw = FALSE,
                         degree = 2, deriv_ord = 1, kernT = "epanechnikov",
                         kernS = "epanechnikov", parallel = TRUE, cores = num_workers)
plot(t_qry2, theta_est2, type="l", col = "blue", xlab = "t", lwd=5,
     ylab="(Estimated) derivative effects")
lines(t_qry2, 2*t_qry2 + 1, col = "red", lwd=3)
legend(-2, 5, legend=c("Estimated derivative", "True derivative"),
       fill = c("blue","red"))
```

DerivEffectBoot — *Nonparametric bootstrap inference on the derivative effect via our localized derivative estimator.*

Description

This function implements the nonparametric bootstrap inference on the derivative of a dose-response curve via our localized derivative estimator.

Usage

```
DerivEffectBoot(
  Y,
  X,
  t_eval = NULL,
  boot_num = 500,
  alpha = 0.95,
  h_bar = NULL,
  kernT_bar = "gaussian",
  h = NULL,
  b = NULL,
```

```
  C_h = 7,
  C_b = 3,
  print_bw = TRUE,
  degree = 2,
  deriv_ord = 1,
  kernT = "epanechnikov",
  kernS = "epanechnikov",
  parallel = TRUE,
  cores = 6
)
```

Arguments

Y	The input n-dimensional outcome variable vector.
X	The input n*(d+1) matrix. The first column of X stores the treatment/exposure variables, while the other d columns are confounding variables.
t_eval	The m-dimensional vector for evaluating the derivative. (Default: t_eval = NULL. Then, t_eval = X[,1], which consists of the observed treatment variables.)
boot_num	The number of bootstrapping times. (Default: boot_num = 500.)
alpha	The confidence level of both the uniform confidence band and pointwise confidence interval. (Default: alpha = 0.95.)
h_bar	The bandwidth parameter for the Nadaraya-Watson conditional CDF estimator. (Default: h_bar = NULL. Then, the Silverman's rule of thumb is applied. See Chen et al. (2016) for details.)
kernT_bar	The name of the kernel function for the Nadaraya-Watson conditional CDF estimator. (Default: kernT_bar = "gaussian".)
h, b	The bandwidth parameters for the treatment/exposure variable and confounding variables in the local polynomial regression. (Default: h = NULL, b = NULL. Then, the rule-of-thumb bandwidth selector in Eq. (A1) of Yang and Tschernig (1999) is used with additional scaling factors C_h and C_b, respectively.)
C_h, C_b	The scaling factors for the rule-of-thumb bandwidth parameters.
print_bw	The indicator of whether the current bandwidth parameters should be printed to the console. (Default: print_bw = TRUE.)
degree	Degree of local polynomials. (Default: degree = 2.)
deriv_ord	The order of the estimated derivative of the conditional mean outcome function. (Default: deriv_ord = 1. It shouldn't be changed in most cases.)
kernT, kernS	The names of kernel functions for the treatment/exposure variable and confounding variables. (Default: kernT = "epanechnikov", kernS = "epanechnikov".)
parallel	The indicator of whether the function should be parallel executed. (Default: parallel = TRUE.)
cores	The number of cores for parallel execution. (Default: cores = 6.)

Value

A list that contains four elements.

- `theta_est` The estimated derivative of the dose-response curve evaluated at points `t_eval`.
- `theta_est_boot` The estimated derivative of the dose-response curve evaluated at points `t_eval` for all the bootstrap samples.
- `theta_alpha` The width of the uniform confidence band.
- `theta_alpha_var` The widths of the pointwise confidence bands at evaluation points `t_eval`.

Author(s)

Yikun Zhang, <yikunzhang@foxmail.com>

References

Zhang, Y., Chen, Y.-C., and Giessing, A. (2024) *Nonparametric Inference on Dose-Response Curves Without the Positivity Condition.* https://arxiv.org/abs/2405.09003.

Examples

```
set.seed(123)
n <- 300

S2 <- cbind(2 * runif(n) - 1, 2 * runif(n) - 1)
Z2 <- 4 * S2[, 1] + S2[, 2]
E2 <- 0.2 * runif(n) - 0.1
T2 <- cos(pi * Z2^3) + Z2 / 4 + E2
Y2 <- T2^2 + T2 + 10 * Z2 + rnorm(n, mean = 0, sd = 1)
X2 <- cbind(T2, S2)

t_qry2 = seq(min(T2) + 0.01, max(T2) - 0.01, length.out = 100)
chk <- Sys.getenv("_R_CHECK_LIMIT_CORES_", "")
if (nzchar(chk) && chk == "TRUE") {
  # use 2 cores in CRAN/Travis/AppVeyor
  num_workers <- 2L
} else {
  # use all cores in devtools::test()
  num_workers <- parallel::detectCores()
}

# Increase bootstrap times "boot_num" to a larger integer in practice
theta_boot2 = DerivEffectBoot(Y2, X2, t_eval = t_qry2, boot_num = 3, alpha = 0.95,
                              h_bar = NULL, kernT_bar = "gaussian", h = NULL,
                              b = NULL, C_h = 7, C_b = 3, print_bw = FALSE,
                              degree = 2, deriv_ord = 1, kernT = "epanechnikov",
                              kernS = "epanechnikov", parallel = TRUE,
                              cores = num_workers)
```

IntegEst *The proposed integral estimator.*

Description

This function implements our proposed integral estimator for estimating the dose-response curve.

Usage

```
IntegEst(
  Y,
  X,
  t_eval = NULL,
  h_bar = NULL,
  kernT_bar = "gaussian",
  h = NULL,
  b = NULL,
  C_h = 7,
  C_b = 3,
  print_bw = TRUE,
  degree = 2,
  deriv_ord = 1,
  kernT = "epanechnikov",
  kernS = "epanechnikov",
  parallel = TRUE,
  cores = 6
)
```

Arguments

`Y`	The input n-dimensional outcome variable vector.
`X`	The input n*(d+1) matrix. The first column of X stores the treatment/exposure variables, while the other d columns are confounding variables.
`t_eval`	The m-dimensional vector for evaluating the dose-response curve. (Default: t_eval = NULL. Then, t_eval = `X[,1]`, which consists of the observed treatment variables.)
`h_bar`	The bandwidth parameter for the Nadaraya-Watson conditional CDF estimator. (Default: h_bar = NULL. Then, the Silverman's rule of thumb is applied. See Chen et al. (2016) for details.)
`kernT_bar`	The name of the kernel function for the Nadaraya-Watson conditional CDF estimator. (Default: "gaussian".)
`h, b`	The bandwidth parameters for the treatment/exposure variable and confounding variables in the local polynomial regression. (Default: h = NULL, b = NULL. Then, the rule-of-thumb bandwidth selector in Eq. (A1) of Yang and Tschernig (1999) is used with additional scaling factors C_h and C_b, respectively.)

C_h, C_b	The scaling factors for the rule-of-thumb bandwidth parameters.
print_bw	The indicator of whether the current bandwidth parameters should be printed to the console. (Default: print_bw = TRUE.)
degree	Degree of local polynomials. (Default: degree = 2.)
deriv_ord	The order of the estimated derivative of the conditional mean outcome function. (Default: deriv_ord = 1. It shouldn't be changed in most cases.)
kernT, kernS	The names of kernel functions for the treatment/exposure variable and confounding variables. (Default: kernT = "epanechnikov", kernS = "epanechnikov".)
parallel	The indicator of whether the function should be parallel executed. (Default: parallel = TRUE.)
cores	The number of cores for parallel execution. (Default: cores = 6.)

Value

The estimated dose-response curve evaluated at points `t_eval`.

Author(s)

Yikun Zhang, <yikunzhang@foxmail.com>

References

Zhang, Y., Chen, Y.-C., and Giessing, A. (2024) *Nonparametric Inference on Dose-Response Curves Without the Positivity Condition.* https://arxiv.org/abs/2405.09003.

Examples

```
set.seed(123)
n <- 300

S2 <- cbind(2*runif(n) - 1, 2*runif(n) - 1)
Z2 <- 4 * S2[, 1] + S2[, 2]
E2 <- 0.2 * runif(n) - 0.1
T2 <- cos(pi * Z2^3) + Z2 / 4 + E2
Y2 <- T2^2 + T2 + 10 * Z2 + rnorm(n, mean = 0, sd = 1)
X2 <- cbind(T2, S2)

t_qry2 = seq(min(T2) + 0.01, max(T2) - 0.01, length.out = 100)
chk <- Sys.getenv("_R_CHECK_LIMIT_CORES_", "")
if (nzchar(chk) && chk == "TRUE") {
  # use 2 cores in CRAN/Travis/AppVeyor
  num_workers <- 2L
} else {
  # use all cores in devtools::test()
  num_workers <- parallel::detectCores()
}
m_est2 = IntegEst(Y2, X2, t_eval = t_qry2, h_bar = NULL, kernT_bar = "gaussian",
                  h = NULL, b = NULL, C_h = 7, C_b = 3, print_bw = FALSE,
                  degree = 2, deriv_ord = 1, kernT = "epanechnikov",
```

```
                    kernS = "epanechnikov", parallel = TRUE, cores = num_workers)

plot(t_qry2, m_est2, type="l", col = "blue", xlab = "t", lwd=5,
     ylab="(Estimated) dose-response curves")
lines(t_qry2, t_qry2^2 + t_qry2, col = "red", lwd=3)
legend(-2, 6, legend=c("Estimated curve", "True curve"), fill = c("blue","red"))
```

IntegEstBoot — *Nonparametric bootstrap inference on the dose-response curve via our integral estimator.*

Description

This function implements the nonparametric bootstrap inference on the dose-response curve via our integral estimator.

Usage

```
IntegEstBoot(
  Y,
  X,
  t_eval = NULL,
  boot_num = 500,
  alpha = 0.95,
  h_bar = NULL,
  kernT_bar = "gaussian",
  h = NULL,
  b = NULL,
  C_h = 7,
  C_b = 3,
  print_bw = TRUE,
  degree = 2,
  deriv_ord = 1,
  kernT = "epanechnikov",
  kernS = "epanechnikov",
  parallel = TRUE,
  cores = 4
)
```

Arguments

Y	The input n-dimensional outcome variable vector.
X	The input n*(d+1) matrix. The first column of X stores the treatment/exposure variables, while the other d columns are confounding variables.

`t_eval`	The m-dimensional vector for evaluating the dose-response curve (Default: t_eval = NULL. Then, t_eval = `X[,1]`, which consists of the observed treatment variables.)
`boot_num`	The number of bootstrapping times. (Default: boot_num = 500.)
`alpha`	The confidence level of both the uniform confidence band and pointwise confidence interval. (Default: alpha = 0.95.)
`h_bar`	The bandwidth parameter for the Nadaraya-Watson conditional CDF estimator. (Default: h_bar = NULL. Then, the Silverman's rule of thumb is applied. See Chen et al. (2016) for details.)
`kernT_bar`	The name of the kernel function for the Nadaraya-Watson conditional CDF estimator. (Default: kernT_bar = "gaussian".)
`h, b`	The bandwidth parameters for the treatment/exposure variable and confounding variables in the local polynomial regression. (Default: h = NULL, b = NULL. Then, the rule-of-thumb bandwidth selector in Eq. (A1) of Yang and Tschernig (1999) is used with additional scaling factors C_h and C_b, respectively.)
`C_h, C_b`	The scaling factors for the rule-of-thumb bandwidth parameters.
`print_bw`	The indicator of whether the current bandwidth parameters should be printed to the console. (Default: print_bw = TRUE.)
`degree`	Degree of local polynomials. (Default: degree = 2.)
`deriv_ord`	The order of the estimated derivative of the conditional mean outcome function. (Default: deriv_ord = 1. It shouldn't be changed in most cases.)
`kernT, kernS`	The names of kernel functions for the treatment/exposure variable and confounding variables. (Default: kernT = "epanechnikov", kernS = "epanechnikov".)
`parallel`	The indicator of whether the function should be parallel executed. (Default: parallel = TRUE.)
`cores`	The number of cores for parallel execution. (Default: cores = 6.)

Value

A list that contains four elements.

`m_est`	The estimated dose-response curve evaluated at points `t_eval`.
`m_est_boot`	The estimated dose-response curve evaluated at points `t_eval` for all the bootstrap samples.
`m_alpha`	The width of the uniform confidence band.
`m_alpha_var`	The widths of the pointwise confidence bands at evaluation points `t_eval`.

Author(s)

Yikun Zhang, <yikunzhang@foxmail.com>

References

Zhang, Y., Chen, Y.-C., and Giessing, A. (2024) *Nonparametric Inference on Dose-Response Curves Without the Positivity Condition.* https://arxiv.org/abs/2405.09003.

Examples

```
set.seed(123)
n <- 300

S2 <- cbind(2 * runif(n) - 1, 2 * runif(n) - 1)
Z2 <- 4 * S2[, 1] + S2[, 2]
E2 <- 0.2 * runif(n) - 0.1
T2 <- cos(pi * Z2^3) + Z2 / 4 + E2
Y2 <- T2^2 + T2 + 10 * Z2 + rnorm(n, mean = 0, sd = 1)
X2 <- cbind(T2, S2)

t_qry2 = seq(min(T2) + 0.01, max(T2) - 0.01, length.out = 100)
chk <- Sys.getenv("_R_CHECK_LIMIT_CORES_", "")
if (nzchar(chk) && chk == "TRUE") {
  # use 2 cores in CRAN/Travis/AppVeyor
  num_workers <- 2L
} else {
  # use all cores in devtools::test()
  num_workers <- parallel::detectCores()
}

# Increase bootstrap times "boot_num" to a larger integer in practice
m_boot2 = IntegEstBoot(Y2, X2, t_eval = t_qry2, boot_num = 3, alpha=0.95,
                      h_bar = NULL, kernT_bar = "gaussian", h = NULL, b = NULL,
                      C_h = 7, C_b = 3, print_bw = FALSE, degree = 2,
                      deriv_ord = 1, kernT = "epanechnikov", kernS = "epanechnikov",
                      parallel = TRUE, cores = num_workers)
```

`KernelRetrieval` *The helper function for retrieving a kernel function and its associated statistics.*

Description

This function helps retrieve the commonly used kernel function, its second moment, and its variance based on the name.

Usage

```
KernelRetrieval(name)
```

Arguments

`name`	The lower-case full name of the kernel function.

Value

A list that contains three elements.

- `KernFunc` The interested kernel function.
- `sigmaK_sq` The second moment of the kernel function.
- `K_sq` The variance of the kernel function.

Author(s)

Yikun Zhang, <yikunzhang@foxmail.com>

Examples

```
kernel_result <- KernelRetrieval("epanechnikov")
kernT <- kernel_result$KernFunc
sigmaK_sq <- kernel_result$sigmaK_sq
K_sq <- kernel_result$K_sq
```

`LocalPolyReg` *The (partial) local polynomial regression.*

Description

This function implements the (partial) local polynomial regression for estimating the conditional mean outcome function and its partial derivatives. We use higher-order local monomials for the treatment variable and first-order local monomials for the confounding variables.

Usage

```
LocalPolyReg(
  Y,
  X,
  x_eval = NULL,
  degree = 2,
  deriv_ord = 1,
  h = NULL,
  b = NULL,
  C_h = 7,
  C_b = 3,
  print_bw = TRUE,
  kernT = "epanechnikov",
  kernS = "epanechnikov"
)
```

Arguments

Y	The input n-dimensional outcome variable vector.
X	The input n*(d+1) matrix. The first column of X stores the treatment/exposure variables, while the other d columns are confounding variables.
x_eval	The n*(d+1) matrix for evaluating the local polynomial regression estimates. (Default: x_eval = NULL. Then, x_eval = X.)
degree	Degree of local polynomials. (Default: degree = 2.)
deriv_ord	The order of the estimated derivative of the conditional mean outcome function. (Default: deriv_ord = 1.)
h	The bandwidth parameter for the treatment/exposure variable. (Default: h = NULL. Then, the rule-of-thumb bandwidth selector in Eq. (A1) of Yang and Tschernig (1999) is used with additional scaling factors C_h.)
b	The bandwidth vector for the confounding variables. (Default: b = NULL. Then, the rule-of-thumb bandwidth selector in Eq. (A1) of Yang and Tschernig (1999) is used with additional scaling factors C_b.)
C_h	The scaling factor for the rule-of-thumb bandwidth parameter h.
C_b	The scaling factor for the rule-of-thumb bandwidth vector b.
print_bw	The indicator of whether the current bandwidth parameters should be printed to the console. (Default: print_bw = TRUE.)
kernT, kernS	The names of kernel functions for the treatment/exposure variable and confounding variables. (Default: kernT = "epanechnikov", kernS = "epanechnikov".)

Value

The estimated conditional mean outcome function or its partial derivatives evaluated at points x_eval.

Author(s)

Yikun Zhang, <yikunzhang@foxmail.com>

References

Zhang, Y., Chen, Y.-C., and Giessing, A. (2024) *Nonparametric Inference on Dose-Response Curves Without the Positivity Condition.* https://arxiv.org/abs/2405.09003.

Fan, J. and Gijbels, I. (1996) *Local Polynomial Modelling and its Applications. Chapman & Hall/CRC.*

Examples

```
library(parallel)
set.seed(123)
n <- 300
S2 <- cbind(2 * runif(n) - 1, 2 * runif(n) - 1)
Z2 <- 4 * S2[, 1] + S2[, 2]
E2 <- 0.2 * runif(n) - 0.1
```

```
T2 <- cos(pi * Z2^3) + Z2 / 4 + E2
Y2 <- T2^2 + T2 + 10 * Z2 + rnorm(n, mean = 0, sd = 1)
X2 <- cbind(T2, S2)
t_qry2 = seq(min(T2) + 0.01, max(T2) - 0.01, length.out = 100)
chk <- Sys.getenv("_R_CHECK_LIMIT_CORES_", "")
if (nzchar(chk) && chk == "TRUE") {
  # use 2 cores in CRAN/Travis/AppVeyor
  num_workers <- 2L
} else {
  # use all cores in devtools::test()
  num_workers <- parallel::detectCores()
}
Y_est2 = LocalPolyReg(Y2, X2, x_eval = NULL, degree = 2, deriv_ord = 0,
                      h = NULL, b = NULL, C_h = 7, C_b = 3, print_bw = TRUE,
                      kernT = "epanechnikov", kernS = "epanechnikov")
```

`LocalPolyRegMain` *The main function of the (partial) local polynomial regression.*

Description

This function implements the main part of the (partial) local polynomial regression for estimating the conditional mean outcome function and its partial derivatives.

Usage

```
LocalPolyRegMain(
  Y,
  X,
  x_eval = NULL,
  degree = 2,
  deriv_ord = 1,
  h = NULL,
  b = NULL,
  kernT = "epanechnikov",
  kernS = "epanechnikov"
)
```

Arguments

`Y`	The input n-dimensional outcome variable vector.
`X`	The input n*(d+1) matrix. The first column of X stores the treatment/exposure variables, while the other d columns are confounding variables.
`x_eval`	The n*(d+1) matrix for evaluating the local polynomial regression estimates. (Default: x_eval = NULL. Then, x_eval = `X`.)
`degree`	Degree of local polynomials. (Default: degree = 2.)

deriv_ord	The order of the estimated derivative of the conditional mean outcome function. (Default: deriv_ord = 1.)
h, b	The bandwidth parameters for the treatment/exposure variable and confounding variables (Default: h = NULL, b = NULL. Then, the rule-of-thumb bandwidth selector in Eq. (A1) of Yang and Tschernig (1999) is used with additional scaling factors C_h and C_b, respectively.)
kernT, kernS	The names of kernel functions for the treatment/exposure variable and confounding variables. (Default: kernT = "epanechnikov", kernS = "epanechnikov".)

Value

The estimated conditional mean outcome function or its partial derivatives evaluated at points `x_eval`.

Author(s)

Yikun Zhang, <yikunzhang@foxmail.com>

References

Zhang, Y., Chen, Y.-C., and Giessing, A. (2024) *Nonparametric Inference on Dose-Response Curves Without the Positivity Condition.* https://arxiv.org/abs/2405.09003.

Fan, J. and Gijbels, I. (1996) *Local Polynomial Modelling and its Applications. Chapman & Hall/CRC.*

`RegAdjust` *The regression adjustment estimator of the dose-response curve.*

Description

This function implements the standard regression adjustment or G-computation estimator of the dose-response curve or its derivative via (partial) local polynomial regression.

Usage

```
RegAdjust(
  Y,
  X,
  t_eval = NULL,
  h = NULL,
  b = NULL,
  C_h = 7,
  C_b = 3,
  print_bw = TRUE,
  degree = 2,
  deriv_ord = 0,
  kernT = "epanechnikov",
```

```
  kernS = "epanechnikov",
  parallel = TRUE,
  cores = 6
)
```

Arguments

`Y`	The input n-dimensional outcome variable vector.
`X`	The input n*(d+1) matrix. The first column of X stores the treatment/exposure variables, while the other d columns are confounding variables.
`t_eval`	The m-dimensional vector for evaluating the dose-response curve. (Default: t_eval = NULL. Then, t_eval = `X[,1]`, which consists of the observed treatment variables.)
`h, b`	The bandwidth parameters for the treatment/exposure variable and confounding variables (Default: h = NULL, b = NULL. Then, the rule-of-thumb bandwidth selector in Eq. (A1) of Yang and Tschernig (1999) is used with additional scaling factors C_h and C_b, respectively.)
`C_h, C_b`	The scaling factors for the rule-of-thumb bandwidth parameters.
`print_bw`	The indicator of whether the current bandwidth parameters should be printed to the console. (Default: print_bw = TRUE.)
`degree`	Degree of local polynomials. (Default: degree = 2.)
`deriv_ord`	The order of the estimated derivative of the conditional mean outcome function. (Default: deriv_ord = 1.)
`kernT, kernS`	The names of kernel functions for the treatment/exposure variable and confounding variables. (Default: kernT = "epanechnikov", kernS = "epanechnikov".)
`parallel`	The indicator of whether the function should be parallel executed. (Default: parallel = TRUE.)
`cores`	The number of cores for parallel execution. (Default: cores = 6.)

Value

The estimated dose-response curves or its derivatives evaluated at points `t_eval`.

Author(s)

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References

Zhang, Y., Chen, Y.-C., and Giessing, A. (2024) *Nonparametric Inference on Dose-Response Curves Without the Positivity Condition.* https://arxiv.org/abs/2405.09003.

Fan, J. and Gijbels, I. (1996) *Local Polynomial Modelling and its Applications. Chapman & Hall/CRC.*

Examples

```
library(parallel)
set.seed(123)
n <- 300

S2 <- cbind(2 * runif(n) - 1, 2 * runif(n) - 1)
Z2 <- 4 * S2[, 1] + S2[, 2]
E2 <- 0.2 * runif(n) - 0.1
T2 <- cos(pi * Z2^3) + Z2 / 4 + E2
Y2 <- T2^2 + T2 + 10 * Z2 + rnorm(n, mean = 0, sd = 1)
X2 <- cbind(T2, S2)

t_qry2 = seq(min(T2) + 0.01, max(T2) - 0.01, length.out = 100)
chk <- Sys.getenv("_R_CHECK_LIMIT_CORES_", "")
if (nzchar(chk) && chk == "TRUE") {
  # use 2 cores in CRAN/Travis/AppVeyor
  num_workers <- 2L
} else {
  # use all cores in devtools::test()
  num_workers <- parallel::detectCores()
}
Y_RA2 = RegAdjust(Y2, X2, t_eval = t_qry2, h = NULL, b = NULL, C_h = 7, C_b = 3,
                  print_bw = FALSE, degree = 2, deriv_ord = 0,
                  kernT = "epanechnikov", kernS = "epanechnikov",
                  parallel = TRUE, cores = num_workers)
```

`RoTBWLocalPoly` *The rule-of-thumb bandwidth selector for the (partial) local polynomial regression.*

Description

This function implements the rule-of-thumb bandwidth selector for the (partial) local polynomial regression.

Usage

```
RoTBWLocalPoly(
  Y,
  X,
  kernT = "epanechnikov",
  kernS = "epanechnikov",
  C_h = 7,
  C_b = 3
)
```

Arguments

`Y`	The input n-dimensional outcome variable vector.
`X`	The input n*(d+1) matrix. The first column of X stores the treatment/exposure variables, while the other d columns are confounding variables.
`kernT`, `kernS`	The names of kernel functions for the treatment/exposure variable and confounding variables. (Default: kernT = "epanechnikov", kernS = "epanechnikov".)
`C_h`, `C_b`	The scaling factors for the rule-of-thumb bandwidth parameters.

Value

A list that contains two elements.

`h`	The rule-of-thumb bandwidth parameter for the treatment/exposure variable.
`b`	The rule-of-thumb bandwidth vector for the confounding variables.

Author(s)

Yikun Zhang, `<yikunzhang@foxmail.com>`

References

Zhang, Y., Chen, Y.-C., and Giessing, A. (2024) *Nonparametric Inference on Dose-Response Curves Without the Positivity Condition.* https://arxiv.org/abs/2405.09003.

Yang, L. and Tschernig, R. (1999). *Multivariate Bandwidth Selection for Local Linear Regression. Journal of the Royal Statistical Society Series B: Statistical Methodology, 61(4), 793-815.*

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