

Package ‘paneltests’

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Type Package

Title Panel Data Pre-Testing and Diagnostic Suite

Version 1.0.6

Description Pre-testing and diagnostic tools for panel data analysis.

Researchers should run these tests before any panel regression to verify modelling assumptions. The package implements: (1) the Hsiao (2014, <ISBN:978-1-107-65763-2>) homogeneity F-tests (F1/F2/F3), Swamy (1970) <doi:10.2307/1913012> parameter heterogeneity test, and Pesaran (2004) <doi:10.2139/ssrn.572504> cross-sectional dependence test via `xtpretest()`; (2) missing-data detection, mechanism testing, and imputation for unbalanced panels via `xtmispanel()`; (3) quantile-regression cross-sectional dependence tests (T_{τ} and $T\text{-}\tilde{\tau}$ statistics) of Demetrescu, Hosseinkouchack and Rodrigues (2023) via `xtcsdq()`; and (4) the panel quantile-regression slope homogeneity $S\text{-}\hat{\tau}$ and $D\text{-}\hat{\tau}$ statistics of Galvao, Juhl, Montes-Rojas and Olmo (2017) <doi:10.1093/jjfinec/nbx016> via `xtqsh()`. Together these tests address three fundamental pre-testing questions: (i) are slopes homogeneous? (ii) is there cross-sectional dependence? and (iii) is the panel balanced and is missingness ignorable?

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Encoding UTF-8

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Depends R (>= 3.5.0)

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Author Muhammad Abdullah Alkhalaf [aut, cre, cph] (ORCID:
<<https://orcid.org/0009-0002-2677-9246>>)

Maintainer Muhammad Abdullah Alkhalaf <muhammedalkhalaf@gmail.com>

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print.xtcsdq	<i>Print method for xtcsdq objects</i>
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Description

Print method for xtcsdq objects

Usage

```
## S3 method for class 'xtcsdq'  
print(x, ...)
```

Arguments

- x An object of class "xtcsdq".
- ... Additional arguments (ignored).

Value

Invisibly returns x.

print.xtqsh	<i>Print Method for xtqsh Objects</i>
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Description

Prints a formatted summary of an "xtqsh" test result.

Usage

```
## S3 method for class 'xtqsh'  
print(x, ...)
```

Arguments

- x

An object of class "xtqsh".
- ...

Additional arguments (ignored).

Value

Invisibly returns x.

qsh_sample	<i>Sample Panel Dataset for Quantile Slope Homogeneity Testing</i>
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Description

A simulated balanced panel dataset for demonstrating the quantile slope homogeneity test ([xtqsh](#)).

Usage

```
data(qsh_sample)
```

Format

- A data frame with columns:
- id**

Cross-sectional unit identifier.
- time**

Time period identifier.
- y**

Dependent variable.
- x1**

First explanatory variable.
- x2**

Second explanatory variable.

summary.xtcsdq	<i>Summary method for xtcsdq objects</i>
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Description

Summary method for xtcsdq objects

Usage

```
## S3 method for class 'xtcsdq'  
summary(object, ...)
```

Arguments

- object

An object of class "xtcsdq".
- ...

Additional arguments (ignored).

Value

Invisibly returns object.

summary.xtqsh	<i>Summary Method for xtqsh Objects</i>
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Description

Prints a summary of an "xtqsh" test result.

Usage

```
## S3 method for class 'xtqsh'
summary(object, ...)
```

Arguments

- object An object of class "xtqsh".
- ... Additional arguments (ignored).

Value

Invisibly returns object.

xtcsdq	<i>Tests of No Cross-Sectional Dependence in Panel Quantile Regressions</i>
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Description

Tests the null hypothesis of no cross-sectional error dependence (CSD) in panel quantile regressions. Implements the T_tau and T-tilde_tau statistics of Demetrescu, Hosseinkouchack and Rodrigues (2023).

Usage

```
xtcsdq(
  formula = NULL,
  data = NULL,
  index = NULL,
  quantiles,
  mode = c("pooled", "individual", "residuals"),
  residuals = NULL,
  bandwidth = NULL,
  correction = TRUE
)
```

Arguments

<code>formula</code>	A formula of the form $y \sim x_1 + x_2 + \dots$. Required for <code>mode = "pooled"</code> (default) and <code>mode = "individual"</code> . Not used when <code>residuals</code> is provided.
<code>data</code>	A data frame containing the panel data in long format. Required unless <code>residuals</code> is provided.
<code>index</code>	A character vector of length 2: <code>c("id_var", "time_var")</code> . Required unless <code>residuals</code> is provided.
<code>quantiles</code>	A numeric vector of quantile levels, each strictly between 0 and 1.
<code>mode</code>	Estimation mode: <code>"pooled"</code> (default, pooled FE-QR), <code>"individual"</code> (per-unit QR), or <code>"residuals"</code> (provide pre-computed residuals via the <code>residuals</code> argument).
<code>residuals</code>	A list (or named list) of numeric vectors or a matrix with one column per quantile, containing pre-computed QR residuals. Only used when <code>mode = "residuals"</code> .
<code>bandwidth</code>	Numeric. KDE bandwidth for sparsity estimation. If NULL (default), uses $0.35(NT)^{-0.2}$.
<code>correction</code>	Logical. If TRUE (default), reports the bias-corrected T-tilde statistic in addition to T_tau.

Details

The T_{τ} statistic (Equation 3 in Demetrescu et al., 2023) tests for CSD by examining pairwise correlations of demeaned QR residuals across units. Under the null of no CSD, T_{τ} is asymptotically standard normal.

The bias-corrected version $T\text{-tilde}_{\tau}$ (Equation 5) subtracts two correction terms that account for the estimation uncertainty in the QR slope and the sparsity at the quantile. Reject H_0 for large positive values.

The portmanteau statistic $M_K = K^{-1} \sum_{q=1}^K T_{\tau}^{(q)}$ aggregates across K quantile levels.

The KDE bandwidth defaults to $h = 0.35(NT)^{-0.2}$ as in the original paper.

Value

An object of class `"xtcsdq"` with components:

T_{τ} Numeric vector of T_{τ} statistics (one per quantile).

$T\text{-tilde}_{\tau}$ Numeric vector of bias-corrected $T\text{-tilde}_{\tau}$ statistics.

pval_T p-values for T_{τ} .

pval_Tilde p-values for $T\text{-tilde}_{\tau}$.

fhat KDE density estimates at zero (one per quantile).

M_K Portmanteau statistic (average of T_{τ} over quantiles).

Mtilde_K Bias-corrected portmanteau statistic.

pval_M p-value for M_K .

pval_Mc p-value for $M\text{-tilde}_K$.

quantiles Quantile levels used.

N Number of cross-sectional units.

TT Number of time periods.

bandwidth KDE bandwidth used.

References

Demetrescu, M., Hosseinkouchack, M. and Rodrigues, P.M.M. (2023). Tests of no cross-sectional error dependence in panel quantile regressions. *Ruhr Economic Papers*, No. 1041. doi:10.4419/96973210

Examples

```
set.seed(42)
n <- 8; tt <- 20
dat <- data.frame(
  id   = rep(1:n, each = tt),
  time = rep(1:tt, times = n),
  y    = rnorm(n * tt),
  x1   = rnorm(n * tt)
)
res <- xtcseq(y ~ x1, data = dat, index = c("id", "time"),
             quantiles = c(0.25, 0.5, 0.75))
print(res)
summary(res)
```

xtmispanel

Missing Data Detection and Imputation for Panel Data

Description

Detects, diagnoses, and imputes missing values in panel (longitudinal) data sets. The function can produce summary tables (Module 1), test the missingness mechanism (Module 2), impute a target variable (Module 3), and run a cross-method sensitivity analysis (Module 4).

Usage

```
xtmispanel(
  data,
  vars = NULL,
  index,
  detect = TRUE,
  test = FALSE,
  impute = NULL,
  target = NULL,
  new_var = NULL,
  sensitivity = FALSE,
  knn_k = 5L
)
```

Arguments

data	A data.frame in long format.
vars	Character vector of variable names to analyse. If NULL (default), all numeric columns except the index are used.
index	Character vector of length 2: c("panel_id", "time_id").
detect	Logical. Run Module 1 (detection tables, default TRUE).
test	Logical. Run Module 2 (MCAR/MAR mechanism tests, default FALSE).
impute	Character or NULL. If a method name is given, run Module 3 (imputation). Supported methods: "mean", "median", "locf", "nocb", "linear", "spline", "pmm", "hotdeck", "knn", "rf", "em".
target	Character. Name of the variable to impute (required when impute is not NULL).
new_var	Character. Name of the output imputed variable (default "{target}_imp").
sensitivity	Logical. Run Module 4 (sensitivity analysis across all imputation methods, default FALSE).
knn_k	Integer. Number of neighbours for KNN imputation (default 5).

Value

A list (invisibly) with components:

detect Summary statistics per variable/panel/period.

test MCAR and MAR test results.

imputed The data frame augmented with the imputed column (when imputation is requested).

impute_stats Summary comparing original vs imputed.

sensitivity Sensitivity analysis results.

References

Little, R. J. A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association*, 83(404), 1198-1202. doi:[10.1080/01621459.1988.10478722](https://doi.org/10.1080/01621459.1988.10478722)

Examples

```
set.seed(1)
df <- data.frame(
  id   = rep(1:4, each = 8),
  time = rep(1:8, times = 4),
  y    = c(rnorm(32))
)
# introduce some NAs
df$y[c(3, 11, 20)] <- NA
res <- xtmispanel(df, vars = "y", index = c("id", "time"), detect = TRUE)
```

xtpretest

Comprehensive Panel Data Pre-Testing Suite

Description

Performs a full battery of panel data pre-tests: Hsiao (2014) homogeneity F-tests, robust (HC1) versions, Swamy (1970) parameter heterogeneity test, cross-sectional dependence (Pesaran 2004), and panel summary statistics.

Usage

```
xtpretest(
  data,
  formula,
  index,
  tests = "ALL",
  level = 0.05
)
```

Arguments

<code>data</code>	A <code>data.frame</code> in long format containing all variables.
<code>formula</code>	A two-sided formula of the form $y \sim x_1 + x_2 + \dots$ specifying the dependent and independent variables.
<code>index</code>	Character vector of length 2: <code>c("panel_id", "time_id")</code> .
<code>tests</code>	Character vector. Which modules to run. Possible values: "summary", "hsiao", "robust", "heterogeneity", "csd". Default "ALL" runs everything.
<code>level</code>	Numeric. Significance level for decisions (default 0.05).

Value

A list (invisibly) with components:

`summary` Panel summary statistics.

`hsiao` Hsiao homogeneity F-test results.

`robust` Robust HC1 F-test results.

`swamy` Swamy heterogeneity test results.

`csd` Cross-sectional dependence test results.

`recommendation` Character. Suggested estimator.

References

- Hsiao, C. (2014). *Analysis of Panel Data* (3rd ed.). Cambridge University Press. doi:10.1017/CBO9781139839327
- Swamy, P. A. V. B. (1970). Efficient inference in a random coefficient regression model. *Econometrica*, 38(2), 311-323. doi:10.2307/1913012
- Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels. Cambridge Working Paper in Economics, No. 0435. doi:10.2139/ssrn.572504

Examples

```
set.seed(10)
n <- 5; t <- 10
df <- data.frame(
  id   = rep(1:n, each = t),
  time = rep(1:t, times = n),
  y    = rnorm(n * t),
  x1   = rnorm(n * t)
)
res <- xtptest(df, y ~ x1, index = c("id", "time"),
               tests = c("hsiao", "csd"))
```

xtqsh

Quantile Regression Slope Homogeneity Test for Panel Data

Description

Tests the null hypothesis of slope homogeneity in panel quantile regressions. Implements the S-hat and D-hat statistics of Galvao et al. (2017).

Usage

```
xtqsh(formula, data, index, tau, bw = "hallsheather", marginal = FALSE)
```

Arguments

formula	A formula of the form $y \sim x_1 + x_2 + \dots$
data	A data frame containing the panel data in long format.
index	Character vector of length 2: <code>c("id_var", "time_var")</code> .
tau	Numeric vector of quantile levels, each strictly between 0 and 1.
bw	Bandwidth method: "hallsheather" (default) or "bofinger".
marginal	Logical. If TRUE, compute per-variable marginal tests. Default FALSE.

Value

An object of class "xtqsh" containing test statistics and p-values.

References

Galvao, A.F., Juhl, T., Montes-Rojas, G. and Olmo, J. (2017). Testing Slope Homogeneity in Quantile Regression Panel Data. *Journal of Financial Econometrics*, 16(2), 211-243.

Examples

```
set.seed(42)
n <- 10; tt <- 20
dat <- data.frame(
  id   = rep(1:n, each = tt),
  time = rep(1:tt, times = n),
  y    = rnorm(n * tt),
  x1   = rnorm(n * tt)
)
res <- xtqsh(y ~ x1, data = dat, index = c("id", "time"), tau = 0.5)
print(res)
```

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