Package 'rfcipDemand'

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Type Package

Title Estimate Federal Crop Insurance Program Demand Models

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Description Tools to construct county–crop–practice–plan–unit panels from the
USDA RMA Summary of Business (SOBTPU) and related sources, and to estimate
FCIP demand systems with two-way cluster-robust covariance. The pipeline
standardizes coverage measures, merges price and instrument variables, adds
rental-rate and price-index controls, reconciles county acreage (FSA/NASS),
and produces diagnostics including robust first-stage F-tests. Methods align
with the empirical design in ``The crop insurance demand response to premium
subsidies Evidence from U.S. Agriculture'' (Food Policy, 2023, 119(3)).

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URL https://github.com/you/rfcipDemand

BugReports https://github.com/you/rfcipDemand/issues

Encoding UTF-8

Roxygen list(markdown = TRUE)

RoxygenNote 7.3.2

VignetteBuilder knitr

Depends R (>= 4.1.0)

Imports rfsa, data.table, systemfit,sandwich,doBy,car,plyr,usmap,stats,utils, tidyr, nlsur

Remotes github::UrbanInstitute/urbnmapr, github::dylan-turner25/rfsa, github::JanMarvin/nlsur

Suggests knitr, rmarkdown, tibble, dplyr, lavaan, testthat (>= 3.0.0)

LazyData true

Cite-us If you find it useful, please consider staring the repository and citing the following studies
- Tsiboe, F. and Turner, D. (2025). ``Incorporating buy-
up price loss coverage into the United States
farm safety net.'' Applied Economic Perspectives and Policy.
- Tsiboe, F., et al. (2025). ``Risk reduction impacts of crop insurance in the United States.''

Applied Economic Perspectives and Policy.
- Gaku, S. and Tsiboe, F. (2024). Evaluation of alternative farm safety net program combination strategies. Agricultural Finance Review.

Contents

`calculate_mode` *Calculate the Statistical Mode*

Description

Returns the element that occurs most frequently in a vector.

Usage

```
calculate_mode(x, na.rm = TRUE)
```

Arguments

x	A vector of any atomic type (numeric, character, factor,).
na.rm	Logical; should missing values be ignored? Defaults to TRUE. If FALSE and x contains any NAs, the function returns NA.

Details

Internally the function:

1. Optionally removes NAs (na.rm = TRUE).

2. Builds a lookup table of unique values via unique(x).

3. Counts the frequency of each unique value with tabulate(match(x, ux)).

4. Returns the value with the maximum count.

Because it relies on base R functions, the implementation is vectorised and generally fast for typical data-frame column sizes.

Value

A single value giving the modal element of x. If two or more values are tied for the highest frequency, the first one encountered in x is returned.

---

estimate_fcip_instruments

Estimate FCIP Instrumental Variables (Unloaded Rates)

Description

Uses historical FCIP rate data to build instrumented unloaded-rate variables following:

1. Tsiboe & Turner (2023), Econometric identification of crop insurance participation *Agricultural and Resource Economics Review*, 52(3):476-497. https://doi.org/10.1017/age.2023.13

Usage

```
estimate_fcip_instruments(year, statplan)
```

Arguments

year	Integer. The target crop year for which to construct instruments.
statplan	A data.table containing FCIP rate elements, including at least:

commodity_year Year of the rate observation.

state_code, county_code County identifiers.

commodity_code Crop identifier.

insured_area, lcr, contiguous_state_code, contiguous_county_code Fields required by estimate_fcip_unloaded_rate().

Details

1. **Task list**: Identify all unique (state, county) pairs with data in the 2-21 years before year.

2. **Unloaded-rate calculation**: For each county in task_list, call estimate_fcip_unloaded_rate() on the same 2-21 year window to get tau. Errors return NULL so processing continues.

3. **Contiguous-county smoothing**:
   - Build a lookup table of contiguous counties (using contiguous_county).
   - For each contiguous group, compute the mean tau to get tau_c.

4. **Merge & fill**: Left-join the raw adm and contiguous_adm; replace any zero/NA/Inf tau with the group mean tau_c into tau_sob.

5. **Cleanup**: Drop helper columns (tau, tau_c), remove invalid rows, add commodity_year, and return the result.

Value

A data.table with one row per county-crop for the specified year, containing:

state_code, county_code, commodity_code Keys.

tau_sob Smoothed unloaded rate (uses contiguous-county means to fill zeros/NAs).

commodity_year The input year, repeated.

See Also

Other FCIP instruments: [get_yu2018_instrument](#)()

---

fcip_contiguous_county

fcip_contiguous_county

Description

A combined dataset for fcip_contiguous_county

Usage

```
data(fcip_contiguous_county)
```

Format

A data frame with 24307 rows and 12 columns covering Inf–Inf.

Source

USDA-RMA, Actuarial Data Master - A0123

```
fcip_demand_data_dispatcher
```
                    Build dataset to estimate Federal Crop Insurance Program (FCIP) de-
                    mand (modular pipeline)

Description

End-to-end pipeline that: (1) prepares SOBTPU and coverage aggregates, (2) adds prices/instruments/rental rates/price index, (3) reconciles county acreage (FSA + NASS), and (4) finalizes bins/labels/pooling for demand estimation.

Usage

```
fcip_demand_data_dispatcher(
  study_years = 2001:(as.numeric(format(Sys.Date(), "%Y")) - 1),
  identifiers = c("commodity_year", FCIP_INSURANCE_POOL, "insurance_plan_code",
    "unit_structure_code")
)
```

Arguments

study_years	Integer vector of commodity years to include. Defaults to `2001:(as.numeric(format(Sys.Date(), "%Y")) - 1)`.
identifiers	Character vector of grouping keys that define the aggregation grain. Must be columns present in SOBTPU (e.g., `"commodity_year"`, `FCIP_INSURANCE_POOL`, `"insurance_plan_code"`, `"unit_structure_code"`, and-if desired-additional keys like `"commodity_code"` or `"practice_code"`). Enrichment joins for recodes are performed only when the required keys are included in `identifiers`

Details

Aligned with Asche, Bekkerman, & Li (2023), *Food Policy*, 119(3):102505 (doi:10.1016/j.foodpol.2023.102505). Requires internet access to download release `.rds` assets and several in-memory lookup tables (see stage docs).

Value

A `data.table` ready for FCIP demand estimation.

```
fcip_demand_elasticities_calibrate
```
                    Calibrate FCIP demand elasticities via IV-SEM (lavaan)

Description

Fits a just-identified IV-style SEM where `instr_rate` instruments `tilda_rate`, and `tilda_rate` enters two outcome equations (`tilda_Gamma`, `tilda_Theta1`). Endogeneity is encoded via residual correlations between `tilda_rate` and each outcome. The instrument is excluded from the outcome disturbances.

Usage

```
fcip_demand_elasticities_calibrate(
  data,
  estimator = c("ML", "MLR"),
  missing = c("fiml", "listwise")
)
```

Arguments

data	data.frame with cols: instr_rate, tilda_rate, tilda_Gamma, tilda_Theta1
estimator	"ML" or "MLR" (default "MLR" = robust SE/tests)
missing	"fiml" or "listwise" (default "fiml")

Details

Constraints imposed:

1. b1 < 0, 2) b2 < 0, 3) b1 + b2 + b1*b2 < 0

Value

A list with:

- `fit`: the lavaan fit object
- `pe`: parameter estimates (including standardized if requested)
- `rsq`: R-squareds (first-stage strength)
- `converged`: logical convergence flag

---

fcip_demand_sys_coeff_table

Tidy coefficient table with cluster-robust SEs (from supplied VCOV)

Description

Builds a clean coefficient table for a `systemfit` model using a **user-supplied covariance matrix** (e.g., two-way clustered from `fcip_demand_sys_vcov()`). Estimates come from `coef(fit)`, standard errors from `diag(vcMat)`, then Z-scores and two-sided normal p-values are computed. The demand column is inferred from the equation prefix in the coefficient names:

- `"Gamma_*"` to `"Gamma"`
- `"Theta_*"`, `"Theta1_*"`, `"Theta2_*"`, ... to `"Theta"` Otherwise the prefix itself is used.

Usage

```
fcip_demand_sys_coeff_table(fit, vcMat, p_digits = 5)
```

Arguments

fit	A fitted `systemfit` object.
vcMat	A covariance matrix conformable with `coef(fit)`. Row/column names are used to align; if missing, positional alignment is assumed.
p_digits	Integer; number of digits to keep for p-values (default 5).

Value

A `data.frame` with columns: demand, coef, Estimate, StdError, Zvalue, Pvalue.

`fcip_demand_sys_effect`

Delta-method "total protection response"

Description

Combines equation-specific effects into a single "Total" effect for each regressor in `c(fields$endogenous,` `fields$included)` using `car::deltaMethod` and a supplied covariance matrix.

Usage

```
fcip_demand_sys_effect(fit, vcMat, fields, data)
```

Arguments

`fit`	A fitted `systemfit` object (the structural system).
`vcMat`	Covariance matrix conformable with `coef(fit)` (e.g., from `fcip_demand_sys_vcov()`).
`fields`	Named list carrying model fields; must include `outcome`, `endogenous`, and `included`.
`data`	Estimation data used to check variable availability and build delta-method expressions.

Value

A `data.frame` with rows demand=`"Total"` and columns: demand, coef, Estimate, StdError, Zvalue, Pvalue.

`fcip_demand_sys_estimate`

System estimator (modular wrapper; preserves original outputs)

Description

Runs: per-level prep -> partial/tilda -> systemfit -> clustered VCOV -> delta-method totals -> (optional) restricted NLSUR -> diagnostics -> bind rows.

Usage

```
fcip_demand_sys_estimate(model, data)
```

Arguments

`model`	List with elements: `outcome`, `endogenous`, `included`, `excluded` (opt), `partial` (opt), `FE` (logical), `disag` (string colname), optional `restrict` (logical), `name` (string).
`data`	Input data.frame/data.table with all referenced columns plus `pool` and `commodity_year`.

Value

A data.frame aggregating results across all disaggregation levels.

---

fcip_demand_sys_fit   *Build systemfit formulas and estimate the system*

Description

Constructs the list of structural equations (g) and instrument sets (h), then runs systemfit() using OLS (when no excluded instruments) or 3SLS-GMM (when excluded instruments are present).

Usage

```
fcip_demand_sys_fit(
  data,
  fields,
  tilda_included,
  tilda_endogenous,
  tilda_excluded
)
```

Arguments

data	Estimation data.frame/data.table containing the tilda_* and instr_* variables referenced by the formulas.
fields	Named list with at least outcome, included, endogenous, and optionally excluded.
tilda_included	Character vector of residualized included regressor names (e.g., "tilda_x1").
tilda_endogenous	
	Character vector of residualized endogenous regressor names (e.g., "tilda_z1").
tilda_excluded	Character vector of instrument names (e.g., "instr_z1"), or NULL when no excluded instruments are used.

Value

A list with elements:

fit	Fitted systemfit object.
g	List of structural formulas.
h	List of instrument formulas.

---

fcip_demand_sys_level_prep

Prepare data for a single level

Description

Filters to one disaggregation `level`, drops incomplete/invalid rows, removes constant partials, and optionally demeans via a fixed-effects helper.

Usage

```
fcip_demand_sys_level_prep(data, fields, level)
```

Arguments

data	Estimation dataset that already contains all columns referenced by `fields`.
fields	Named list: `outcome`, `endogenous`, `included`, `excluded` (opt), `partial` (opt), `FE` (logical), `disag` (column name).
level	One element of the disaggregation levels.

Value

A list: `data` (prepped), `NFE` (number of FE), `partial` (possibly reduced).

---

fcip_demand_sys_level_run

Orchestrate one disaggregation level

Description

Runs the full pipeline for a single level: level prep -> partial/tilda creation -> systemfit -> two-way clustered VCOV -> delta-method totals -> optional restricted step -> diagnostics; then returns a tidy coefficient table with metadata.

Usage

```
fcip_demand_sys_level_run(base_data, fields, level)
```

Arguments

base_data	Full estimation dataset (before subsetting to the level).
fields	Named list carrying model fields (see `fcip_demand_estimation()`), including `disag`, `FE`, `outcome`, `endogenous`, `included`, optional `excluded`, `partial`, `restrict`, and name.
level	One value of `fields$disag` to estimate for (e.g., a crop name).

Value

A `data.frame` with columns `demand`, `coef`, `Estimate`, `StdError`, `Zvalue`, `Pvalue` and meta-columns `model`, `endogenous`, `FE`, `name`, `disag`, `level`.

`fcip_demand_sys_partial`

Residualize ("partial out") and build tilded / instrument variables

---

Description

If excluded instruments exist, runs first-stage OLS for each endogenous variable e: e ~ 1 + partial + included + excluded, storing the fitted values as instr_e. If partial is non-empty, it then regresses instr_e ~ 1 + partial and replaces instr_e <- instr_e - fitted(instr_e ~ partial) (i.e., removes the partial component; conceptually $\widehat{\text{instr}}_e(\text{partial})$).

Outcomes, included, and endogenous variables are residualized on partial to create tilda_<var> (or copied if partial is empty).

Usage

```
fcip_demand_sys_partial(data, fields, partial_override = NULL)
```

Arguments

data	A data.frame/data.table with referenced variables.
fields	List with: outcome, endogenous, included, optional excluded, optional partial.
partial_override	
	Optional character vector to override fields$partial.

Details

Uses defensive checks so absent columns are ignored (with a warning) rather than erroring. If partial is empty, residualization is a no-op and tilda_* simply copy the originals. Formulas are constructed via stats::reformulate() to avoid paste/quoting pitfalls.

Value

List with data, tilda_included, tilda_endogenous, tilda_excluded.

`fcip_demand_sys_restricted`

Optional restricted NLSUR step (when restrict = TRUE*)*

Description

If enabled and feasible, estimates a nonlinear SUR with re-parameterized coefficients (negative exponents) using the optional **nlsur** package and appends "restricted_" rows to the results. Skips gracefully if **nlsur** is not installed or the step fails.

Usage

```
fcip_demand_sys_restricted(
  restrict,
  res,
  fit,
  data,
  outcome,
  tilda_endogenous,
  tilda_excluded,
  tilda_included
)
```

Arguments

restrict	Logical flag; when `TRUE` attempt the restricted step.
res	Coefficient table from the unrestricted system (used to check signs).
fit	Fitted `systemfit` object from the unrestricted system.
data	Estimation data used to fit the restricted NLSUR model.
outcome	Character vector of outcome equation names (length 2 expected).
tilda_endogenous	
	Character vector of endogenous regressors used in the tilded system (e.g., `"tilda_z1"`).
tilda_excluded	Character vector of excluded instruments (e.g., `"instr_z1"`).
tilda_included	Character vector of included regressors (`"tilda_x1"`, ...).

Value

A `data.frame` with rows for `Gamma`, `Theta`, and `Total` labeled `restricted_*`, or an empty `data.frame` if skipped.

Note

This step uses `nlsur::nlsur()` if available; it is optional and should be listed under `Suggests` in `DESCRIPTION`.

---

fcip_demand_sys_tests	*System diagnostics: two-way robust first-stage F (+ optional approx. J)*

Description

Produces diagnostics **without** re-running GMM:

- **FTest**: joint relevance of excluded instruments in each first stage, using the same two-way (pool by crop year) cluster-robust covariance via [`fcip_demand_sys_vcov()`](fcip_demand_sys_vcov()) with `kind = "lm"`. Reports the **minimum** F across endogenous regressors.

- **JTest** (optional): an *approximate* over-identification test computed as the sum of per-equation Sargan statistics $J_k \approx n_k R_k^2$ from regressions of equation residuals on that equation's instrument set. This is a quick check (not the system Hansen J).

Usage

```
fcip_demand_sys_tests(g, h, data, fit, NFE, approx_j = FALSE)
```

Arguments

g	List of system equations (the same formulas passed to `systemfit`).
h	List of instrument formulas (the same formulas passed to `systemfit`).
data	Estimation `data.frame`/`data.table` containing all variables in g/h plus clustering columns `pool` and `crop_yr`.
fit	A fitted `systemfit` object (used for N and `residCov_*` extraction).
NFE	Integer: number of absorbed fixed effects (for reporting only).
approx_j	Logical, compute the approximate (non-robust) Sargan J as described above. Default `FALSE` (returns `NA` for `JTest`).

Value

A `data.frame` with rows: N, NFE, `residCov_11`, `residCov_22`, `residCov_12`, JTest, FTest.

---

fcip_demand_sys_vcov *Two-way cluster-robust covariance for FCIP demand models*

Description

Computes a Cameron-Gelbach-Miller two-way cluster-robust covariance matrix using inclusion-exclusion: $V = V_{pool} + V_{year} - V_{pool\_year}$. Works for both `systemfit` (stacked system) and `lm` (first-stage).

Usage

```
fcip_demand_sys_vcov(
  object,
  data,
  kind = c("systemfit", "lm"),
  pool_col = "pool",
  year_col = "commodity_year",
  NFE = 0L,
  n_partial = 0L,
  n_eq = NULL
)
```

Arguments

object	Fitted model: either a `systemfit` or `lm`.
data	Estimation data containing pool and year identifiers.
kind	One of `c("systemfit","lm")`. If omitted, auto-detected.
pool_col	Name of the pool/cluster id column in `data` (default `"pool"`).
year_col	Name of the year/time id column in `data` (default `"crop_yr"`).
NFE	Integer; number of absorbed fixed effects (for df rescaling).

n_partial	Integer; count of variables partialed out per equation.
n_eq	Integer; number of equations (length(object$eq) for systemfit, 1 for lm). You can override if needed.

Details

Rescaling. Let n be the number of observations (stacked across equations for systemfit). With k_old the number of coefficients and $k_new = k_old + NFE + n\_partial * n\_eq$, the returned matrix is scaled by $(n - k_old - 1)/(n - k_new - 1)$.

Row alignment (lm). Rows used by lm are inferred from rownames(model.matrix(object)). If they cannot be mapped back to data, the first nobs(object) rows are used.

Value

Covariance matrix aligned with coef(object).

---

fcip_recodes_commodity_groupings

fcip_recodes_commodity_groupings

Description

A combined dataset for fcip_recodes_commodity_groupings

Usage

    data(fcip_recodes_commodity_groupings)

Format

A data frame with 3572 rows and 10 columns covering 1997-2025.

Source

USDA-RMA, Actuarial Data Master - A00400 and A00420 supplemented data from legacy ADM files

---

fcip_recodes_insurance_plan

fcip_recodes_insurance_plan

Description

A combined dataset for fcip_recodes_insurance_plan

Usage

    data(fcip_recodes_insurance_plan)

Format

A data frame with 773 rows and 10 columns covering 1989-2025.

Source

USDA-RMA, Actuarial Data Master - A00460 supplemented data from legacy ADM files

---

fcip_recodes_practice   *fcip_recodes_practice*

Description

A combined dataset for fcip_recodes_practice

Usage

```
data(fcip_recodes_practice)
```

Format

A data frame with 28639 rows and 8 columns covering 1997-2025.

Source

USDA-RMA, Actuarial Data Master - A00510 supplemented data from legacy ADM files

---

fcip_recodes_type   *fcip_recodes_type*

Description

A combined dataset for fcip_recodes_type

Usage

```
data(fcip_recodes_type)
```

Format

A data frame with 232709 rows and 7 columns covering 1999-2025.

Source

Generated internally, using harmonize_crop_type_codes()

```
fixed_effect_model_data_prep
```
Prepare and demean data for fixed-effects models

Description

This function

1. Filters to complete cases on the specified panel, time, weight, variables, and output
2. If `output` is NULL, creates a dummy output column filled with 1s
3. Drops any panel with only one observation
4. Computes within-panel means for the output + each variable in `varlist` (`_mean_i`)
5. Computes overall sample means for the same set of variables (`_mean`)
6. Replaces each variable in `varlist` by value − `within_panel_mean` + `overall_mean`

Usage

```
fixed_effect_model_data_prep(
  data,
  varlist,
  panel,
  time,
  wvar = NULL,
  output = NULL
)
```

Arguments

`data`	A data.frame or data.table containing the data.
`varlist`	Character vector of variable names to be demeaned.
`panel`	Character vector of column name(s) defining the panel identifier.
`time`	Character scalar name of the time variable.
`wvar`	Character scalar name of a variable to keep but *not* demean (optional, default NULL).
`output`	Character scalar name of an output variable whose means are computed but not altered; if NULL, a dummy column named `"output"` is created (optional, default NULL).

Value

A list with components

- **data**: a data.table containing
  - the original `panel`, `time`, `wvar`, `varlist`, and `output` columns
  - two mean columns for each of `c(output, varlist)`: `<name>_mean_i` (within-panel) and `<name>_mean` (overall)
- **NFE**: the number of panels with more than one observation

See Also

Other Estimators panel models: panel_based_spatial_smoothing_estimator()

---

format_fcip_demand_table

Table: Crop Insurance Demand System for US Federal Crop Insurance Pools (2001/22)

Description

Build a two-column, GitHub-safe panel table summarizing a crop insurance demand system. The table is organized into panels for coverage level (Theta), insured acres (Gamma), total protection response, a covariance matrix block, and additional statistics. Coefficients are formatted as estimate (std. error) with significance stars.

Usage

```
format_fcip_demand_table(df, var_labels)
```

Arguments

df   A data frame containing the results with columns:

- demand (chr): panel identifier; expected values include "Theta", "Gamma", and "Total".
- coef (chr): raw coefficient/row labels (e.g., "tilda_rate", "residCov_11", "N").
- Estimate (dbl): point estimates.
- StdError (dbl): standard errors (may be NA for scalars).
- Pvalue (dbl): p-values used to add significance stars.

var_labels   A named character vector mapping raw names to display labels,

Details

Designed for README/output knitted as github_document; use with knitr::kable(..., format = "pipe") to avoid HTML-only features.

Value

A tibble with two columns, Variables and Estimates, where panel headers have empty Estimates to enable bolding (if rendered in HTML) and coefficients are formatted as "estimate*** (se)".

---

fsa_crop_linker *Simulator Helper Datasets*

Description

A combined dataset for fsa_crop_linker

Usage

```
data(fsa_crop_linker)
```

Format

A data frame with 8594 rows and 8 columns covering Inf–Inf.

Source

Internal innovation

---

get_yu2018_instrument *Formulate & Merge National Subsidy Rate Instrument (Yu et al., 2018)*

Description

Downloads the historical Summary of Business RDS and computes national subsidy-rate instruments at specified coverage levels, following Yu et al. (2018).

Usage

```
get_yu2018_instrument(
  dt,
  delivery_systems = c("RBUP", "FBUP"),
  plan_codes = c(1:3, 90, 44, 25, 42),
  coverage_levels = c(65, 75)
)
```

Arguments

dt   sobcov

delivery_systems

Character vector. Delivery systems to include; default c("RBUP","FBUP").

plan_codes   Integer vector. Insurance plan codes to include; default c(1:3, 90, 44, 25, 42).

coverage_levels

Numeric vector. Percent coverage levels to keep; default c(65, 75).

Value

A data.table with columns: commodity_year, subsidy_rate_65, subsidy_rate_75.

See Also

Other FCIP instruments: [estimate_fcip_instruments](#)()

---

nass_census_state_beginning_farmer_and_rancher_data
nass_census_state_beginning_farmer_and_rancher_data

Description

A combined dataset for nass_census_state_beginning_farmer_and_rancher_data

Usage

    data(nass_census_state_beginning_farmer_and_rancher_data)

Format

A data frame with 255 rows and 16 columns covering Inf–Inf.

Source

USDA NASS Quick Stats

---

nass_index_for_price_recived
nass_index_for_price_recived

Description

A combined dataset for nass_index_for_price_recived

Usage

    data(nass_index_for_price_recived)

Format

A data frame with 35 rows and 3 columns covering 1990-2024.

Source

USDA NASS Quick Stats

nass_marketing_year_avg_price

nass_marketing_year_avg_price

Description

A combined dataset for nass_marketing_year_avg_price

Usage

```
data(nass_marketing_year_avg_price)
```

Format

A data frame with 31139 rows and 7 columns covering 1866-2024.

Source

USDA NASS Quick Stats

nass_state_rental_rates

nass_state_rental_rates

Description

A combined dataset for nass_state_rental_rates

Usage

```
data(nass_state_rental_rates)
```

Format

A data frame with 1792 rows and 5 columns covering 1994-2025.

Source

Output from get_state_rental_rates() function

nass_us_ag_price_index_monthly

nass_us_ag_price_index_monthly

Description

A combined dataset for nass_us_ag_price_index_monthly

Usage

```
data(nass_us_ag_price_index_monthly)
```

Format

A data frame with 2255 rows and 8 columns covering Inf–Inf.

Source

USDA NASS: https://www.nass.usda.gov/Charts_and_Maps/graphics/data

panel_based_spatial_smoothing_estimator

Panel-based spatial smoothing estimator

Description

This function

1. Constructs spatially-varying treatment interactions (one variable per spatial unit)

2. Applies within-panel/time fixed-effects demeaning to both outcome and interactions

3. Fits an OLS model by hand (`lm.fit`) to recover one coefficient per spatial unit

Usage

```
panel_based_spatial_smoothing_estimator(
  data,
  output,
  treatment,
  time,
  panel,
  spatialvar
)
```

Arguments

data	A data.table or data.frame containing panel data.
output	Name of the outcome variable (character scalar).
treatment	Name of the treatment variable whose spatial effects we estimate (character scalar).
time	Name of the time variable (character scalar).
panel	Name(s) of the panel identifier variable(s) (character vector).
spatialvar	Name of the spatial grouping variable (e.g. county FIPS; character scalar).

Details

Internally, we

1. Build treatment_code = I(spatialvar==code) * treatment for each spatial unit code.
2. Call fixed_effect_model_data_prep() to demean the outcome and all treatment_code variables.
3. Assemble the design matrix X = [output_mean_i, treatment_*] and response y.
4. Solve $\hat{\beta} = (\tilde{X}'\tilde{X})^{-1}\tilde{X}'\tilde{y}$ via lm.fit.
5. Return a row per spatial unit with its coefficient.

Value

A data.table with columns:

- estimate: the estimated spatial-unit coefficient
- county_fips: the spatial unit identifier (5-digit FIPS)
- state_code, county_code: parsed FIPS components

See Also

Other Estimators panel models: fixed_effect_model_data_prep()

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