

Package ‘acsmoe’

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Title Propagate Uncertainty for ACS Tabular Estimates

Version 0.1.0

Description Utilities for propagating uncertainty in American Community Survey tabular workflows that use published estimates and margins of error, following U.S. Census Bureau derived-estimate guidance and complementing 'tidycensus' margin-of-error workflows. Includes covariance-aware derived estimates, simulation helpers, geographic aggregation, confidence-interval conversion, and reliability diagnostics.

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URL <https://dshkol.github.io/acsmoe/>, <https://github.com/dshkol/acsmoe>

BugReports <https://github.com/dshkol/acsmoe/issues>

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acs_aggregate	<i>Aggregate paired ACS estimate and MOE columns by group.</i>
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Description

Aggregate paired ACS estimate and MOE columns by group.

Usage

```
acs_aggregate(
  data,
  group_var,
  value_cols,
  moe_cols,
  cov_strategy = c("zero", "supplied", "constant"),
  cov_value = 0,
  conf = 0.9
)
```

Arguments

data	A data frame containing ACS estimate and MOE columns.
group_var	Name of the grouping column, supplied as a single string.
value_cols	Character vector of estimate column names to aggregate.
moe_cols	Character vector of MOE column names paired with value_cols.
cov_strategy	Covariance strategy: "zero", "supplied", or "constant".
cov_value	For "constant", a scalar correlation. For "supplied", a named list of full covariance matrices keyed by estimate column.
conf	Confidence level associated with input and output MOEs.

Details

cov_strategy = "constant" interprets cov_value as a correlation, not a covariance. This differs from scalar cov arguments in core propagation functions, where a scalar means an off-diagonal covariance on the standard-error scale.

Output rows are ordered by first appearance of each group level in data, not alphabetically.

Value

A data frame with one row per group and aggregated estimate/MOE columns.

Examples

```
tracts <- data.frame(
  region = c("north", "north", "south", "south"),
  pop = c(1000, 1200, 900, 1100),
  pop_moe = c(120, 140, 100, 130)
)
acs_aggregate(tracts, "region", "pop", "pop_moe")
acs_aggregate(tracts, "region", "pop", "pop_moe",
  cov_strategy = "constant", cov_value = 0.25)
```

acs_cv

*Calculate coefficient of variation from an ACS estimate and MOE.***Description**

Calculate coefficient of variation from an ACS estimate and MOE.

Usage

```
acs_cv(estimate, moe, conf = 0.9)
```

Arguments

estimate	Numeric estimate.
moe	Numeric MOE.
conf	Confidence level associated with moe.

Value

Numeric coefficient of variation, using standard error divided by absolute estimate.

Examples

```
acs_cv(estimate = 1000, moe = 80)
acs_cv(estimate = c(1000, 100, 0), moe = c(80, 60, 5))
```

acs_diff	<i>Propagate ACS uncertainty for a difference.</i>
----------	--

Description

Propagate ACS uncertainty for a difference.

Usage

```
acs_diff(estimate1, moe1, estimate2, moe2, cov = 0, conf = 0.9)
```

Arguments

estimate1	First estimate.
moe1	MOE for estimate1.
estimate2	Second estimate.
moe2	MOE for estimate2.
cov	Covariance between the two estimates on the standard-error scale.
conf	Confidence level associated with input and output MOEs.

Value

A data frame with estimate, moe, and se.

Examples

```
acs_diff(100, 10, 40, 8)
acs_diff(100, 10, 40, 8, cov = 5)
```

acs_linear	<i>Propagate ACS uncertainty for a linear combination.</i>
------------	--

Description

Propagate ACS uncertainty for a linear combination.

Usage

```
acs_linear(estimates, moes, weights, cov = NULL, conf = 0.9)
```

Arguments

estimates	Numeric estimates.
moes	Numeric MOEs corresponding to estimates.
weights	Numeric weights for the linear combination.
cov	Optional covariance matrix on the standard-error scale. A scalar is interpreted as a common off-diagonal covariance.
conf	Confidence level associated with input and output MOEs.

Details

A scalar cov is a covariance, not a correlation. In contrast, `acs_aggregate(cov_strategy = "constant")` accepts a scalar correlation because that interface derives covariances from group-specific MOEs.

Value

A one-row data frame with estimate, moe, and se.

Examples

```
acs_linear(c(100, 50, 25), c(10, 8, 6), weights = c(2, -1, 0.5))
```

acs_product	<i>Propagate ACS uncertainty for a product.</i>
-------------	---

Description

Propagate ACS uncertainty for a product.

Usage

```
acs_product(estimate1, moe1, estimate2, moe2, cov = 0, conf = 0.9)
```

Arguments

estimate1	First estimate.
moe1	MOE for estimate1.
estimate2	Second estimate.
moe2	MOE for estimate2.
cov	Covariance between the two estimates on the standard-error scale.
conf	Confidence level associated with input and output MOEs.

Value

A data frame with estimate, moe, and se.

Examples

```
acs_product(10, 2, 50, 5)
```

acs_prop

Propagate ACS uncertainty for a proportion.

Description

Propagate ACS uncertainty for a proportion.

Usage

```
acs_prop(num, num_moe, denom, denom_moe, cov = 0, conf = 0.9)
```

Arguments

num	Numerator estimate.
num_moe	Numerator MOE.
denom	Denominator estimate.
denom_moe	Denominator MOE.
cov	Numerator-denominator covariance on the standard-error scale.
conf	Confidence level associated with input and output MOEs.

Details

This function follows the Census approximation used for proportions where the numerator is a subset of the denominator. It does not validate that $\text{num} \leq \text{denom}$; behavior for non-nested ratios is formulaic rather than a claim that the inputs define a valid proportion.

Value

A data frame with estimate, moe, and se.

Examples

```
acs_prop(num = 10, num_moe = 2, denom = 50, denom_moe = 5)
```

acs_ratio	<i>Propagate ACS uncertainty for a ratio.</i>
-----------	---

Description

Propagate ACS uncertainty for a ratio.

Usage

```
acs_ratio(num, num_moe, denom, denom_moe, cov = 0, conf = 0.9)
```

Arguments

num	Numerator estimate.
num_moe	Numerator MOE.
denom	Denominator estimate.
denom_moe	Denominator MOE.
cov	Numerator-denominator covariance on the standard-error scale.
conf	Confidence level associated with input and output MOEs.

Value

A data frame with estimate, moe, and se.

Examples

```
acs_ratio(num = 10, num_moe = 2, denom = 50, denom_moe = 5)
```

acs_reliability	<i>Categorize ACS estimate reliability by CV thresholds.</i>
-----------------	--

Description

Categorize ACS estimate reliability by CV thresholds.

Usage

```
acs_reliability(  
  estimate,  
  moe,  
  conf = 0.9,  
  thresholds = c(reliable = 0.12, caveat = 0.4)  
)
```

Arguments

estimate	Numeric estimate.
moe	Numeric MOE.
conf	Confidence level associated with moe.
thresholds	Named numeric vector with reliable and caveat CV thresholds. Defaults of 0.12 and 0.40 reflect commonly used applied conventions (e.g., reliable below 12% CV, unreliable above 40% CV); these are not a Census Bureau standard and should be adjusted to your domain, agency guidance, or project-specific quality standard.

Value

Ordered factor with levels reliable, caveat, unreliable.

Examples

```
acs_reliability(estimate = 1000, moe = 80)
acs_reliability(estimate = c(1000, 200, 50), moe = c(80, 60, 50))
```

acs_simulate	<i>Simulate ACS estimates from published estimates and MOEs.</i>
--------------	--

Description

Simulate ACS estimates from published estimates and MOEs.

Usage

```
acs_simulate(
  estimates,
  moes,
  cov = NULL,
  n_sims = 1000,
  dist = c("normal", "censored_normal"),
  conf = 0.9
)
```

Arguments

estimates	Numeric estimates.
moes	Numeric MOEs corresponding to estimates.
cov	Optional covariance matrix on the standard-error scale.
n_sims	Number of Monte Carlo simulations.
dist	Distribution assumption: "normal" or "censored_normal". The censored variant replaces below-zero draws with zero, matching the convention used in Napierala & Denton (2017) for ACS counts.
conf	Confidence level associated with input MOEs.

Value

A numeric matrix of simulated draws.

Examples

```
set.seed(1)
acs_simulate(c(x = 100, y = 50), c(10, 5), n_sims = 5)
```

acs_simulate_fn	<i>Simulate a derived ACS statistic.</i>
-----------------	--

Description

Simulate a derived ACS statistic.

Usage

```
acs_simulate_fn(
  estimates,
  moes,
  fn,
  cov = NULL,
  n_sims = 1000,
  dist = c("normal", "censored_normal"),
  conf = 0.9,
  summary = c("mean", "median", "ci"),
  point = c("mean", "median")
)
```

Arguments

estimates	Numeric estimates.
moes	Numeric MOEs corresponding to estimates.
fn	Function applied to each simulated row.
cov	Optional covariance matrix on the standard-error scale.
n_sims	Number of Monte Carlo simulations.
dist	Distribution assumption: "normal" or "censored_normal". The censored variant replaces below-zero draws with zero, matching the convention used in Napierala & Denton (2017) for ACS counts.
conf	Confidence level associated with input MOEs.
summary	Summary to return: "mean", "median", or "ci".
point	For summary = "ci", point estimate to report alongside the percentile interval: "mean" (default) or "median".

Details

For `summary = "ci"`, the returned interval is the central conf-level percentile interval of the simulated derived values. The reported estimate is the chosen point summary of those values.

Value

A data frame summarizing the simulated derived statistic.

Examples

```
set.seed(1)
acs_simulate_fn(c(100, 50), c(10, 5), fn = sum, n_sims = 500)
set.seed(1)
acs_simulate_fn(c(100, 50), c(10, 5), fn = sum, n_sims = 500,
  summary = "ci", conf = 0.90)
```

acs_sum

Propagate ACS uncertainty for a sum.

Description

Propagate ACS uncertainty for a sum.

Usage

```
acs_sum(estimates, moes, cov = NULL, conf = 0.9)
```

Arguments

<code>estimates</code>	Numeric estimates to sum.
<code>moes</code>	Numeric MOEs corresponding to estimates.
<code>cov</code>	Optional covariance matrix on the standard-error scale. A scalar is interpreted as a common off-diagonal covariance.
<code>conf</code>	Confidence level associated with input and output MOEs.

Details

A scalar `cov` is a covariance, not a correlation. In contrast, `acs_aggregate(cov_strategy = "constant")` accepts a scalar correlation because that interface derives covariances from group-specific MOEs.

Value

A one-row data frame with estimate, moe, and se.

Examples

```
acs_sum(c(100, 50, 25), c(12, 8, 6))
acs_sum(c(100, 50), c(12, 8), cov = 5)
```

moe_ci	<i>Convert an ACS MOE to lower and upper confidence bounds.</i>
--------	---

Description

Convert an ACS MOE to lower and upper confidence bounds.

Usage

```
moe_ci(estimate, moe, conf_in = 0.9, conf_out = 0.95)
```

Arguments

estimate	Numeric estimate.
moe	Numeric margin of error.
conf_in	Confidence level associated with moe.
conf_out	Desired confidence level for the returned interval.

Value

A data frame with estimate, lower, upper, and moe.

Examples

```
moe_ci(estimate = 100, moe = 10)
moe_ci(estimate = c(100, 200), moe = c(10, 25), conf_out = 0.99)
```

moe_to_se	<i>Convert an ACS margin of error to a standard error.</i>
-----------	--

Description

Convert an ACS margin of error to a standard error.

Usage

```
moe_to_se(moe, conf = 0.9)
```

Arguments

moe	Numeric margin of error.
conf	Confidence level associated with moe.

Value

Numeric standard error.

Examples

```
moe_to_se(c(10, 25, 100))  
moe_to_se(10, conf = 0.95)
```

se_to_moe

Convert a standard error to an ACS-style margin of error.

Description

Convert a standard error to an ACS-style margin of error.

Usage

```
se_to_moe(se, conf = 0.9)
```

Arguments

se	Numeric standard error.
conf	Desired confidence level.

Value

Numeric margin of error.

Examples

```
se_to_moe(c(6, 15, 60))  
se_to_moe(6, conf = 0.95)
```

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