Package: MFRCD (via r-universe)

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Type Package

Title Optimal Row-Column Designs for Asymmetrical Factorial Experiments

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Description Constructs and analyzes optimal row-column designs for mixed-level factorial experiments under square and rectangular field layouts. For square field layouts, the package implements direct common-factor constructions by first forming two component treatment arrays, one for each factor or super-factor, and then combining them through a symbolic cell-wise product following Gopinath, Parsad and Mandal (2018) <doi:10.1080/03610926.2017.1376091>. For rectangular field layouts, the package constructs designs by extracting a balanced principal block from a mixed-level block design, treating it as the principal column, taking the complete treatment set as the principal row, and generating the full row-column design by cyclic modular development. The package also includes repair utilities for improving disconnected or partially connected row-column designs through bounded treatment-swap searches while preserving the row-column layout structure. The package provides diagnostic tools for connectedness, orthogonal factorial structure, balance, estimability, and selected optimality criteria for row-column designs.

License GPL-3

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Imports stats

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Contents

`analyse_rcd` *Analyze a factorial row-column design*

Description

Analyze a factorial row-column design.

Usage

```
analyse_rcd(
  design,
  factor_levels = NULL,
  input = c("auto", "number", "factor_label"),
  sep = "",
  tol = 1e-08
)
```

Arguments

design	A row-column design matrix.
factor_levels	Integer vector of factor levels.
input	Coding used by the supplied design.
sep	Character separator used in treatment labels.
tol	Numerical tolerance.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
D <- matrix(c(1, 2, 3, 4), nrow = 2)
res <- analyse_rcd(D, factor_levels = c(2, 2), input = "number")
stopifnot(inherits(res, "rcd_analysis"))
```

---

check_rc_factorial_n *Check basic row-column factorial design properties*

Description

Check basic row-column factorial design properties.

Usage

```
check_rc_factorial_n(D)
```

Arguments

D	A design object or design matrix.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
ex <- rc_factorial_n(c(2, 2))
chk <- check_rc_factorial_n(ex)
stopifnot(is.list(chk))
```

`make_connected_rcd_bounded` *Repair a row-column design under bounded swaps*

Description

Repair a row-column design under bounded swaps.

Usage

```
make_connected_rcd_bounded(
  design,
  factor_levels,
  input = c("factor_label", "number", "auto"),
  sep = "",
  tol = 1e-08,
  replication = "auto",
  horizontal_reps = 1,
  vertical_reps = 1,
  max_per_row = horizontal_reps,
  max_per_column = vertical_reps,
  max_iter = 100,
  max_candidates = NULL,
  seed = NULL,
  verbose = FALSE
)
```

Arguments

`design`	A row-column design matrix.
`factor_levels`	Integer vector of factor levels.
`input`	Coding used by the supplied design.
`sep`	Character separator used in treatment labels.
`tol`	Numerical tolerance.
`replication`	Replication target or "auto".
`horizontal_reps`	Maximum horizontal replication bound.
`vertical_reps`	Maximum vertical replication bound.
`max_per_row`	Maximum allowed occurrences of a treatment in a row.
`max_per_column`	Maximum allowed occurrences of a treatment in a column.
`max_iter`	Maximum number of repair iterations.
`max_candidates`	Maximum number of candidate swaps to examine.
`seed`	Optional random seed.
`verbose`	Logical; if TRUE, emit progress or summary messages.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
D <- matrix(c(1, 2, 3, 4), nrow = 2)
res <- make_connected_rcd_bounded(
  D, factor_levels = c(2, 2), input = "number",
  max_iter = 1, max_candidates = 5
)
stopifnot(is.list(res))
```

---

make_D2_from_complete_sets

Create a D2 design from complete treatment sets

Description

Create a D2 design from complete treatment sets.

Usage

```
make_D2_from_complete_sets(
  design,
  factor_levels,
  input = c("factor_label", "number", "auto"),
  sep = "",
  prefer_margin = c("rows", "columns"),
  tol = 1e-08,
  max_solutions_checked = 100000L,
  treatment_universe = c("auto", "factorial", "observed")
)
```

Arguments

`design`	A row-column design matrix.
`factor_levels`	Integer vector of factor levels.
`input`	Coding used by the supplied design.
`sep`	Character separator used in treatment labels.
`prefer_margin`	Preferred margin for complete-set reshuffling.
`tol`	Numerical tolerance.
`max_solutions_checked`	Maximum number of candidate partitions to check.
`treatment_universe`	Treatment universe used for connectedness and repair.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
D <- mfrcd(c(2, 2))
res <- make_D2_from_complete_sets(D, factor_levels = c(2, 2))
stopifnot(is.list(res))
```

`mfrcd` *Generate a mixed-level factorial row-column design*

Description

Generate a mixed-level factorial row-column design.

Usage

```
mfrcd(
  levels,
  block_size = NULL,
  sep = "",
  details = FALSE,
  check_properties = FALSE,
  use_mixedfact = TRUE,
  mixedfact_method = "auto",
  choose_block = "best",
  group1 = NULL,
  group2 = NULL,
  prefer = c("auto", "direct", "mixedfact"),
  tol = 1e-07
)
```

Arguments

`levels`	Integer vector of factor levels.
`block_size`	Block size used in the construction.
`sep`	Character separator used in treatment labels.
`details`	Logical; if TRUE, return construction details.
`check_properties`	Logical; if TRUE, compute design-property diagnostics.
`use_mixedfact`	Logical; if TRUE, allow the mixedfact-based construction route.
`mixedfact_method`	Method passed to mixedfact when that route is used.

choose_block	Rule for choosing a block when several are available.
group1	Optional integer vector of factor indices in the first group.
group2	Optional integer vector of factor indices in the second group.
prefer	Construction route preference.
tol	Numerical tolerance.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
d <- mfrcd(c(2, 2))
stopifnot(is.matrix(d))
```

---

mfrcd_check_repair *Generate, check, and optionally repair an MFRCD design*

Description

Generate, check, and optionally repair an MFRCD design.

Usage

```
mfrcd_check_repair(
  levels,
  block_size = NULL,
  sep = "",
  use_mixedfact = TRUE,
  mixedfact_method = "auto",
  choose_block = "best",
  group1 = NULL,
  group2 = NULL,
  prefer = c("auto", "direct", "mixedfact"),
  tol = 1e-08,
  repair_if_disconnected = TRUE,
  replication = "auto",
  horizontal_reps = NULL,
  vertical_reps = NULL,
  max_per_row = NULL,
  max_per_column = NULL,
  max_iter = 100,
  max_candidates = NULL,
  seed = NULL,
  complete_set_prefer = c("rows", "columns"),
```

```
  max_complete_set_search = 100000L,
  treatment_universe = c("auto", "factorial", "observed"),
  verbose = FALSE
)
```

Arguments

levels	Integer vector of factor levels.
block_size	Block size used in the construction.
sep	Character separator used in treatment labels.
use_mixedfact	Logical; if TRUE, allow the mixedfact-based construction route.
mixedfact_method	Method passed to mixedfact when that route is used.
choose_block	Rule for choosing a block when several are available.
group1	Optional integer vector of factor indices in the first group.
group2	Optional integer vector of factor indices in the second group.
prefer	Construction route preference.
tol	Numerical tolerance.
repair_if_disconnected	Logical; if TRUE, attempt repair when the design is disconnected.
replication	Replication target or "auto".
horizontal_reps	Maximum horizontal replication bound.
vertical_reps	Maximum vertical replication bound.
max_per_row	Maximum allowed occurrences of a treatment in a row.
max_per_column	Maximum allowed occurrences of a treatment in a column.
max_iter	Maximum number of repair iterations.
max_candidates	Maximum number of candidate swaps to examine.
seed	Optional random seed.
complete_set_prefer	Preferred direction for complete-set reshuffling.
max_complete_set_search	Maximum number of complete-set partitions to inspect.
treatment_universe	Treatment universe used for connectedness and repair.
verbose	Logical; if TRUE, emit progress or summary messages.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
res <- mfrcd_check_repair(c(2, 2), repair_if_disconnected = FALSE, max_iter = 1, max_candidates = 5)
stopifnot(inherits(res, "mfrcd_check_repair"))
```

print.mfrcd_check_repair *Print an MFRCD check-and-repair result*

Description

Print an MFRCD check-and-repair result.

Usage

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

Arguments

x	An object.
...	Additional arguments passed to or from methods.

Value

Invisibly returns ‘x‘.

Examples

```
res <- mfrcd_check_repair(c(2, 2), repair_if_disconnected = FALSE, max_iter = 1, max_candidates = 5)
print(res)
```

print.rcd_analysis *Print a row-column design analysis*

Description

Print a row-column design analysis.

Usage

```
## S3 method for class 'rcd_analysis'
print(x, digits = 6, ...)
```

Arguments

x	An object.
digits	Number of digits used for printing.
...	Additional arguments passed to or from methods.

Value

Invisibly returns ‘x‘.

Examples

```
D <- matrix(c(1, 2, 3, 4), nrow = 2)
res <- analyse_rcd(D, factor_levels = c(2, 2), input = "number")
print(res)
```

`rc_factorial_n` *Construct a mixed-level factorial row-column design*

Description

Construct a mixed-level factorial row-column design.

Usage

```
rc_factorial_n(levels, sep = "", details = FALSE, group1 = NULL, group2 = NULL)
```

Arguments

`levels`	Integer vector of factor levels.
`sep`	Character separator used in treatment labels.
`details`	Logical; if TRUE, return construction details.
`group1`	Optional integer vector of factor indices in the first group.
`group2`	Optional integer vector of factor indices in the second group.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
ex <- rc_factorial_n(c(2, 2))
stopifnot(is.matrix(ex))
```

rc_from_principal_block *Construct a row-column design from a principal block*

Description

Construct a row-column design from a principal block.

Usage

```
rc_from_principal_block(
  levels,
  block_size,
  principal_block = NULL,
  use_mixedfact = TRUE,
  mixedfact_method = "auto",
  choose_block = "best",
  sep = "",
  details = FALSE
)
```

Arguments

levels	Integer vector of factor levels.
block_size	Block size used in the construction.
principal_block	Optional principal block of treatment labels.
use_mixedfact	Logical; if TRUE, allow the mixedfact-based construction route.
mixedfact_method	Method passed to mixedfact when that route is used.
choose_block	Rule for choosing a block when several are available.
sep	Character separator used in treatment labels.
details	Logical; if TRUE, return construction details.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
pb <- matrix(c(0, 0, 0, 1), ncol = 2, byrow = TRUE)
ex <- rc_from_principal_block(c(2, 2), block_size = 2, principal_block = pb, details = TRUE)
stopifnot(is.matrix(ex$design))
```

rc_method1 *Construct a two-factor row-column design using Method 1*

Description

Construct a two-factor row-column design using Method 1.

Usage

```
rc_method1(s1, s2, f = NULL, sep = "")
```

Arguments

s1	Number of levels for the first factor or factor group.
s2	Number of levels for the second factor or factor group.
f	Common factor used by Method 1.
sep	Character separator used in treatment labels.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
ex <- rc_method1(2, 4)
stopifnot(is.matrix(ex$design))
```

rc_method2 *Construct a two-factor row-column design using Method 2*

Description

Construct a two-factor row-column design using Method 2.

Usage

```
rc_method2(s1, s2, sep = "")
```

Arguments

s1	Number of levels for the first factor or factor group.
s2	Number of levels for the second factor or factor group.
sep	Character separator used in treatment labels.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
ex <- rc_method2(2, 4)
stopifnot(is.matrix(ex$design))
```

`rcd_analysis_summary` *Summarize row-column design analysis*

Description

Summarize row-column design analysis.

Usage

```
rcd_analysis_summary(ans)
```

Arguments

`ans`	Analysis result.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
D <- matrix(c(1, 2, 3, 4), nrow = 2)
ans <- analyse_rcd(D, factor_levels = c(2, 2), input = "number")
res <- rcd_analysis_summary(ans)
stopifnot(is.data.frame(res))
```

`rcd_feasibility_check` *Check feasibility of a row-column design*

Description

Check feasibility of a row-column design.

Usage

```
rcd_feasibility_check(
  design,
  factor_levels,
  input = c("factor_label", "number", "auto"),
  sep = "",
  tol = 1e-08
)
```

Arguments

`design`	A row-column design matrix.
`factor_levels`	Integer vector of factor levels.
`input`	Coding used by the supplied design.
`sep`	Character separator used in treatment labels.
`tol`	Numerical tolerance.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
D <- matrix(c(1, 2, 3, 4), nrow = 2)
res <- rcd_feasibility_check(D, factor_levels = c(2, 2), input = "number")
stopifnot(is.list(res))
```

summarize_rcd_layout *Summarize a row-column design layout*

Description

Summarize a row-column design layout.

Usage

```
summarize_rcd_layout(
  design,
  factor_levels,
  input = c("factor_label", "number", "auto"),
  sep = ""
)
```

Arguments

design	A row-column design matrix.
factor_levels	Integer vector of factor levels.
input	Coding used by the supplied design.
sep	Character separator used in treatment labels.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
D <- matrix(c(1, 2, 3, 4), nrow = 2)
res <- summarize_rcd_layout(D, factor_levels = c(2, 2), input = "number")
stopifnot(is.list(res))
stopifnot(is.data.frame(res$total_replication_by_treatment))
```

tetra_connectedness *Check connectedness of a row-column design*

Description

Check connectedness of a row-column design.

Usage

```
tetra_connectedness(
  design,
  factor_levels = NULL,
  input = c("auto", "number", "factor_label"),
  sep = "",
  tol = 1e-08
)
```

Arguments

design	A row-column design matrix.
factor_levels	Integer vector of factor levels.
input	Coding used by the supplied design.
sep	Character separator used in treatment labels.
tol	Numerical tolerance.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
D <- matrix(c(1, 2, 3, 4), nrow = 2)
res <- tetra_connectedness(D, factor_levels = c(2, 2), input = "number")
stopifnot(is.logical(res$connected))
```

---

validate_bounded_rcd *Validate row-column replication bounds*

Description

Validate row-column replication bounds.

Usage

```
validate_bounded_rcd(
  design,
  factor_levels,
  input = c("factor_label", "number", "auto"),
  sep = "",
  replication = "auto",
  max_per_row = 1,
  max_per_column = 1
)
```

Arguments

design	A row-column design matrix.
factor_levels	Integer vector of factor levels.
input	Coding used by the supplied design.
sep	Character separator used in treatment labels.
replication	Replication target or "auto".
max_per_row	Maximum allowed occurrences of a treatment in a row.
max_per_column	Maximum allowed occurrences of a treatment in a column.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
D <- matrix(c(1, 2, 3, 4), nrow = 2)
res <- validate_bounded_rcd(D, factor_levels = c(2, 2), input = "number")
stopifnot(is.list(res))
```

---

verify_mfrcd *Verify a mixed-level factorial row-column design*

Description

Verify a mixed-level factorial row-column design.

Usage

```
verify_mfrcd(
  x,
  levels = NULL,
  sep = "",
  tol = 1e-07,
  max_order = NULL,
  verbose = FALSE
)
```

Arguments

x	An object.
levels	Integer vector of factor levels.
sep	Character separator used in treatment labels.
tol	Numerical tolerance.
max_order	Maximum factorial effect order to include.
verbose	Logical; if TRUE, emit progress or summary messages.

Value

A list, matrix, data frame, or classed object containing the requested row-column design information.

Examples

```
d <- mfrcd(c(2, 2), details = TRUE, check_properties = FALSE)
res <- verify_mfrcd(d, levels = c(2, 2))
stopifnot(is.list(res))
```

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