

# Package ‘joinspy’

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**Title** Diagnostic Tools for Data Frame Joins

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**Language** en-US

**Description** Provides diagnostic tools for understanding and debugging data frame joins. Analyzes key columns before joining to detect duplicates, mismatches, encoding issues, and other common problems. Explains unexpected row count changes and provides safe join wrappers with cardinality enforcement. Concepts and diagnostics build on tidy data principles as described in 'Wickham' (2014) <[doi:10.18637/jss.v059.i10](https://doi.org/10.18637/jss.v059.i10)>.

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<https://github.com/gcol33/joinspy>

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## Contents

analyze_join_chain	2
check_cartesian	3
detect_cardinality	4
full_join_spy	5
get_log_file	5
inner_join_spy	6
is_join_report	7
join_diff	7
join_explain	8
join_repair	9
join_spy	10
join_strict	11
key_check	13
key_duplicates	14
last_report	15
left_join_spy	15
log_report	16
plot.JoinReport	17
print.JoinReport	18
right_join_spy	19
set_log_file	19
suggest_repairs	20
summary.JoinReport	21

<b>Index</b>	<b>22</b>
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analyze_join_chain	<i>Analyze Multi-Table Join Chain</i>
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---

### Description

Analyzes a sequence of joins to identify potential issues in the chain. Useful for debugging complex multi-table joins.

### Usage

```
analyze_join_chain(tables, joins)
```

### Arguments

tables	A named list of data frames to join.
joins	A list of join specifications, each with elements: <b>left</b> Name of left table <b>right</b> Name of right table <b>by</b> Join column(s)

**Value**

A summary of the join chain analysis.

**See Also**

[join\\_spy\(\)](#), [check\\_cartesian\(\)](#)

**Examples**

```
orders <- data.frame(order_id = 1:3, customer_id = c(1, 2, 2))
customers <- data.frame(customer_id = 1:3, region_id = c(1, 1, 2))
regions <- data.frame(region_id = 1:2, name = c("North", "South"))

analyze_join_chain(
  tables = list(orders = orders, customers = customers, regions = regions),
  joins = list(
    list(left = "orders", right = "customers", by = "customer_id"),
    list(left = "result", right = "regions", by = "region_id")
  )
)
```

---

check\_cartesian

*Detect Potential Cartesian Product*

---

**Description**

Warns if a join will produce a very large result due to many-to-many relationships (Cartesian product explosion).

**Usage**

```
check_cartesian(x, y, by, threshold = 10)
```

**Arguments**

x	A data frame (left table).
y	A data frame (right table).
by	Column names to join by.
threshold	Warn if result will exceed this many times the larger input. Default 10.

**Value**

A list with explosion analysis.

**See Also**

[join\\_spy\(\)](#), [join\\_strict\(\)](#)

## Examples

```
# Dangerous: both tables have duplicates
x <- data.frame(id = c(1, 1, 2, 2), val_x = 1:4)
y <- data.frame(id = c(1, 1, 2, 2), val_y = 1:4)

check_cartesian(x, y, by = "id")
```

---

detect\_cardinality     *Detect Join Relationship Type*

---

## Description

Determines the actual cardinality relationship between two tables.

## Usage

```
detect_cardinality(x, y, by)
```

## Arguments

x	A data frame (left table).
y	A data frame (right table).
by	Column names to join by.

## Value

Character string: "1:1", "1:m", "m:1", or "m:m".

## See Also

[join\\_strict\(\)](#), [join\\_spy\(\)](#)

## Examples

```
# 1:1 relationship
x <- data.frame(id = 1:3, val = 1:3)
y <- data.frame(id = 1:3, name = c("A", "B", "C"))
detect_cardinality(x, y, "id")

# 1:m relationship
x <- data.frame(id = 1:3, val = 1:3)
y <- data.frame(id = c(1, 1, 2, 3), name = c("A1", "A2", "B", "C"))
detect_cardinality(x, y, "id")
```

---

full_join_spy	<i>Full Join with Diagnostics</i>
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---

**Description**

Performs a full join and automatically prints diagnostic information.

**Usage**

```
full_join_spy(x, y, by, verbose = TRUE, .quiet = FALSE, backend = NULL, ...)
```

**Arguments**

x	A data frame (left table).
y	A data frame (right table).
by	A character vector of column names to join by.
verbose	Logical. If TRUE (default), prints diagnostic summary.
.quiet	Logical. If TRUE, suppresses all output (overrides verbose). Useful for silent pipeline operations. Use <a href="#">last_report()</a> to access the diagnostics afterward.
backend	Character or NULL. The join backend to use. If NULL (default), auto-detects from input class: data.table inputs use data.table, tibble inputs use dplyr, otherwise base R merge(). Explicit values: "base", "dplyr", "data.table".
...	Additional arguments passed to the underlying join function.

**Value**

The joined data frame with a "join\_report" attribute.

**See Also**

[left\\_join\\_spy\(\)](#), [join\\_spy\(\)](#), [last\\_report\(\)](#)

---

get_log_file	<i>Get Current Log File</i>
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---

**Description**

Returns the current automatic log file path, if set.

**Usage**

```
get_log_file()
```

**Value**

The log file path, or NULL if not set.

**See Also**

[set\\_log\\_file\(\)](#)

---

inner\_join\_spy      *Inner Join with Diagnostics*

---

**Description**

Performs an inner join and automatically prints diagnostic information.

**Usage**

```
inner_join_spy(x, y, by, verbose = TRUE, .quiet = FALSE, backend = NULL, ...)
```

**Arguments**

x	A data frame (left table).
y	A data frame (right table).
by	A character vector of column names to join by.
verbose	Logical. If TRUE (default), prints diagnostic summary.
.quiet	Logical. If TRUE, suppresses all output (overrides verbose). Useful for silent pipeline operations. Use <a href="#">last_report()</a> to access the diagnostics afterward.
backend	Character or NULL. The join backend to use. If NULL (default), auto-detects from input class: data.table inputs use data.table, tibble inputs use dplyr, otherwise base R merge(). Explicit values: "base", "dplyr", "data.table".
...	Additional arguments passed to the underlying join function.

**Value**

The joined data frame with a "join\_report" attribute.

**See Also**

[left\\_join\\_spy\(\)](#), [join\\_spy\(\)](#), [last\\_report\(\)](#)

---

is_join_report	<i>Check if Object is a JoinReport</i>
----------------	--

---

**Description**

Check if Object is a JoinReport

**Usage**

```
is_join_report(x)
```

**Arguments**

x                    An object to test.

**Value**

TRUE if x is a JoinReport, FALSE otherwise.

---

join_diff	<i>Compare Data Frame Before and After Join</i>
-----------	---

---

**Description**

Shows a side-by-side comparison of key statistics before and after a join operation.

**Usage**

```
join_diff(before, after, by = NULL)
```

**Arguments**

before                The original data frame (before joining).  
after                  The result data frame (after joining).  
by                    Optional. Column names to analyze for key statistics.

**Value**

Invisibly returns a comparison summary. Prints a formatted comparison.

**See Also**

[join\\_explain\(\)](#), [join\\_spy\(\)](#)

**Examples**

```
before <- data.frame(id = 1:3, x = letters[1:3])
after <- data.frame(id = c(1, 2, 2, 3), x = c("a", "b", "b", "c"), y = 1:4
)

join_diff(before, after)
```

---

join\_explain

*Explain Row Count Changes After a Join*


---

**Description**

After performing a join, use this function to understand why the row count changed. It analyzes the original tables and the result to explain the difference.

**Usage**

```
join_explain(result, x, y, by, type = NULL)
```

**Arguments**

result	The result of a join operation.
x	The original left data frame.
y	The original right data frame.
by	A character vector of column names used in the join.
type	Character. The type of join that was performed. One of "left", "right", "inner", "full". If NULL (default), attempts to infer the join type from row counts.

**Value**

Invisibly returns a list with explanation details. Prints a human-readable explanation.

**See Also**

[join\\_spy\(\)](#), [join\\_diff\(\)](#)

**Examples**

```
orders <- data.frame(id = c(1, 2, 2, 3), value = 1:4)
customers <- data.frame(id = c(1, 2, 2, 4), name = c("A", "B1", "B2", "D"))

result <- merge(orders, customers, by = "id", all.x = TRUE)

# Explain why we got more rows than expected
join_explain(result, orders, customers, by = "id", type = "left")
```

---

join_repair	<i>Repair Common Key Issues</i>
-------------	---------------------------------

---

### Description

Automatically fixes trivial join key issues like whitespace and case mismatches. Returns the repaired data frame(s) with a summary of changes.

### Usage

```
join_repair(  
  x,  
  y = NULL,  
  by,  
  trim_whitespace = TRUE,  
  standardize_case = NULL,  
  remove_invisible = TRUE,  
  empty_to_na = FALSE,  
  dry_run = FALSE  
)
```

### Arguments

x	A data frame (left table).
y	A data frame (right table). If NULL, only repairs x.
by	A character vector of column names to repair.
trim_whitespace	Logical. Trim leading/trailing whitespace. Default TRUE.
standardize_case	Character. Standardize case to "lower", "upper", or NULL (no change). Default NULL.
remove_invisible	Logical. Remove invisible Unicode characters. Default TRUE.
empty_to_na	Logical. Convert empty strings to NA. Default FALSE.
dry_run	Logical. If TRUE, only report what would be changed without modifying data. Default FALSE.

### Value

If y is NULL, returns the repaired x. If both are provided, returns a list with x and y. In dry\_run mode, returns a summary of proposed changes.

### See Also

[join\\_spy\(\)](#), [key\\_check\(\)](#)

**Examples**

```
# Data with whitespace issues
orders <- data.frame(
  id = c(" A", "B ", "C"),
  value = 1:3,
  stringsAsFactors = FALSE
)

# Dry run to see what would change
join_repair(orders, by = "id", dry_run = TRUE)

# Actually repair
orders_fixed <- join_repair(orders, by = "id")
```

---

 join\_spy

---

*Comprehensive Pre-Join Diagnostic Report*


---

**Description**

Analyzes two data frames before joining to detect potential issues and predict the outcome. Returns a detailed report of key quality, match rates, and detected problems.

**Usage**

```
join_spy(x, y, by, sample = NULL, ...)
```

**Arguments**

x	A data frame (left table in the join).
y	A data frame (right table in the join).
by	A character vector of column names to join by, or a named character vector for joins where column names differ (e.g., c("id" = "customer_id")).
sample	Integer or NULL. If provided, randomly sample this many rows from each table for faster diagnostics on large datasets. Default NULL (analyze all rows).
...	Reserved for future use.

**Details**

This function detects the following common join issues:

- **Duplicate keys:** Keys appearing multiple times, which cause row multiplication during joins
- **Whitespace:** Leading or trailing spaces that prevent matches
- **Case mismatches:** Keys that differ only by case (e.g., "ABC" vs "abc")
- **Encoding issues:** Different character encodings or invisible Unicode characters
- **NA values:** Missing values in key columns

**Value**

A JoinReport object with the following components:

**x\_summary** Summary statistics for keys in the left table

**y\_summary** Summary statistics for keys in the right table

**match\_analysis** Details of which keys will/won't match

**issues** List of detected problems (duplicates, whitespace, etc.)

**expected\_rows** Predicted row counts for each join type

**See Also**

[key\\_check\(\)](#), [join\\_explain\(\)](#), [join\\_strict\(\)](#)

**Examples**

```
# Create sample data with issues
orders <- data.frame(
  order_id = 1:5,
  customer_id = c("A", "B", "B", "C", "D ")
)
customers <- data.frame(
  customer_id = c("A", "B", "C", "E"),
  name = c("Alice", "Bob", "Carol", "Eve")
)

# Get diagnostic report
join_spy(orders, customers, by = "customer_id")
```

---

join\_strict

*Strict Join with Cardinality Enforcement*

---

**Description**

Performs a join operation that fails if the specified cardinality constraint is violated. Use this to catch unexpected many-to-many relationships early.

**Usage**

```
join_strict(
  x,
  y,
  by,
  type = c("left", "right", "inner", "full"),
  expect = c("1:1", "1:m", "1:many", "m:1", "many:1", "m:m", "many:many"),
  backend = NULL,
  ...
)
```

**Arguments**

x	A data frame (left table).
y	A data frame (right table).
by	A character vector of column names to join by.
type	Character. The type of join to perform. One of "left" (default), "right", "inner", "full".
expect	Character. The expected cardinality relationship. One of: <b>"1:1"</b> Each key in x matches at most one key in y, and vice versa <b>"1:m" or "1:many"</b> Each key in x can match multiple keys in y, but each key in y matches at most one key in x <b>"m:1" or "many:1"</b> Each key in y can match multiple keys in x, but each key in x matches at most one key in y <b>"m:m" or "many:many"</b> No cardinality constraints (allows all relationships)
backend	Character or NULL. The join backend to use. If NULL (default), auto-detects from input class. See <a href="#">left_join_spy()</a> for details.
...	Additional arguments passed to the underlying join function.

**Value**

The joined data frame if the cardinality constraint is satisfied. Throws an error if the constraint is violated.

**See Also**

[join\\_spy\(\)](#), [left\\_join\\_spy\(\)](#)

**Examples**

```
orders <- data.frame(id = 1:3, product = c("A", "B", "C"))
customers <- data.frame(id = 1:3, name = c("Alice", "Bob", "Carol"))

# This succeeds (1:1 relationship)
join_strict(orders, customers, by = "id", expect = "1:1")

# This fails if customers had duplicate ids (wrapped in try to show error)
customers_dup <- data.frame(id = c(1, 1, 2), name = c("A1", "A2", "B"))
try(join_strict(orders, customers_dup, by = "id", expect = "1:1"))
```

---

key_check	<i>Quick Key Quality Check</i>
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---

### Description

A fast check of join key quality that returns a simple pass/fail status with a brief summary. Use this for quick validation; use [join\\_spy\(\)](#) for detailed diagnostics.

### Usage

```
key_check(x, y, by, warn = TRUE)
```

### Arguments

x	A data frame (left table in the join).
y	A data frame (right table in the join).
by	A character vector of column names to join by.
warn	Logical. If TRUE (default), prints warnings for detected issues. Set to FALSE for silent operation.

### Value

Invisibly returns a logical: TRUE if no issues detected, FALSE otherwise. Also prints a brief status message unless warn = FALSE.

### See Also

[join\\_spy\(\)](#), [key\\_duplicates\(\)](#)

### Examples

```
orders <- data.frame(id = c(1, 2, 2, 3), value = 1:4)
customers <- data.frame(id = c(1, 2, 4), name = c("A", "B", "D"))

# Quick check
key_check(orders, customers, by = "id")

# Silent check
is_ok <- key_check(orders, customers, by = "id", warn = FALSE)
```

---

key_duplicates	<i>Find Duplicate Keys</i>
----------------	----------------------------

---

### Description

Identifies rows with duplicate values in the specified key columns. Returns a data frame containing only the rows with duplicated keys, along with a count of occurrences.

### Usage

```
key_duplicates(data, by, keep = c("all", "first", "last"))
```

### Arguments

data	A data frame.
by	A character vector of column names to check for duplicates.
keep	Character. Which duplicates to return: "all" Return all rows with duplicated keys (default) "first" Return only the first occurrence of each duplicate "last" Return only the last occurrence of each duplicate

### Value

A data frame containing the duplicated rows, with an additional column `.n_duplicates` showing how many times each key appears. Returns an empty data frame (0 rows) if no duplicates found.

### See Also

[key\\_check\(\)](#), [join\\_spy\(\)](#)

### Examples

```
df <- data.frame(  
  id = c(1, 2, 2, 3, 3, 3, 4),  
  value = letters[1:7]  
)  
  
# Find all duplicates  
key_duplicates(df, by = "id")  
  
# Find first occurrence only  
key_duplicates(df, by = "id", keep = "first")
```

---

last_report	<i>Get the Last Join Report</i>
-------------	---------------------------------

---

**Description**

Retrieves the most recent `JoinReport` object from any `*_join_spy()` call. Useful when using `.quiet = TRUE` in pipelines and wanting to inspect the diagnostics afterward.

**Usage**

```
last_report()
```

**Value**

The last `JoinReport` object, or `NULL` if no join has been performed.

**See Also**

[left\\_join\\_spy\(\)](#), [join\\_spy\(\)](#)

**Examples**

```
orders <- data.frame(id = 1:3, value = c(10, 20, 30))
customers <- data.frame(id = c(1, 2, 4), name = c("A", "B", "D"))

# Silent join in a pipeline
result <- left_join_spy(orders, customers, by = "id", .quiet = TRUE)

# Inspect the report afterward
last_report()
```

---

left_join_spy	<i>Left Join with Diagnostics</i>
---------------	-----------------------------------

---

**Description**

Performs a left join and automatically prints diagnostic information about the operation. The diagnostic report is also attached as an attribute.

**Usage**

```
left_join_spy(x, y, by, verbose = TRUE, .quiet = FALSE, backend = NULL, ...)
```

**Arguments**

x	A data frame (left table).
y	A data frame (right table).
by	A character vector of column names to join by.
verbose	Logical. If TRUE (default), prints diagnostic summary.
.quiet	Logical. If TRUE, suppresses all output (overrides verbose). Useful for silent pipeline operations. Use <code>last_report()</code> to access the diagnostics afterward.
backend	Character or NULL. The join backend to use. If NULL (default), auto-detects from input class: <code>data.table</code> inputs use <code>data.table</code> , <code>tibble</code> inputs use <code>dplyr</code> , otherwise base R <code>merge()</code> . Explicit values: "base", "dplyr", "data.table".
...	Additional arguments passed to the underlying join function.

**Value**

The joined data frame with a "join\_report" attribute containing the diagnostic information.

**See Also**

[join\\_spy\(\)](#), [join\\_strict\(\)](#), [last\\_report\(\)](#)

**Examples**

```
orders <- data.frame(id = 1:3, value = c(10, 20, 30))
customers <- data.frame(id = c(1, 2, 4), name = c("A", "B", "D"))

result <- left_join_spy(orders, customers, by = "id")

# Access the diagnostic report
attr(result, "join_report")

# Silent mode for pipelines
result2 <- left_join_spy(orders, customers, by = "id", .quiet = TRUE)
last_report() # Access diagnostics afterward
```

---

log\_report

*Log Join Report to File*


---

**Description**

Writes a `JoinReport` object to a file for audit trails and reproducibility. Supports plain text, JSON, and RDS formats.

**Usage**

```
log_report(report, file, append = FALSE, timestamp = TRUE)
```

**Arguments**

report	A JoinReport object from <code>join_spy()</code> or retrieved via <code>last_report()</code> .
file	File path to write to. Extension determines format: <ul style="list-style-type: none"> <li>• .txt or .log: Plain text (human-readable)</li> <li>• .json: JSON format (machine-readable)</li> <li>• .rds: R binary format (preserves all data)</li> </ul>
append	Logical. If TRUE, appends to existing file (text/log only). Default FALSE.
timestamp	Logical. If TRUE (default), includes timestamp in output.

**Value**

Invisibly returns the file path.

**See Also**

[join\\_spy\(\)](#), [last\\_report\(\)](#)

**Examples**

```
orders <- data.frame(id = 1:3, value = c(10, 20, 30))
customers <- data.frame(id = c(1, 2, 4), name = c("A", "B", "D"))

report <- join_spy(orders, customers, by = "id")

# Log to temporary file
tmp <- tempfile(fileext = ".log")
log_report(report, tmp, append = TRUE)
unlink(tmp)
```

---

plot.JoinReport

*Plot Method for JoinReport*


---

**Description**

Creates a Venn diagram showing key overlap between tables.

**Usage**

```
## S3 method for class 'JoinReport'
plot(
  x,
  file = NULL,
  width = 6,
  height = 5,
  colors = c("#4A90D9", "#D94A4A"),
  ...
)
```

**Arguments**

<code>x</code>	A JoinReport object.
<code>file</code>	Optional file path to save the plot (PNG, SVG, or PDF based on extension). If NULL (default), displays in the current graphics device.
<code>width</code>	Width in inches (default 6).
<code>height</code>	Height in inches (default 5).
<code>colors</code>	Character vector of length 2 for left and right circle colors.
<code>...</code>	Additional arguments (ignored).

**Value**

Invisibly returns the plot data (`left_only`, `both`, `right_only` counts).

**Examples**

```
orders <- data.frame(id = 1:5, val = 1:5)
customers <- data.frame(id = 3:7, name = letters[3:7])

report <- join_spy(orders, customers, by = "id")
plot(report)
```

---

`print.JoinReport`      *Print Method for JoinReport*

---

**Description**

Print Method for JoinReport

**Usage**

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

**Arguments**

<code>x</code>	A JoinReport object.
<code>...</code>	Additional arguments (ignored).

**Value**

Invisibly returns `x`.

---

right_join_spy	<i>Right Join with Diagnostics</i>
----------------	------------------------------------

---

**Description**

Performs a right join and automatically prints diagnostic information.

**Usage**

```
right_join_spy(x, y, by, verbose = TRUE, .quiet = FALSE, backend = NULL, ...)
```

**Arguments**

x	A data frame (left table).
y	A data frame (right table).
by	A character vector of column names to join by.
verbose	Logical. If TRUE (default), prints diagnostic summary.
.quiet	Logical. If TRUE, suppresses all output (overrides verbose). Useful for silent pipeline operations. Use <a href="#">last_report()</a> to access the diagnostics afterward.
backend	Character or NULL. The join backend to use. If NULL (default), auto-detects from input class: data.table inputs use data.table, tibble inputs use dplyr, otherwise base R merge(). Explicit values: "base", "dplyr", "data.table".
...	Additional arguments passed to the underlying join function.

**Value**

The joined data frame with a "join\_report" attribute.

**See Also**

[left\\_join\\_spy\(\)](#), [join\\_spy\(\)](#), [last\\_report\(\)](#)

---

set_log_file	<i>Configure Automatic Logging</i>
--------------	------------------------------------

---

**Description**

Sets up automatic logging of all join reports to a specified file. When enabled, every \*\_join\_spy() call will append its report to the log.

**Usage**

```
set_log_file(file, format = c("text", "json"))
```

**Arguments**

file            File path for automatic logging. Set to NULL to disable.  
format         Log format: "text" (default) or "json".

**Value**

Invisibly returns the previous log file setting.

**See Also**

[log\\_report\(\)](#), [get\\_log\\_file\(\)](#)

**Examples**

```
# Enable automatic logging to temp file
tmp <- tempfile(fileext = ".log")
old <- set_log_file(tmp)

# Disable logging and clean up
set_log_file(NULL)
unlink(tmp)
```

---

suggest_repairs	<i>Suggest Repair Code</i>
-----------------	----------------------------

---

**Description**

Analyzes join issues and returns R code snippets to fix them.

**Usage**

```
suggest_repairs(report)
```

**Arguments**

report            A JoinReport object from [join\\_spy\(\)](#).

**Value**

Character vector of R code snippets to fix detected issues.

**See Also**

[join\\_repair\(\)](#), [join\\_spy\(\)](#)

## Examples

```
orders <- data.frame(id = c("A ", "B"), val = 1:2, stringsAsFactors = FALSE)
customers <- data.frame(id = c("a", "b"), name = c("Alice", "Bob"), stringsAsFactors = FALSE)

report <- join_spy(orders, customers, by = "id")
suggest_repairs(report)
```

---

summary.JoinReport      *Summary Method for JoinReport*

---

## Description

Returns a compact summary data frame of the join diagnostic report.

## Usage

```
## S3 method for class 'JoinReport'
summary(object, format = c("data.frame", "text", "markdown"), ...)
```

## Arguments

object	A JoinReport object.
format	Output format: "data.frame" (default), "text", or "markdown".
...	Additional arguments (ignored).

## Value

A data frame with key metrics (or printed output for text/markdown).

## Examples

```
orders <- data.frame(id = 1:5, val = 1:5)
customers <- data.frame(id = 3:7, name = letters[3:7])

report <- join_spy(orders, customers, by = "id")
summary(report)
summary(report, format = "markdown")
```

# Index

analyze\_join\_chain, 2

check\_cartesian, 3  
check\_cartesian(), 3

detect\_cardinality, 4

full\_join\_spy, 5

get\_log\_file, 5  
get\_log\_file(), 20

inner\_join\_spy, 6  
is\_join\_report, 7

join\_diff, 7  
join\_diff(), 8  
join\_explain, 8  
join\_explain(), 7, 11  
join\_repair, 9  
join\_repair(), 20  
join\_spy, 10  
join\_spy(), 3–9, 12–17, 19, 20  
join\_strict, 11  
join\_strict(), 3, 4, 11, 16

key\_check, 13  
key\_check(), 9, 11, 14  
key\_duplicates, 14  
key\_duplicates(), 13

last\_report, 15  
last\_report(), 5, 6, 16, 17, 19  
left\_join\_spy, 15  
left\_join\_spy(), 5, 6, 12, 15, 19  
log\_report, 16  
log\_report(), 20

plot.JoinReport, 17  
print.JoinReport, 18

right\_join\_spy, 19

set\_log\_file, 19  
set\_log\_file(), 6  
suggest\_repairs, 20  
summary.JoinReport, 21