

# Package ‘ICCDesign’

May 27, 2026

**Title** Intraclass Correlation Coefficient (ICC) Design, Calculation and Interactive 'shiny' Toolkit

**Version** 0.1.0

**Description** A comprehensive toolkit for intraclass correlation coefficient (ICC) analysis, integrating three core functionalities: (1) Closed-form sample size calculation for ICC estimation with assurance probability, based on Zou (2012) <[doi:10.1002/sim.5466](https://doi.org/10.1002/sim.5466)>; (2) Full implementation of all 10 ICC types (6 common + 4 supplementary) for point estimation, exact confidence interval calculation, and formal hypothesis testing, following the methods of McGraw & Wong (1996) <[doi:10.1037/1082-989X.1.1.30](https://doi.org/10.1037/1082-989X.1.1.30)> and the standard decision framework; (3) An interactive 'shiny' application that guides users through ICC type selection, performs calculations, and provides reliability evaluation based on the Koo & Li (2016) <[doi:10.1016/j.jcm.2016.02.012](https://doi.org/10.1016/j.jcm.2016.02.012)> criteria. Compared to existing packages, it provides a unified decision workflow and supports all less common ICC variants.

**License** GPL (>= 3)

**Depends** R (>= 4.1.0)

**Imports** stats, shiny

**Suggests** testthat, knitr, rmarkdown

**Encoding** UTF-8

**LazyData** false

**URL** <https://github.com/KlariZhang/ICCDesign>

**BugReports** <https://github.com/KlariZhang/ICCDesign/issues>

**Config/roxygen2/version** 8.0.0

**RoxygenNote** 8.0.0

**NeedsCompilation** no

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**Repository** CRAN

**Date/Publication** 2026-05-27 19:50:21 UTC

## Contents

ICCDesign-package . . . . .	2
icc_calc . . . . .	3
icc_data . . . . .	5
icc_power . . . . .	6
icc_preprocess_data . . . . .	7
icc_sample_size . . . . .	8
icc_sample_size_lower . . . . .	9
icc_sample_size_width . . . . .	10
run_icc_app . . . . .	11

<b>Index</b>	<b>12</b>
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ICCDesign-package	<i>ICCDesign: Intraclass Correlation Coefficient Analysis and Study Planning</i>
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## Description

A comprehensive, user-friendly R package for intraclass correlation coefficient (ICC) analysis and sample size planning. Implements the full McGraw & Wong (1996) framework supporting all 10 ICC types, with an intuitive 4-question decision system that eliminates the need for users to memorize ICC type codes.

The package provides both a command-line interface for advanced users and a fully interactive Shiny web application for point-and-click analysis. It also includes automated reliability evaluation based on Koo & Li (2016) criteria, publication-ready report generation, and rigorous sample size and power calculation functions.

## Key Features

- Full support for all 10 ICC types from McGraw & Wong (1996)
- Intuitive 4-question decision framework for ICC type selection
- Automated reliability rating and interpretation
- Publication-ready text, Markdown, and HTML reports
- Sample size calculation based on confidence interval lower bound or width
- Power analysis for existing study designs
- Interactive Shiny web application with data upload and visualization
- Comprehensive data validation and error handling

## Main Functions

`icc_calc` Top-level function for complete ICC analysis  
`icc_sample_size` Unified interface for sample size and power calculation  
`run_icc_app` Launch the interactive Shiny application  
`icc_preprocess_data` Data preprocessing and validation utility

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**References**

McGraw, K. O., & Wong, S. P. (1996). Forming inferences about some intraclass correlation coefficients. *Psychological Methods*, 1(1), 30-46.

Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine*, 15(2), 155-163.

**See Also**

Useful links:

- <https://github.com/KlariZhang/ICCDesign>
- Report bugs at <https://github.com/KlariZhang/ICCDesign/issues>

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icc\_calc

*Calculate Intraclass Correlation Coefficient (ICC)*

---

**Description**

Top-level main function for complete ICC analysis. Users only need to provide raw data and answer 4 design questions. The function automatically handles data preprocessing, parameter validation, ICC type mapping, core calculation, reliability evaluation, and report generation.

**Usage**

```
icc_calc(  
  data,  
  same_raters,  
  rater_effect = NULL,  
  rating_type,  
  agreement_type = NULL,  
  alpha = 0.05,  
  rho0 = NULL,  
  interaction = TRUE,  
  na.rm = TRUE,  
  verbose = TRUE  
)
```

## Arguments

<code>data</code>	Data frame or matrix. Raw data where rows = subjects, columns = raters/measurements.
<code>same_raters</code>	Logical. Are all subjects measured by the same group of raters?
<code>rater_effect</code>	Character. "random" or "fixed". Ignored if <code>same_raters = FALSE</code> .
<code>rating_type</code>	Character. "single" (single rating) or "average" (average of k ratings).
<code>agreement_type</code>	Character. "absolute" (absolute agreement) or "consistency" (consistency). Ignored if <code>same_raters = FALSE</code> .
<code>alpha</code>	Numeric. Significance level for confidence interval, default 0.05.
<code>rho0</code>	Numeric. Optional null hypothesis value for non-zero test, default NULL.
<code>interaction</code>	Logical. Whether to include interaction term in two-way models, default TRUE.
<code>na.rm</code>	Logical. Whether to automatically remove rows with missing values, default TRUE.
<code>verbose</code>	Logical. Whether to emit warnings and tips, default TRUE.

## Value

A named list containing:

**data\_summary** List. Data preprocessing summary.

**icc\_result** List. Full ICC calculation results.

**evaluation** List. Reliability evaluation results.

**report** Character. Standardized report text.

**warning\_msg** Character or NULL. Warning message.

**tip\_msg** Character or NULL. Tip message.

## References

McGraw, K. O., & Wong, S. P. (1996). Forming inferences about some intraclass correlation coefficients. *Psychological Methods*, 1(1), 30-46.

Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine*, 15(2), 155-163.

## Examples

```
# Example 0: Use built-in example dataset
data(icc_data)
result <- icc_calc(icc_data, same_raters = TRUE, rater_effect = "random",
  rating_type = "single", agreement_type = "absolute")
# Example 1: One-way random effects, single rating (ICC(1,1))
data <- matrix(rnorm(100), nrow = 20, ncol = 5)
result <- icc_calc(data, same_raters = FALSE, rating_type = "single")

# Example 2: Two-way random effects, average rating, absolute agreement (ICC(2,k))
result <- icc_calc(data, same_raters = TRUE, rater_effect = "random",
  rating_type = "average", agreement_type = "absolute")
```

```

# Example 3: Two-way mixed effects, single rating, consistency (ICC(3,1))
result <- icc_calc(data, same_raters = TRUE, rater_effect = "fixed",
                  rating_type = "single", agreement_type = "consistency")

# Example 4: Special scenario - automatic mapping with tip
# Random effects + consistency (automatically mapped to ICC(3,1))
result <- icc_calc(data, same_raters = TRUE, rater_effect = "random",
                  rating_type = "single", agreement_type = "consistency")

# Example 5: Special scenario - not recommended combination with warning
# Fixed effects + absolute agreement (NOT RECOMMENDED)
result <- icc_calc(data, same_raters = TRUE, rater_effect = "fixed",
                  rating_type = "average", agreement_type = "absolute")

# Example 6: Advanced parameters - custom alpha and non-zero test
result <- icc_calc(data, same_raters = TRUE, rater_effect = "random",
                  rating_type = "single", agreement_type = "absolute",
                  alpha = 0.1, rho0 = 0.6, verbose = FALSE)

# Example 7: Extract specific results
result$icc_result$point_est # ICC point estimate
result$evaluation$rating_en # Reliability rating
result$report               # Full text report

```

---

 icc\_data

*Example ICC Dataset*


---

## Description

A small, carefully constructed example dataset containing ratings from 4 raters on 5 subjects. Designed to demonstrate all package functionality with fast execution and predictable results.

## Format

A numeric matrix with 5 rows (subjects) and 4 columns (raters). Row names are "Subject1" to "Subject5", column names are "Rater1" to "Rater4".

## Details

This dataset can be used to calculate all 10 ICC types supported by the package, simply by changing the design parameters in `icc_calc`.

The dataset was simulated to have an approximate ICC of 0.8, which falls into the "Good" reliability category according to Koo & Li (2016).

## Source

Simulated data for demonstration purposes.

**Examples**

```
data(icc_data)
head(icc_data)
```

---

 icc\_power

*Power Calculation for ICC Study Design*


---

**Description**

Power Calculation for ICC Study Design

**Usage**

```
icc_power(
  n,
  rho,
  rho0 = NULL,
  omega = NULL,
  k = 3,
  same_raters,
  rater_effect = NULL,
  rating_type,
  agreement_type = NULL,
  alpha = 0.05,
  method = c("lower", "width"),
  verbose = TRUE
)
```

**Arguments**

n	Number of subjects.
rho	Anticipated ICC value.
rho0	Lower bound for method="lower".
omega	Half-width for method="width".
k	Number of observations. Default 3.
same_raters	Logical.
rater_effect	"random" or "fixed".
rating_type	"single" or "average".
agreement_type	"absolute" or "consistency".
alpha	Significance level. Default 0.05.
method	"lower" or "width".
verbose	Print messages. Default TRUE.

**Value**

Power.

**Examples**

```
# Note: It is recommended to use the unified interface icc_sample_size()
icc_power(n = 30, rho = 0.7, rho0 = 0.5, k = 3,
          same_raters = TRUE, rater_effect = "fixed",
          rating_type = "single", agreement_type = "consistency")
```

---

icc\_preprocess\_data    *Preprocess and Validate Data for ICC Analysis*

---

**Description**

Performs standardized data cleaning, format conversion, and legality validation for raw input data. Provides a unified valid data input for all ICC calculation functions to avoid repetitive validation code.

**Usage**

```
icc_preprocess_data(data, na.rm = TRUE)
```

**Arguments**

<code>data</code>	A data frame or matrix. Rows represent subjects, columns represent raters/ repeated measurements. Must contain only numeric values.
<code>na.rm</code>	Logical. Default is TRUE. If TRUE, remove rows with missing values; if FALSE, retain missing values and return a warning.

**Value**

A named list containing:

**data\_matrix** Numeric matrix. Standardized numeric matrix (no missing values if `na.rm = TRUE`).

**n** Integer. Number of valid subjects (rows).

**k** Integer. Number of raters/repeated measurements (columns).

**warning\_msg** Character or NULL. Warning message for missing values, NULL if no missing values.

**error\_msg** Character or NULL. Error message for invalid data, NULL if data is valid.

**Examples**

```
# Preprocess the built-in example dataset
data(icc_data)
processed <- icc_preprocess_data(icc_data)
str(processed)
```

---

icc\_sample\_size      *Unified ICC Sample Size & Power Interface*

---

**Description**

Unified ICC Sample Size & Power Interface

**Usage**

```
icc_sample_size(method = c("lower", "width", "power"), ...)
```

**Arguments**

method            "lower", "width", "power".  
...                Arguments passed to underlying functions.

**Value**

Sample size or power.

**Examples**

```
# Method 1: Sample size based on lower confidence limit (most recommended)
# Ensure 95% CI lower bound >= 0.75 (good reliability)
n1 <- icc_sample_size(
  method = "lower",
  rho = 0.85,
  rating_target = "good",
  k = 3,
  same_raters = TRUE,
  rater_effect = "random",
  rating_type = "single",
  agreement_type = "absolute"
)

# Method 2: Sample size based on confidence interval width
# Ensure 95% CI half-width <= 0.1
n2 <- icc_sample_size(
  method = "width",
  rho = 0.7,
  omega = 0.1,
  k = 3,
  same_raters = FALSE,
  rating_type = "average"
)

# Method 3: Power calculation for existing study design
power <- icc_sample_size(
  method = "power",
```

```

n = 30,
rho = 0.7,
rho0 = 0.5,
k = 3,
same_raters = TRUE,
rater_effect = "fixed",
rating_type = "single",
agreement_type = "consistency"
)

```

---

icc\_sample\_size\_lower *Sample Size for ICC based on Lower Confidence Limit*

---

### Description

Sample Size for ICC based on Lower Confidence Limit

### Usage

```

icc_sample_size_lower(
  rho,
  rho0 = NULL,
  k = 3,
  same_raters,
  rater_effect = NULL,
  rating_type,
  agreement_type = NULL,
  alpha = 0.05,
  assurance = 0.8,
  rating_target = NULL,
  verbose = TRUE
)

```

### Arguments

rho	Anticipated ICC value.
rho0	Desired lower bound.
k	Number of observations per subject. Default 3.
same_raters	Logical.
rater_effect	"random" or "fixed".
rating_type	"single" or "average".
agreement_type	"absolute" or "consistency".
alpha	Significance level. Default 0.05.
assurance	Assurance probability. Default 0.8.
rating_target	Shortcut for rho0.
verbose	Print messages. Default TRUE.

**Value**

Required sample size.

**Examples**

```
# Note: It is recommended to use the unified interface icc_sample_size()
icc_sample_size_lower(rho = 0.8, rho0 = 0.6, k = 3, same_raters = FALSE, rating_type = "single")
```

---

icc\_sample\_size\_width *Sample Size for ICC based on Confidence Interval Width*

---

**Description**

Sample Size for ICC based on Confidence Interval Width

**Usage**

```
icc_sample_size_width(
  rho,
  omega,
  k = 3,
  same_raters,
  rater_effect = NULL,
  rating_type,
  agreement_type = NULL,
  alpha = 0.05,
  assurance = 0.8,
  verbose = TRUE
)
```

**Arguments**

rho	Anticipated ICC value.
omega	Desired half-width.
k	Number of observations. Default 3.
same_raters	Logical.
rater_effect	"random" or "fixed".
rating_type	"single" or "average".
agreement_type	"absolute" or "consistency".
alpha	Significance level. Default 0.05.
assurance	Assurance probability. Default 0.8.
verbose	Print messages. Default TRUE.

**Value**

Required sample size.

**Examples**

```
# Note: It is recommended to use the unified interface icc_sample_size()
icc_sample_size_width(rho = 0.7, omega = 0.1, k = 3, same_raters = FALSE, rating_type = "average")
```

---

`run_icc_app`*Launch the ICCDesign Shiny Application*

---

**Description**

Starts an interactive Shiny application for ICC analysis, reliability reporting, and sample size or power planning.

**Usage**

```
run_icc_app(
  host = "127.0.0.1",
  port = NULL,
  launch.browser = interactive(),
  ...
)
```

**Arguments**

<code>host</code>	Host address passed to <code>shiny::runApp</code> . Default is "127.0.0.1".
<code>port</code>	Optional port passed to <code>shiny::runApp</code> . If NULL, Shiny selects an available port.
<code>launch.browser</code>	Logical. Whether to open the app in a browser. Default is <code>interactive()</code> .
<code>...</code>	Additional arguments passed to <code>shiny::runApp</code> .

**Value**

Runs the Shiny application.

**Examples**

```
if (interactive()) {
# Launch the interactive Shiny application
run_icc_app()
}
```

# Index

## \* utilities

icc\_preprocess\_data, 7

icc\_calc, 2, 3, 5

icc\_data, 5

icc\_power, 6

icc\_preprocess\_data, 2, 7

icc\_sample\_size, 2, 8

icc\_sample\_size\_lower, 9

icc\_sample\_size\_width, 10

ICCDesign (ICCDesign-package), 2

ICCDesign-package, 2

run\_icc\_app, 2, 11