

Package ‘rcdf’

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Type Package

Title A Comprehensive Toolkit for Working with Encrypted Parquet Files

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Description Utilities for reading, writing, and managing RCDF files, including encryption and decryption support. It offers a flexible interface for handling data stored in encrypted Parquet format, along with metadata extraction, key management, and secure operations using Advanced Encryption Standard (AES) and Rivest-Shamir-Adleman (RSA) encryption.

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Contents

add_metadata	2
as_rcdf	3
generate_pw	4
generate_rsa_keys	5
get_data_dictionary	5
get_rcdf_metadata	6
merge_rcdf	7
rcdf_list	8
read_env	8
read_parquet	9
read_rcdf	10
write_parquet	12
write_rcdf	13
write_rcdf_as	14
write_rcdf_csv	15
write_rcdf_dta	16
write_rcdf_json	17
write_rcdf_parquet	18
write_rcdf_sav	19
write_rcdf_sqlite	20
write_rcdf_tsv	21
write_rcdf_xlsx	22
Index	23

add_metadata	<i>Add metadata attributes to a data frame</i>
--------------	--

Description

Adds variable labels and value labels to a data frame based on a metadata dictionary. This is particularly useful for preparing datasets for use with packages like haven or for exporting to formats like SPSS or Stata.

Usage

```
add_metadata(data, metadata, ..., set_data_types = FALSE)
```

Arguments

data	A data frame containing the raw dataset.
metadata	A data frame that serves as a metadata dictionary. It must contain at least the columns: variable_name, label, and type. Optionally, it may include a valueset column for categorical variables, which should be a list column with data frames containing value and label columns.
...	Additional arguments (currently unused).

`set_data_types` Logical; if TRUE, attempts to coerce column data types to match those implied by the metadata. (Note: currently not fully implemented.)

Details

The function first checks the structure of the metadata using an internal helper. Then, for each variable listed in metadata, it: - Adds a label using the `label` attribute - Converts values to labelled vectors using `haven::labelled()` if a `valueset` is provided

If value labels are present, the function tries to align data types between the data and the `valueset` (e.g., converting character codes to integers if necessary).

Value

A ‘tibble’ with the same data as `data`, but with added attributes: - Variable labels (via the `label` attribute) - Value labels (as a `haven::labelled` class, if applicable)

Examples

```
data <- data.frame(
  sex = c(1, 2, 1),
  age = c(23, 45, 34)
)

metadata <- data.frame(
  variable_name = c("sex", "age"),
  label = c("Gender", "Age in years"),
  type = c("categorical", "numeric"),
  valueset = I(list(
    data.frame(value = c(1, 2), label = c("Male", "Female")),
    NULL
  ))
)

labelled_data <- add_metadata(data, metadata)
str(labelled_data)
```

as_rcdf

Convert to rcdf class

Description

Converts an existing list or compatible object into an object of class `rcdf`.

Usage

```
as_rcdf(data)
```

Arguments

`data` A list or object to be converted to class `rcdf`.

Value

The input object with class set to `rcdf`.

Examples

```
my_list <- list(a = 1, b = 2)
rcdf_obj <- as_rcdf(my_list)
class(rcdf_obj)
```

generate_pw	<i>Generate a random password</i>
-------------	-----------------------------------

Description

This function generates a random password of a specified length. It includes alphanumeric characters by default and can optionally include special characters.

Usage

```
generate_pw(length = 16, special_chr = TRUE)
```

Arguments

`length` Integer. The length of the password to generate. Default is 16.

`special_chr` Logical. Whether to include special characters (e.g., `'_'`, `'@'`, `'#'`, etc.) in the password. Default is `TRUE`.

Value

A character string representing the generated password.

Examples

```
generate_pw()
generate_pw(32)
generate_pw(12, special_chr = FALSE)
```

generate_rsa_keys	<i>Generate RSA key pair and save to files</i>
-------------------	--

Description

This function generates an RSA key pair (public and private) and saves them to specified files.

Usage

```
generate_rsa_keys(path, ..., password = NULL, which = "public", prefix = NULL)
```

Arguments

path	A character string specifying the directory path where the key files in .pem format should be saved.
...	Additional arguments passed to the openssl::rsa_keygen() function, such as key size.
password	A character string specifying the password for the private key. If NULL, the private key will not be encrypted.
which	A character string specifying which key to return. Can be either "public" or "private". Default is "public".
prefix	A character string used as a prefix for the key file names. Defaults to NULL, which will result in no prefix.

Value

A character string representing the file path of the generated key (either public or private, based on the which argument).

Examples

```
# Generate both public and private RSA keys and save them to the temp directory
path_to <- tempdir()
generate_rsa_keys(path = path_to, password = "securepassword")
```

get_data_dictionary	<i>Extract data dictionary from RCDF object</i>
---------------------	---

Description

This function retrieves the data dictionary embedded in the RCDF object

Usage

```
get_data_dictionary(data)
```

Arguments

data Object of class rcdf.

Value

A data frame that serves as a metadata dictionary. It must contain at least the columns: variable_name, label, and type. Optionally, it may include a valueset column for categorical variables, which should be a list column with data frames containing value and label columns.

Examples

```
dir <- system.file("extdata", package = "rcdf")
rcdf_path <- file.path(dir, 'mtcars.rcdf')
private_key <- file.path(dir, 'sample-private-key.pem')

rcdf_data <- read_rcdf(path = rcdf_path, decryption_key = private_key)
data_dictionary <- get_data_dictionary(rcdf_data)
names(data_dictionary)
```

get_rcdf_metadata	<i>Extract metadata from an RCDF file</i>
-------------------	---

Description

Retrieves a specific metadata value from a .rcdf file.

Usage

```
get_rcdf_metadata(path, key)
```

Arguments

path Character string. The file path to the .rcdf file.

key Character string. The metadata key to extract from the file.

Value

The value associated with the specified metadata key, or NULL if the key does not exist.

Examples

```
## Not run:
# Assuming "example.rcdf" is a valid RCDF file in the working directory:
get_rcdf_metadata("example.rcdf", "creation_date")

## End(Not run)
```

merge_rcdf	<i>Merge multiple RCDF files</i>
------------	----------------------------------

Description

Merge multiple RCDF files

Usage

```
merge_rcdf(  
  rcdf_files,  
  decryption_keys,  
  passwords,  
  merged_file_path,  
  pub_key = NULL  
)
```

Arguments

rcdf_files	A character vector of RCDF file paths
decryption_keys	Decryption keys associated with each RCDF file. Must match the length of the vector passed in the rcdf_files argument.
passwords	Password of the associated decryption keys. Must match the length of decryption_keys.
merged_file_path	File path or name of the merged RCDF file.
pub_key	Public key to encrypt the merged file. If NULL, a new RSA key pair will be generated.

Value

NULL (void)

Examples

```
dir <- system.file("extdata", package = "rcdf")  
  
rcdf_path <- file.path(dir, 'mtcars-pw.rcdf')  
private_key <- file.path(dir, 'sample-private-key-pw.pem')  
pw <- '1234'  
  
temp_dir <- tempdir()  
  
data <- merge_rcdf(  
  rcdf_files = rcdf_path,  
  decryption_keys = private_key,  
  passwords = pw,
```

```
merged_file_path = file.path(temp_dir, "merged.rcdf")
)

unlink(temp_dir, force = TRUE)
```

rcdf_list	Create an empty rcdf object
-----------	-----------------------------

Description

Initializes and returns an empty rcdf object. This is a convenient constructor for creating a new rcdf-class list structure.

Usage

```
rcdf_list(...)
```

Arguments

... Optional elements to include in the list. These will be passed to the internal list constructor and included in the resulting rcdf object.

Value

A list object of class rcdf.

Examples

```
rcdf <- rcdf_list()
class(rcdf)
```

read_env	Read environment variables from a file
----------	--

Description

Reads a .env file containing environment variables in the format KEY=VALUE, and returns them as a named list. Lines starting with # are considered comments and ignored.

Usage

```
read_env(path)
```

Arguments

path A string specifying the path to the .env file. If not provided, defaults to .env in the current working directory.

Value

A named list of environment variables. Each element is a key-value pair extracted from the file. If no variables are found, NULL is returned.

Examples

```
## Not run:
# Assuming an `.env` file with the following content:
# DB_HOST=localhost
# DB_USER=root
# DB_PASS="secret"

env_vars <- read_env(".env")
print(env_vars)
# Should output something like:
# $DB_HOST
# [1] "localhost"

# If no path is given, it defaults to `.env` in the current directory.
env_vars <- read_env()

## End(Not run)
```

read_parquet

Read Parquet file with optional decryption

Description

This function reads a Parquet file, optionally decrypting it using the provided decryption key. If no decryption key is provided, it reads the file normally without decryption. It supports reading Parquet files as Arrow tables or regular data frames, depending on the `as_arrow_table` argument.

Usage

```
read_parquet(
  path,
  ...,
  decryption_key = NULL,
  as_arrow_table = TRUE,
  metadata = NULL
)
```

Arguments

<code>path</code>	The file path to the Parquet file.
<code>...</code>	Additional arguments passed to <code>arrow::open_dataset()</code> when no decryption key is provided.

decryption_key A list containing `aes_key` and `aes_iv`. If provided, the Parquet file will be decrypted using these keys. Default is `'NULL'`.

as_arrow_table Logical. If `TRUE`, the function will return the result as an Arrow table. If `FALSE`, a regular data frame will be returned. Default is `TRUE`.

metadata Optional metadata (e.g., a data dictionary) to be applied to the resulting data.

Value

An Arrow table or a data frame, depending on the value of `as_arrow_table`.

Examples

```
# Using sample Parquet files from `mtcars` dataset
dir <- system.file("extdata", package = "rcdf")

# Without decryption
df <- read_parquet(file.path(dir, "mtcars.parquet"))
df

# With decryption
decryption_key <- list(
  aes_key = "5bddd0ea4ab48ed5e33b1406180d68158aa255cf3f368bdd4744abc1a7909ead",
  aes_iv = "7D3EF463F4CCD81B11B6EC3230327B2D"
)

df_with_encryption <- read_parquet(
  file.path(dir, "mtcars-encrypted.parquet"),
  decryption_key = decryption_key
)
df_with_encryption
```

read_rcdf

Read and decrypt RCDF data

Description

This function reads an RCDF file, decrypts its contents using the specified decryption key, and loads it into R as an RCDF object.

Usage

```
read_rcdf(
  path,
  decryption_key,
  ...,
  password = NULL,
  metadata = list(),
  ignore_duplicates = TRUE,
```

```

    recursive = FALSE,
    pre_collect = TRUE,
    return_meta = FALSE
  )

```

Arguments

path	A string specifying the path to the RCDF archive (zip file). If a directory is provided, all .rcdf files within that directory will be processed.
decryption_key	The key used to decrypt the RCDF. This can be an RSA or AES key, depending on how the RCDF was encrypted.
...	Additional parameters passed to other functions, if needed.
password	A password used for RSA decryption (optional).
metadata	An optional list of metadata object containing data dictionaries, value sets, and primary key constraints for data integrity measure (a data.frame or tibble that includes at least two columns: file and pk_field_name. This metadata is applied to the data if provided.
ignore_duplicates	A logical flag. If TRUE, a warning is issued when duplicates are found, based on the primary key/s defined during creation of RCDF file. If FALSE, the function stops with an error.
recursive	Logical. If TRUE and path is a directory, the function will search recursively for .rcdf files.
pre_collect	Logical. Whether to load the data in the environment as data frame or a lazy data frame (e.g. from dbplyr or dtplyr) from database connection.
return_meta	Logical. If TRUE, the metadata will be returned as an attribute of the RCDF object.

Value

An RCDF object, which is a list of Parquet files (one for each record) along with attached metadata.

Examples

```

dir <- system.file("extdata", package = "rcdf")
rcdf_path <- file.path(dir, 'mtcars.rcdf')
private_key <- file.path(dir, 'sample-private-key.pem')

rcdf_data <- read_rcdf(path = rcdf_path, decryption_key = private_key)
rcdf_data

# Using encrypted/password protected private key
rcdf_path_pw <- file.path(dir, 'mtcars-pw.rcdf')
private_key_pw <- file.path(dir, 'sample-private-key-pw.pem')
pw <- '1234'

rcdf_data_with_pw <- read_rcdf(
  path = rcdf_path_pw,

```

```

    decryption_key = private_key_pw,
    password = pw
  )

  rcdf_data_with_pw

```

write_parquet

Write Parquet file with optional encryption

Description

This function writes a dataset to a Parquet file. If an encryption key is provided, the data will be encrypted before writing. Otherwise, the function writes the data as a regular Parquet file without encryption.

Usage

```
write_parquet(data, path, ..., encryption_key = NULL)
```

Arguments

data	A data frame or tibble to write to a Parquet file.
path	The file path where the Parquet file will be written.
...	Additional arguments passed to <code>arrow::write_parquet()</code> if no encryption key is provided.
encryption_key	A list containing <code>aes_key</code> and <code>aes_iv</code> . If provided, the data will be encrypted using AES before writing to Parquet.

Value

None. The function writes the data to a Parquet file at the specified path.

Examples

```

data <- mtcars
key <- "5bddd0ea4ab48ed5e33b1406180d68158aa255cf3f368bdd4744abc1a7909ead"
iv <- "7D3EF463F4CCD81B11B6EC3230327B2D"

temp_dir <- tempdir()

rcdf::write_parquet(
  data = data,
  path = file.path(temp_dir, "mtcars.parquet"),
  encryption_key = list(aes_key = key, aes_iv = iv)
)

unlink(file.path(temp_dir, "mtcars.parquet"), force = TRUE)

```

write_rcdf	<i>Write data to RCDF format</i>
------------	----------------------------------

Description

This function writes data to an RCDF (Reusable Data Container Format) archive. It encrypts the data using AES, generates metadata, and then creates a zip archive containing both the encrypted Parquet files and metadata. The function supports the inclusion of metadata such as system information and encryption keys.

Usage

```
write_rcdf(
  data,
  path,
  pub_key,
  ...,
  metadata = list(),
  ignore_duplicates = TRUE
)
```

Arguments

<code>data</code>	A list of data frames or tables to be written to RCDF format. Each element of the list represents a record.
<code>path</code>	The path where the RCDF file will be written. The file will be saved with a <code>.rcdf</code> extension if not already specified.
<code>pub_key</code>	The public RSA key used to encrypt the AES encryption keys.
<code>...</code>	Additional arguments passed to helper functions if needed.
<code>metadata</code>	A list of metadata to be included in the RCDF file.
<code>ignore_duplicates</code>	A logical flag. If <code>TRUE</code> , a warning is issued when duplicates are found. If <code>FALSE</code> , the function stops with an error.

Value

`NULL`. The function writes the data to a `.rcdf` file at the specified path.

Examples

```
# Example usage of writing an RCDF file

rcdf_data <- rcdf_list()
rcdf_data$mtcars <- mtcars

dir <- system.file("extdata", package = "rcdf")
```

```
temp_dir <- tempdir()

write_rcdf(
  data = rcdf_data,
  path = file.path(temp_dir, "mtcars.rcdf"),
  pub_key = file.path(dir, 'sample-public-key.pem')
)

write_rcdf(
  data = rcdf_data,
  path = file.path(temp_dir, "mtcars-pw.rcdf"),
  pub_key = file.path(dir, 'sample-public-key-pw.pem')
)

unlink(file.path(temp_dir, "mtcars.rcdf"), force = TRUE)
unlink(file.path(temp_dir, "mtcars-pw.rcdf"), force = TRUE)
```

write_rcdf_as

Write RCDF data to multiple formats

Description

Exports RCDF-formatted data to one or more supported open data formats. The function automatically dispatches to the appropriate writer function based on the formats provided.

Usage

```
write_rcdf_as(data, path, formats, ...)
```

Arguments

data	A named list or RCDF object. Each element should be a table or tibble-like object (typically a dbplyr or dplyr table).
path	The target directory where output files should be saved.
formats	A character vector of file formats to export to. Supported formats include: "csv", "tsv", "json", "parquet", "xlsx", "dta", "sav", and "sqlite".
...	Additional arguments passed to the respective writer functions.

Value

Invisibly returns NULL. Files are written to disk.

See Also

[write_rcdf_csv](#) [write_rcdf_tsv](#) [write_rcdf_json](#) [write_rcdf_xlsx](#) [write_rcdf_dta](#) [write_rcdf_sav](#) [write_rcdf_sqlite](#)

Examples

```

dir <- system.file("extdata", package = "rcdf")
rcdf_path <- file.path(dir, 'mtcars.rcdf')
private_key <- file.path(dir, 'sample-private-key.pem')

rcdf_data <- read_rcdf(path = rcdf_path, decryption_key = private_key)
temp_dir <- tempdir()

write_rcdf_as(data = rcdf_data, path = temp_dir, formats = c("csv", "xlsx"))

unlink(temp_dir, force = TRUE)

```

write_rcdf_csv	<i>Write RCDF data to CSV files</i>
----------------	-------------------------------------

Description

Writes each table in the RCDF object as a separate .csv file.

Usage

```
write_rcdf_csv(data, path, ..., parent_dir = NULL)
```

Arguments

data	A valid RCDF object.
path	The base output directory.
...	Additional arguments passed to write.csv().
parent_dir	Optional subdirectory under path to group CSV files.

Value

Invisibly returns NULL. Files are written to disk.

See Also

[write_rcdf_as](#)

Examples

```

dir <- system.file("extdata", package = "rcdf")
rcdf_path <- file.path(dir, 'mtcars.rcdf')
private_key <- file.path(dir, 'sample-private-key.pem')

rcdf_data <- read_rcdf(path = rcdf_path, decryption_key = private_key)
temp_dir <- tempdir()

write_rcdf_csv(data = rcdf_data, path = temp_dir)

```

```
unlink(temp_dir, force = TRUE)
```

write_rcdf_dta	<i>Write RCDF data to Stata .dta files</i>
----------------	--

Description

Writes each table in the RCDF object to a .dta file for use in Stata.

Usage

```
write_rcdf_dta(data, path, ..., parent_dir = NULL)
```

Arguments

data	A valid RCDF object.
path	Output directory for files.
...	Additional arguments passed to <code>foreign::write.dta()</code> .
parent_dir	Optional subdirectory under path to group Stata files.

Value

Invisibly returns NULL. Files are written to disk.

See Also

[write_rcdf_as](#)

Examples

```
dir <- system.file("extdata", package = "rcdf")
rcdf_path <- file.path(dir, 'mtcars.rcdf')
private_key <- file.path(dir, 'sample-private-key.pem')

rcdf_data <- read_rcdf(path = rcdf_path, decryption_key = private_key)
temp_dir <- tempdir()

write_rcdf_dta(data = rcdf_data, path = temp_dir)

unlink(temp_dir, force = TRUE)
```

write_rcdf_json	<i>Write RCDF data to JSON files</i>
-----------------	--------------------------------------

Description

Writes each table in the RCDF object as a separate .json file.

Usage

```
write_rcdf_json(data, path, ..., parent_dir = NULL)
```

Arguments

data	A valid RCDF object.
path	The output directory for files.
...	Additional arguments passed to <code>jsonlite::write_json()</code> .
parent_dir	Optional subdirectory under path to group JSON files.

Value

Invisibly returns NULL. Files are written to disk.

See Also

[write_rcdf_as](#)

Examples

```
dir <- system.file("extdata", package = "rcdf")
rcdf_path <- file.path(dir, 'mtcars.rcdf')
private_key <- file.path(dir, 'sample-private-key.pem')

rcdf_data <- read_rcdf(path = rcdf_path, decryption_key = private_key)
temp_dir <- tempdir()

write_rcdf_json(data = rcdf_data, path = temp_dir)

unlink(temp_dir, force = TRUE)
```

write_rcdf_parquet	<i>Write RCDF data to Parquet files</i>
--------------------	---

Description

This function writes an RCDF object (a list of data frames) to multiple Parquet files. Each data frame in the list is written to its corresponding Parquet file in the specified path.

Usage

```
write_rcdf_parquet(
  data,
  path,
  ...,
  parent_dir = NULL,
  primary_key = NULL,
  ignore_duplicates = TRUE
)
```

Arguments

<code>data</code>	A list where each element is a data frame or tibble that will be written to a Parquet file.
<code>path</code>	The directory path where the Parquet files will be written.
<code>...</code>	Additional arguments passed to <code>rcdf::write_parquet()</code> while writing each Parquet file.
<code>parent_dir</code>	An optional parent directory to be included in the path where the files will be written.
<code>primary_key</code>	A data.frame or tibble that includes at least two columns: <code>file</code> and <code>pk_field_name</code> .
<code>ignore_duplicates</code>	A logical flag. If <code>TRUE</code> , a warning is issued when duplicates are found. If <code>FALSE</code> , the function stops with an error.

Value

A character vector of file paths to the written Parquet files.

Examples

```
dir <- system.file("extdata", package = "rcdf")
rcdf_path <- file.path(dir, 'mtcars.rcdf')
private_key <- file.path(dir, 'sample-private-key.pem')

rcdf_data <- read_rcdf(path = rcdf_path, decryption_key = private_key)
temp_dir <- tempdir()

write_rcdf_parquet(data = rcdf_data, path = temp_dir)
```

```
unlink(temp_dir, force = TRUE)
```

write_rcdf_sav	<i>Write RCDF data to SPSS .sav files</i>
----------------	---

Description

Writes each table in the RCDF object to a .sav file using the haven package for compatibility with SPSS.

Usage

```
write_rcdf_sav(data, path, ..., parent_dir = NULL)
```

Arguments

data	A valid RCDF object.
path	Output directory for files.
...	Additional arguments passed to haven::write_sav().
parent_dir	Optional subdirectory under path to group SPSS files.

Value

Invisibly returns NULL. Files are written to disk.

See Also

[write_rcdf_as](#)

Examples

```
dir <- system.file("extdata", package = "rcdf")
rcdf_path <- file.path(dir, 'mtcars.rcdf')
private_key <- file.path(dir, 'sample-private-key.pem')

rcdf_data <- read_rcdf(path = rcdf_path, decryption_key = private_key)
temp_dir <- tempdir()

write_rcdf_sav(data = rcdf_data, path = temp_dir)

unlink(temp_dir, force = TRUE)
```

write_rcdf_sqlite	<i>Write RCDF data to a SQLite database</i>
-------------------	---

Description

Writes all tables in the RCDF object to a single SQLite database file.

Usage

```
write_rcdf_sqlite(data, path, db_name = "cbms_data", ..., parent_dir = NULL)
```

Arguments

data	A valid RCDF object.
path	Output directory for the database file.
db_name	Name of the SQLite database file (without extension).
...	Additional arguments passed to <code>DBI::dbWriteTable()</code> .
parent_dir	Optional subdirectory under 'path' to store the SQLite file.

Value

Invisibly returns NULL. A .db file is written to disk.

See Also

[write_rcdf_as](#)

Examples

```
dir <- system.file("extdata", package = "rcdf")
rcdf_path <- file.path(dir, 'mtcars.rcdf')
private_key <- file.path(dir, 'sample-private-key.pem')

rcdf_data <- read_rcdf(path = rcdf_path, decryption_key = private_key)
temp_dir <- tempdir()

write_rcdf_sqlite(data = rcdf_data, path = temp_dir)

unlink(temp_dir, force = TRUE)
```

write_rcdf_tsv	<i>Write RCDF data to TSV files</i>
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Description

Writes each table in the RCDF object as a separate tab-separated .txt file.

Usage

```
write_rcdf_tsv(data, path, ..., parent_dir = NULL)
```

Arguments

data	A valid RCDF object.
path	The base output directory.
...	Additional arguments passed to <code>write.table()</code> .
parent_dir	Optional subdirectory under path to group TSV files.

Value

Invisibly returns NULL. Files are written to disk.

See Also

[write_rcdf_as](#)

Examples

```
dir <- system.file("extdata", package = "rcdf")
rcdf_path <- file.path(dir, 'mtcars.rcdf')
private_key <- file.path(dir, 'sample-private-key.pem')

rcdf_data <- read_rcdf(path = rcdf_path, decryption_key = private_key)
temp_dir <- tempdir()

write_rcdf_tsv(data = rcdf_data, path = temp_dir)

unlink(temp_dir, force = TRUE)
```

write_rcdf_xlsx	<i>Write RCDF data to Excel files</i>
-----------------	---------------------------------------

Description

Writes each table in the RCDF object as a separate .xlsx file using the openxlsx package.

Usage

```
write_rcdf_xlsx(data, path, ..., parent_dir = NULL)
```

Arguments

data	A valid RCDF object.
path	The output directory.
...	Additional arguments passed to openxlsx::write.xlsx().
parent_dir	Optional subdirectory under path to group Excel files.

Value

Invisibly returns NULL. Files are written to disk.

See Also

[write_rcdf_as](#)

Examples

```
dir <- system.file("extdata", package = "rcdf")
rcdf_path <- file.path(dir, 'mtcars.rcdf')
private_key <- file.path(dir, 'sample-private-key.pem')

rcdf_data <- read_rcdf(path = rcdf_path, decryption_key = private_key)
temp_dir <- tempdir()

write_rcdf_xlsx(data = rcdf_data, path = temp_dir)

unlink(temp_dir, force = TRUE)
```

Index

`add_metadata`, [2](#)
`as_rcdf`, [3](#)

`generate_pw`, [4](#)
`generate_rsa_keys`, [5](#)
`get_data_dictionary`, [5](#)
`get_rcdf_metadata`, [6](#)

`merge_rcdf`, [7](#)

`rcdf_list`, [8](#)
`read_env`, [8](#)
`read_parquet`, [9](#)
`read_rcdf`, [10](#)

`write_parquet`, [12](#)
`write_rcdf`, [13](#)
`write_rcdf_as`, [14](#), [15–17](#), [19–22](#)
`write_rcdf_csv`, [14](#), [15](#)
`write_rcdf_dta`, [14](#), [16](#)
`write_rcdf_json`, [14](#), [17](#)
`write_rcdf_parquet`, [18](#)
`write_rcdf_sav`, [14](#), [19](#)
`write_rcdf_sqlite`, [14](#), [20](#)
`write_rcdf_tsv`, [14](#), [21](#)
`write_rcdf_xlsx`, [14](#), [22](#)