

The openxlsx2 book

Jan Marvin Garbuszus (JanMarvin) and openxlsx2 authors

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Preface

This is a work in progress book describing the features of [openxlsx2](#) (Barbone and Garbuszus 2023). Having written a book before, I never imagined to do this again and therefore I shall not do it. But still I consider it a nice addition to have something more flexible as our *vignettes*.

This manual was compiled using:

```
R.version
```

```
platform      -
arch           x86_64-pc-linux-gnu
os            linux-gnu
system        x86_64, linux-gnu
status
major         4
minor         3.2
year          2023
month         10
day           31
svn rev       85441
language      R
version.string R version 4.3.2 (2023-10-31)
nickname      Eye Holes
```

and

```
packageVersion("openxlsx2")
```

```
[1] '1.2.0.9000'
```

Graphics might reflect earlier states and are not constantly updated. If you find any irregularities where our code produces different output than expected, please let us know in the issue tracker at <https://github.com/JanMarvin/openxlsx2/>.

1 Introduction

Unfortunately the entire business world is still built almost entirely on Microsofts Office tools and whenever data is involved, this means that is is largely built on the spreadsheet software Excel. R users that want to interact with this previously closed source file format had to rely on various packages (the following is not necessarily a complete list of all packages). Packages that create workbook objects like `xlsx` (Dragulescu and Arendt 2023) and `openxlsx` (Schauberger and Walker 2023) and packages for special tasks namely `readxl` (Wickham and Bryan 2023), `readxlsb` (Allen 2023), `tidyxl` (Garmonsway 2022), `writexl` (Ooms 2023) and `WriteXLS` (Schwartz 2022), some are Windows exclusive interacting with Excel via a DCOM server `RDCOMClient` and `RExcel` ¹, some are not, `XLconnect`.

In Excel 2007 a new open standard called OOXML(short for office open xml)² which we will refer to as *openxml* was introduced. In December 2006 this standard was accepted by the ECMA and it subsequently replaced the previously used `xls` files wherever people are working with spreadsheet software (after all we are all aware that accounting does not really care whatever file format they are using as long as it opens up in their favorite spreadsheet software). The openxml standard introduced the so called Excel 2007 workbook format `xlsx`. These files are a collection of zipped XML-files. This makes is easy to import the files to R, because all you need is a tool to unzip the files and an XML-parser to import the files as data frames. Still, since there are various tasks available to interact with spreadsheet file, there are also various tools required. If all you want to do is read from files `readxl` is probably enough, if all you want to do is write `xlsx` files `writexl` is probably the fastest choice available. Yet there are a plethora of other tasks available and this book is about them.

The predecessor to `openxlsx2` (Barbone and Garbuszus 2023) called `openxlsx` (originally founded by Andrew Walker) was inspired by the `rJava` based `xlsx` package, but dropped the `rJava` dependency, and the support for the old `xls` files and wrote a custom XML parser in `Rcpp` (Eddelbuettel and François 2011). Later Phillip Schauburger picked up the abandoned `openxlsx` package and continues to maintain it. Finally `openxlsx2` was forked from `openxlsx` to include (1) the `pugixml` (Kapoulkine 2006-2022) library to address shortcomings of the `openxlsx` XML parser and (2) to switch to the `R6` (Chang 2021) package to introduce modern programming flows. Since then `openxlsx2` has evolved a lot, includes many new features and is approaching a stable API release 1.0. This manual is supposed to bundle and extend the existing vignettes and to document the changes.

¹See <https://github.com/omegahat/RDCOMClient>.

²See https://wikipedia.org/wiki/Office_Open_XML.

1.1 Installation

You can install the stable version of `openxlsx2` with:

```
install.packages('openxlsx2')
```

You can install the development version of `openxlsx2` from [GitHub](#) with:

```
# install.packages("remotes")
remotes::install_github("JanMarvin/openxlsx2")
```

Or from [r-universe](#) with:

```
# Enable repository from janmarvin
options(repos = c(
  janmarvin = 'https://janmarvin.r-universe.dev',
  CRAN = 'https://cloud.r-project.org'))
# Download and install openxlsx2 in R
install.packages('openxlsx2')
```

```
#| context: setup
webr::install(
  'openxlsx2',
  repos = c(
    'https://janmarvin.r-universe.dev',
    'https://cran.r-universe.dev'
  )
)
```

1.2 Working with the package

We offer two different variants how to work with `openxlsx2`.

- The first one is to simply work with R objects. It is possible to read (`read_xlsx()`) and write (`write_xlsx()`) data from and to files. We offer a number of options in the commands to support various features of the openxml format, including reading and writing named ranges and tables. Furthermore, there are several ways to read certain information of an openxml spreadsheet without having opened it in a spreadsheet software before, e.g. to get the contained sheet names or tables.

- As a second variant `openxlsx2` offers the work with so called `wbWorkbook` objects. Here an openxml file is read into a corresponding `wbWorkbook` object (`wb_load()`) or a new one is created (`wb_workbook()`). Afterwards the object can be further modified using various functions. For example, worksheets can be added or removed, the layout of cells or entire worksheets can be changed, and cells can be modified (overwritten or rewritten). Afterwards the `wbWorkbook` objects can be written as openxml files and processed by suitable spreadsheet software.

1.3 Example

This is a basic example which shows you how to solve a common problem:

```
library(openxlsx2)
# read xlsx or xlsx files
path <- system.file("extdata/openxlsx2_example.xlsx", package = "openxlsx2")
read_xlsx(path)

# or import workbooks
wb <- wb_load(path)
wb

# read a data frame
wb_to_df(wb)

# and save
temp <- temp_xlsx()
if (interactive()) wb_save(wb, temp)

## or create one yourself
wb <- wb_workbook()
# add a worksheet
wb$add_worksheet("sheet")
# add some data
wb$add_data("sheet", cars)
# open it in your default spreadsheet software
if (interactive()) wb$open()
```

1.4 Authors and contributions

For a full list of all authors that have made this package possible and for whom we are grateful, please see:

```
readLines(system.file("AUTHORS", package = "openxlsx2"))
```

If you feel like you should be included on this list, please let us know. If you have something to contribute, you are welcome. If something is not working as expected, open issues or if you have solved an issue, open a pull request. Please be respectful and be aware that we are volunteers doing this for fun in our unpaid free time. We will work on problems when we have time or need.

1.5 License

The `openxlsx2` package is licensed under the MIT license and is based on [openxlsx](#) (by Alexander Walker and Philipp Schauburger; COPYRIGHT 2014-2022) and [pugixml](#) (by Arseny Kapoulkine; COPYRIGHT 2006-2022). Both released under the MIT license.

1.6 A note on speed and memory usage

The current state of `openxlsx2` is that it is reasonably fast. That is, it works well with reasonably large input data when reading or writing. It may not work well with data that tests the limits of the `openxml` specification. Things may slow down on the R side of things, and performance and usability will depend on the speed and size of the local operating system's CPU and memory.

Note that there are at least two cases where `openxlsx2` constructs potentially large data frames (i) when loading, `openxlsx2` usually needs to read the entire input file into `pugixml` and convert it into long data frame(s), and `wb_to_df()` converts one long data frame into two data frames that construct the output object and (ii) when adding data to the workbook, `openxlsx2` reshapes the input data frame into a long data frame and stores it in the workbook, and writes the entire worksheet into a `pugixml` file that is written when it is complete. Applying cell styles, date conversions etc. will further slow down the process and finally the sheets will be zipped to provide the `xlsx` output.

Therefore, if you are faced with an unreasonably large dataset, either give yourself enough time, use another package to write the `xlsx` output (`openxlsx2` was not written with the intention of working with maximum memory efficiency), and by all means use other ways to store data (binary file formats or a database). However, we are always happy to improve, so if you have

found a way to improve what we are currently doing, please let us know and open an issue or a pull request.

1.7 Invitation to contribute

We have put a lot of work into `openxls2` to make it useful for our needs, improving what we found useful about `openxlsx` and removing what we didn't need. We do not claim to be omniscient about all the things you can do with spreadsheet software, nor do we claim to be omniscient about all the things you can do in `openxlsx2`. Nevertheless, we are quite fond of our little package and invite others to try it out and comment on what they like and of course what they think we are missing or if something doesn't work. `openxlsx2` is a complex piece of software that certainly does not work bug-free, even if we did our best. If you want to contribute to the development of `openxlsx2`, please be our guest on our Github. Join or open a discussion, post or fix issues or write us a mail.

2 basics

Welcome to the basic manual to `openxlsx2`. In this manual you will learn how to use `openxlsx2` to import data from `xlsx`-files to R as well as how to export data from R to `xlsx`, and how to import and modify these `openxml` workbooks in R. This package is based on the work of many contributors to `openxlsx`. It was mostly rewritten using `pugixml` and `R6` making use of modern technology, providing a fresh and easy to use R package.

Over the years many people have worked on the tricky task to handle `xls` and `xlsx` files. Notably `openxlsx`, but there are countless other R-packages as well as third party libraries or calculation software capable of handling such files. Please feel free to use and test your files with other software and or let us know about your experience. Open an issue on github or write us a mail.

2.1 Importing data

Coming from `openxlsx` you might know about `read.xlsx()` (two functions, one for files and one for workbooks) and `readWorkbook()`. Functions that do different things, but mostly the same. In `openxlsx2` we tried our best to reduce the complexity under the hood and for the user as well. In `openxlsx2` they are replaced with `read_xlsx()`, `wb_read()` and they share the same underlying function `wb_to_df()`.

For this example we will use example data provided by the package. You can locate it in our “inst/extdata” folder. The files are included with the package source and you can open them in any calculation software as well.

2.1.1 Basic import

We begin with the `openxlsx2_example.xlsx` file by telling R where to find this file on our system

```
xlsxFile <- system.file("extdata", "openxlsx2_example.xlsx", package = "openxlsx2")
```

The object contains a path to the `xlsx` file and we pass this file to our function to read the workbook into R

```
# import workbook
wb_to_df(xlsxFile)
#>      Var1 Var2 NA  Var3  Var4      Var5      Var6      Var7      Var8
#> 3   TRUE   1 NA    1     a 2023-05-29 3209324 This #DIV/0! 01:27:15
#> 4   TRUE  NA NA  #NUM!    b 2023-05-23      <NA>      0 14:02:57
#> 5   TRUE   2 NA   1.34    c 2023-02-01      <NA> #VALUE! 23:01:02
#> 6  FALSE   2 NA  <NA> #NUM!      <NA>      <NA>      2 17:24:53
#> 7  FALSE   3 NA   1.56    e      <NA>      <NA>      <NA>
#> 8  FALSE   1 NA   1.7    f 2023-03-02      <NA>      2.7 08:45:58
#> 9    NA  NA NA  <NA>  <NA>      <NA>      <NA>      <NA>
#> 10 FALSE   2 NA    23    h 2023-12-24      <NA>      25      <NA>
#> 11 FALSE   3 NA   67.3    i 2023-12-25      <NA>      3      <NA>
#> 12    NA   1 NA   123  <NA> 2023-07-31      <NA>     122      <NA>
```

The output is created as a data frame and contains data types date, logical, numeric and character. The function to import the file to R, `wb_to_df()` provides similar options as the `openxlsx` functions `read.xlsx()` and `readWorkbook()` and a few new functions we will go through the options. As you might have noticed, we return the column of the xlsx file as the row name of the data frame returned. Per default the first sheet in the workbook is imported. If you want to switch this, either provide the `sheet` parameter with the correct index or provide the sheet name.

2.1.2 col_names - first row as column name

In the previous example the first imported row was used as column name for the data frame. This is the default behavior, but not always wanted or expected. Therefore this behavior can be disabled by the user.

```
# do not convert first row to column names
wb_to_df(xlsxFile, col_names = FALSE)
#>      B    C D    E    F      G      H      I      J
#> 2    NA Var2 NA  Var3  Var4      Var5      Var6      Var7      Var8
#> 3   TRUE   1 NA    1     a 2023-05-29 3209324 This #DIV/0! 01:27:15
#> 4   TRUE <NA> NA  #NUM!    b 2023-05-23      <NA>      0 14:02:57
#> 5   TRUE   2 NA   1.34    c 2023-02-01      <NA> #VALUE! 23:01:02
#> 6  FALSE   2 NA  <NA> #NUM!      <NA>      <NA>      2 17:24:53
#> 7  FALSE   3 NA   1.56    e      <NA>      <NA>      <NA>
#> 8  FALSE   1 NA   1.7    f 2023-03-02      <NA>      2.7 08:45:58
#> 9    NA <NA> NA  <NA>  <NA>      <NA>      <NA>      <NA>
#> 10 FALSE   2 NA    23    h 2023-12-24      <NA>      25      <NA>
#> 11 FALSE   3 NA   67.3    i 2023-12-25      <NA>      3      <NA>
```

```
#> 12      NA      1 NA      123 <NA> 2023-07-31      <NA>      122      <NA>
```

2.1.3 detect_dates - convert cells to R dates

The creators of the openxml standard are well known for mistakenly treating something as a date and `openxlsx2` has built in ways to identify a cell as a date and will try to convert the value for you, but unfortunately this is not always a trivial task and might fail. In such a case we provide an option to disable the date conversion entirely. In this case the underlying numerical value will be returned.

```
# do not try to identify dates in the data
wb_to_df(xlsxFile, detect_dates = FALSE)
#>      Var1 Var2 NA  Var3  Var4  Var5      Var6  Var7      Var8
#> 3  TRUE      1 NA      1      a 45075 3209324 This #DIV/0! 0.06059028
#> 4  TRUE      NA NA #NUM!      b 45069      <NA>      0 0.58538194
#> 5  TRUE      2 NA  1.34      c 44958      <NA> #VALUE! 0.95905093
#> 6 FALSE      2 NA  <NA> #NUM!      NA      <NA>      2 0.72561343
#> 7 FALSE      3 NA  1.56      e      NA      <NA>      <NA>      NA
#> 8 FALSE      1 NA  1.7      f 44987      <NA>      2.7 0.36525463
#> 9      NA      NA NA  <NA>  <NA>      NA      <NA>      <NA>      NA
#> 10 FALSE      2 NA      23      h 45284      <NA>      25      NA
#> 11 FALSE      3 NA  67.3      i 45285      <NA>      3      NA
#> 12      NA      1 NA      123 <NA> 45138      <NA>      122      NA
```

2.1.4 show_formula - show formulas instead of results

Sometimes things might feel off. This can be because the openxml files are not updating formula results in the sheets unless they are opened in software that provides such functionality as certain tabular calculation software. Therefore the user might be interested in the underlying functions to see what is going on in the sheet. Using `show_formula` this is possible

```
# return the underlying Excel formula instead of their values
wb_to_df(xlsxFile, show_formula = TRUE)
#>      Var1 Var2 NA  Var3  Var4      Var5      Var6      Var7      Var8
#> 3  TRUE      1 NA      1      a 2023-05-29 3209324 This      E3/0 01:27:15
#> 4  TRUE      NA NA #NUM!      b 2023-05-23      <NA>      C4 14:02:57
#> 5  TRUE      2 NA  1.34      c 2023-02-01      <NA>      #VALUE! 23:01:02
#> 6 FALSE      2 NA  <NA> #NUM!      <NA>      <NA>      C6+E6 17:24:53
#> 7 FALSE      3 NA  1.56      e      <NA>      <NA>      <NA>      <NA>
#> 8 FALSE      1 NA  1.7      f 2023-03-02      <NA>      C8+E8 08:45:58
```

```
#> 9      NA      NA NA <NA> <NA> <NA> <NA> <NA> <NA>
#> 10 FALSE      2 NA      23      h 2023-12-24 <NA> SUM(C10,E10) <NA>
#> 11 FALSE      3 NA      67.3      i 2023-12-25 <NA> PRODUCT(C11,E3) <NA>
#> 12      NA      1 NA      123 <NA> 2023-07-31 <NA> E12-C12 <NA>
```

2.1.5 dims - read specific dimension

Sometimes the entire worksheet contains too much data, in such case we provide functions to read only a selected dimension range. Such a range consists of either a specific cell like “A1” or a cell range in the notation used in the `openxml` standard

```
# read dimension without column names
wb_to_df(xlsxFile, dims = "A2:C5", col_names = FALSE)
#>   A      B      C
#> 2 NA      NA Var2
#> 3 NA TRUE      1
#> 4 NA TRUE <NA>
#> 5 NA TRUE      2
```

Alternatively, if you don't know the Excel sheet's address, you can use `wb_dims()` to specify the dimension. See below or `in?wb_dims` for more details.

```
# read dimension without column names with `wb_dims()`
wb_to_df(xlsxFile, dims = wb_dims(rows = 2:5, cols = 1:3), col_names = FALSE)
#>   A      B      C
#> 2 NA      NA Var2
#> 3 NA TRUE      1
#> 4 NA TRUE <NA>
#> 5 NA TRUE      2
```

2.1.6 cols - read selected columns

If you do not want to read a specific cell, but a cell range you can use the column attribute. This attribute takes a numeric vector as argument

```
# read selected cols
wb_to_df(xlsxFile, cols = c("A:B", "G"))
#>   NA Var1      Var5
#> 3 NA TRUE 2023-05-29
#> 4 NA TRUE 2023-05-23
```

```
#> 5  NA  TRUE 2023-02-01
#> 6  NA FALSE      <NA>
#> 7  NA FALSE      <NA>
#> 8  NA FALSE 2023-03-02
#> 9  NA  NA      <NA>
#> 10 NA FALSE 2023-12-24
#> 11 NA FALSE 2023-12-25
#> 12 NA  NA 2023-07-31
```

2.1.7 rows - read selected rows

The same goes with rows. You can select them using numeric vectors

```
# read selected rows
wb_to_df(xlsxFile, rows = c(2, 4, 6))
#>   Var1 Var2 NA  Var3  Var4      Var5 Var6 Var7      Var8
#> 4  TRUE  NA NA  #NUM!      b 2023-05-23  NA   0 14:02:57
#> 6 FALSE   2 NA  <NA> #NUM!      <NA>  NA   2 17:24:53
```

2.1.8 convert - convert input to guessed type

In xml exists no difference between value types. All values are per default characters. To provide these as numerics, logicals or dates, `openxlsx2` and every other software dealing with xlsx files has to make assumptions about the cell type. This is especially tricky due to the notion of worksheets. Unlike in a data frame, a worksheet can have a wild mix of all types of data. Even though the conversion process from character to date or numeric is rather solid, sometimes the user might want to see the data without any conversion applied. This might be useful in cases where something unexpected happened or the import created warnings. In such a case you can look at the raw input data. If you want to disable date detection as well, please see the entry above.

```
# convert characters to numerics and date (logical too?)
wb_to_df(xlsxFile, convert = FALSE)
#>   Var1 Var2  NA  Var3  Var4      Var5      Var6      Var7      Var8
#> 3  TRUE   1 <NA>    1    a 2023-05-29 3209324 This #DIV/0! 01:27:15
#> 4  TRUE <NA> <NA> #NUM!    b 2023-05-23      <NA>      0 14:02:57
#> 5  TRUE   2 <NA>  1.34    c 2023-02-01      <NA> #VALUE! 23:01:02
#> 6 FALSE   2 <NA> <NA> #NUM!      <NA>      <NA>      2 17:24:53
#> 7 FALSE   3 <NA>  1.56    e      <NA>      <NA> <NA>      <NA>
#> 8 FALSE   1 <NA>   1.7    f 2023-03-02      <NA>      2.7 08:45:58
```



```
#> 9  <NA> <NA> <NA> <NA> <NA> <NA> <NA> <NA> <NA>
#> 10 FALSE 2 <NA> 23 h 2023-12-24 <NA> 25 <NA>
#> 11 FALSE 3 <NA> 67.3 i 2023-12-25 <NA> 3 <NA>
#> 12 <NA> 1 <NA> 123 <NA> 2023-07-31 <NA> 122 <NA>
```

2.1.9 skip_empty_rows - remove empty rows

Even though `openxlsx2` imports everything as requested, sometimes it might be helpful to remove empty lines from the data. These might be either left empty intentional or empty because they were formatted, but the cell value was removed afterwards. This was added mostly for backward comparability, but the default has been changed to `FALSE`. The behavior has changed a bit as well. Previously empty cells were removed prior to the conversion to R data frames, now they are removed after the conversion and are removed only if they are completely empty

```
# erase empty rows from dataset
wb_to_df(xlsxFile, sheet = 1, skip_empty_rows = TRUE) |> tail()
#>   Var1 Var2 NA Var3 Var4 Var5 Var6 Var7 Var8
#> 6 FALSE 2 NA <NA> #NUM! <NA> <NA> 2 17:24:53
#> 7 FALSE 3 NA 1.56 e <NA> <NA> <NA> <NA>
#> 8 FALSE 1 NA 1.7 f 2023-03-02 <NA> 2.7 08:45:58
#> 10 FALSE 2 NA 23 h 2023-12-24 <NA> 25 <NA>
#> 11 FALSE 3 NA 67.3 i 2023-12-25 <NA> 3 <NA>
#> 12 NA 1 NA 123 <NA> 2023-07-31 <NA> 122 <NA>
```

2.1.10 skip_empty_cols - remove empty columns

The same for columns

```
# erase empty columns from dataset
wb_to_df(xlsxFile, skip_empty_cols = TRUE)
#>   Var1 Var2 Var3 Var4 Var5 Var6 Var7 Var8
#> 3 TRUE 1 1 a 2023-05-29 3209324 This #DIV/0! 01:27:15
#> 4 TRUE NA #NUM! b 2023-05-23 <NA> 0 14:02:57
#> 5 TRUE 2 1.34 c 2023-02-01 <NA> #VALUE! 23:01:02
#> 6 FALSE 2 <NA> #NUM! <NA> <NA> 2 17:24:53
#> 7 FALSE 3 1.56 e <NA> <NA> <NA> <NA>
#> 8 FALSE 1 1.7 f 2023-03-02 <NA> 2.7 08:45:58
#> 9 NA NA <NA> <NA> <NA> <NA> <NA> <NA>
#> 10 FALSE 2 23 h 2023-12-24 <NA> 25 <NA>
```

```
#> 11 FALSE      3  67.3      i 2023-12-25      <NA>      3      <NA>
#> 12      NA      1   123 <NA> 2023-07-31      <NA>     122     <NA>
```

2.1.11 row_names - keep rownames from input

Sometimes the data source might provide rownames as well. In such a case you can `openxlsx2` to treat the first column as rowname

```
# convert first row to rownames
wb_to_df(xlsxFile, sheet = 2, dims = "C6:G9", row_names = TRUE)
#>           mpg cyl disp  hp
#> Mazda RX4    21.0   6  160 110
#> Mazda RX4 Wag 21.0   6  160 110
#> Datsun 710    22.8   4  108  93
```

2.1.12 types - convert column to specific type

If the user know better than the software what type to expect in a worksheet, this can be provided via `types`. This parameter takes a named numeric. 0 is character, 1 is numeric and 2 is date

```
# define type of the data.frame
wb_to_df(xlsxFile, cols = c(2, 5), types = c("Var1" = 0, "Var3" = 1))
#>      Var1  Var3
#> 3  TRUE  1.00
#> 4  TRUE   NaN
#> 5  TRUE  1.34
#> 6 FALSE   NA
#> 7 FALSE  1.56
#> 8 FALSE  1.70
#> 9  <NA>   NA
#> 10 FALSE 23.00
#> 11 FALSE 67.30
#> 12 <NA> 123.00
```

2.1.13 start_row - where to begin

Often the creator of the worksheet has used a lot of creativity and the data does not begin in the first row, instead it begins somewhere else. To define the row where to begin reading,

define it via the `start_row` parameter

```
# start in row 5
wb_to_df(xlsxFile, start_row = 5, col_names = FALSE)
#>      B C D      E      F      G H      I      J
#> 5  TRUE 2 NA  1.34      c 2023-02-01 NA #VALUE! 23:01:02
#> 6 FALSE 2 NA      NA #NUM!      <NA> NA      2 17:24:53
#> 7 FALSE 3 NA  1.56      e      <NA> NA      <NA>      <NA>
#> 8 FALSE 1 NA  1.70      f 2023-03-02 NA      2.7 08:45:58
#> 9      NA NA NA      NA <NA>      <NA> NA      <NA>      <NA>
#> 10 FALSE 2 NA  23.00      h 2023-12-24 NA      25      <NA>
#> 11 FALSE 3 NA  67.30      i 2023-12-25 NA      3      <NA>
#> 12      NA 1 NA 123.00 <NA> 2023-07-31 NA      122      <NA>
```

2.1.14 `na.strings` - define missing values

There is the “#N/A” string, but often the user will be faced with custom missing values and other values we are not interested. Such strings can be passed as character vector via `na.strings`

```
# na strings
wb_to_df(xlsxFile, na.strings = "")
#>      Var1 Var2 NA  Var3  Var4      Var5      Var6      Var7      Var8
#> 3  TRUE      1 NA      1      a 2023-05-29 3209324 This #DIV/0! 01:27:15
#> 4  TRUE      NA NA #NUM!      b 2023-05-23      <NA>      0 14:02:57
#> 5  TRUE      2 NA  1.34      c 2023-02-01      <NA> #VALUE! 23:01:02
#> 6 FALSE      2 NA      <NA> #NUM!      <NA>      <NA>      2 17:24:53
#> 7 FALSE      3 NA  1.56      e      <NA>      <NA>      <NA>      <NA>
#> 8 FALSE      1 NA  1.7      f 2023-03-02      <NA>      2.7 08:45:58
#> 9      NA      NA NA      <NA>      <NA>      <NA>      <NA>      <NA>
#> 10 FALSE      2 NA      23      h 2023-12-24      <NA>      25      <NA>
#> 11 FALSE      3 NA  67.3      i 2023-12-25      <NA>      3      <NA>
#> 12      NA      1 NA  123      <NA> 2023-07-31      <NA>      122      <NA>
```

2.1.15 Importing as workbook

In addition to importing directly from `xlsx` or `xlsm` files, `openxlsx2` provides the `wbWorkbook` class used for importing and modifying entire the `openxml` files in R. This `workbook` class is the heart of `openxlsx2` and probably the reason why you are reading this manual in the first place.

Importing a file into a workbook looks like this:

```
# the file we are going to load
xlsxFile <- system.file("extdata", "openxlsx2_example.xlsx", package = "openxlsx2")
# loading the file into the workbook
wb <- wb_load(file = xlsxFile)
```

The additional options `wb_load()` provides are for internal use: `sheet` loads only a selected sheet from the workbook and `data_only` reads only the data parts from a workbook and ignores any additional graphics or pivot tables. Both functions create workbook objects that can only be used to read data, and we do not recommend end users to use them. Especially not if they intend to re-export the workbook afterwards.

Once a workbook is imported, we provide several functions to interact with and modify it (the `wb_to_df()` function mentioned above works the same way for an imported workbook). It is possible to add new sheets and remove sheets, as well as to add or remove data. R-plots can be inserted and also the style of the workbook can be changed, new fonts, background colors and number formats. There is a wealth of options explained in the man pages and the additional style vignette (more vignettes to follow).

2.2 Exporting data

2.2.1 Exporting data frames or vectors

If you want to export a data frame from R, you can use `write_xlsx()` which will create an xlsx file. This file can be tweaked further. See `?openxlsx2::write_xlsx` to see all the options. (Further explanation and examples will follow).

```
write_xlsx(x = mtcars, file = "mtcars.xlsx")
```

2.2.2 Exporting a wbWorkbook

Imported workbooks can be saved as xlsx or xlsxm files with the wrapper `wb_save()` or with `wb$save()`. Both functions take the filename and an optional `overwrite` option. If the latter is set, an optional guard is provided to check if the file you want to write already exists. But be careful, this is optional. The default is to save the file and replace an existing file. Of course, on Windows, files that are locked (for example, if they were opened by another process) will not be replaced.

```
# replace the existing file
wb$save("mtcars.xlsx")

# do not overwrite the existing file
try(wb$save("mtcars.xlsx", overwrite = FALSE))
```

2.3 dims/ wb_dims()

In `openxlsx2` functions that interact with worksheet cells are using `dims` as argument and require the users to provide these. `dims` are cells or cell ranges in A1 notation. The single argument `dims` hereby replaces `col/row`, `cols/rows` and `xy`. Since A1 notation is rather simple in the first few columns it might get confusing after the 26. Therefore we provide a wrapper to construct it:

```
# various options
wb_dims(from_row = 4)
#> [1] "A4"

wb_dims(rows = 4, cols = 4)
#> [1] "D4"
wb_dims(rows = 4, cols = "D")
#> [1] "D4"

wb_dims(rows = 4:10, cols = 5:9)
#> [1] "E4:I10"

wb_dims(rows = 4:10, cols = "A:D") # same as below
#> [1] "A4:D10"
wb_dims(rows = seq_len(7), cols = seq_len(4), from_row = 4)
#> [1] "A4:D10"
# 10 rows and 15 columns from indice B2.
wb_dims(rows = 1:10, cols = 1:15, from_col = "B", from_row = 2)
#> [1] "B2:P11"

# data + col names
wb_dims(x = mtcars)
#> [1] "A1:K33"
# only data
wb_dims(x = mtcars, select = "data")
#> [1] "A2:K33"
```

```

# The dims of the values of a column in `x`
wb_dims(x = mtcars, cols = "cyl")
#> [1] "B2:B33"
# a column in `x` with the column name
wb_dims(x = mtcars, cols = "cyl", select = "x")
#> [1] "B1:B33"
# rows in `x`
wb_dims(x = mtcars)
#> [1] "A1:K33"

# in a wb chain
wb <- wb_workbook()$
  add_worksheet()$
  add_data(x = mtcars)$
  add_fill(
    dims = wb_dims(x = mtcars, rows = 1:5), # only 1st 5 rows of x data
    color = wb_color("yellow")
  )$
  add_fill(
    dims = wb_dims(x = mtcars, select = "col_names"), # only column names
    color = wb_color("cyan2")
  )

# or if the data's first coord needs to be located in B2.

wb_dims_custom <- function(...) {
  wb_dims(x = mtcars, from_col = "B", from_row = 2, ...)
}

wb <- wb_workbook()$
  add_worksheet()$
  add_data(x = mtcars, dims = wb_dims_custom())$
  add_fill(
    dims = wb_dims_custom(rows = 1:5),
    color = wb_color("yellow")
  )$
  add_fill(
    dims = wb_dims_custom(select = "col_names"),
    color = wb_color("cyan2")
  )

```

3 styling

Welcome to the styling manual for **openxlsx2**. In this manual you will learn how to use **openxlsx2** to style your worksheets. data from xlsx-files to R as well as how to export data from R to xlsx, and how to import and modify these openxml workbooks in R.

3.1 Colors, text rotation and number formats

Below we show you two ways how to create styled tables with **openxlsx2** one using the high level functions to style worksheet areas and one using the bare metal approach of creating the identical table. We show both ways to create styles in **openxlsx2** to show how you could build on our functions or create your very own functions.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24	X25	X26	X27	X28	
1	44132.91602	43812	43984.44	44.322	43.546.08	44833499	447385.848	448E+04	44242.1/6	44253	1/8	22.02.19	23. Jul 21	09. Aug	Dec 22	6:13 PM	2:58:44 PM	22.92	07:54:08	21:05:19 09:54	43.656	43.981	44.787.56	44.192.48	58.17	1071955.1530	07.17.2	44.0E+0	45.006.1206
2	44316.25149	45140	44708.46	44.628	44.413.16	4429848	4464877.539	437E+04	44477.1/6	44804	7/31	18.10.22	09. Oct 24	16. May	May 21	3:21 PM	11:50:24 PM	19.93	21:45:48	14:07:21 04:38	44.515	44.765	43.713.34	44.009.11	23.46	1058327.01.11	18.25.4	45.0E+0	44.332.10073
3	45309.08311	44881	44152.74	45.053	44.752.27	43971468	4432446.388	441E+04	44053	45331	5/29	07.04.22	28. Aug 23	29. Dec	Apr 22	4:10 PM	2:31:38 AM	20.97	00:25:19	25:04:20 17:58	45.524	43.840	42.884.58	43.765.28	35.26	1067871.04.54	58.47.1	45.0E+0	44.311.08622
4	44443.13216	44280	44563.85	44.686	44.611.54	4360336	4448023.769	438E+04	44046	44394	11/23	10.04.21	30. Oct 22	10. Jul	Mar 20	3:57 PM	2:35:37 AM	21.05	15:54:54	13:07:18 17:35	44.889	45.288	44.702.06	45.302.17	08.41	1040526.03.17	04.28.0	44.9E+0	44.335.28147
5	44515.74469	44941	44564.70	44.263	44.502.65	4355515	4442509.276	437E+04	44935	45042	27/92	09.11.21	20. Jan 19	17. Aug	Dec 22	8:23 AM	4:01:48 AM	14.02	08:24:12	27:11:21 07:36	45.091	43.786	44.910.50	43.658.32	38.58	1051738.66.09	06.12.1	43.4E+0	44.743.58379
6	45395.86107	44931	44165.21	45.082	44.084.81	4414935	4565259.088	432E+04	43880.1/3	44794	5/73	18.11.21	06. Oct 20	19. Feb	Dec 20	9:08 AM	1:29:22 AM	22.20	07:14:53	23:07:21 00:54	44.643	44.500	44.285.36	44.620.71	25.19	1048970.71.49	34.09.4	45.2E+0	44.786.13292
7	44699.80849	44900	44259.07	44.995	43.972.41	43632738	4403255.858	443E+04	45529.1/5	44380	53/57	05.01.22	21. Feb 21	20. Mar	May 25	7:42 AM	2:04:01 PM	00.46	03:49:11	12:07:21 23:02	44.106	44.740	44.723.79	44.913.77	07.03	1055285.43.56	03.44.9	44.4E+0	44.786.19514
8	42741.89101	44826	43878.69	44.748	43.879.61	44625799	4385772.216	447E+04	44999.7/8	43993	17/71	03.05.24	30. Sep 22	06. Oct	Mar 19	5:19 AM	1:14:27 AM	04.90	07:57:39	02:01:22 23:09	44.332	44.770	43.802.47	44.542.90	46.94	1057421.13.01	51.21.1	44.7E+0	45.504.88066
9	44002.79667	44751	43849.16	44.676	44.509.29	4500950	4444497.268	442E+04	44563	44154	39/50	06.05.21	08. Jul 21	07. Aug	Dec 20	4:14 AM	1:07:53 PM	04.53	15:03:35	07:01:23 18:36	44.292	44.277	44.373.43	43.958.23	56.11	1071748.36.16	38.53.4	44.8E+0	44.648.45184
10	44166.65761	44410	44612.46	44.096	43.918.15	4372970	4461631.688	442E+04	44034.1/9	44172	5/61	07.12.21	07. Oct 19	05. Jan	Dec 22	9:33 AM	1:05:29 PM	19.57	06:24:56	28:12:21 02:33	44.184	44.488	43.366.46	44.966.35	01.13	1079737.44.41	26.27.9	44.4E+0	44.981.16186
11	45123.3654	44274	44692.76	45.159	44.171.74	44881208	4468627.059	440E+04	44125.1/5	44470	7/41	15.06.23	27. Mar 24	30. Oct	Jun 22	5:09 PM	6:18:58 AM	23.48	16:46:48	27:09:20 21:04	44.835	44.978	45.099.56	44.538.68	35.59	1056867.15.05	47.15.9	44.4E+0	45.152.50117
12	44643.68667	44233	44473.42	44.111	44.301.87	44870828	4431960.736	441E+04	44713	45165	36/59	13.04.23	23. Jan 23	22. Oct	Oct 20	11:49 PM	12:36:23 AM	04.29	05:03:52	24:07:20 04:08	43.779	43.636	45.476.25	43.853.76	43.07	1053780.06.17	51.39.3	45.0E+0	44.919.14649
13	44664.42816	44058	44955.86	45.658	44.467.34	44628378	4385385.409	454E+04	44342.1/2	45716	56/85	02.06.23	14. Jan 22	13. Mar	Feb 20	5:40 AM	12:30:48 PM	22.34	22:02:28	23:06:21 20:23	44.925	44.010	45.040.08	43.673.63	46.12	1052780.42.16	45.28.3	44.8E+0	44.265.34961
14	44505.42891	44329	45581.80	45.295	44.082.17	4388435	4514506.788	444E+04	44676.1/2	45302	49/54	19.10.20	13. Jul 23	28. May	Nov 21	10:43 PM	8:55:30 PM	14.20	13:39:22	24:02:22 01:25	44.924	44.622	44.428.82	45.602.13	34.50	1061133.40.41	58.03.8	45.0E+0	45.269.75
15	44135.50817	43742	44371.48	44.113	44.574.64	4437770	4424994.408	445E+04	44624	44170	8/79	20.09.24	23. Aug 19	22. Mar	Aug 21	9:16 PM	4:32:01 PM	18.28	06:57:18	05:02:20 23:27	43.779	44.197	44.423.50	44.067.43	46.36	1064472.07.58	16.14.1	45.8E+0	43.118.29993
16	45453.78679	45648	43162.41	43.874	44.487.27	4428848	4396364.049	446E+04	44010.1/4	43469	7/95	12.10.21	06. Sep 22	26. Aug	Dec 18	7:20 PM	12:45:25 AM	04.04	05:56:58	25:05:21 17:00	44.799	45.204	43.602.58	43.414.16	58.53	1073097.47.08	57.27.4	44.8E+0	44.201.55996
17	44720.30702	45114	45002.18	44.050	43.910.17	4475646	4431286.488	451E+04	44006.1/5	44228	5/22	07.07.24	18. Nov 20	10. Jan	Sep 21	11:03 PM	1:12:30 PM	12.04	05:11:51	23:02:23 20:00	45.793	44.818	44.882.66	44.739.96	47.50	1062375.57.31	11.44.0	44.6E+0	44.697.89145
18	43352.52748	43821	44050.39	44.587	44.404.42	4423739	4433456.749	442E+04	44165.2/7	44493	25/49	17.08.19	19. Sep 22	08. Nov	Dec 21	3:19 AM	1:12:15 AM	13.20	01:38:30	06:07:21 21:42	44.135	44.484	44.327.04	44.616.18	27.13	1038970.51.21	37.14.0	45.2E+0	43.546.13556
19	44813.32323	44220	44062.16	44.807	45.245.79	44986278	4500600.388	439E+04	44274.1/6	44812	55/56	16.09.21	02. Aug 21	27. Apr	Dec 21	4:29 AM	1:09:50 AM	04.47	10:41:39	13:08:20 09:02	44.913	43.607	44.079.51	43.892.42	25.25	1065480.05.44	34.33.1	45.9E+0	44.699.13446
20	44813.60077	44185	45013.19	44.251	44.649.58	4423613	4449102.929	454E+04	43812.1/5	44978	13/64	30.07.23	22. Aug 22	09. Mar	Jan 20	3:39 PM	7:26:13 PM	23.10	06:23:13	04:04:21 20:24	44.010	44.458	43.660.33	43.365.66	46.40	1082469.19.42	49.38.0	44.2E+0	44.686.14164
21	43851.53784	44877	44285.95	44.166	44.466.88	4502825	4486249.999	442E+04	44344.5/8	44823	19/24	04.08.20	16. Sep 21	21. Apr	May 22	1:33 PM	5:17:14 AM	03.51	22:12:17	16:05:23 15:07	45.000	44.268	44.277.63	44.379.45	38.22	1082528.07.44	54.42.2	45.8E+0	44.441.74634
22	44323.03392	44398	43766.50	44.419	44.209.51	4386113	4416489.298	440E+04	44549.4/5	43669	33/53	14.07.20	09. Sep 21	17. Aug	Oct 23	9:31 PM	9:31:36 AM	09.02	11:40:49	07:07:22 06:35	44.548	44.387	43.973.77	45.076.36	55.35	1056147.00.36	50.01.9	44.7E+0	44.839.45802
23	43847.56753	44585	44344.62	44.008	43.304.45	4374464	4454301.719	438E+04	44388	44915	16/29	02.04.20	23. Mar 23	06. Dec	May 22	9:49 AM	5:44:11 AM	08.34	02:00:27	23:07:23 08:31	45.361	43.788	44.223.65	44.797.05	04.31	1046309.36.59	19.33.3	45.3E+0	44.707.756
24	44039.46537	44428	44366.92	43.518	45.071.89	4624278	4426379.939	437E+04	43689.2/7	44196	9/56	29.01.20	15. Nov 19	02. Aug	Dec 19	1:15 AM	1:28:03 AM	18.39	10:44:27	21:11:21 04:47	43.634	44.721	43.768.23	44.170.42	48.00	1099397.21.57	35.01.4	44.4E+0	44.289.11495
25	44097.73021	44420	44447.20	44.233	43.953.34	4421264	4449469.399	441E+04	44075	44541	1/65	05.01.21	31. Jul 20	14. May	Jan 21	10:01 AM	11:04:56 PM	18.17	22:47:14	20:44:22 16:51	44.416	43.967	45.380.61	43.381.03	36.16	1064492.33.20	25.36.2	44.7E+0	44.895.43721
26	44507.88521	45104	44657.83	44.954	44.854.67	44609526	4394707.339	448E+04	44713.3/7	44485	3/8	07.03.22	27. Dec 23	01. Sep	Mar 22	7:23 PM	6:04:34 PM	03.50	11:56:05	30:10:20 01:21	44.152	44.318	44.435.32	44.594.44	13.50	1053557.56.68	18.03.5	44.6E+0	44.945.96168
27	44908.97181	44319	44128.28	44.125	45.503.55	4379730	4371550.519	451E+04	44235.1/2	44681	31/49	14.08.18	02. Apr 22	03. Feb	Mar 20	3:30 AM	1:03:54 PM	04.58	20:46:37	06:08:22 23:32	44.335	44.656	45.040.59	44.531.33	28.27	1057382.05.21	42.49.3	44.3E+0	44.445.89387
28	44019.12208	45286	44801.63	44.781	44.643.64	4475500	4555245.349	448E+04	44132.1/6	44457	23/56	31.12.21	24. Jul 18	27. Mar	May 18	7:41 PM	3:55:37 AM	04.23	20:08:12	27:11:20 23:38	44.495	44.009	43.000.06	44.793.49	39.01	1045156.59.40	09.26.9	44.4E+0	43.790.93885

Figure 3.1: The example below, with increased column width.

3.1.1 the quick way: using high level functions

```
# add some dummy data
set.seed(123)
mat <- matrix(rnorm(28 * 28, mean = 44444, sd = 555), ncol = 28)
colnames(mat) <- make.names(seq_len(ncol(mat)))
border_col <- wb_color(theme = 1)
border_sty <- "thin"
```

```

# prepare workbook with data and formatted first row
wb <- wb_workbook() %>%
  wb_add_worksheet("test") %>%
  wb_add_data(x = mat) %>%
  wb_add_border(dims = "A1:AB1",
    top_color = border_col, top_border = border_sty,
    bottom_color = border_col, bottom_border = border_sty,
    left_color = border_col, left_border = border_sty,
    right_color = border_col, right_border = border_sty,
    inner_hcolor = border_col, inner_hgrid = border_sty
  ) %>%
  wb_add_fill(dims = "A1:AB1", color = wb_color(hex = "FF334E6F")) %>%
  wb_add_font(dims = "A1:AB1", name = "Arial", bold = TRUE, color = wb_color(hex = "FFFFFFF")) %>%
  wb_add_cell_style(dims = "A1:AB1", horizontal = "center", text_rotation = 45)

# create various number formats
x <- c(
  0, 1, 2, 3, 4, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,
  37, 38, 39, 40, 45, 46, 47, 48, 49
)

# apply the styles
for (i in seq_along(x)) {
  cell <- sprintf("%s2:%s29", int2col(i), int2col(i))
  wb <- wb %>% wb_add_numfmt(dims = cell, numfmt = x[i])
}

# wb$open()

```

3.1.2 the long way: using bare metal functions

```

# create workbook
wb <- wb_workbook() %>% wb_add_worksheet("test")

# add some dummy data to the worksheet
set.seed(123)
mat <- matrix(rnorm(28 * 28, mean = 44444, sd = 555), ncol = 28)
colnames(mat) <- make.names(seq_len(ncol(mat)))
wb$add_data(x = mat, col_names = TRUE)

```



```

# create a border style and assign it to the workbook
black <- wb_color(hex = "FF000000")
new_border <- create_border(
  bottom = "thin", bottom_color = black,
  top = "thin", top_color = black,
  left = "thin", left_color = black,
  right = "thin", right_color = black
)
wb$styles_mgr$add(new_border, "new_border")

# create a fill style and assign it to the workbook
new_fill <- create_fill(patternType = "solid", fgColor = wb_color(hex = "FF334E6F"))
wb$styles_mgr$add(new_fill, "new_fill")

# create a font style and assign it to the workbook
new_font <- create_font(sz = 20, name = "Arial", b = TRUE, color = wb_color(hex = "FFFFFFF"))
wb$styles_mgr$add(new_font, "new_font")

# create a new cell style, that uses the fill, the font and the border style
new_cellxfs <- create_cell_style(
  num_fmt_id = 0,
  horizontal = "center",
  text_rotation = 45,
  fill_id = wb$styles_mgr$get_fill_id("new_fill"),
  font_id = wb$styles_mgr$get_font_id("new_font"),
  border_id = wb$styles_mgr$get_border_id("new_border")
)
# assign this style to the workbook
wb$styles_mgr$add(new_cellxfs, "new_styles")

# assign the new cell style to the header row of our data set
cell <- sprintf("A1:%s1", int2col(nrow(mat)))
wb <- wb %>% wb_set_cell_style(
  dims = cell,
  style = wb$styles_mgr$get_xf_id("new_styles")
)

## style the cells with some builtin format codes (no new numFmt entry is needed)
# add builtin style ids
x <- c(

```

```

1, 2, 3, 4, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22,
37, 38, 39, 40, 45, 46, 47, 48, 49
)

# create styles
new_cellxfs <- create_cell_style(num_fmt_id = x, horizontal = "center")

# assign the styles to the workbook
for (i in seq_along(x)) {
  wb$styles_mgr$add(new_cellxfs[i], paste0("new_style", i))
}

# new styles are 1:28
new_styles <- wb$styles_mgr$get_xf()
for (i in as.integer(new_styles$id[new_styles$name %in% paste0("new_style", seq_along(x))])
  cell <- sprintf("%s2:%s29", int2col(i), int2col(i))
  wb <- wb %>% wb_set_cell_style(dims = cell, style = i)
}

# assign a custom tabColor
wb$worksheets[[1]]$sheetPr <- xml_node_create(
  "sheetPr",
  xml_children = xml_node_create(
    "tabColor",
    xml_attributes = wb_color(hex = "FF00FF00")
  )
)

# # look at the beauty you've created
# wb_open(wb)

```

4 Working with number formats

Per default `openxlsx2` will pick up number formats for selected R classes.

4.1 numfmts

```
## Create Workbook object and add worksheets
wb <- wb_workbook()
wb$add_worksheet("S1")
wb$add_worksheet("S2")

df <- data.frame(
  "Date" = Sys.Date() - 0:19,
  "T" = TRUE, "F" = FALSE,
  "Time" = Sys.time() - 0:19 * 60 * 60,
  "Cash" = paste("$", 1:20), "Cash2" = 31:50,
  "hLink" = "https://CRAN.R-project.org/",
  "Percentage" = seq(0, 1, length.out = 20),
  "TinyNumbers" = runif(20) / 1E9, stringsAsFactors = FALSE
)

## openxlsx will apply default Excel styling for these classes
class(df$Cash) <- c(class(df$Cash), "currency")
class(df$Cash2) <- c(class(df$Cash2), "accounting")
class(df$hLink) <- "hyperlink"
class(df$Percentage) <- c(class(df$Percentage), "percentage")
class(df$TinyNumbers) <- c(class(df$TinyNumbers), "scientific")

wb$add_data("S1", x = df, start_row = 4, row_names = FALSE)
wb$add_data_table("S2", x = df, start_row = 4, row_names = FALSE)
```

4.2 numfmts2

In addition, you can set the style to be picked up using `openxlsx2` options.

```

wb <- wb_workbook()
wb <- wb_add_worksheet(wb, "test")

options("openxlsx2.dateFormat" = "yyyy")
options("openxlsx2.datetimeFormat" = "yyyy-mm-dd")
options("openxlsx2.numFmt" = "€ #.0")

df <- data.frame(
  "Date" = Sys.Date() - 0:19,
  "T" = TRUE, "F" = FALSE,
  "Time" = Sys.time() - 0:19 * 60 * 60,
  "Cash" = paste("$", 1:20), "Cash2" = 31:50,
  "hLink" = "https://CRAN.R-project.org/",
  "Percentage" = seq(0, 1, length.out = 20),
  "TinyNumbers" = runif(20) / 1E9, stringsAsFactors = FALSE,
  "numeric" = 1
)

## openxlsx will apply default Excel styling for these classes
class(df$Cash) <- c(class(df$Cash), "currency")
class(df$Cash2) <- c(class(df$Cash2), "accounting")
class(df$hLink) <- "hyperlink"
class(df$Percentage) <- c(class(df$Percentage), "percentage")
class(df$TinyNumbers) <- c(class(df$TinyNumbers), "scientific")

wb$add_data("test", df)

```

5 Modifying the column widths

5.1 `wb_set_col_widths`

```
wb <- wb_workbook() %>%  
  wb_add_worksheet() %>%  
  wb_add_data(x = mtcars, row_names = TRUE)  
  
cols <- 1:12  
wb <- wb %>% wb_set_col_widths(cols = cols, widths = "auto")
```

6 Adding borders

6.1 add borders

```
wb <- wb_workbook()
# full inner grid
wb$add_worksheet("S1", grid_lines = FALSE)$add_data(x = mtcars)
wb$add_border(
  dims = "A2:K33",
  inner_hgrid = "thin", inner_hcolor = wb_color(hex = "FF808080"),
  inner_vgrid = "thin", inner_vcolor = wb_color(hex = "FF808080")
)
# only horizontal grid
wb$add_worksheet("S2", grid_lines = FALSE)$add_data(x = mtcars)
wb$add_border(dims = "A2:K33", inner_hgrid = "thin", inner_hcolor = wb_color(hex = "FF808080"))
# only vertical grid
wb$add_worksheet("S3", grid_lines = FALSE)$add_data(x = mtcars)
wb$add_border(dims = "A2:K33", inner_vgrid = "thin", inner_vcolor = wb_color(hex = "FF808080"))
# no inner grid
wb$add_worksheet("S4", grid_lines = FALSE)$add_data(x = mtcars)
wb$add_border("S4", dims = "A2:K33")
```

6.2 styled table

Below we show you two ways how to create styled tables with `openxlsx2` one using the high level functions to style worksheet areas and one using the bare metal approach of creating the identical table.

X1	X2
1	3
2	4

6.2.1 the quick way: using high level functions

```
# add some dummy data to the worksheet
mat <- matrix(1:4, ncol = 2, nrow = 2)
colnames(mat) <- make.names(seq_len(ncol(mat)))

wb <- wb_workbook() %>%
  wb_add_worksheet("test") %>%
  wb_add_data(x = mat, col_names = TRUE, start_col = 2, start_row = 2) %>%
  # center first row
  wb_add_cell_style(dims = "B2:C2", horizontal = "center") %>%
  # add border for first row
  wb_add_border(
    dims = "B2:C2",
    bottom_color = wb_color(theme = 1), bottom_border = "thin",
    top_color = wb_color(theme = 1), top_border = "double",
    left_border = NULL, right_border = NULL
  ) %>%
  # add border for last row
  wb_add_border(
    dims = "B4:C4",
    bottom_color = wb_color(theme = 1), bottom_border = "double",
    top_border = NULL, left_border = NULL, right_border = NULL
  )
```

6.2.2 the long way: creating everything from the bone

```
# add some dummy data to the worksheet
mat <- matrix(1:4, ncol = 2, nrow = 2)
colnames(mat) <- make.names(seq_len(ncol(mat)))

wb <- wb_workbook() %>%
  wb_add_worksheet("test") %>%
  wb_add_data(x = mat, start_col = 2, start_row = 2)

# create a border style and assign it to the workbook
black <- wb_color(hex = "FF000000")
top_border <- create_border(
  top = "double", top_color = black,
  bottom = "thin", bottom_color = black
```

```

)

bottom_border <- create_border(bottom = "double", bottom_color = black)

wb$styles_mgr$add(top_border, "top_border")
wb$styles_mgr$add(bottom_border, "bottom_border")

# create a new cell style, that uses the fill, the font and the border style
top_cellxfs <- create_cell_style(
  numFmtId = 0,
  horizontal = "center",
  borderId = wb$styles_mgr$get_border_id("top_border")
)
bottom_cellxfs <- create_cell_style(
  numFmtId = 0,
  borderId = wb$styles_mgr$get_border_id("bottom_border")
)

# assign this style to the workbook
wb$styles_mgr$add(top_cellxfs, "top_styles")
wb$styles_mgr$add(bottom_cellxfs, "bottom_styles")

# assign the new cell style to the header row of our data set
cell <- "B2:C2"
wb <- wb %>% wb_set_cell_style(dims = cell, style = wb$styles_mgr$get_xf_id("top_styles"))
cell <- "B4:C4"
wb <- wb %>% wb_set_cell_style(dims = cell, style = wb$styles_mgr$get_xf_id("bottom_styles"))

```


7 Use workbook colors and modify them

The loop below will apply the tint attribute to the fill color

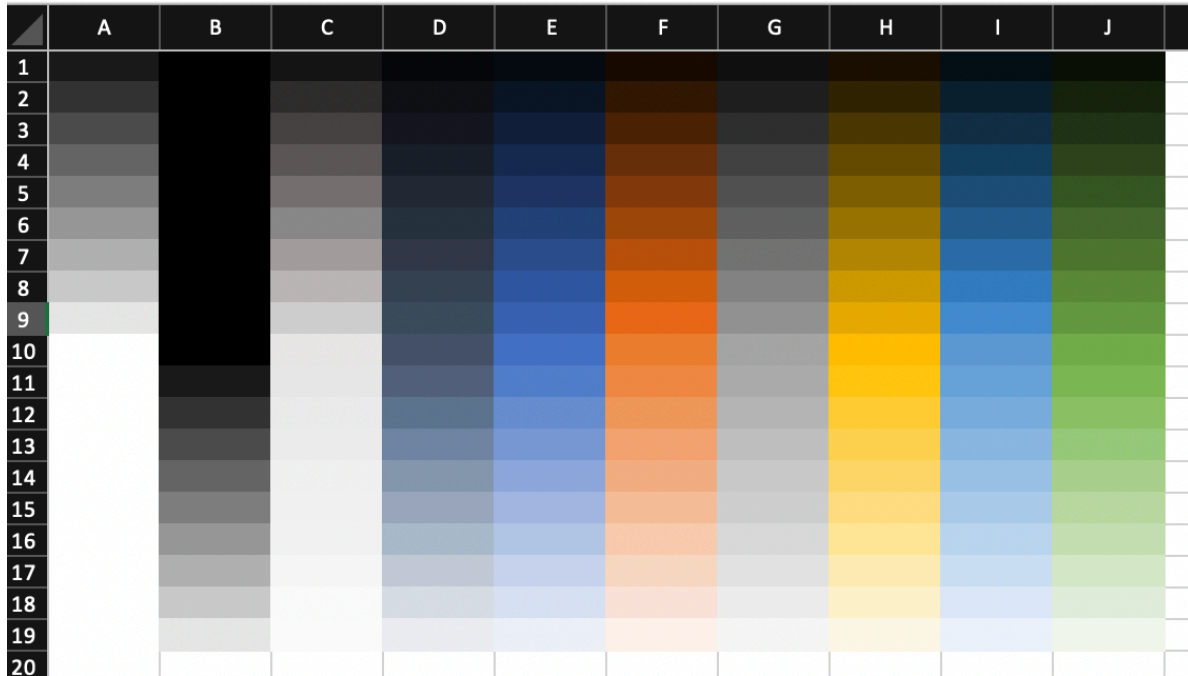


Figure 7.1: Tint variations of the theme colors.

```
wb <- wb_workbook() %>% wb_add_worksheet("S1")

tints <- seq(-0.9, 0.9, by = 0.1)

for (i in 0:9) {
  for (tnt in tints) {
    col <- paste0(int2col(i + 1), which(tints %in% tnt))

    if (tnt == 0) {
      wb <- wb %>% wb_add_fill(dims = col, color = wb_color(theme = i))
    } else {
```

```
    wb <- wb %>% wb_add_fill(dims = col, color = wb_color(theme = i, tint = tint))  
  }  
}  
}
```

8 Copy cell styles

It is possible to copy the styles of several cells at once. In the following example, the styles of some cells from a formatted workbook are applied to a previously empty cell range. Be careful though, `wb_get_cell_style()` returns only some styles, so you have to make sure that the copy-from and copy-to dimensions match in a meaningful way.

```
wb <- wb_load(system.file("extdata", "xlsx2_sheet.xlsx", package = "openxlsx2")) %>%  
  wb_set_cell_style(1, "A30:G35", wb_get_cell_style(., 1, "A10:G15"))  
# wb_open(wb)
```

	A	B	C	D	E	F	H	I
1								
2		Header						
3		Date	Value1		Value2		Value3	
4			€	%	€	%	€	%
6		Jan-21	1,000		431		29	
7		Feb-21	264	26 %	777	180.28 %	28	96.55 %
8		Mar-21	4	1 %	4567	587.77 %	27	96.43 %
9		Apr-21	4,393	120492 %	464	10.16 %	26	96.30 %
10		May-21	53	1 %	433	93.32 %	25	96.15 %
11		Jun-21	63	119 %	356	82.22 %	24	96.00 %
12		Jul-21	838	1324 %	354	99.44 %	23	95.83 %
13		Aug-21	23,131	2760 %	3355	947.74 %	22	95.65 %
14		Sep-21	2,323	10 %	334	9.96 %	21	95.45 %
15		Oct-21	3,323	143 %	541	161.98 %	20	95.24 %
16		Nov-21	35	1 %	555	102.59 %	20	100.00 %
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								

9 Style strings

Using `fmt_txt()` is possible to style strings independently of the cell containing the string.

```
txt <-  
  fmt_txt("Embracing the full potential of ") +  
  fmt_txt("openxlsx2", bold = TRUE, size = 16) +  
  fmt_txt(" with ") +  
  fmt_txt("fmt_txt()", font = "Courier") +  
  fmt_txt(" !")  
  
wb <- wb_workbook()$add_worksheet()$add_data(x = txt, col_names = FALSE)
```

	A	B	C	D	E	F
1	Embracing the full potential of openxlsx2 with <code>fmt_txt()</code> !					
2						

As shown above it is possible to combine multiple styles together into a longer string. It is even possible to use `fmt_txt()` as `na.strings`:

```
df <- mtcars  
df[df < 4] <- NA  
  
na_red <- fmt_txt("N/A", color = wb_color("red"), italic = TRUE, bold = TRUE)  
  
wb <- wb_workbook()$add_worksheet()$add_data(x = df, na.strings = na_red)
```

D	E	F	G	H	I	J	K	
p	drat	wt	qsec	vs	am	gear	carb	
110	N/A	N/A	16.46	N/A	N/A	4	4	
110	N/A	N/A	17.02	N/A	N/A	4	4	
93	N/A	N/A	18.61	N/A	N/A	4	N/A	
110	N/A	N/A	19.44	N/A	N/A	N/A	N/A	
175	N/A	N/A	17.02	N/A	N/A	N/A	N/A	
105	N/A	N/A	20.22	N/A	N/A	N/A	N/A	
245	N/A	N/A	15.84	N/A	N/A	N/A		4
62	N/A	N/A	20	N/A	N/A	4	N/A	
95	N/A	N/A	22.9	N/A	N/A	4	N/A	
123	N/A	N/A	18.3	N/A	N/A	4		4
123	N/A	N/A	18.9	N/A	N/A	4		4
180	N/A	4.07	17.4	N/A	N/A	N/A	N/A	
180	N/A	N/A	17.6	N/A	N/A	N/A	N/A	

10 Create custom table styles

With `create_tablestyle()` it is possible to create your own table styles. This function uses `create_dxfs_style()` (just like your spreadsheet software does). Therefore, it is not quite as user-friendly. The following example shows how the function creates a red table style. The various dxfs styles must be created and assigned to the workbook (similar styles are used in conditional formatting). In `create_tablestyle()` these styles are assigned to the table style elements. Once the table style is created, it must also be assigned to the workbook. After that you can use it in the workbook like any other table style.

```
# a red table style
dx0 <- create_dxfs_style(
  border = TRUE,
  left_color = wb_color("red"),
  right_color = NULL, right_style = NULL,
  top_color = NULL, top_style = NULL,
  bottom_color = NULL, bottom_style = NULL
)

dx1 <- create_dxfs_style(
  border = TRUE,
  left_color = wb_color("red"),
  right_color = NULL, right_style = NULL,
  top_color = NULL, top_style = NULL,
  bottom_color = NULL, bottom_style = NULL
)

dx2 <- create_dxfs_style(
  border = TRUE,
  top_color = wb_color("red"),
  left_color = NULL, left_style = NULL,
  right_color = NULL, right_style = NULL,
  bottom_color = NULL, bottom_style = NULL
)

dx3 <- create_dxfs_style(
```

```

border = TRUE,
top_color = wb_color("red"),
left_color = NULL, left_style = NULL,
right_color = NULL, right_style = NULL,
bottom_color = NULL, bottom_style = NULL
)

dx4 <- create_dxfs_style(
  text_bold = TRUE
)

dx5 <- create_dxfs_style(
  text_bold = TRUE
)

dx6 <- create_dxfs_style(
  font_color = wb_color("red"),
  text_bold = TRUE,
  border = TRUE,
  top_style = "double",
  left_color = NULL, left_style = NULL,
  right_color = NULL, right_style = NULL,
  bottom_color = NULL, bottom_style = NULL
)

dx7 <- create_dxfs_style(
  font_color = wb_color("white"),
  text_bold = TRUE,
  bgFill = wb_color("red"),
  fgColor = wb_color("red")
)

dx8 <- create_dxfs_style(
  border = TRUE,
  left_color = wb_color("red"),
  top_color = wb_color("red"),
  right_color = wb_color("red"),
  bottom_color = wb_color("red")
)

```



```

wb <- wb_workbook() %>%
  wb_add_worksheet(grid_lines = FALSE)

wb$add_style(dx0)
wb$add_style(dx1)
wb$add_style(dx2)
wb$add_style(dx3)
wb$add_style(dx4)
wb$add_style(dx5)
wb$add_style(dx6)
wb$add_style(dx7)
wb$add_style(dx8)

# finally create the table
xml <- create_tablestyle(
  name = "red_table",
  whole_table = wb$styles_mgr$get_dxf_id("dx8"),
  header_row = wb$styles_mgr$get_dxf_id("dx7"),
  total_row = wb$styles_mgr$get_dxf_id("dx6"),
  first_column = wb$styles_mgr$get_dxf_id("dx5"),
  last_column = wb$styles_mgr$get_dxf_id("dx4"),
  first_row_stripe = wb$styles_mgr$get_dxf_id("dx3"),
  second_row_stripe = wb$styles_mgr$get_dxf_id("dx2"),
  first_column_stripe = wb$styles_mgr$get_dxf_id("dx1"),
  second_column_stripe = wb$styles_mgr$get_dxf_id("dx0")
)

wb$add_style(xml)

# create a table and apply the custom style
wb <- wb %>%
  wb_add_data_table(x = mtcars, table_style = "red_table")

```

	A	B	C	D	
1	mpg	cyl	disp	hp	drat
2	21	6	160	110	
3	21	6	160	110	
4	22.8	4	108	93	
5	21.4	6	258	110	
6	18.7	8	360	175	
7	18.1	6	225	105	
8	14.3	8	360	175	

11 Named styles

```
wb <- wb_workbook()$add_worksheet()

name <- "Normal"
dims <- "A1"
wb$add_data(dims = dims, x = name)

name <- "Bad"
dims <- "B1"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Good"
dims <- "C1"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Neutral"
dims <- "D1"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Calculation"
dims <- "A2"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Check Cell"
dims <- "B2"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Explanatory Text"
dims <- "C2"
```

```

wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Input"
dims <- "D2"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Linked Cell"
dims <- "E2"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Note"
dims <- "F2"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Output"
dims <- "G2"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Warning Text"
dims <- "H2"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Heading 1"
dims <- "A3"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Heading 2"
dims <- "B3"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Heading 3"
dims <- "C3"
wb$add_named_style(dims = dims, name = name)

```

```

wb$add_data(dims = dims, x = name)

name <- "Heading 4"
dims <- "D3"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Title"
dims <- "E3"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Total"
dims <- "F3"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

for (i in seq_len(6)) {

  name <- paste0("20% - Accent", i)
  dims <- paste0(int2col(i), "4")
  wb$add_named_style(dims = dims, name = name)
  wb$add_data(dims = dims, x = name)

  name <- paste0("40% - Accent", i)
  dims <- paste0(int2col(i), "5")
  wb$add_named_style(dims = dims, name = name)
  wb$add_data(dims = dims, x = name)

  name <- paste0("60% - Accent", i)
  dims <- paste0(int2col(i), "6")
  wb$add_named_style(dims = dims, name = name)
  wb$add_data(dims = dims, x = name)

  name <- paste0("Accent", i)
  dims <- paste0(int2col(i), "7")
  wb$add_named_style(dims = dims, name = name)
  wb$add_data(dims = dims, x = name)

}

```

```

name <- "Comma"
dims <- "A8"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Comma [0]"
dims <- "B8"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Currency"
dims <- "C8"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Currency [0]"
dims <- "D8"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

name <- "Per cent"
dims <- "E8"
wb$add_named_style(dims = dims, name = name)
wb$add_data(dims = dims, x = name)

# wb$open()

```

	A	B	C	D	E	F	G	H
1	Normal	Bad	Good	Neutral				
2	Calculation	Check Cell	Explinator	Input	Linked Cell	Note	Output	Warning Text
3	Heading	Heading 2	Heading 3	Heading 4	Title	Total		
4	20% - Accent1	20% - Accent2	20% - Accent3	20% - Accent4	20% - Accent5	20% - Accent6		
5	40% - Accent1	40% - Accent2	40% - Accent3	40% - Accent4	40% - Accent5	40% - Accent6		
6	60% - Accent1	60% - Accent2	60% - Accent3	60% - Accent4	60% - Accent5	60% - Accent6		
7	Accent1	Accent2	Accent3	Accent4	Accent5	Accent6		
8	Comma	Comma [0]	Currency	Currency [0]	Per cent			
9								
10								

12 Conditional Formatting

```
library(openxlsx2)
```

```
wb <- wb_workbook()
negStyle <- create_dxfs_style(font_color = wb_color(hex = "FF9C0006"), bg_fill = wb_color(hex = "FF9C0006"))
posStyle <- create_dxfs_style(font_color = wb_color(hex = "FF006100"), bg_fill = wb_color(hex = "FF006100"))
wb$styles_mgr$add(negStyle, "negStyle")
wb$styles_mgr$add(posStyle, "posStyle")
```

12.1 Rule applies to all each cell in range

	A	B
	-5	A
	-4	B
	-3	C
	-2	D
	-1	E
	0	F
	1	G
	2	H
	3	I
0	4	J
1	5	K
2		

```
wb$add_worksheet("cellIs")
wb$add_data("cellIs", -5:5)
wb$add_data("cellIs", LETTERS[1:11], start_col = 2)
wb$add_conditional_formatting(
  "cellIs",
  dims = "A1:A11",
```

```

        rule = "!<0",
        style = "negStyle"
    )
    wb$add_conditional_formatting(
        "cellIs",
        dims = "A1:A11",
        rule = "=<0",
        style = "posStyle"
    )

```

12.2 Highlight row dependent on first cell in row

	A	B
1	-5 A	
2	-4 B	
3	-3 C	
4	-2 D	
5	-1 E	
6	0 F	
7	1 G	
8	2 H	
9	3 I	
10	4 J	
11	5 K	
12		

```

wb$add_worksheet("Moving Row")
wb$add_data("Moving Row", -5:5)
wb$add_data("Moving Row", LETTERS[1:11], start_col = 2)
wb$add_conditional_formatting(
    "Moving Row",
    dims = "A1:B11",
    rule = "$A1<0",
    style = "negStyle"
)
wb$add_conditional_formatting(
    "Moving Row",
    dims = "A1:B11",

```



```

    rule = "$A1>0",
    style = "posStyle"
)

```

12.3 Highlight column dependent on first cell in column

	A	B
-5	A	
-4	B	
-3	C	
-2	D	
-1	E	
0	F	
1	G	
2	H	
3	I	
4	J	
5	K	

```

wb$add_worksheet("Moving Col")
wb$add_data("Moving Col", -5:5)
wb$add_data("Moving Col", LETTERS[1:11], start_col = 2)
wb$add_conditional_formatting(
  "Moving Col",
  dims = "A1:B11",
  rule = "A$1<0",
  style = "negStyle"
)
wb$add_conditional_formatting(
  "Moving Col",
  dims = "A1:B11",
  rule = "A$1>0",
  style = "posStyle"
)

```

12.4 Highlight entire range cols X rows dependent only on cell A1

1	-5	A	
2	-4	B	
3	-3	C	
4	-2	D	
5	-1	E	
6	0	F	
7	1	G	
8	2	H	
9	3	I	
10	4	J	
11	5	K	
12			
13			
14			
15	x	y	
16	1	0,287578	
17	2	0,788305	
18	3	0,408977	
19	4	0,883017	
20	5	0,940467	
21	6	0,045556	
22	7	0,528105	
23	8	0,892419	
24	9	0,551435	
25	10	0,456615	
26			

```
wb$add_worksheet("Dependent on")
wb$add_data("Dependent on", -5:5)
wb$add_data("Dependent on", LETTERS[1:11], start_col = 2)
wb$add_conditional_formatting(
  "Dependent on",
  dims = "A1:B11",
  rule = "$A$1 < 0",
  style = "negStyle"
)
```

```
wb$add_conditional_formatting(
  "Dependent on",
  dims = "A1:B11",
  rule = "$A$1>0",
  style = "posStyle"
)
```

12.5 Highlight cells in column 1 based on value in column 2

```
wb$add_data("Dependent on", data.frame(x = 1:10, y = runif(10)), startRow = 15)
wb$add_conditional_formatting(
  "Dependent on",
  dims = "A16:A25",
  rule = "B16<0.5",
  style = "negStyle"
)
wb$add_conditional_formatting(
  "Dependent on",
  dims = "A16:A25",
  rule = "B16>=0.5",
  style = "posStyle"
)
```

12.6 Highlight duplicates using default style

	A	
1	D	
2	N	
3	F	
4	I	
5	J	
6	K	
7	E	
8	C	
9	K	
10	I	
11		

```

wb$add_worksheet("Duplicates")
wb$add_data("Duplicates", sample(LETTERS[1:15], size = 10, replace = TRUE))
wb$add_conditional_formatting(
  "Duplicates",
  dims = "A1:A10",
  type = "duplicatedValues"
)

```

12.7 Cells containing text

	A	B
1	D-L-N-S-G-I-V-B-P-M	
2	S-X-T-O-G-D-A-H-P-K	
3	P-T-H-C-D-Y-L-Q-J-K	
4	Y-W-H-N-U-M-B-K-V-Z	
5	F-Y-H-L-D-M-N-P-A-X	
6	H-J-Z-R-U-I-G-T-Y-K	
7	A-Y-S-J-U-M-K-T-G-I	
8	I-E-W-N-X-F-A-J-Q-R	
9	Z-U-G-Y-I-T-F-R-Q-E	
10	Y-T-C-N-A-B-D-J-V-E	

```

fn <- function(x) paste(sample(LETTERS, 10), collapse = "-")
wb$add_worksheet("containsText")
wb$add_data("containsText", sapply(1:10, fn))
wb$add_conditional_formatting(
  "containsText",
  dim = "A1:A10",
  type = "containsText",
  rule = "A"
)
wb$add_worksheet("notcontainsText")

```

12.8 Cells not containing text

	A	B
1	D-L-N-S-G-I	V-B-P-M
2	S-X-T-O-G-D-A-H-P-K	
3	P-T-H-C-D-Y-L-Q-J-K	
4	Y-W-H-N-U-M-B-K-V-Z	
5	F-Y-H-L-D-M-N-P-A-X	
6	H-J-Z-R-U-I-G-T-Y-K	
7	A-Y-S-J-U-M-K-T-G-I	
8	I-E-W-N-X-F-A-J-Q-R	
9	Z-U-G-Y-I-T-F-R-Q-E	
10	Y-T-C-N-A-B-D-J-V-E	
11		

```
fn <- function(x) paste(sample(LETTERS, 10), collapse = "-")
wb$add_data("notcontainsText", x = sapply(1:10, fn))
wb$add_conditional_formatting(
  "notcontainsText",
  dim = "A1:A10",
  type = "notContainsText",
  rule = "A"
)
```

12.9 Cells begins with text

76	O-L-N-S-W-Q-I-M-X-F	
77	A-P-H-E-J-I-W-N-Z-Y	
78	F-T-H-N-W-X-K-E-V-A	
79	A-E-C-D-X-N-R-J-L-P	
80	C-L-E-M-H-Q-X-S-F-B	
81	Q-W-Z-H-S-R-V-E-N-L	

```
fn <- function(x) paste(sample(LETTERS, 10), collapse = "-")
wb$add_worksheet("beginsWith")
wb$add_data("beginsWith", x = sapply(1:100, fn))
wb$add_conditional_formatting(
```

```

    "beginsWith",
    dim = "A1:A100",
    type = "beginsWith",
    rule = "A"
)

```

12.10 Cells ends with text

60	K-X-H-A-C-N-J-O-G-P	
61	L-T-I-C-S-M-H-Q-D-J	
62	Q-J-E-K-I-L-X-D-B-A	
63	S-P-K-G-E-B-I-O-F-R	
64	W-D-V-O-F-C-J-E-X-A	
65	C-H-B-N-S-A-Z-E-M-I	
66	O-O-N-L-W-I-L-L-E-E-S	

```

fn <- function(x) paste(sample(LETTERS, 10), collapse = "-")
wb$add_worksheet("endsWith")
wb$add_data("endsWith", x = sapply(1:100, fn))
wb$add_conditional_formatting(
  "endsWith",
  dim = "A1:A100",
  type = "endsWith",
  rule = "A"
)

```

12.11 Colorscale colors cells based on cell value

```

df <- read_xlsx("https://github.com/JanMarvin/openxlsx-data/raw/main/readTest.xlsx", sheet = "readTest")
wb$add_worksheet("colorScale", zoom = 30)
wb$add_data("colorScale", x = df, col_names = FALSE) ## write data.frame

```

Rule is a vector or colors of length 2 or 3 (any hex color or any of `colors()`). If rule is NULL, min and max of cells is used. Rule must be the same length as style or L.

```

wb$add_conditional_formatting(
  "colorScale",
  dims = wb_dims(x = df, col_names = FALSE),

```



Figure 12.1: Yep, that is a color scale image.

```

    style = c("black", "white"),
    rule = c(0, 255),
    type = "colorScale"
)
wb$set_col_widths("colorScale", cols = seq_along(df), widths = 1.07)
wb$set_row_heights("colorScale", rows = seq_len(nrow(df)), heights = 7.5)

```

12.12 Between

1	-5
2	-4
3	-3
4	-2
5	-1
6	0
7	1
8	2
9	3
10	4
11	5
12	

Highlight cells in interval $[-2, 2]$

```

wb$add_worksheet("between")
wb$add_data("between", -5:5)
wb$add_conditional_formatting(
  "between",
  dims = "A1:A11",
  type = "between",
  rule = c(-2, 2)
)
wb$add_worksheet("topN")

```


12.13 Top N

	A	B
1	x	y
2	1	1,604212
3	2	-0,51541
4	3	1,012537
5	4	-0,03594
6	5	-0,66734
7	6	0,92338
8	7	1,3811
9	8	0,87825
0	9	-0,5094
1	10	-0,46979

```
wb$add_data("topN", data.frame(x = 1:10, y = rnorm(10)))
```

Highlight top 5 values in column x

```
wb$add_conditional_formatting(
  "topN",
  dims = "A2:A11",
  style = "posStyle",
  type = "topN",
  params = list(rank = 5)
)
```

Highlight top 20 percentage in column y

```
wb$add_conditional_formatting(
  "topN",
  dims = "B2:B11",
  style = "posStyle",
  type = "topN",
  params = list(rank = 20, percent = TRUE)
)
wb$add_worksheet("bottomN")
```

12.14 Bottom N

	A	B	
1	x	y	
2	1	1,377676	
3	2	0,352826	
4	3	0,829574	
5	4	-0,3387	
6	5	1,261035	
7	6	-0,80876	
8	7	0,625352	
9	8	-0,81717	
10	9	-2,46258	
11	10	-1,34296	
12			

```
wb$add_data("bottomN", data.frame(x = 1:10, y = rnorm(10)))
```

Highlight bottom 5 values in column x

```
wb$add_conditional_formatting(  
  "bottomN",  
  dims = "A2:A11",  
  style = "negStyle",  
  type = "bottomN",  
  params = list(rank = 5)  
)
```

Highlight bottom 20 percentage in column y

```
wb$add_conditional_formatting(  
  "bottomN",  
  dims = "B2:B11",  
  style = "negStyle",  
  type = "bottomN",  
  params = list(rank = 20, percent = TRUE)  
)  
wb$add_worksheet("logical operators")
```

12.15 Logical Operators

	A	
1	1	
2	2	
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	
10	10	
11		

You can use Excel's logical Operators

```
wb$add_data("logical operators", 1:10)
wb$add_conditional_formatting(
  "logical operators",
  dims = "A1:A10",
  rule = "OR($A1=1,$A1=3,$A1=5,$A1=7)"
)
```

12.16 (Not) Contains Blanks

	A	B	
1			
2	1	1	
3	2	2	
4			
5			
6			

```
wb$add_worksheet("contains blanks")
wb$add_data(x = c(NA, 1, 2, ''), colNames = FALSE, na.strings = NULL)
wb$add_data(x = c(NA, 1, 2, ''), colNames = FALSE, na.strings = NULL, start_col = 2)
```

```
wb$add_conditional_formatting(dims = "A1:A4", type = "containsBlanks")
wb$add_conditional_formatting(dims = "B1:B4", type = "notContainsBlanks")
```

12.17 (Not) Contains Errors

	A	B
1	1	1
2	#VALUE!	#VALUE!
3		
4		

```
wb$add_worksheet("contains errors")
wb$add_data(x = c(1, NaN), colNames = FALSE)
wb$add_data(x = c(1, NaN), colNames = FALSE, start_col = 2)
wb$add_conditional_formatting(dims = "A1:A3", type = "containsErrors")
wb$add_conditional_formatting(dims = "A1:A3", type = "notContainsErrors")
```

12.18 Iconset

	A
1	100
2	50
3	30

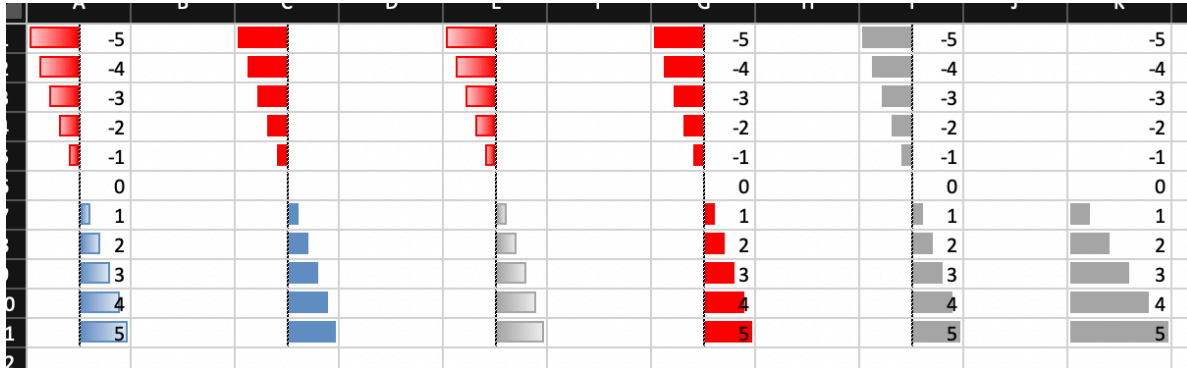
```
wb$add_worksheet("iconset")
wb$add_data(x = c(100, 50, 30), colNames = FALSE)
wb$add_conditional_formatting(
  dims = "A1:A6",
  rule = c(-67, -33, 0, 33, 67),
  type = "iconSet",
  params = list(
    percent = FALSE,
    iconSet = "5Arrows",
    reverse = TRUE)
)
```

12.19 Unique Values

	A
1	1
2	2
3	3
4	4
5	1
6	2
7	

```
wb$add_worksheet("unique values")
wb$add_data(x = c(1:4, 1:2), colNames = FALSE)
wb$add_conditional_formatting(dims = "A1:A6", type = "uniqueValues")
```

13 Databars



```
wb$add_worksheet("databar")
## Databars
wb$add_data("databar", -5:5, start_col = 1)
wb <- wb_add_conditional_formatting(
  wb,
  "databar",
  dims = "A1:A11",
  type = "dataBar"
) ## Default colors

wb$add_data("databar", -5:5, start_col = 3)
wb <- wb_add_conditional_formatting(
  wb,
  "databar",
  dims = "A1:A10",
  type = "dataBar",
  params = list(
    showValue = FALSE,
    gradient = FALSE
  )
) ## Default colors

wb$add_data("databar", -5:5, start_col = 5)
```

```

wb <- wb_add_conditional_formatting(
  wb,
  "databar",
  dims = "E1:E11",
  type = "dataBar",
  style = c("#a6a6a6"),
  params = list(showValue = FALSE)
)

wb$add_data("databar", -5:5, start_col = 7)
wb <- wb_add_conditional_formatting(
  wb,
  "databar",
  dims = "G1:G11",
  type = "dataBar",
  style = c("red"),
  params = list(
    showValue = TRUE,
    gradient = FALSE
  )
)


# custom color
wb$add_data("databar", -5:5, start_col = 9)
wb <- wb_add_conditional_formatting(
  wb,
  "databar",
  dims = wb_dims(cols = 9, rows = 1:11),
  type = "dataBar",
  style = c("#a6a6a6", "#a6a6a6"),
  params = list(showValue = TRUE, gradient = FALSE)
)

# with rule
wb$add_data(x = -5:5, start_col = 11)
wb <- wb_add_conditional_formatting(
  wb,
  "databar",
  dims = wb_dims(cols = 11, rows = 1:11),
  type = "dataBar",
  rule = c(0, 5),

```

```
style = c("#a6a6a6", "#a6a6a6"),  
params = list(showValue = TRUE, gradient = FALSE)  
)
```


14 Sparklines

	A	B	C	D	E	F	G	H	I	J	K	L	
1	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb		
2	21	6	160	110	3.9	2.62	16.46	0	1	4	4		
3	21	6	160	110	3.9	2.875	17.02	0	1	4	4		
4	22.8	4	108	93	3.85	2.32	18.61	1	1	4	1		

```
s1 <- create_sparklines("Sheet 1", "A3:K3", "L3")
wb <- wb_workbook() %>%
  wb_add_worksheet() %>%
  wb_add_data(x = mtcars) %>%
  wb_add_sparklines(sparklines = s1)
```

15 charts

The following manual will present various ways to add plots and charts to `openxlsx2` worksheets and even chartsheets. This assumes that you have basic knowledge how to handle `openxlsx2` and are familiar with either the default R graphics functions like `plot()` or `barplot()` and `grDevices`, or with the packages `{ggplot2}`, `{rvg}` or `{mschart}`. There are plenty of other manuals that cover using these better than we could ever tell you to.

```
library(openxlsx2) # openxlsx2 >= 0.4 for mschart and rvg support

## create a workbook
wb <- wb_workbook()
```

15.1 Add plot to workbook

You can include any image in PNG or JPEG format. Simply open a device and save the output and pass it to the worksheet with `wb_add_image()`.

```
myplot <- tempfile(fileext = ".jpg")
jpeg(myplot)
print(plot(AirPassengers))
#> NULL
dev.off()
#> pdf
#> 2

# Add basic plots to the workbook
wb$add_worksheet("add_image")$add_image(file = myplot)
```

15.2 Add {ggplot2} plot to workbook

You can include `{ggplot2}` plots similar to how you would include them with `openxlsx`. Call the plot first and afterwards use `wb_add_plot()`.

```

if (requireNamespace("ggplot2")) {

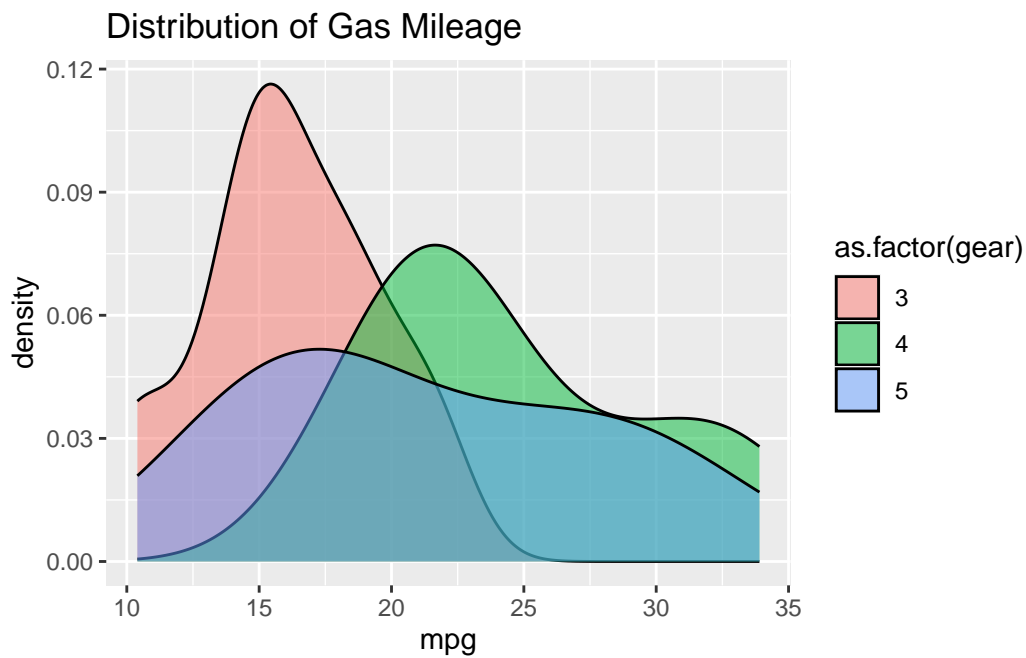
library(ggplot2)

print(ggplot(mtcars, aes(x = mpg, fill = as.factor(gear))) +
  ggtitle("Distribution of Gas Mileage") +
  geom_density(alpha = 0.5))

# Add ggplot to the workbook
wb$add_worksheet("add_plot")$
  add_plot(width = 5, height = 3.5, fileType = "png", units = "in")

}
#> Loading required namespace: ggplot2

```



15.3 Add plot via {rvg}

If you want vector graphics that can be modified in spreadsheet software the `dml_xlsx()` device comes in handy. You can pass the output via `wb_add_drawing()`.

```

if (requireNamespace("ggplot2") && requireNamespace("rvg")) {

  library(rvg)

  ## create rvg example
  tmp <- tempfile(fileext = ".xml")
  dml_xlsx(file = tmp, fonts = list(sans = "Bradley Hand"))
  print(ggplot(data = iris,
    mapping = aes(x = Sepal.Length, y = Petal.Width)) +
    geom_point() + labs(title = "With font Bradley Hand") +
    theme_minimal(base_family = "sans", base_size = 18))
  dev.off()

  # Add rvg to the workbook
  wb$add_worksheet("add_drawing")$
    add_drawing(xml = tmp)$
    add_drawing(xml = tmp, dims = NULL)

}
#> Loading required namespace: rvg

```

15.4 Add {mschart} plots

If you want native open xml charts, have a look at {mschart}. Create one of the chart files and pass it to the workbook with `wb_add_mschart()`. There are two options possible. 1. Either the default {mschart} output identical to the one in {officer}. Passing a data object and let {mschart} prepare the data. In this case `wb_add_mschart()` will add a new data region. 2. Passing a `wb_data()` object to {mschart}. This object contains references to the data on the worksheet and allows using data “as is”.

```

if (requireNamespace("mschart")) {

  library(mschart) # mschart >= 0.4 for openxlsx2 support

  ## create chart from mschart object (this creates new input data)
  mylc <- ms_linechart(
    data = browser_ts,
    x = "date",
    y = "freq",
    group = "browser"
  )
}

```

```

)

wb$add_worksheet("add_mschart")$add_mschart(dims = "A10:G25", graph = mylc)

## create chart referencing worksheet cells as input
# write data starting at B2
wb$add_worksheet("add_mschart - wb_data")$
  add_data(x = mtcars, dims = "B2")$
  add_data(x = data.frame(name = rownames(mtcars)), dims = "A2")

# create wb_data object this will tell this mschart
# from this PR to create a file corresponding to openxlsx2
dat <- wb_data(wb, dims = "A2:G10")

# create a few mscharts
scatter_plot <- ms_scatterchart(
  data = dat,
  x = "mpg",
  y = c("disp", "hp")
)

bar_plot <- ms_barchart(
  data = dat,
  x = "name",
  y = c("disp", "hp")
)

area_plot <- ms_areachart(
  data = dat,
  x = "name",
  y = c("disp", "hp")
)

line_plot <- ms_linechart(
  data = dat,
  x = "name",
  y = c("disp", "hp"),
  labels = c("disp", "hp")
)

```

```

# add the charts to the data
wb <- wb %>%
  wb_add_mschart(dims = "F4:L20", graph = scatter_plot) %>%
  wb_add_mschart(dims = "F21:L37", graph = bar_plot) %>%
  wb_add_mschart(dims = "M4:S20", graph = area_plot) %>%
  wb_add_mschart(dims = "M21:S37", graph = line_plot)

# add chartsheet
wb <- wb %>%
  wb_add_chartsheet() %>%
  wb_add_mschart(graph = scatter_plot)
}
#> Loading required namespace: mschart

```

16 openxlsx2 formulas manual

```
library(openxlsx2)
```

Below you find various examples how to create formulas with `openxlsx2`. Though, before we start with the examples, let us begin with a word of warning. Please be aware, while it is possible to create all these formulas, they are not evaluated unless they are opened in spreadsheet software. Even worse, if there are cells containing the result of some formula, it can not be trusted unless the formula is evaluated in spreadsheet software.

This can be shown in a simple example: We have a spreadsheet with a formula $A1 + B1$. This formula was evaluated with spreadsheet software as $A1 + B1 = 2$. Therefore if we read the cell, we see the value 2. Lets recreate this output in `openxlsx2`

```
# Create artificial xlsx file
wb <- wb_workbook()$add_worksheet()$add_data(x = t(c(1, 1)), col_names = FALSE)$
  add_formula(dims = "C1", x = "A1 + B1")
# Users should never modify cc as shown here
wb$worksheets[[1]]$sheet_data$cc$v[3] <- 2

# we expect a value of 2
wb_to_df(wb, col_names = FALSE)
#>   A B C
#> 1 1 1 2
```

Now, lets assume we modify the data in cell A1.

```
wb$add_data(x = 2)

# we expect 3
wb_to_df(wb, col_names = FALSE)
#>   A B C
#> 1 2 1 2
```

What happened? Even though we see cells A1 and B1 show a value of 2 and 1 our formula in C1 was not updated. It still shows a value of 2. This is because `openxlsx2` does not evaluate

formulas and workbooks on a more general scale. In the open xml style the cell looks something like this:

```
<c r="C1">
  <f>A1 + B1</f>
  <v>2</v>
</c>
```

And when we read from this cell, we always return the value of `v`. In this case it is obvious, but still wrong and it is a good idea to check if underlying fields contain formulas.

```
wb_to_df(wb, col_names = FALSE, show_formula = TRUE)
#>   A B      C
#> 1 2 1 A1 + B1
```

If `openxlsx2` writes formulas, as shown in the examples below, the fields will be entirely blank. These fields will only be evaluated and filled, once the output file is opened in spreadsheet software.

The only way to avoid surprises is to be aware of this all the time and similar, checking for similar things all the time.

17 Simple formulas

```
wb <- wb_workbook()$add_worksheet()$  
  add_data(x = head(cars))$  
  add_formula(x = "SUM(A2, B2)", dims = "D2")$  
  add_formula(x = "A2 + B2", dims = "D3")  
# wb$open()
```

18 Array formulas

```
wb <- wb_workbook()$add_worksheet()$  
  add_data(x = head(cars))$  
  add_formula(x = "A2:A7 * B2:B7", dims = "C2:C7", array = TRUE)  
# wb$open()
```

19 Array formulas creating multiple fields

In the example below we want to use `MMULT()` which creates a matrix multiplication. This requires us to write an array formula and to specify the region where the output will be written to.

```
m1 <- matrix(1:6, ncol = 2)
m2 <- matrix(7:12, nrow = 2)

wb <- wb_workbook()$add_worksheet()$
  add_data(x = m1, startCol = 1)$
  add_data(x = m2, startCol = 4)$
  add_formula(x = "MMULT(A2:B4, D2:F3)", dims = "H2:J4", array = TRUE)
# wb$open()
```

Similar a the coefficients of a linear regression

```
# we expect to find this in D1:E1
coef(lm(head(cars)))
#> (Intercept)      dist
#>  5.2692308  0.1153846
wb <- wb_workbook()$add_worksheet()$
  add_data(x = head(cars))$
  add_formula(x = "LINEST(A2:A7, B2:B7, TRUE)", dims = "D2:E2", array = TRUE)
# wb$open()
```

20 Cell error handling

```
# wb_add_ignore_error()
```

21 cells metadata (cm) formulas

Similar to array formulas, these cell metadata (cm) formulas hide to the user that they are array formulas. Using these is implemented in `openxlsx2 > 0.6.1`:

```
wb <- wb_workbook()$add_worksheet()$  
  add_data(x = head(cars))$  
  add_formula(x = 'SUM(ABS(A2:A7))', dims = "D2", cm = TRUE)  
#> Warning in write_data2(wb = wb, sheet = sheet, data = x, name = name, colNames  
#> = colNames, : modifications with cm formulas are experimental. use at own risk  
# wb$open()
```

22 dataTable formulas¹

22.0.0.1 dataTable formula differences

	A	B	C
1	sales_price	COGS	sales_quantity
2	20	5	1
3	30	11	2
4	40	13	3

Given a basic table like the above, a similarly basic formula for `total_sales` would be “= A2 * C2” with the row value changing at each row.

An implementation for this formula using `wb_add_formula()` would look this (taken from current documentation) lets say we’ve read in the data and assigned it to the table `company_sales`

```
## creating example data
company_sales <- data.frame(
  sales_price = c(20, 30, 40),
  COGS = c(5, 11, 13),
  sales_quantity = c(1, 2, 3)
)

## write in the formula
company_sales$total_sales <- paste(paste0("A", 1:3 + 1L), paste0("C", 1:3 + 1L), sep = "
## add the formula class
class(company_sales$total_sales) <- c(class(company_sales$total_sales), "formula")

## write a workbook
wb <- wb_workbook()$
  add_worksheet("Total Sales")$
  add_data_table(x = company_sales)
```

¹this example was originally provided by @zykezero for `openxlsx`.

Then we create the workbook, worksheet, and use `wb_add_data_table()`.

One of the advantages of the open xml `dataTable` syntax is that we don't have to specify row numbers or columns as letters. The table also grows dynamically, adding new rows as new data is appended and extending formulas to the new rows. These `dataTable` have named columns that we can use instead of letters. When writing the formulas within the `dataTable` we would use the following syntax `[@[column_name]]` to reference the current row. So the `total_sales` formula written in open xml in `dataTable` would look like this; `=[@[sales_price]] * [@[sales_quantity]]`

If we are writing the formula outside of the `dataTable` we have to reference the table name. In this case let's say the table name is 'daily_sales' `=daily_sales[@[sales_price]] * daily_sales[@[sales_quantity]]`

However, if we were to pass this as the text for the formula to be written it would cause an error because the syntax that open xml requires for selecting the current row is different.

In open xml the `dataTable` formula looks like this:

```
<calculatedColumnFormula>
  daily_sales[[#This Row],[sales_price]]*daily_sales[[#ThisRow],[sales_quantity]]
</calculatedColumnFormula>
```

Now we can see that open xml replaces `[@[sales_price]]` with `daily_sales[[#This Row],[sales_price]]` We must then use this syntax when writing formulas for `dataTable`

```
## Because we want the `dataTable` formula to propagate down the entire column of the data
## we can assign the formula by itself to any column and allow that single string to be re

## creating example data
example_data <-
  data.frame(
    sales_price = c(20, 30, 40),
    COGS = c(5, 11, 13),
    sales_quantity = c(1, 2, 3)
  )

## base R method
example_data$gross_profit <- "daily_sales[[#This Row],[sales_price]] - daily_sales[[#This Row],[COGS]]"
example_data$total_COGS <- "daily_sales[[#This Row],[COGS]] * daily_sales[[#This Row],[sales_quantity]]"
example_data$total_sales <- "daily_sales[[#This Row],[sales_price]] * daily_sales[[#This Row],[sales_quantity]]"
example_data$total_gross_profit <- "daily_sales[[#This Row],[total_sales]] - daily_sales[[#This Row],[total_COGS]]"
class(example_data$gross_profit) <- c(class(example_data$gross_profit), "formula")
class(example_data$total_COGS) <- c(class(example_data$total_COGS), "formula")
```

```

class(example_data$total_sales)      <- c(class(example_data$total_sales),      "formula")
class(example_data$total_gross_profit) <- c(class(example_data$total_gross_profit), "formula")

wb$
  add_worksheet("Daily Sales")$
  add_data_table(
    x          = example_data,
    table_style = "TableStyleMedium2",
    table_name  = "daily_sales"
  )

```

And if we open the workbook to view the table we created we can see that the formula has worked.

	A	B	C	D	E	F	G
1	sales_price	COGS	sales_quantity	gross_profit	total_COGS	total_sales	total_gross_profit
2	20	5	1	15	5	20	15
3	30	11	2	19	22	60	38
4	40	13	3	27	39	120	81

We can also see that it has replaced [#This Row] with @.

	A	B	C	D	E	F	G
1	sales_price	COGS	sales_quantity	gross_profit	total_COGS	total_sales	total_gross_profit
2	20	5	1	=[@sales_price]*[@COGS]	=[@sales_price]*[@total_sales]		
				- [@total_COGS]			
3	30	11	2	=[@sales_price]*[@COGS]	=[@sales_price]*[@total_sales]		
				- [@total_COGS]			
4	40	13	3	=[@sales_price]*[@COGS]	=[@sales_price]*[@total_sales]		
				- [@total_COGS]			

For completion, the formula as we wrote it appears as;

D	E	F	G
gross_profit	total_COGS	total_sales	total_gross_profit

D	E	F	G
=gross_profit[[#This Row],[sales_price]] - gross_profit[[#This Row],[COGS]]	=gross_profit[[#This Row],[COGS]] * gross_profit[[#This Row],[sales_quantity]]	=gross_profit[[#This Row],[sales_price]] * gross_profit[[#This Row],[sales_quantity]]	=gross_profit[[#This Row],[total_sales]] - gross_profit[[#This Row],[total_COGS]]
=gross_profit[[#This Row],[sales_price]] - gross_profit[[#This Row],[COGS]]	=gross_profit[[#This Row],[COGS]] * gross_profit[[#This Row],[sales_quantity]]	=gross_profit[[#This Row],[sales_price]] * gross_profit[[#This Row],[sales_quantity]]	=gross_profit[[#This Row],[total_sales]] - gross_profit[[#This Row],[total_COGS]]
=gross_profit[[#This Row],[sales_price]] - gross_profit[[#This Row],[COGS]]	=gross_profit[[#This Row],[COGS]] * gross_profit[[#This Row],[sales_quantity]]	=gross_profit[[#This Row],[sales_price]] * gross_profit[[#This Row],[sales_quantity]]	=gross_profit[[#This Row],[total_sales]] - gross_profit[[#This Row],[total_COGS]]

```
#### sum dataTable examples
wb$add_worksheet("sum_examples")

### Note: dataTable formula do not need to be used inside of dataTables. dataTable formula
sum_examples <- data.frame(
  description = c("sum_sales_price", "sum_product_Price_Quantity"),
  formula = c("", "")
)

wb$add_data(x = sum_examples)

# add formulas
wb$add_formula(x = "sum(daily_sales[[#Data],[sales_price]])", dims = "B2")
wb$add_formula(x = "sum(daily_sales[[#Data],[sales_price]] * daily_sales[[#Data],[sales_qu

#### dataTable referencing
wb$add_worksheet("dt_references")

### Adding the headers by themselves.
wb$add_formula(
  x = "daily_sales[[#Headers],[sales_price]:[total_gross_profit]]",
  dims = "A1:G1",
  array = TRUE
)

### Adding the raw data by reference and selecting them directly.
```

```
wb$add_formula(  
  x = "daily_sales[[#Data],[sales_price]:[total_gross_profit]]",  
  start_row = 2,  
  dims = "A2:G4",  
  array = TRUE  
)  
# wb$open()
```

23 Pivot tables

Pivot tables are a feature of spreadsheet software dating back to Lotus Improv. They allow creating interactive tables to aggregate data that still allows the user to modify the table, by changing the aggregation function or variables. Pivot tables are frequently used in reports to create something like a dashboard.

Even though they are a long requested feature, it took a while until support was added to `openxlsx2`. Since release 0.5 users are able to use `wb_add_pivot_table()` and since then support was further improved and now it is also possible to add slicers to pivot tables. Slicers further increase the dashboard character of pivot tables, as they provide a button interface to filter the pivot table.

The state of pivot tables is now that they work quite well, though they bring a few features users should be aware of. Most importantly, our function only provides the spreadsheet with an instruction set how to create the pivot table, while the actual sheet where the table is supposed to appear remains empty until it is evaluated by the spreadsheet software. This is similar to our approach with formulas.

23.1 Adding pivot tables

```
library(openxlsx2)

wb <- wb_workbook()$
  add_worksheet()$
  add_data(x = esoph)

df <- wb_data(wb)

wb$add_pivot_table(df, rows = "agegp", cols = "tobgp", data = c("ncontrols"))

# for visual comparison
library(pivottabler)
pt <- PivotTable$new()
pt$addData(esoph)
```

```

pt$addColumnDataGroups("tobgp")
pt$addRowDataGroups("agegp")
pt$defineCalculation(calculationName="ncontrols", summariseExpression="sum(ncontrols)")
pt$evaluatePivot()
pt
#>      0-9g/day  10-19  20-29  30+  Total
#> 25-34      70     18     11    16    115
#> 35-44     107     42     24    17    190
#> 45-54      90     44     25     8    167
#> 55-64      92     42     26     6    166
#> 65-74      68     26     10     2    106
#> 75+       20      6      3     2     31
#> Total     447    178     99    51    775

wb$add_data_table(dims = "A14", x = pt$asDataFrame(), row_names = TRUE)

if (interactive()) wb$open()

```

	A	B	C	D	E	F
1						
2						
3	Sum of ncontrols	Column Labels				
4	Row Labels	0-9g/day	10-19	20-29	30+	Grand Total
5	25-34	70	18	11	16	115
6	35-44	107	42	24	17	190
7	45-54	90	44	25	8	167
8	55-64	92	42	26	6	166
9	65-74	68	26	10	2	106
10	75+	20	6	3	2	31
11	Grand Total	447	178	99	51	775
12						
13						
14	_rowNames_	0-9g/day	10-	20-	3	Total
15	25-34	70	18	11	16	115
16	35-44	107	42	24	17	190
17	45-54	90	44	25	8	167
18	55-64	92	42	26	6	166
19	65-74	68	26	10	2	106
20	75+	20	6	3	2	31
21	Total	447	178	99	51	775
22						

Unlike `pivottabler` the pivot tables in `openxlsx2` are not evaluated. Therefore there is nothing in the sheet region A3:F11 and if you write something here, spreadsheet software will complain.¹

23.1.1 Filter, row, column, and data

Similar to pivot tables in Excel, it is possible to assign variables to the table dimensions filter, row, column, and data. It is not required to have all dimensions filled. You can assign each variable only once per dimension, but can combine multiple variables.

```
wb <- wb_workbook()$
  add_worksheet()$
  add_data(x = esoph)
```

¹It should be possible to integrate results similar to `pivottabler` into `wb_add_pivot_table()` so that you should be able to have evaluated pivot tables straight ahead. Pull requests are welcome.

```
df <- wb_data(wb)
```

```
wb$add_pivot_table(df, dims = "A3", rows = "agegp", cols = "tobgp", data = c("ncontrols"))
wb$add_pivot_table(df, dims = "A13", rows = "agegp", data = c("ncontrols", "ncases"))
wb$add_pivot_table(df, dims = "A18", rows = "agegp", cols = "tobgp", data = c("ncontrols",
```

	A	B	C	D	E	F	G	H	I	J	K
1											
2											
3	Sum of ncontrols	Column Labels						Values			
4	Row Labels	0-9g/day	10-19	20-29	30+	Grand Total		Row Labels	Sum of ncontrols	Sum of ncases	
5	25-34	70	18	11	16	115		25-34	115	1	
6	35-44	107	42	24	17	190		35-44	190	9	
7	45-54	90	44	25	8	167		45-54	167	46	
8	55-64	92	42	26	6	166		55-64	166	76	
9	65-74	68	26	10	2	106		65-74	106	55	
10	75+	20	6	3	2	31		75+	31	13	
11	Grand Total	447	178	99	51	775		Grand Total	775	200	
12											
13		Column Labels									
14		Sum of ncontrols						Sum of ncases			
15	Row Labels	0-9g/day	10-19	20-29	30+	0-9g/day	10-19	20-29	30+	Total Sum of ncontrols	Total Sum of ncases
16	25-34	70	18	11	16	0	1	0	0	115	1
17	35-44	107	42	24	17	2	4	3	0	190	9
18	45-54	90	44	25	8	14	13	8	11	167	46
19	55-64	92	42	26	6	25	23	12	16	166	76
20	65-74	68	26	10	2	31	12	10	2	106	55
21	75+	20	6	3	2	6	5	0	2	31	13
22	Grand Total	447	178	99	51	78	58	33	31	775	200
23											

23.1.2 Aggregation functions

The default aggregation function is SUM, but others are possible as well: AVERAGE, COUNT, COUNTA, MAX, MIN, PRODUCT, STDEV, STDEVP, SUM, VAR, VARP. This is limited to functions available in the openxml specification.

```
wb <- wb_workbook()$
  add_worksheet()$
  add_data(x = mtcars)
```

```
df <- wb_data(wb)
```

```
wb$add_pivot_table(df, dims = "A1", rows = "cyl", cols = "gear", data = c("disp", "hp"))
wb$add_pivot_table(df, dims = "A10", sheet = 2, rows = "cyl", cols = "gear", data = c("dis
wb$add_pivot_table(df, dims = "A20", sheet = 2, rows = "cyl", cols = "gear", data = c("dis
wb$add_pivot_table(df, dims = "A30", sheet = 2, rows = "cyl", cols = "gear", data = c("dis
```

	A	B	C	D	E	F	G	H	I	J	K
1											
2											
3	Sum of disp	Column Labels					count of disp	Column Labels			
4	Row Labels	3	4	5	Grand Total		Row Labels	3	4	5	Grand Total
5	4	120.1	821	215.4	1156.5		4	1	8	2	11
6	6	483	655.2	145	1283.2		6	2	4	1	7
7	8	4291.4		652	4943.4		8	12		2	14
8	Grand Total	4894.5	1476.2	1012.4	7383.1		Grand Total	15	12	5	32
9											
10	average of disp	Column Labels					sum of disp	Column Labels			
11	Row Labels	3	4	5	Grand Total		Row Labels	3	4	5	Grand Total
12	4	120.1	102.625	107.7	105.1363636		4	120.1	821	215.4	1156.5
13	6	241.5	163.8	145	183.3142857		6	483	655.2	145	1283.2
14	8	357.6166667		326	353.1		8	4291.4		652	4943.4
15	Grand Total	326.3	123.0166667	202.48	230.721875		Grand Total	4894.5	1476.2	1012.4	7383.1
16											

23.1.3 Styling pivot tables

There is no real support for individual pivot table styles. As seen they can be disabled and auto format styles can be applied (see annex G.3 - Built-in PivotTable AutoFormats of ECMA-376-1 (2016))

```
wb <- wb_workbook() %>%
  wb_add_worksheet("table") %>%
  wb_add_worksheet("data") %>%
  wb_add_data(x = mtcars)

df <- wb_data(wb)

wb <- wb %>%

# pivot table without style
wb_add_pivot_table(
  df, dims = "A3", sheet = "table",
  rows = c("cyl", "am"), cols = "gear", data = "disp",
  fun = "average",
  params = list(no_style = TRUE, numfmt = c(formatCode = "##0.0"))
) %>%

# Applied a few params and use auto_format_id
wb_add_pivot_table(
  df, dims = "G3", sheet = "table",
  rows = c("cyl", "am"), cols = "vs", data = "disp",
  fun = "average",
  params = list(
```

```
if (interactive()) wb$open()
```

With `params` it is possible to tweak many pivot table arguments such as `params = list(col_header_caption = "test caption")`

It is possible to use `dims` without `end row`. This way the entire column is used as input. This obviously is slower than using a fixed range, because the `wb_data()` object will contain each possible row. This is

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```

pt$addRowDataGroups("TOC",
  outlineBefore=list(isEmpty=FALSE, groupStyleDeclarations=list(color="b
  outlineTotal=list(isEmpty=FALSE, groupStyleDeclarations=list(color="bl
pt$addRowDataGroups("PowerType", addTotal=FALSE)
pt$defineCalculation(calculationName="TotalTrains", summariseExpression="n()")

```

	Express Passenger	Ordinary Passenger	Total
Arriva Trains Wales	3079	830	3909
DMU	3079	830	3909
CrossCountry	22865	63	22928
DMU	22133	63	22196
HST	732		732
London Midland	14487	33792	48279
DMU	5638	5591	11229
EMU	8849	28201	37050
Virgin Trains	8594		8594
DMU	2137		2137
EMU	6457		6457
Total	49025	34685	83710

```

# use A:P
wb <- wb_workbook()$add_worksheet()$add_data(x = bhmtrains, na.strings = NULL)
df <- wb_data(wb, dims = "A:P")

# use TrainCategory on column and data
wb$add_pivot_table(
  df,
  rows = c("TOC", "PowerType"),
  cols = "TrainCategory",
  data = "TrainCategory",
  fun = "count"
)

if (interactive()) wb$open()

```

23.1.5 Using number formats

```
## Pivot table example 1
wb <- wb_workbook() %>% wb_add_worksheet() %>% wb_add_data(x = mtcars, inline_strings = F)

wb$add_numfmt(dims = wb_dims(x = mtcars, cols = "disp"), numfmt = "$ #,###")

df <- wb_data(wb)

# basic pivot table with filter, rows, cols and data
wb$add_pivot_table(
  df,
  rows = "cyl", cols = "gear",
  data = c("disp", "hp"),
  fun = c("sum", "count"),
  params = list(
    numfmt = c(formatCode = "$ ###", formatCode = "#")
  ))
```

	A	B	C	D	E	
1						
2						
3	count of TrainCategory	Column Labels <input type="text"/>				
4	Row Labels <input type="text"/>	Express Passenger	Ordinary Passenger	(blank)	Grand Total	
5	⊗ Arriva Trains Wales	3079	830		3909	
6	DMU	3079	830		3909	
7	⊗ CrossCountry	22865	63		22928	
8	DMU	22133	63		22196	
9	HST	732			732	
10	⊗ London Midland	14487	33792		48279	
11	DMU	5638	5591		11229	
12	EMU	8849	28201		37050	
13	⊗ Virgin Trains	8594			8594	
14	DMU	2137			2137	
15	EMU	6457			6457	
16	⊗ (blank)					
17	(blank)					
18	Grand Total	49025	34685		83710	
19						

23.2 Adding slicers to pivot tables

Since `openxlsx2` release 1.1 it is possible to add slicers to pivot tables created with `wb_add_pivot_tables()`.

```
wb <- wb_workbook() %>%
  wb_add_worksheet() %>% wb_add_data(x = mtcars)

df <- wb_data(wb, sheet = 1)

wb$
  add_pivot_table(
    df, dims = "A3", slicer = "vs", rows = "cyl", cols = "gear", data = "disp",
    pivot_table = "mtcars"
  )$
  add_slicer(x = df, dims = "B7:D9", slicer = "vs", pivot_table = "mtcars",
    params = list(edit_as = "twoCell"))

if (interactive()) wb$open()

wb <- wb_workbook() %>%
  ### Sheet 1
  wb_add_worksheet() %>%
  wb_add_data(x = mtcars)

df <- wb_data(wb, sheet = 1)

varname <- c("vs", "drat")

### Sheet 2
wb$
  # first pivot
  add_pivot_table(
    df, dims = "A3", slicer = varname, rows = "cyl", cols = "gear", data = "disp",
    pivot_table = "mtcars"
  )$
  add_slicer(x = df, sheet = current_sheet(), slicer = "vs", pivot_table = "mtcars")$
  add_slicer(x = df, dims = "B18:D24", sheet = current_sheet(), slicer = "drat", pivot_table = "mtcars",
    params = list(columnCount = 5))$
  # second pivot
  add_pivot_table(
```

```

    df, dims = "G3", sheet = current_sheet(), slicer = varname, rows = "gear", cols = "car
    pivot_table = "mtcars2"
  )$
  add_slicer(x = df, dims = "G12:I16", slicer = "vs", pivot_table = "mtcars2",
            params = list(sortOrder = "descending", caption = "Wow!"))

### Sheet 3
wb$
  add_pivot_table(
    df, dims = "A3", slicer = varname, rows = "gear", cols = "carb", data = "mpg",
    pivot_table = "mtcars3"
  )$
  add_slicer(x = df, dims = "A12:D16", slicer = "vs", pivot_table = "mtcars3")

if (interactive()) wb$open()

wb <- wb_workbook() %>%
  wb_add_worksheet("table") %>%
  wb_add_worksheet("data") %>%
  wb_add_data(x = datasets::esoph)

df <- wb_data(wb)

# add a pivot table and a slicer and preselect
# a few cases and style it a bit
wb <- wb %>%
  wb_add_pivot_table(
    df, dims = "A3", sheet = "table",
    rows = "agegp", cols = "tobgp", data = "ncases",
    slicer = "alcgp", pivot_table = "pt1",
    param = list(
      show_data_as = c("percentOfRow"),
      numfmt = c(formatCode = "0.0%"),
      compact = FALSE, outline = FALSE, compact_data = FALSE,
      row_grand_totals = FALSE, col_grand_totals = FALSE,
      choose = c(agegp = 'x > "25-34"')
    )
  ) %>%
  wb_add_slicer(
    x = df, dims = "B14:D18",
    slicer = "alcgp", pivot_table = "pt1",





```

```

param = list(
  columnCount = 2,
  choose = c(alcgp = 'x %in% c("40-79", "80-119")')
)

if (interactive()) wb$open()

```

	A	B	C	D	E	F
1						
2						
3	Sum of ncases tobgp 					
4	agegp 	0-9g/day	10-19	20-29	30+	
5	35-44	0.0%	75.0%	25.0%	0.0%	
6	45-54	28.1%	31.3%	18.8%	21.9%	
7	55-64	39.1%	30.4%	15.2%	15.2%	
8	65-74	60.5%	18.4%	18.4%	2.6%	
9	75+	50.0%	33.3%	0.0%	16.7%	
10						
11	alcgp  					
12	0-39g/day		120+			
13						
14	40-79		80-119			
15						
16						
17						

24 Form control

```
wb <- wb_workbook()$
# Checkbox
add_worksheet()$
add_form_control(dims = "B2")$
add_form_control(dims = "B3", text = "A text")$
add_data(dims = "A4", x = 0, colNames = FALSE)$
add_form_control(dims = "B4", link = "A4")$
add_data(dims = "A5", x = TRUE, colNames = FALSE)$
add_form_control(dims = "B5", range = "'Sheet 1'!A5", link = "B5")$
# Radio
add_worksheet()$
add_form_control(dims = "B2", type = "Radio")$
add_form_control(dims = "B3", type = "Radio", text = "A text")$
add_data(dims = "A4", x = 0, colNames = FALSE)$
add_form_control(dims = "B4", type = "Radio", link = "A4")$
add_data(dims = "A5", x = 1, colNames = FALSE)$
add_form_control(dims = "B5", type = "Radio")$
# Drop
add_worksheet()$
add_form_control(dims = "B2", type = "Drop")$
add_form_control(dims = "B3", type = "Drop", text = "A text")$
add_data(dims = "A4", x = 0, colNames = FALSE)$
add_form_control(dims = "B4", type = "Drop", link = "A1", range = "D4:D15")$
add_data(dims = "A5", x = 1, colNames = FALSE)$
add_form_control(dims = "B5", type = "Drop", link = "'Sheet 3'!D1:D26", range = "A1")$
add_data(dims = "D1", x = letters)
```

		<input checked="" type="checkbox"/>	
		<input checked="" type="checkbox"/> A text	
	0	<input type="checkbox"/>	
	1	<input checked="" type="checkbox"/>	

	A	B	C	
1				
2		<input type="radio"/>		
3		<input type="radio"/> A text		
4	3	<input checked="" type="radio"/>		
5	1	<input type="radio"/>		
6				
7				
8				
9				

	A	B	C	D	E
1	2			a	
2		<input type="text"/>		b	
3		<input type="text"/>		c	
4	0	e <input type="text"/>		d	
5	1	<input type="text"/>		e	
6				f	
7				g	
8				h	
9				i	
10				j	

25 Extending openxlsx2

```
library(openxlsx2)
```

25.1 msoc - Encrypting / Decrypting workbooks

You might want to look at `msoc` (Garbuszus 2023) for openxml file level encryption/decryption.

```
library(msoc)

xlsx <- temp_xlsx()

# let us write some worksheet
wb_workbook()$add_worksheet()$add_data(x = mtcars)$save(xlsx)

# now we can encrypt it
encrypt(xlsx, xlsx, pass = "msoc")
#> [1] "/tmp/Rtmpnjrni/temp_xlsx_1c443f17568d.xlsx"

# the file is encrypted, we can not read it
try(wb <- wb_load(xlsx))
#> Warning in unzip(file, exdir = xmlDir): error 1 in extracting from zip file
#> Error in wb_load(xlsx) : object 'sheets' not found

# we have to decrypt it first
decrypt(xlsx, xlsx, pass = "msoc")
#> [1] "/tmp/Rtmpnjrni/temp_xlsx_1c443f17568d.xlsx"

# now we can load it again
wb_load(xlsx)$to_df() %>% head()
#>   mpg cyl disp  hp drat   wt  qsec vs am gear carb
#> 2 21.0   6  160 110 3.90 2.620 16.46  0  1   4    4
#> 3 21.0   6  160 110 3.90 2.875 17.02  0  1   4    4
```



```
#> 4 22.8    4  108   93 3.85 2.320 18.61  1  1    4    1
#> 5 21.4    6  258  110 3.08 3.215 19.44  1  0    3    1
#> 6 18.7    8  360  175 3.15 3.440 17.02  0  0    3    2
#> 7 18.1    6  225  105 2.76 3.460 20.22  1  0    3    1
```

25.2 flexlsx - Exporting flextable to workbooks

Using `flexlsx` (Heidler 2023) you can extend `openxlsx2` to write `flextable` (Gohel and Skintzos 2023).

```
library(flexlsx)

wb <- wb_workbook()$add_worksheet("mtcars")

# Create a flextable and an openxlsx2 workbook
ft <- flextable::as_flextable(table(mtcars[,1:2]))

# add the flextable ft to the workbook, sheet "mtcars"
# offset the table to cell 'C2'
wb <- flexlsx::wb_add_flextable(wb, "mtcars", ft, dims = "C2")

if (interactive()) wb$open()
```

26 Upgrade from openxlsx

26.1 Basic read and write functions

Welcome to the `openxlsx2` update vignette. In this vignette we will take some common code examples from `openxlsx` and show you how similar results can be replicated in `openxlsx2`. Thank you for taking a look, and let's get started. While previous `openxlsx` functions used the `.` in function calls, as well as camelCase, we have tried to switch to snake_case (this is still a work in progress, there may still be function arguments that use camelCase).

26.1.1 Read xlsx or xlsxm files

The basic read function changed from `read.xlsx` to `read_xlsx`. Using a default xlsx file included in the package:

```
file <- system.file("extdata", "openxlsx2_example.xlsx", package = "openxlsx2")
```

The old syntax looked like this:

```
# read in openxlsx
openxlsx::read.xlsx(xlsxFile = file)
```

This has changed to this:

```
# read in openxlsx2
openxlsx2::read_xlsx(file = file)
```

#>	Var1	Var2	NA	Var3	Var4	Var5	Var6	Var7	Var8
#> 3	TRUE	1	NA	1	a	2023-05-29 3209324	This	#DIV/0!	01:27:15
#> 4	TRUE	NA	NA	#NUM!	b	2023-05-23	<NA>	0	14:02:57
#> 5	TRUE	2	NA	1.34	c	2023-02-01	<NA>	#VALUE!	23:01:02
#> 6	FALSE	2	NA	<NA>	#NUM!	<NA>	<NA>	2	17:24:53
#> 7	FALSE	3	NA	1.56	e	<NA>	<NA>	<NA>	<NA>
#> 8	FALSE	1	NA	1.7	f	2023-03-02	<NA>	2.7	08:45:58
#> 9	NA	NA	NA	<NA>	<NA>	<NA>	<NA>	<NA>	<NA>
#> 10	FALSE	2	NA	23	h	2023-12-24	<NA>	25	<NA>

```
#> 11 FALSE      3 NA  67.3      i 2023-12-25      <NA>      3      <NA>
#> 12      NA      1 NA  123    <NA> 2023-07-31      <NA>     122      <NA>
```

As you can see, we return the spreadsheet return codes (e.g., `#NUM`) in `openxlsx2`. Another thing to see above, we return the cell row as rowname for the data frame returned. `openxlsx2` should return a data frame of the selected size, even if it empty. If you preferred `openxlsx::readWorkbook()` this has become `wb_read()`. All of these are wrappers for the newly introduced function `wb_to_df()` which provides the most options. `read_xlsx()` and `wb_read()` were created for backward comparability.

26.2 Write xlsx files

Basic writing in `openxlsx2` behaves identical to `openxlsx`. Though be aware that `overwrite` is an optional parameter in `openxlsx2` and just like in other functions like `base::write.csv()` if you write onto an existing file name, this file will be replaced.

Setting the output to some temporary xlsx file

```
output <- temp_xlsx()
```

The previous write function looks like this:

```
# write in openxlsx
openxlsx::write_xlsx(iris, file = output, colNames = TRUE)
```

The new function looks quite similar:

```
# write in openxlsx2
openxlsx2::write_xlsx(iris, file = output, col_names = TRUE)
```

26.3 Basic workbook functions

Workbook functions have been renamed to begin with `wb_` there are plenty of these in the package, therefore looking at the man pages seems to be the fastest way. Yet, it all begins with loading the workbook.

26.3.1 Loading a workbook

A major feature in `openxlsx` are workbooks. Obviously they remain a central piece in `openxlsx2`. Previously you would load them with:

```
wb <- openxlsx::loadWorkbook(file = file)
```

In `openxlsx2` loading was changed to:

```
wb <- wb_load(file = file)
```

There are plenty of functions to interact with workbooks and we will not describe every single one here. A detailed list can be found over at [our references](#)

26.3.2 Styles

One of the biggest user facing change was the removal of the `stylesObject`. In the following section we use code from `openxlsx::addStyle()`

```
# openxlsx
## Create a new workbook
wb <- createWorkbook(creator = "My name here")
addWorksheet(wb, "Expenditure", gridLines = FALSE)
writeData(wb, sheet = 1, USPersonalExpenditure, rowNames = TRUE)

## style for body
bodyStyle <- createStyle(border = "TopBottom", borderColor = "#4F81BD")
addStyle(wb, sheet = 1, bodyStyle, rows = 2:6, cols = 1:6, gridExpand = TRUE)

## set column width for row names column
setColWidths(wb, 1, cols = 1, widths = 21)
```

In `openxlsx2` the same code looks something like this:

```
# openxlsx2 chained
border_color <- wb_color(hex = "4F81BD")
wb <- wb_workbook(creator = "My name here")$
  add_worksheet("Expenditure", grid_lines = FALSE)$
  add_data(x = USPersonalExpenditure, row_names = TRUE)$
  add_border( # add the outer and inner border
    dims = "A1:F6",
```

```

    top_border = "thin", top_color = border_color,
    bottom_border = "thin", bottom_color = border_color,
    inner_hgrid = "thin", inner_hcolor = border_color,
    left_border = "", right_border = ""
  )$
  set_col_widths( # set column width
    cols = 1:6,
    widths = c(20, rep(10, 5))
  )$ # remove the value in A1
  add_data(dims = "A1", x = "")

```

The code above uses chaining. If you prefer piping, we provide the chained functions with the prefix `wb_` so `wb_add_worksheet()`, `wb_add_data()`, `wb_add_border()` and `wb_set_col_widths()` would be the functions to use with pipes `%>%` or `|>`.

With pipes the code from above becomes

```

# openxlsx2 with pipes
border_color <- wb_color(hex = "4F81BD")
wb <- wb_workbook(creator = "My name here") %>%
  wb_add_worksheet(sheet = "Expenditure", grid_lines = FALSE) %>%
  wb_add_data(x = USPersonalExpenditure, row_names = TRUE) %>%
  wb_add_border( # add the outer and inner border
    dims = "A1:F6",
    top_border = "thin", top_color = border_color,
    bottom_border = "thin", bottom_color = border_color,
    inner_hgrid = "thin", inner_hcolor = border_color,
    left_border = "", right_border = ""
  ) %>%
  wb_set_col_widths( # set column width
    cols = 1:6,
    widths = c(20, rep(10, 5))
  ) %>% # remove the value in A1
  wb_add_data(dims = "A1", x = "")

```

Be aware that chains modify an object in place and pipes do not.

```

# openxlsx2
wbp <- wb_workbook() %>% wb_add_worksheet()
wbc <- wb_workbook()$add_worksheet()

# need to assign wbp

```

```
wbp <- wbp %>% wb_add_data(x = iris)
wbc$add_data(x = iris)
```

You can re-use styles with `wb_get_cell_style()` and `wb_set_cell_style()`. Abandoning `stylesObject` in `openxlsx2` has the huge benefit that we can import and export a spreadsheet without changing any cell style. It is still possible to modify a cell style with `wb_add_border()`, `wb_add_fill()`, `wb_add_font()` and `wb_add_numfmt()`.

Additional examples regarding styles can be found in the styles vignette.

26.3.3 Conditional formatting

See `vignette("conditional-formatting")` for extended examples on formatting.

Here is a minimal example:

```
# openxlsx2 with chains
wb <- wb_workbook()$
  add_worksheet("a")$
  add_data(x = 1:4, col_names = FALSE)$
  add_conditional_formatting(dims = "A1:A4", rule = ">2")

# openxlsx2 with pipes
wb <- wb_workbook() %>%
  wb_add_worksheet("a") %>%
  wb_add_data(x = 1:4, col_names = FALSE) %>%
  wb_add_conditional_formatting(dims = "A1:A4", rule = ">2")
```

26.3.4 Data validation

Similarly, data validation has been updated and improved. This `openxlsx` code for data validation

```
# openxlsx
wb <- createWorkbook()
addWorksheet(wb, "Sheet 1")
writeDataTable(wb, 1, x = iris[1:30, ])
dataValidation(wb, 1,
  col = 1:3, rows = 2:31, type = "whole",
  operator = "between", value = c(1, 9)
)
```

looks in `openxlsx2` something like this:

```
# openxlsx2 with chains
wb <- wb_workbook()$
  add_worksheet("Sheet 1")$
  add_data_table(1, x = iris[1:30, ])$
  add_data_validation(1,
    dims = wb_dims(rows = 2:31, cols = 1:3),
    # alternatively, dims can also be "A2:C31" if you know the span in your Excel workbook
    type = "whole",
    operator = "between",
    value = c(1, 9)
  )

# openxlsx2 with pipes
wb <- wb_workbook() %>%
  wb_add_worksheet("Sheet 1") %>%
  wb_add_data_table(1, x = iris[1:30, ]) %>%
  wb_add_data_validation(
    sheet = 1,
    dims = "A2:C31", # alternatively, dims = wb_dims(rows = 2:31, cols = 1:3)
    type = "whole",
    operator = "between",
    value = c(1, 9)
  )
```

26.3.5 Saving

Saving has been switched from `saveWorkbook()` to `wb_save()` and opening a workbook has been switched from `openXL()` to `wb_open()`.

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