The `openxlsx2` book

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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
R.version
```

```
               _
platform       x86_64-pc-linux-gnu
arch           x86_64
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

```r
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/.

For many more examples of what `openxlsx2` can do, have a look at the `Show and tell` section of the `openxlsx2` discussion board: https://github.com/JanMarvin/openxlsx2/discussions/categories/show-and-tell

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 Schauberger 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.

[1] See https://github.com/omegahat/RDCOMClient.

[2] See 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')
```

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

```
    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>
```

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

```
A Workbook object.

Worksheets:
 Sheets: Sheet1, Sheet2
 Write order: 1, 2
```

```
# read a data frame
wb_to_df(wb)
```

```
    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>
```

```
# 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 greatful, please see:

```
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 Schauberger; 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>     <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>
```

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>     <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>
```

2.1.3 `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 to 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 notion 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 are 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>     <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:

```r
# 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).

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

2.2.2 Exporting a `wbWorkbook`

Imported workbooks can be saved as xlsx or xlsm 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"
```

```r
# 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 Of strings and numbers

Contrary to `R`, spreadsheets do not require identicial data types. While in `R` a column always consists of a unique type (the base types supported by `openxlsx2` are `character`, `integer`, `numeric`, `Date`, and `POSIXct`/`POSIXlt`), spreadsheets might consist of arbitary mixes of data types. E.g. it is not uncommon, to have tables consisting of multiple rows. In addition some spreadsheet software has issues identifiying certain date types and a well known issue of spreadsheets is the number stored as text error. Below we will describe ways to write data with `openxlsx2` and how to handle the most common types characters and numerics. Though in addition `openxlsx2` also supports dates, date formats and makes use of the `hms` date class.

```r
wb <- wb_workbook()
```

3.1 Default numeric data frame

Using a few rows of the `cars` data frame we show how to write numerics. The strings are left aligned and the numbers right aligned.

```r
# default data frame
dat <- data.frame(
  speed = c(4, 4, 7, 7, 8, 9),
  dist = c(2, 10, 4, 22, 16, 10)
)

# Consisting only of numerics
str(dat)
#> 'data.frame':	6 obs. of  2 variables:
#>  $ speed: num  4 4 7 7 8 9
#>  $ dist : num  2 10 4 22 16 10

wb$add_worksheet("dat")$add_data(x = dat)
```

3.2 Data frame with multiple row header

Now we alter the data frame with a second row adding the column label. Since R does not know mixed column types the entire data frame is converted to characters.

```
# add subtitle to the data
dat_w_subtitle <- data.frame(
  speed = c("Speed (mph)", 4, 4, 7, 7, 8, 9),
  dis = c("Stopping distance (ft)", 2, 10, 4, 22, 16, 10)
)
# Check that both columns are character
str(dat_w_subtitle)
#> 'data.frame':    7 obs. of  2 variables:
#>  $ speed: chr  "Speed (mph)" "4" "4" "7" ...
#>  $ dis  : chr  "Stopping distance (ft)" "2" "10" "4" ...

# write data as is. this creates number stored as text error
# this can be surpressed with: wb_add_ignore_error(number_stored_as_text)
wb$add_worksheet("dat_w_subtitle")$add_data(x = dat_w_subtitle)
```

Now the data is written as strings. Therefore the numbers are not written as 4, but as "4". In the openxml format characters are treated differently as numbers and are stored as inline strings (openxlsx2 default) or as shared string. The file loads fine, but now all cells are right alligned and the previous numeric cells are all showing the number stored as text error. Spreadsheet software will treat these cells independently of the data type, so it does not matter other that the error is thrown and that number formats are not applied.

Since conversions to character are sometimes not wanted, we provide a way to detect these numbers stored as text and will convert them when the data is written into the workbook.

```
# write character string, but write string numbers as numerics
options("openxlsx2.string_nums" = TRUE)
wb$add_worksheet("string_nums")$add_data(x = dat_w_subtitle)
options("openxlsx2.string_nums" = NULL)
```

This way the data is written as numerics, but still right aligned. This is due to the cell style, otherwise it looks entirely identical to previous attemt. Since this conversion is not generally wanted this option needs to be enabled explicitly. Gernally openxlsx2 assumes that the users are mature and want what they request.

3.3 How to write multiple header rows?

The better approach to avoid the entire conversion is to write the column headers and the column data separately. The recommended approach to this would be something like this:

```
wb$add_worksheet("characters and numbers")$
  add_data(x = dat_w_subtitle[1, ])$
  add_data(dims = wb_dims(x = dat, col_names = FALSE, from_row = 3),
           x = dat, col_names = FALSE)
```

3.4 Labelled data

In addition to pure `numbers` and `characters` it is also possible to write `labelled` vectors such as factors or columns modified with the `labelled` package.

```
# Factors
x <- c("Man", "Male", "Man", "Lady", "Female")
xf <- factor(x, levels = c("Male", "Man" , "Lady",   "Female"),
             labels = c("Male", "Male", "Female", "Female"))

wb$add_worksheet("factors")$add_data(x = data.frame(x, xf))

# Labelled
v <- labelled::labelled(
  c(1, 2, 2, 2, 3, 9, 1, 3, 2, NA),
  c(yes = 1, no = 3, "don't know" = 8, refused = 9)
)

wb$add_worksheet("labelled")$add_data(x = v)
```

3.5 Hour - Minute - Second

If the `hms` package is loaded `openxlsx2` makes use of this as well. Otherwise the data would be returned as

```
set.seed(123)
wb$add_worksheet("hms")$add_data(x = hms::hms(sample(1:100000, 5, TRUE)))
```

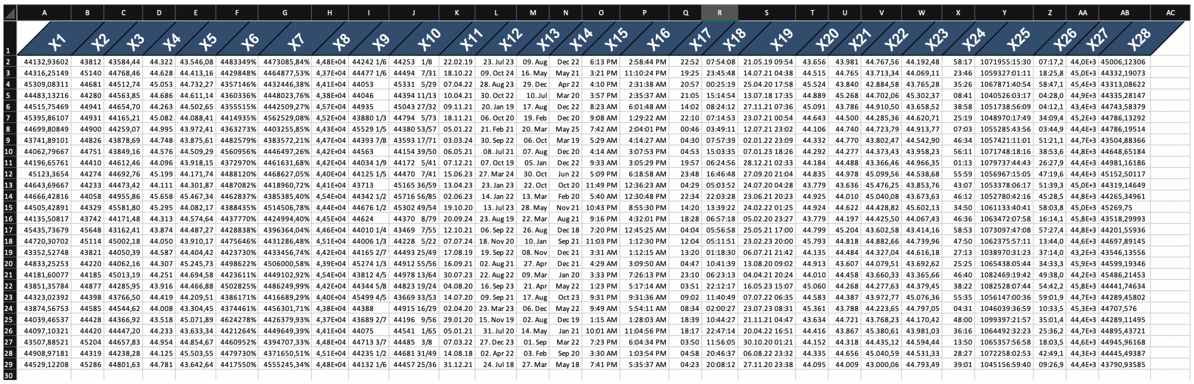
```r
df <- wb_to_df(wb, sheet = "hms")
str(df)
#> 'data.frame':    5 obs. of  1 variable:
#>  $ x: 'hms' num  14:21:03 16:04:30 00:49:46 08:18:45 ...


unloadNamespace("hms")
df <- wb_to_df(wb, sheet = "hms")
str(df)
#> 'data.frame':    5 obs. of  1 variable:
#>  $ x: chr  "14:21:03" "16:04:30" "00:49:46" "08:18:45" ...
```

4 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.

4.1 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
1	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
2	44132,93602	43812	43584,44	44.322	43.546,08	4483349%	4473085,84%	4,48E+04	44242 1/6	44253 1/8
3	44316,25149	45140	44768,46	44.628	44.413,16	4429848%	4464877,53%	4,37E+04	44477 1/6	44494 7/31
4	45309,08311	44681	44512,74	45.053	44.732,27	4357146%	4432446,38%	4,41E+04	44053	45331 5/29
5	44483,13216	44280	44563,85	44.686	44.611,14	4360336%	4448023,76%	4,38E+04	44046	44394 11/13
6	44515,75469	44941	44654,70	44.263	44.502,65	4355515%	4442509,27%	4,57E+04	44935	45043 27/32
7	45395,86107	44931	44165,21	45.082	44.088,41	4414935%	4562529,08%	4,52E+04	43880 1/3	44794 5/73
8	44699,80849	44900	44259,07	44.995	43.972,41	4363273%	4403255,85%	4,43E+04	45529 1/5	44380 53/57
9	43741,89101	44826	43878,69	44.748	43.875,61	4482579%	4383572,21%	4,47E+04	44393 7/8	43593 17/71
10	44062,79667	44751	43849,16	44.576	44.509,29	4560956%	4446497,26%	4,42E+04	44563	44154 39/50
11	44196,65761	44410	44612,46	44.096	43.918,15	4372970%	4461631,68%	4,42E+04	44034 1/9	44172 5/41
12	45123,3654	44274	44692,76	45.199	44.171,74	4488120%	4468627,05%	4,40E+04	44125 1/5	44470 7/41
13	44643,69667	44233	44473,42	44.111	44.301,87	4487082%	4418960,72%	4,41E+04	43713	45165 36/59
14	44666,42816	44058	44955,86	45.658	45.467,34	4462837%	4385385,40%	4,54E+04	44342 1/2	45716 56/85
15	44505,42891	44329	45581,80	45.295	44.082,17	4388435%	4514506,78%	4,44E+04	44676 1/2	45302 49/54
16	44135,50817	43742	44171,48	44.313	44.574,64	4437770%	4424994,40%	4,45E+04	44624	44370 8/79
17	45435,73679	45648	43162,41	43.874	44.487,27	4428838%	4396364,04%	4,46E+04	44010 1/4	43469 7/55
18	44720,30702	45114	45002,18	44.050	43.910,17	4475646%	4431286,48%	4,51E+04	44006 1/3	44228 5/22
19	43352,52748	43821	44050,39	44.587	44.404,42	4423730%	4433456,74%	4,42E+04	44165 2/7	44493 25/49
20	44833,25253	44220	44062,16	44.307	45.245,73	4498622%	4506000,58%	4,39E+04	45274 1/3	44912 55/56
21	44181,60077	44185	45013,19	44.251	44.694,58	4423611%	4449102,92%	4,54E+04	43812 4/5	44978 13/64
22	43851,35784	44877	44285,95	43.916	44.466,88	4502825%	4486249,99%	4,42E+04	44344 5/8	44823 19/24
23	44323,02392	44398	43766,50	44.419	44.209,51	4386171%	4416689,29%	4,40E+04	45499 4/5	43669 33/53
24	43874,56753	44585	44544,62	44.008	43.304,45	4374461%	4456301,71%	4,38E+04	44388	44915 16/29
25	44039,46537	44428	44366,92	43.518	45.071,89	4624278%	4426379,93%	4,37E+04	43689 2/7	44196 9/56
26	44097,10321	44420	44447,20	44.233	43.633,34	4421264%	4449649,39%	4,41E+04	44075	44541 1/65
27	43507,88521	45204	44657,83	44.954	44.854,67	4460952%	4394707,33%	4,48E+04	44713 3/7	44485 3/8
28	44908,97181	44319	44238,28	44.125	45.503,55	4479730%	4371650,51%	4,51E+04	44235 1/2	44681 31/49
29	44529,12208	45286	44801,63	44.781	43.642,64	4417550%	4555245,34%	4,48E+04	44132 1/6	44457 25/36
30										

	K	L	M	N	O	P	Q	R	S
1	X11	X12	X13	X14	X15	X16	X17	X18	X19
2	22.02.19	23. Jul 23	09. Aug	Dec 22	6:13 PM	2:58:44 PM	22:52	07:54:08	21.05.19 09:54
3	18.10.22	09. Oct 24	16. May	May 21	3:21 PM	11:10:24 PM	19:25	23:45:48	14.07.21 04:38
4	07.04.22	28. Aug 23	29. Dec	Apr 22	4:10 PM	2:31:38 AM	20:57	00:25:19	25.04.20 17:58
5	10.04.21	30. Oct 22	10. Jul	Mar 20	3:57 PM	2:35:37 AM	21:05	15:14:54	13.07.18 17:35
6	09.11.21	20. Jan 19	17. Aug	Dec 22	8:23 AM	6:01:48 AM	14:02	08:24:12	27.11.21 07:36
7	18.11.21	06. Oct 20	19. Feb	Dec 20	9:08 AM	1:29:22 AM	22:10	07:14:53	23.07.21 00:54
8	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
9	03.03.24	30. Sep 22	06. Oct	Mar 19	5:29 AM	4:14:27 AM	04:30	07:57:39	02.01.22 23:09
10	06.05.21	08. Jul 21	07. Aug	Dec 20	4:14 AM	3:07:53 PM	04:53	15:03:35	07.01.23 18:26
11	07.12.21	07. Oct 19	05. Jan	Dec 22	9:33 AM	3:05:29 PM	19:57	06:24:56	28.12.21 02:33
12	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
13	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 04:28
14	02.06.23	14. Jan 22	13. Mar	Feb 20	5:40 AM	12:30:48 PM	22:34	22:03:28	23.06.21 20:23
15	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
16	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
17	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
18	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
19	17.08.19	19. Sep 22	08. Nov	Dec 21	3:31 AM	1:12:15 AM	13:20	01:18:30	06.07.21 21:42
20	16.09.21	02. Aug 21	27. Apr	Dec 21	4:29 AM	3:09:50 AM	04:47	10:41:39	13.08.20 09:02
21	30.07.23	22. Aug 22	09. Mar	Jan 20	3:33 PM	7:26:13 PM	23:10	06:23:13	04.04.21 20:24
22	04.08.20	16. Sep 23	21. Apr	May 22	1:23 PM	5:17:14 AM	03:51	22:12:17	16.05.23 15:07
23	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
24	02.04.20	23. Mar 23	06. Dec	May 22	9:49 AM	5:54:11 AM	08:34	02:00:27	23.07.23 08:31
25	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
26	05.01.21	31. Jul 20	14. May	Jan 21	10:01 AM	11:04:56 PM	18:17	22:47:14	20.04.22 16:51
27	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
28	14.08.18	02. Apr 22	03. Feb	Sep 20	3:30 AM	1:03:54 PM	04:58	20:46:37	06.08.22 23:32
29	31.12.21	24. Jul 18	27. Mar	May 18	7:41 PM	5:35:37 AM	04:23	20:08:12	27.11.20 23:38
30									

	T	U	V	W	X	Y	Z	AA	AB	AC
1	X20	X21	X22	X23	X24	X25	X26	X27	X28	
2	43.656	43.981	44.767,56	44.192,48	58:17	1071955:15:30	07:17,2	44,0E+3	45006,12306	
3	44.515	44.765	43.713,34	44.069,11	23:46	1059327:01:11	18:25,8	45,0E+3	44332,19073	
4	45.524	43.840	42.884,58	43.765,28	35:26	1067871:40:54	58:47,1	45,4E+3	43313,08622	
5	44.889	45.268	44.702,06	45.302,37	08:41	1040526:03:17	04:28,0	44,9E+3	44335,28147	
6	45.091	43.786	44.910,50	43.658,52	38:58	1051738:56:09	04:12,1	43,4E+3	44743,58379	
7	44.643	44.500	44.285,36	44.620,71	25:19	1048970:17:49	34:09,4	45,2E+3	44786,13292	
8	44.106	44.740	44.723,79	44.913,77	07:03	1055285:43:56	03:44,9	44,4E+3	44786,19514	
9	44.332	44.770	43.802,47	44.542,90	46:34	1057421:11:01	51:21,1	44,7E+3	43504,88366	
10	44.292	44.277	44.373,43	43.958,23	56:11	1071748:18:16	38:53,6	44,8E+3	44648,65184	
11	44.184	44.488	43.366,46	44.966,35	01:13	1079737:44:43	26:27,9	44,4E+3	44981,16186	
12	44.835	44.978	45.099,56	44.538,68	55:59	1056967:15:05	47:19,6	44,4E+3	45152,50117	
13	43.779	43.636	45.476,25	43.853,76	43:07	1053378:06:17	51:39,3	45,0E+3	44319,14649	
14	44.925	44.010	45.040,08	43.673,63	46:12	1052780:42:16	45:28,5	44,8E+3	44265,34961	
15	44.924	44.622	44.428,82	45.602,13	34:50	1061133:40:41	58:03,8	45,0E+3	45269,75	
16	43.779	44.197	44.425,50	44.067,43	46:36	1063472:07:58	16:14,1	45,8E+3	43518,29993	
17	44.799	45.204	43.602,58	43.414,16	58:53	1073097:47:08	57:27,4	44,8E+3	44201,55936	
18	45.793	44.818	44.882,66	44.739,96	47:50	1062375:57:11	13:44,0	44,6E+3	44697,89145	
19	44.135	44.484	44.327,04	44.616,18	27:13	1038970:31:23	37:14,0	43,2E+3	43546,13556	
20	44.913	43.607	44.079,51	43.692,62	25:25	1065438:05:44	34:33,3	45,9E+3	44599,19346	
21	44.010	44.458	43.660,33	43.365,66	46:40	1082469:19:42	49:38,0	44,2E+3	45486,21453	
22	45.060	44.268	44.277,63	44.379,45	38:22	1082528:07:44	54:42,2	45,8E+3	44441,74634	
23	44.583	44.387	43.972,77	45.076,36	55:35	1056147:00:36	59:01,9	44,7E+3	44289,45802	
24	45.361	43.788	44.223,65	44.797,05	04:31	1046039:36:59	10:33,5	45,3E+3	44707,576	
25	43.634	44.721	43.768,23	44.170,42	48:00	1099397:21:57	35:01,4	44,4E+3	44289,11495	
26	44.416	43.867	45.380,61	43.981,03	36:16	1064492:32:23	25:36,2	44,7E+3	44895,43721	
27	44.152	44.318	44.435,12	44.594,44	13:50	1065357:56:58	18:03,5	44,6E+3	44945,96168	
28	44.335	44.656	45.040,59	44.531,33	28:27	1072258:02:53	42:49,1	44,3E+3	44445,49387	
29	44.095	44.009	43.000,06	44.793,49	39:01	1045156:59:40	09:26,9	44,4E+3	43790,93585	
30										

Figure 4.1: The example below, with increased column width.

4.1.1 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 formated 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 = "FFFFFF
  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()
```

4.1.2 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)
```

5 Working with number formats

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

5.1 numfmts

```r
## 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)
```

5.2 numfmts2

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

```r
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)
```

6 Modifying the column widths

6.1 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")
```

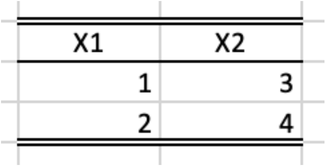
7 Adding borders

7.1 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 = "FF8080
# only vertical grid
wb$add_worksheet("S3", grid_lines = FALSE)$add_data(x = mtcars)
wb$add_border(dims = "A2:K33", inner_vgrid = "thin", inner_vcolor = wb_color(hex = "FF8080
# no inner grid
wb$add_worksheet("S4", grid_lines = FALSE)$add_data(x = mtcars)
wb$add_border("S4", dims = "A2:K33")
```

7.2 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

7.2.1 the quick way: using high level functions

```r
# 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
  )
```

7.2.2 the long way: creating everything from the bone

```r
# 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
```

8 Use workbook colors and modify them

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

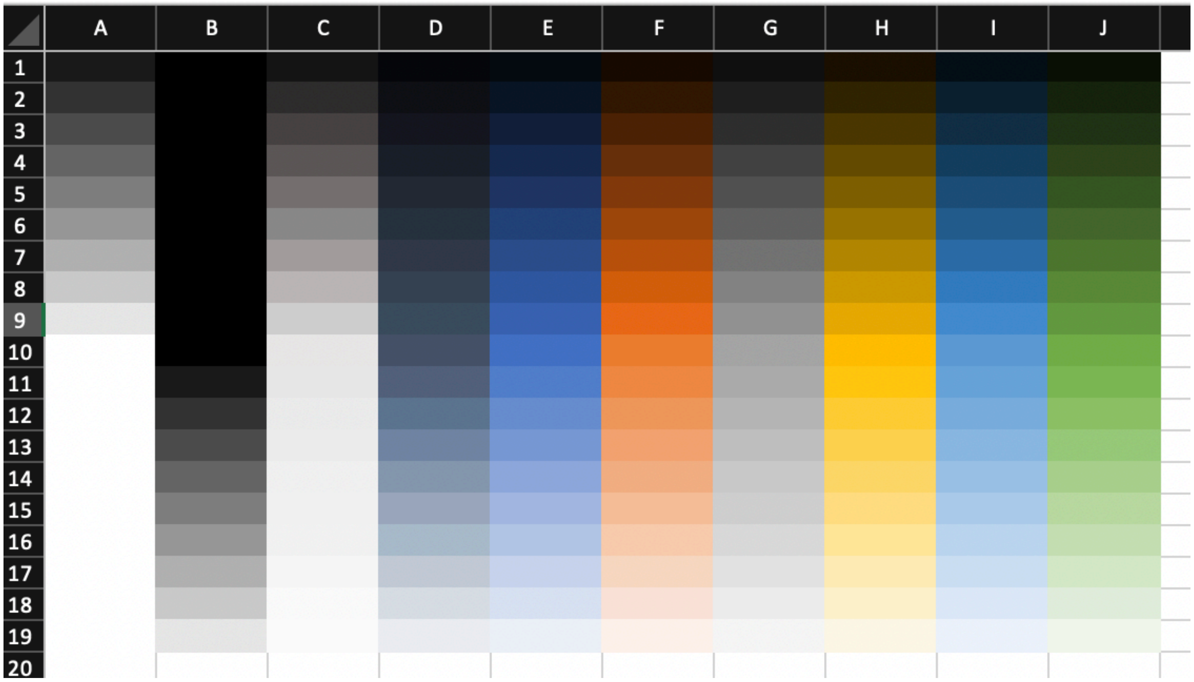


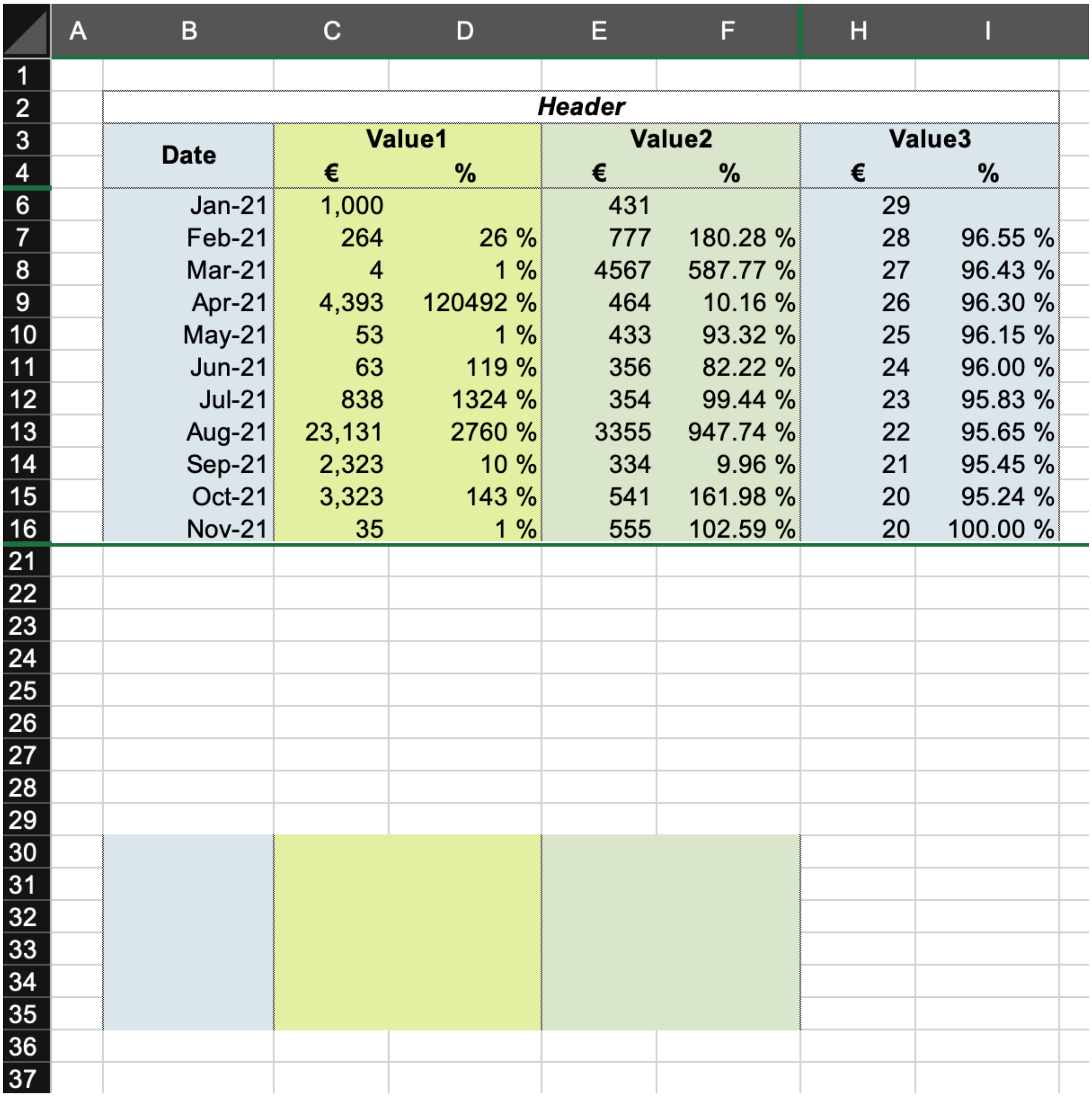
Figure 8.1: Tint variations of the theme colors.

```r
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 = tnt))
    }
  }
}
```

9 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", "oxlsx2_sheet.xlsx", package = "openxlsx2")) %>%
  wb_set_cell_style(1, "A30:G35", wb_get_cell_style(., 1, "A10:G15"))
# wb_open(wb)
```

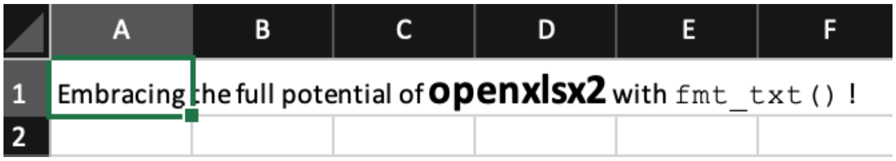


Header						
Date	Value1		Value2		Value3	
	€	%	€	%	€	%
Jan-21	1,000		431		29	
Feb-21	264	26 %	777	180.28 %	28	96.55 %
Mar-21	4	1 %	4567	587.77 %	27	96.43 %
Apr-21	4,393	120492 %	464	10.16 %	26	96.30 %
May-21	53	1 %	433	93.32 %	25	96.15 %
Jun-21	63	119 %	356	82.22 %	24	96.00 %
Jul-21	838	1324 %	354	99.44 %	23	95.83 %
Aug-21	23,131	2760 %	3355	947.74 %	22	95.65 %
Sep-21	2,323	10 %	334	9.96 %	21	95.45 %
Oct-21	3,323	143 %	541	161.98 %	20	95.24 %
Nov-21	35	1 %	555	102.59 %	20	100.00 %

10 Style strings

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

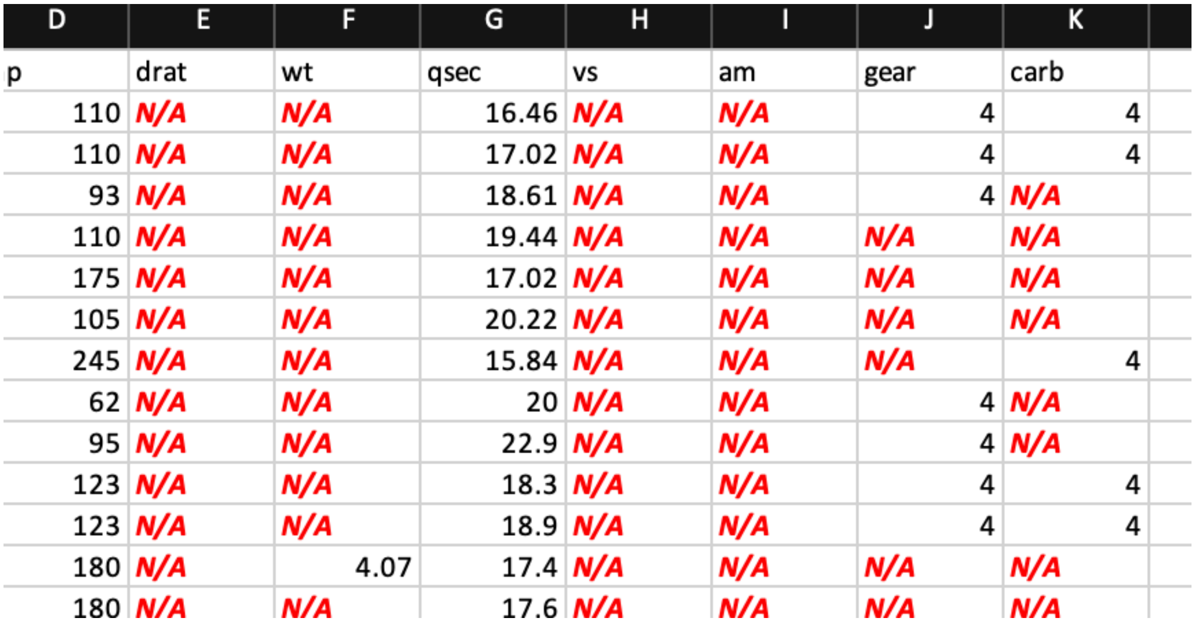
```
txt <-
  fmt_txt("Embracing the full potential of ") +
  fmt_txt("openxlsx2", bold = TRUE, size = 16) +
  fmt_txt(" with ") +
  fmt_txt("fmt_txt()", font = "Courier") +
  fmt_txt(" !")

wb <- wb_workbook()$add_worksheet()$add_data(x = txt, col_names = FALSE)
```



Embracing the full potential of **openxlsx2** with `fmt_txt()` !

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)
```



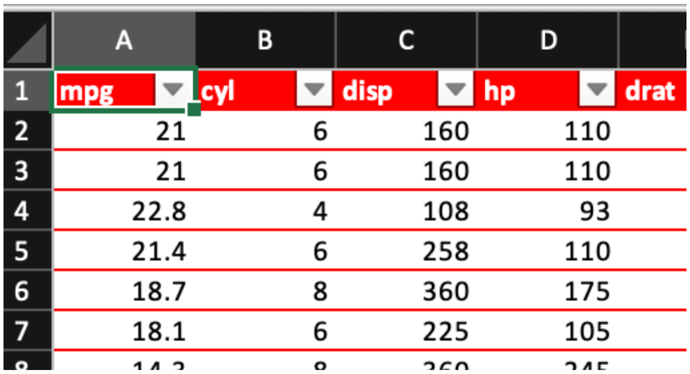
D	E	F	G	H	I	J	K
p	drat	wt	qsec	vs	am	gear	carb
110	N/A	N/A	16.46	N/A	N/A	4	4
110	N/A	N/A	17.02	N/A	N/A	4	4
93	N/A	N/A	18.61	N/A	N/A	4	N/A
110	N/A	N/A	19.44	N/A	N/A	N/A	N/A
175	N/A	N/A	17.02	N/A	N/A	N/A	N/A
105	N/A	N/A	20.22	N/A	N/A	N/A	N/A
245	N/A	N/A	15.84	N/A	N/A	N/A	4
62	N/A	N/A	20	N/A	N/A	4	N/A
95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

11 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.

```r
# 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")
)
```

```r
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	245	

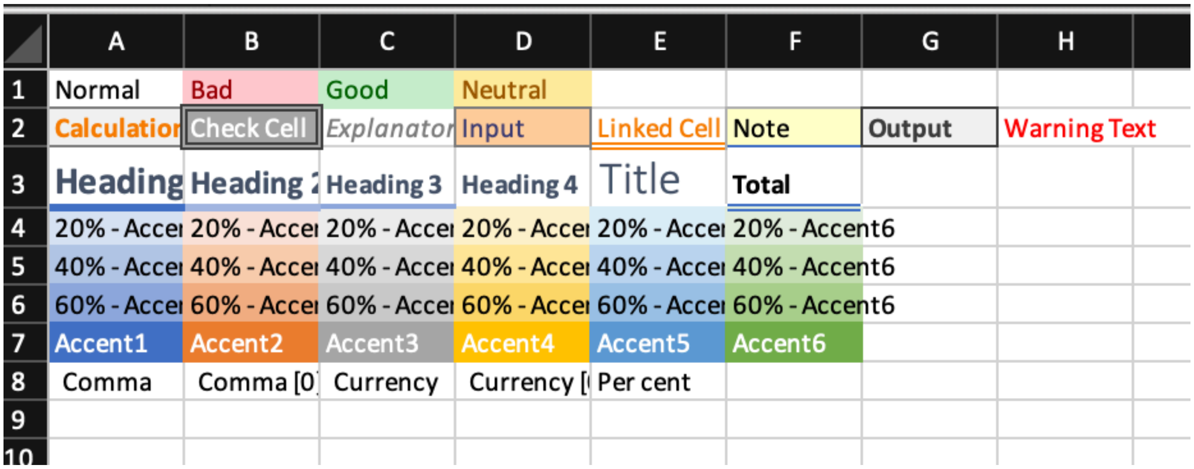
12 Named styles

```
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)
```

```r
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()
```



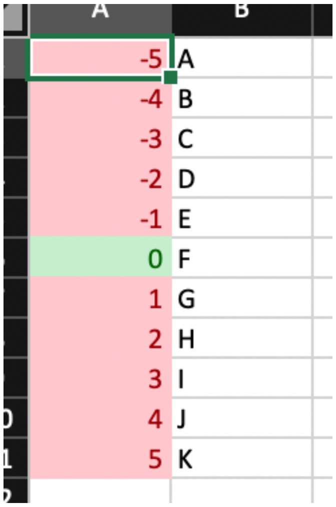
	A	B	C	D	E	F	G	H
1	Normal	Bad	Good	Neutral				
2	Calculatior	Check Cell	Explanator	Input	Linked Cell	Note	Output	Warning Text
3	Heading	Heading :	Heading 3	Heading 4	Title	Total		
4	20% - Accei	20% - Accei	20% - Accei	20% - Accei	20% - Accei	20% - Accent6		
5	40% - Accei	40% - Accei	40% - Accei	40% -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

13 Conditional Formatting

```r
library(openxlsx2)
```

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

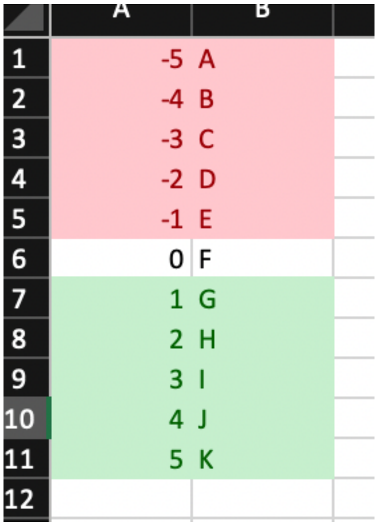
13.1 Rule applies to all each cell in range



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

```r
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"
)
```

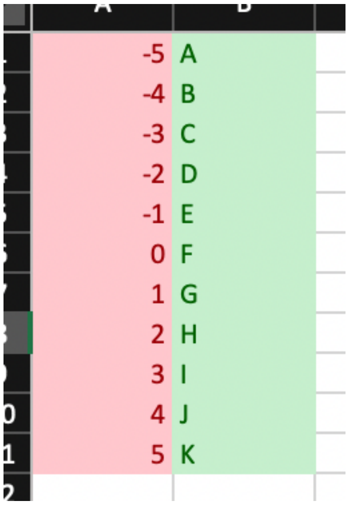
13.2 Highlight row dependent on first cell in row



	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"
)
```

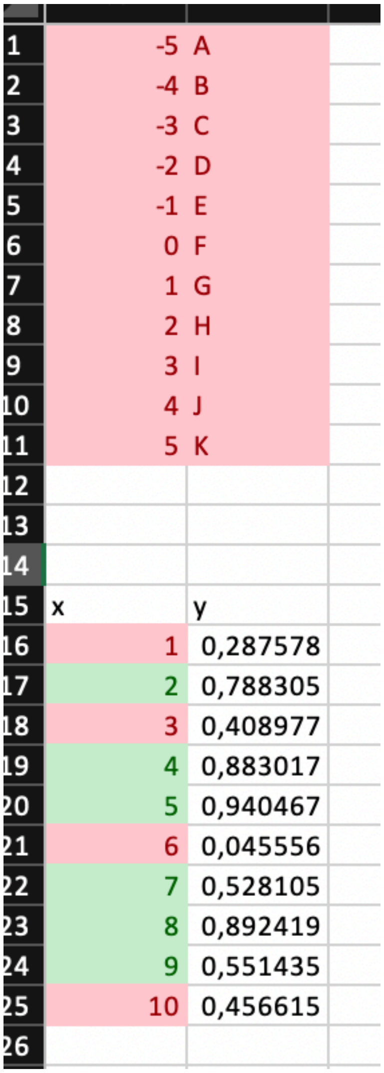
13.3 Highlight column dependent on first cell in column



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"
)
```

13.4 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		

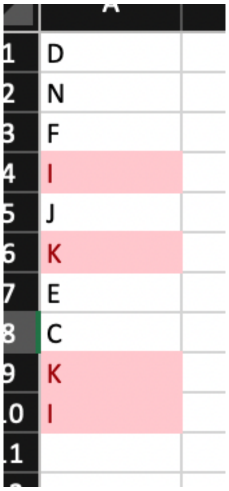
```r
wb$add_worksheet("Dependent on")
wb$add_data("Dependent on", -5:5)
wb$add_data("Dependent on", LETTERS[1:11], start_col = 2)
wb$add_conditional_formatting(
  "Dependent on",
  dims = "A1:B11",
  rule = "$A$1 < 0",
  style = "negStyle"
)
```

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

13.5 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"
)
```

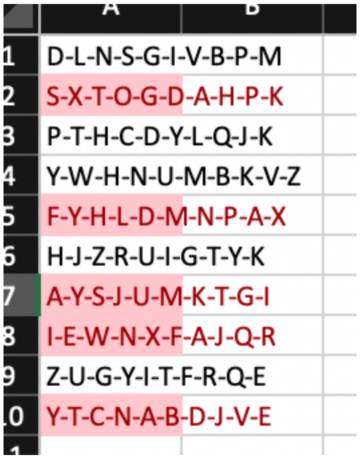
13.6 Highlight duplicates using default style



	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"
)
```

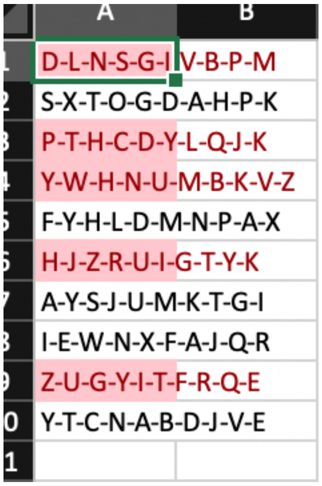
13.7 Cells containing text



	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")
```

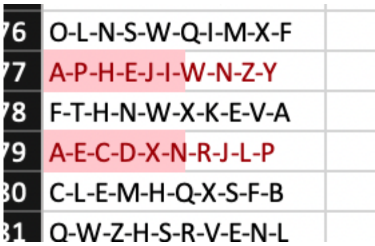
13.8 Cells not containing text



	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		

```r
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"
)
```

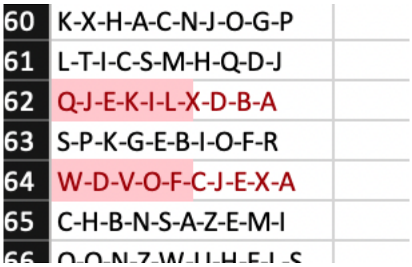
13.9 Cells begins with text



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	

```r
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"
)
```

13.10 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-Q-N-Z-W-U-H-F-I-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"
)
```

13.11 Colorscale colors cells based on cell value

```
df <- read_xlsx("https://github.com/JanMarvin/openxlsx-data/raw/main/readTest.xlsx", sheet
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),
```

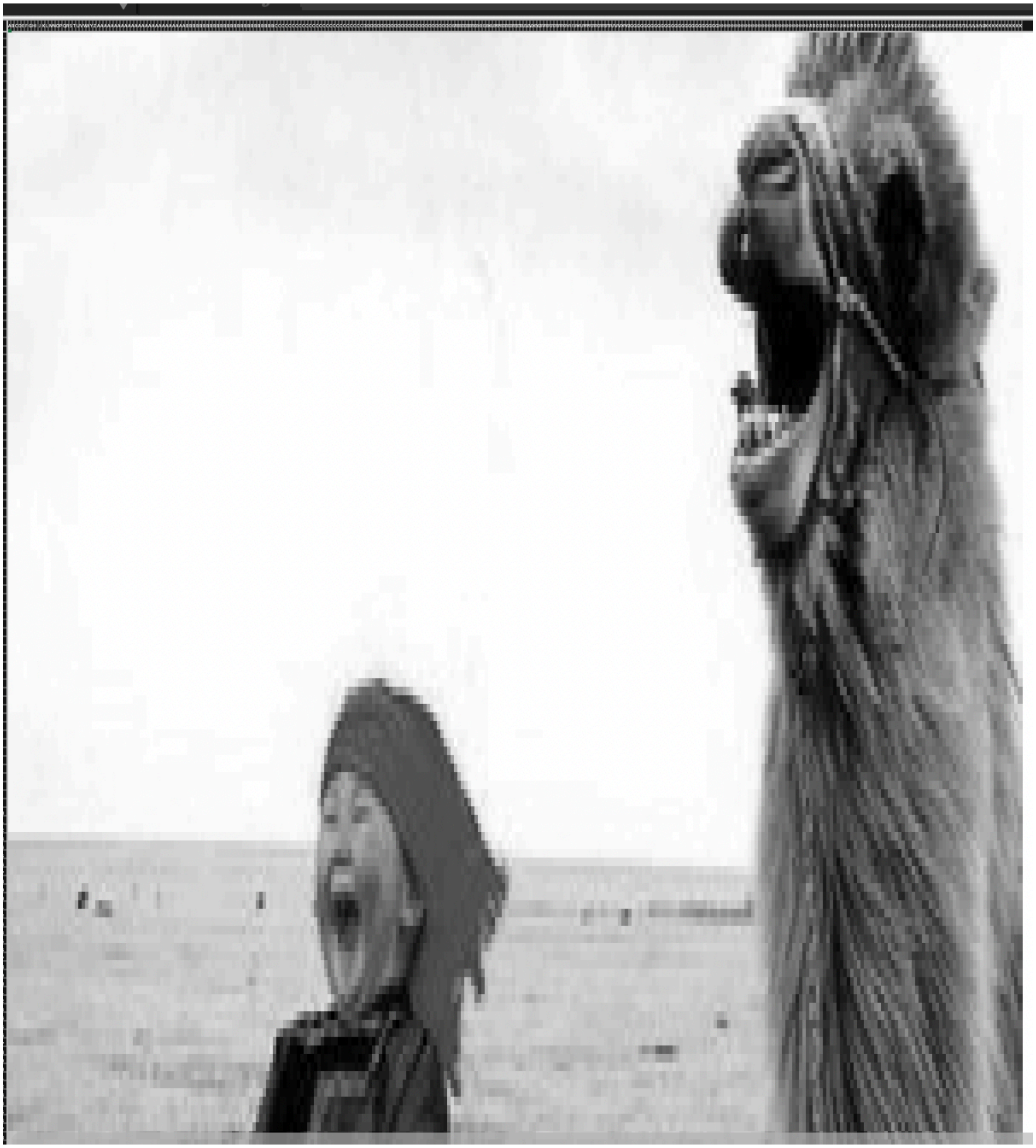
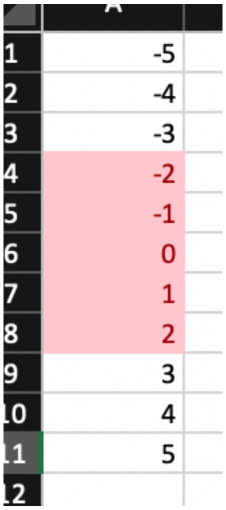


Figure 13.1: Yep, that is a color scale image.

```
  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)
```

13.12 Between

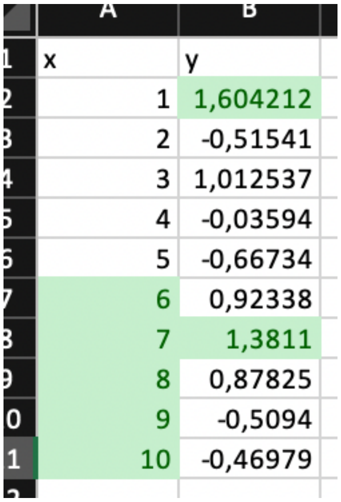


	A
1	-5
2	-4
3	-3
4	-2
5	-1
6	0
7	1
8	2
9	3
10	4
11	5
12	

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")
```

13.13 Top N



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

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

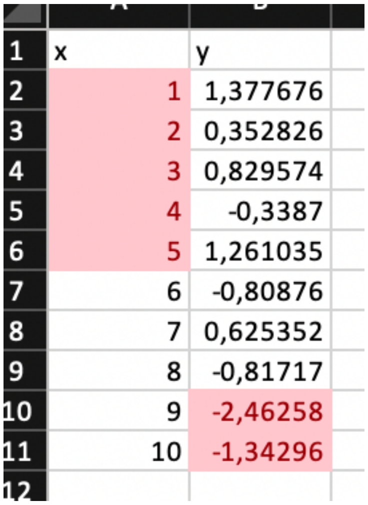
Highlight top 5 values in column x

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

Highlight top 20 percentage in column y

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

13.14 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		

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

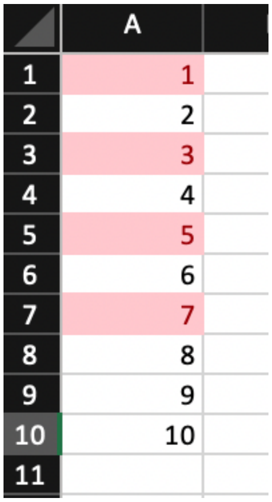
Highlight bottom 5 values in column x

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

Highlight bottom 20 percentage in column y

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

13.15 Logical Operators

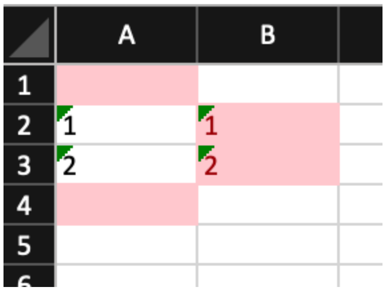


	A
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	

You can use Excels 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)"
)
```

13.16 (Not) Contains Blanks

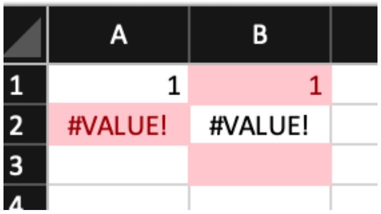


	A	B
1		
2	1	1
3	2	2
4		
5		

```
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")
```

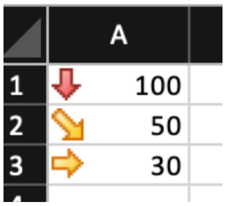
13.17 (Not) Contains Errors



	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")
```

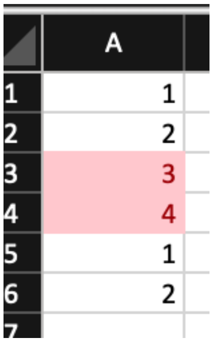
13.18 Iconset



	A
1	⇩ 100
2	⇘ 50
3	⇨ 30
4	

```
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)
  )
```

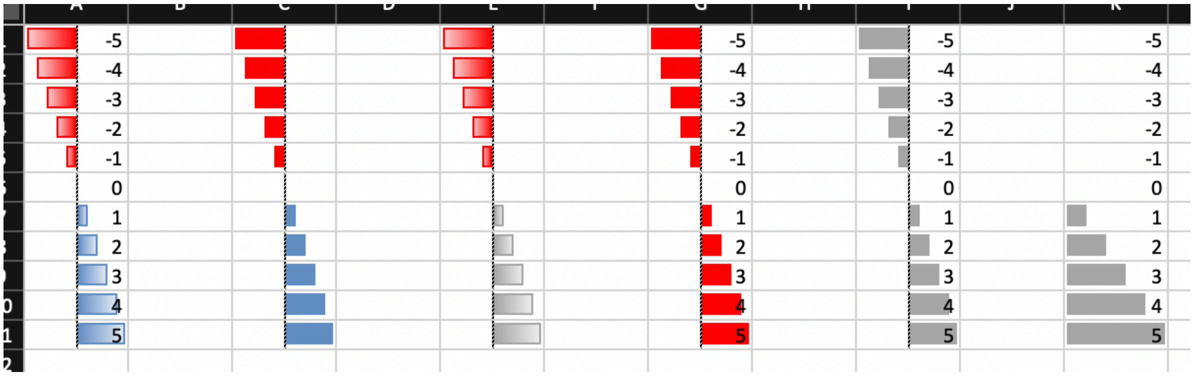
13.19 Unique Values



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

```r
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")
```

14 Databars

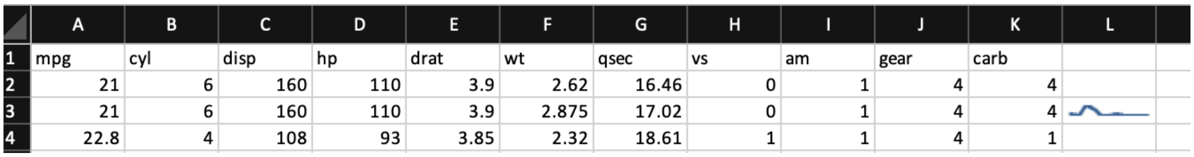


A	B	C	D	E	F	G	H	I	J	K
-5						-5		-5		-5
-4						-4		-4		-4
-3						-3		-3		-3
-2						-2		-2		-2
-1						-1		-1		-1
0						0		0		0
1						1		1		1
2						2		2		2
3						3		3		3
4						4		4		4
5						5		5		5

```r
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)
)
```

15 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	

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

16 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.

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

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

16.1 Add plot to workbook

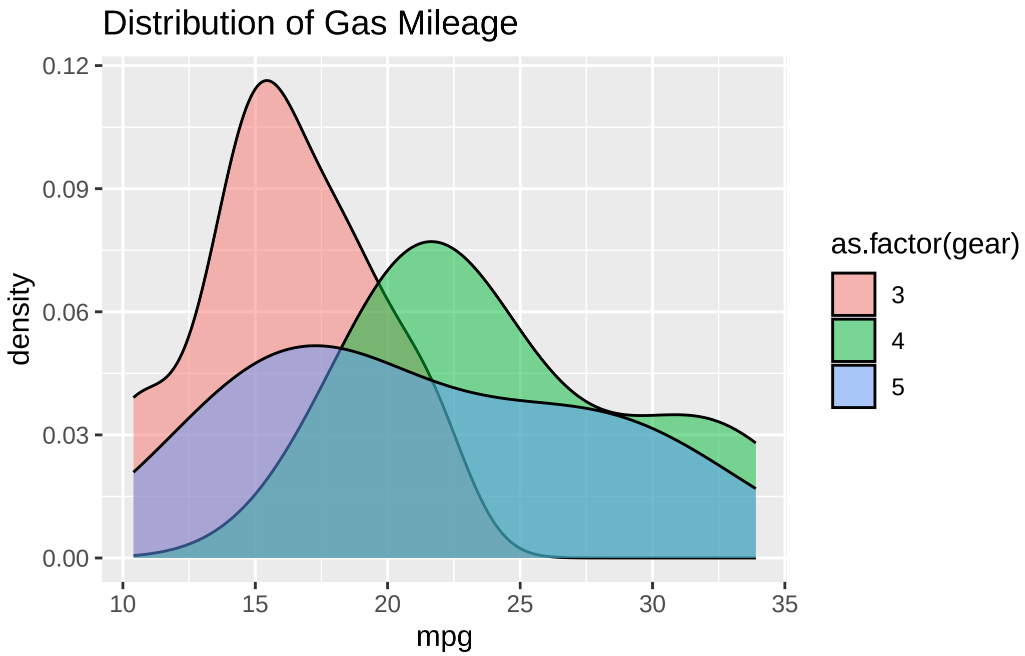
You can include any image in PNG or JPEG format. Simply open a device and save the output and pass it to the worksheet with `wb_add_image()`.

```r
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)
```

16.2 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
```



16.3 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
```

16.4 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")
)
```

```r
# 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
```

17 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.

18 Simple formulas

```r
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()
```

19 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()
```

20 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()
```

21 Cell error handling

```
# wb_add_ignore_error()
```

22 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()
```

23 `dataTable` formulas[1]

23.0.0.1 `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`

```r
## 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)
```

[1] this 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 lets 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$gross_profit       <- "daily_sales[[#This Row],[sales_price]] - daily_sales[[
example_data$total_COGS        <- "daily_sales[[#This Row],[COGS]] * daily_sales[[#This Ro
example_data$total_sales       <- "daily_sales[[#This Row],[sales_price]] * daily_sales[[#
example_data$total_gross_profit <- "daily_sales[[#This Row],[total_sales]] - daily_sales[[
class(example_data$gross_profit)       <- c(class(example_data$gross_profit),       "formu
class(example_data$total_COGS)        <- c(class(example_data$total_COGS),          "formu
```

```r
class(example_data$total_sales)        <- c(class(example_data$total_sales),         "formu
class(example_data$total_gross_profit) <- c(class(example_data$total_gross_profit), "formu
```

```r
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]	=[@COGS] * [@sales_quantity]	=[@sales_price] * [@sales_quantity]	=[@[total_sales]] - [@[total_COGS]]
3	30	11	2	=[@sales_price] - [@COGS]	=[@COGS] * [@sales_quantity]	=[@sales_price] * [@sales_quantity]	=[@[total_sales]] - [@[total_COGS]]
4	40	13	3	=[@sales_price] - [@COGS]	=[@COGS] * [@sales_quantity]	=[@sales_price] * [@sales_quantity]	=[@[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]]

```r
#### 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.
```

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

24 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.

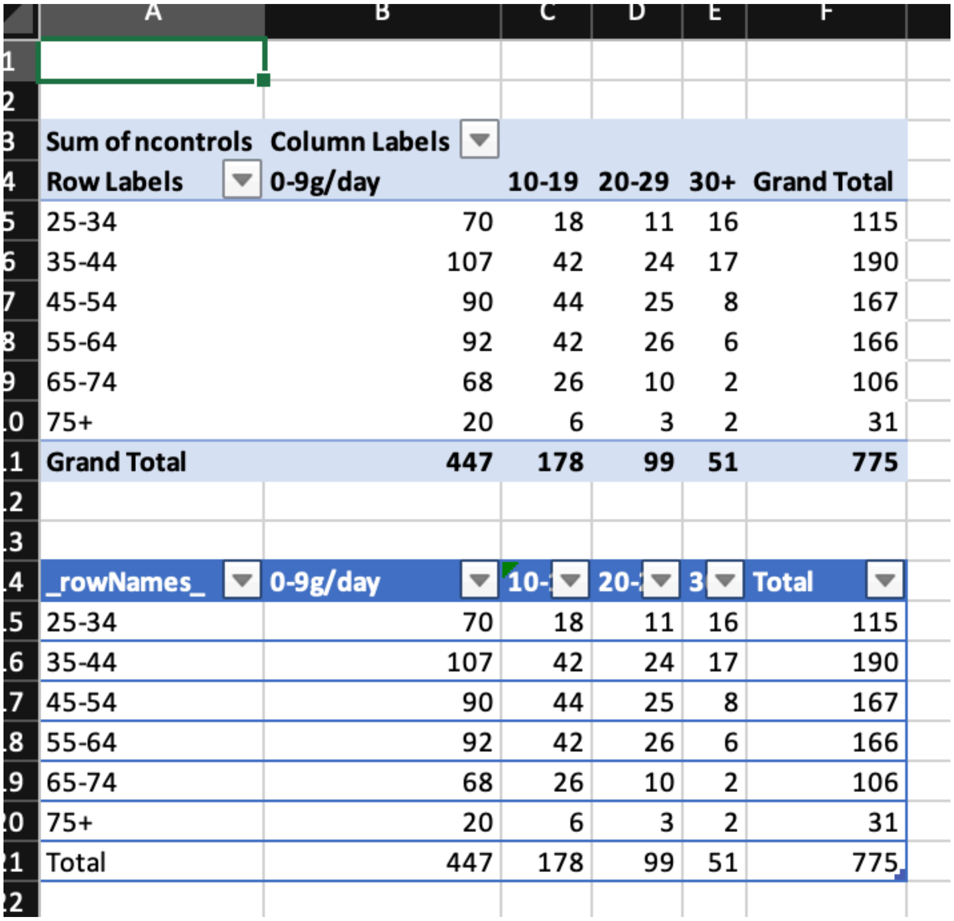
The state of pivot tables is now that they work quite well, though they bring a few features users should be aware of. Most importantly, our function only provides the spreadsheet with an instruction set how to create the pivot table, while the actual sheet where the table is supposed to appear remains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

Please, though, be a little careful if you start experimenting with pivot table params as there are actual cases, where the instruction set results into spreadsheet software crashes. Make copies and try to prevent some headaches afterwards.

24.1 Adding pivot tables

```r
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()
```



Sum of ncontrols	Column Labels				
Row Labels	0-9g/day	10-19	20-29	30+	Grand 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
Grand Total	447	178	99	51	775

rowNames	0-9g/day	10-	20-	3	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

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]

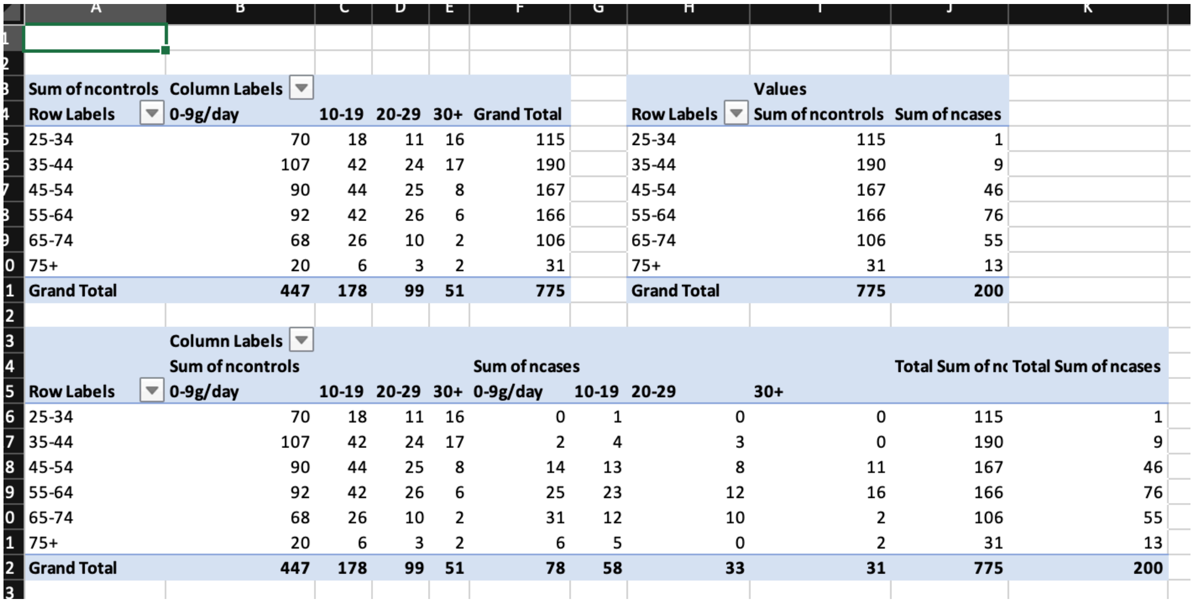
24.1.1 Filter, row, column, and data

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.

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

[1] It 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.

```r
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",
```



Sum of ncontrols	Column Labels ▼				
Row Labels ▼	0-9g/day	10-19	20-29	30+	Grand 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
Grand Total	447	178	99	51	775

	Values	
Row Labels ▼	Sum of ncontrols	Sum of ncases
25-34	115	1
35-44	190	9
45-54	167	46
55-64	166	76
65-74	106	55
75+	31	13
Grand Total	775	200

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

24.1.2 Sorting

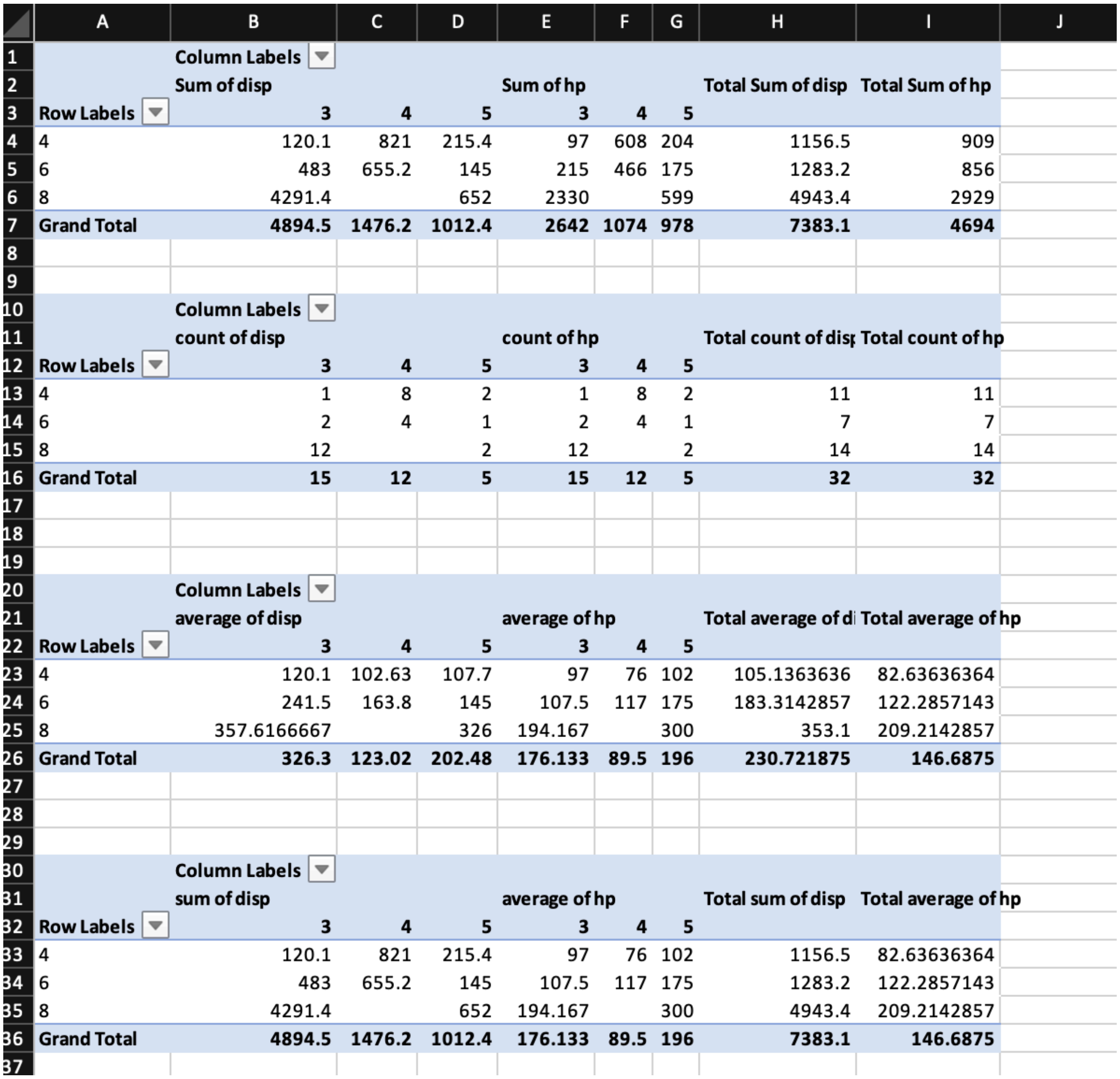
Using `sort_item` it is possible to order the pivot table. `sort_item` can take either integers or characters, the latter is beneficial in cases as below, where the variable you want to sort is a factor. Though, be aware that pivot table uses a different approach to distinct unique elements and that `Berlin` and `BERLIN` are identical to it. You can check for distinct cases with `openxlsx2:::distinct()`.

```r
library(openxlsx2)

tbl_prueba_2 <- data.frame(
  var_1 = as.Date(rep(
    c(
      "2023-02-01", "2023-03-01", "2023-04-01", "2023-05-01", "2023-06-01",
      "2023-07-01", "2023-08-01", "2023-09-01", "2023-10-01", "2023-11-01",
      "2023-12-01", "2024-01-01", "2024-02-01", "2024-03-01"
    ),
    each = 2L
  )),
  var_2 = rep(2:15, each = 2L),
  year = rep(c(2023, 2024), c(22L, 6L)),
  month = ordered(
    rep(
      c(
        "Feb", "Mar", "Apr", "May", "Jun", "Jul", "Aug", "Sep", "Oct", "Nov", "Dec",
        "Jan", "Feb", "Mar"
      ),
      each = 2L
    ),
    levels = c("Jan", "Feb", "Mar", "Apr", "May", "Jun", "Jul", "Aug", "Sep", "Oct", "Nov"
  )
)


wb_1 <- wb_workbook() |>
  wb_add_worksheet() |>
  wb_add_data(x = tbl_prueba_2)

df <- wb_data(wb_1)

wb_1 <- wb_1 |>
  wb_add_pivot_table(
    x = df,
    cols = c("year", "month"),
    data = "var_2",
    fun = "sum",
    params = list(
      sort_item = list(month = rev(levels(tbl_prueba_2$month)))
    )
  )

if (interactive()) wb_1$open()
```

24.1.3 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. Each data variable can use a different function.

```r
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
```

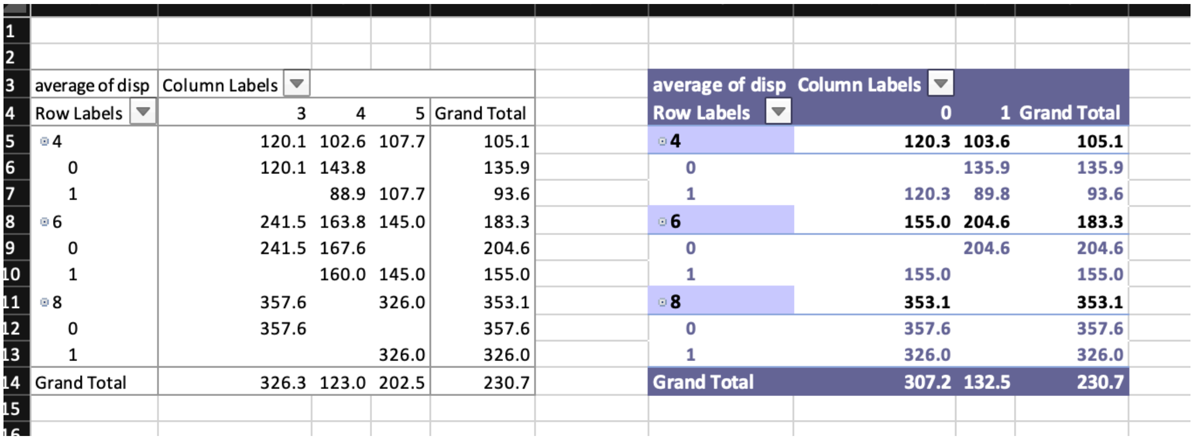


	A	B	C	D	E	F	G	H	I	J
1		Column Labels ▼								
2		Sum of disp			Sum of hp			Total Sum of disp	Total Sum of hp	
3	Row Labels ▼	3	4	5	3	4	5			
4	4	120.1	821	215.4	97	608	204	1156.5	909	
5	6	483	655.2	145	215	466	175	1283.2	856	
6	8	4291.4		652	2330		599	4943.4	2929	
7	**Grand Total**	**4894.5**	**1476.2**	**1012.4**	**2642**	**1074**	**978**	**7383.1**	**4694**	
8										
9										
10		Column Labels ▼								
11		count of disp			count of hp			Total count of dis	Total count of hp	
12	Row Labels ▼	3	4	5	3	4	5			
13	4	1	8	2	1	8	2	11	11	
14	6	2	4	1	2	4	1	7	7	
15	8	12		2	12		2	14	14	
16	**Grand Total**	**15**	**12**	**5**	**15**	**12**	**5**	**32**	**32**	
17										
18										
19										
20		Column Labels ▼								
21		average of disp			average of hp			Total average of di	Total average of hp	
22	Row Labels ▼	3	4	5	3	4	5			
23	4	120.1	102.63	107.7	97	76	102	105.1363636	82.63636364	
24	6	241.5	163.8	145	107.5	117	175	183.3142857	122.2857143	
25	8	357.6166667		326	194.167		300	353.1	209.2142857	
26	**Grand Total**	**326.3**	**123.02**	**202.48**	**176.133**	**89.5**	**196**	**230.721875**	**146.6875**	
27										
28										
29										
30		Column Labels ▼								
31		sum of disp			average of hp			Total sum of disp	Total average of hp	
32	Row Labels ▼	3	4	5	3	4	5			
33	4	120.1	821	215.4	97	76	102	1156.5	82.63636364	
34	6	483	655.2	145	107.5	117	175	1283.2	122.2857143	
35	8	4291.4		652	194.167		300	4943.4	209.2142857	
36	**Grand Total**	**4894.5**	**1476.2**	**1012.4**	**176.133**	**89.5**	**196**	**7383.1**	**146.6875**	
37										

24.1.4 Styling pivot tables

There is no real support for individual pivot table styles. Aside from the default style, it is possible to disable the style and to apply auto format styles (for various styles see annex `G.3 - Built-in PivotTable AutoFormats` of ECMA-376-1 (2016)). In the example below style id `4099` is applied, ids range from `4096` to `4117`.

```
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(
      apply_alignment_formats    = TRUE,
      apply_number_formats       = TRUE,
      apply_border_formats       = TRUE,
      apply_font_formats         = TRUE,
      apply_pattern_formats      = TRUE,
      apply_width_height_formats = TRUE,
      auto_format_id             = 4099,
      numfmt = c(formatCode = "##0.0")
    )
  )

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

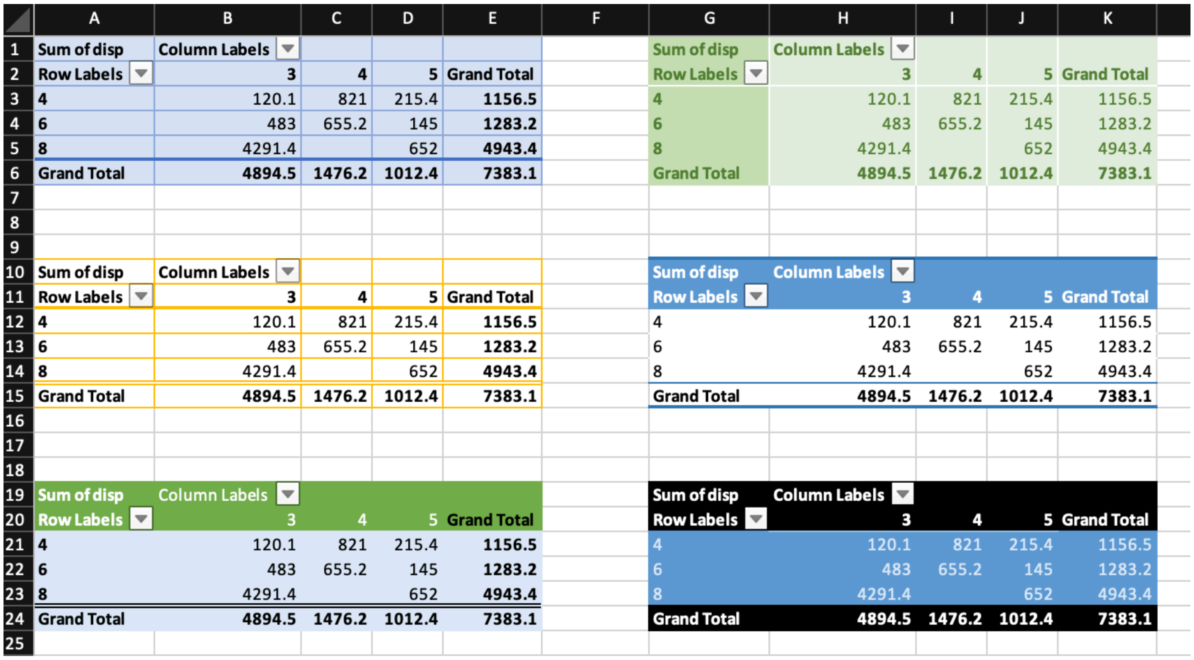


average of disp	Column Labels			
Row Labels	3	4	5	Grand Total
⊖4	120.1	102.6	107.7	105.1
0	120.1	143.8		135.9
1		88.9	107.7	93.6
⊖6	241.5	163.8	145.0	183.3
0	241.5	167.6		204.6
1		160.0	145.0	155.0
⊖8	357.6		326.0	353.1
0	357.6			357.6
1			326.0	326.0
Grand Total	326.3	123.0	202.5	230.7

average of disp	Column Labels		
Row Labels	0	1	Grand Total
⊖4	120.3	103.6	105.1
0		135.9	135.9
1	120.3	89.8	93.6
⊖6	155.0	204.6	183.3
0		204.6	204.6
1	155.0		155.0
⊖8	353.1		353.1
0	357.6		357.6
1	326.0		326.0
Grand Total	307.2	132.5	230.7

With `params` it is possible to tweak many pivot table arguments such as `params = list(col_header_caption = "test caption")`. This way it is also possible to apply built in pivot table styles. The default is `PivotStyleLight16` (for more built in styles see `G.1 Built-in Table Styles` of ECMA-376-1 (2016)).

```
library(openxlsx2)

wb <- wb_workbook()$
  add_worksheet("table")$
  add_worksheet("data")$add_data(x = mtcars)

df <- wb_data(wb)

wb$add_pivot_table(df, sheet = "table", dims = "A1", rows = "cyl", cols = "gear", data = "
wb$add_pivot_table(df, sheet = "table", dims = "A10", rows = "cyl", cols = "gear", data =
wb$add_pivot_table(df, sheet = "table", dims = "A19", rows = "cyl", cols = "gear", data =

wb$add_pivot_table(df, sheet = "table", dims = "G1", rows = "cyl", cols = "gear", data = "
wb$add_pivot_table(df, sheet = "table", dims = "G10", rows = "cyl", cols = "gear", data =
wb$add_pivot_table(df, sheet = "table", dims = "G19", rows = "cyl", cols = "gear", data =

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

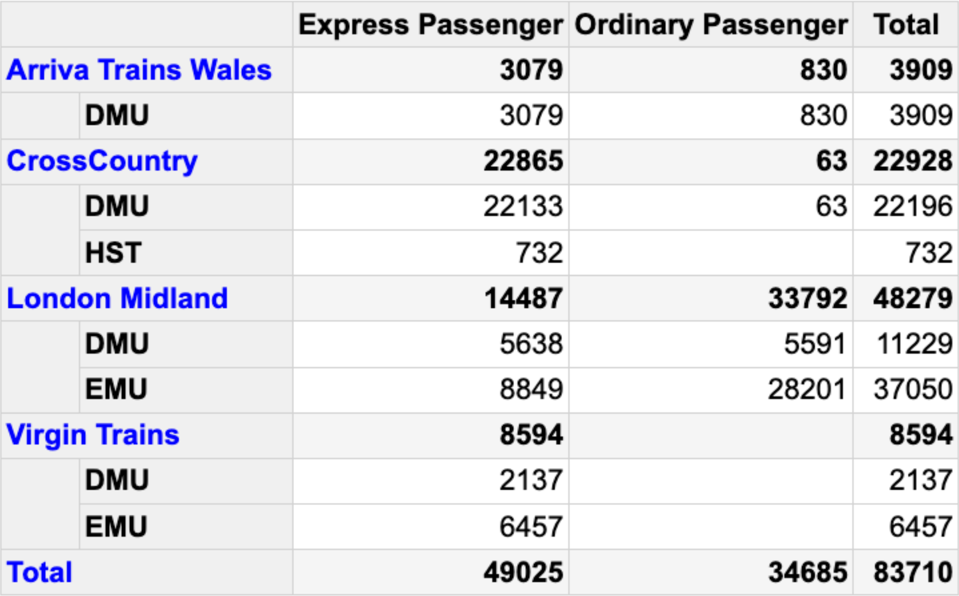


	A	B	C	D	E	F	G	H	I	J	K
1	Sum of disp	Column Labels ▼					Sum of disp	Column Labels ▼			
2	Row Labels ▼	3	4	5	Grand Total		Row Labels ▼	3	4	5	Grand Total
3	4	120.1	821	215.4	1156.5		4	120.1	821	215.4	1156.5
4	6	483	655.2	145	1283.2		6	483	655.2	145	1283.2
5	8	4291.4		652	4943.4		8	4291.4		652	4943.4
6	Grand Total	4894.5	1476.2	1012.4	7383.1		Grand Total	4894.5	1476.2	1012.4	7383.1
7											
8											
9											
10	Sum 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	821	215.4	1156.5		4	120.1	821	215.4	1156.5
13	6	483	655.2	145	1283.2		6	483	655.2	145	1283.2
14	8	4291.4		652	4943.4		8	4291.4		652	4943.4
15	Grand Total	4894.5	1476.2	1012.4	7383.1		Grand Total	4894.5	1476.2	1012.4	7383.1
16											
17											
18											
19	Sum of disp	Column Labels ▼					Sum of disp	Column Labels ▼			
20	Row Labels ▼	3	4	5	Grand Total		Row Labels ▼	3	4	5	Grand Total
21	4	120.1	821	215.4	1156.5		4	120.1	821	215.4	1156.5
22	6	483	655.2	145	1283.2		6	483	655.2	145	1283.2
23	8	4291.4		652	4943.4		8	4291.4		652	4943.4
24	Grand Total	4894.5	1476.2	1012.4	7383.1		Grand Total	4894.5	1476.2	1012.4	7383.1
25											

24.1.5 Pivot table `dims`

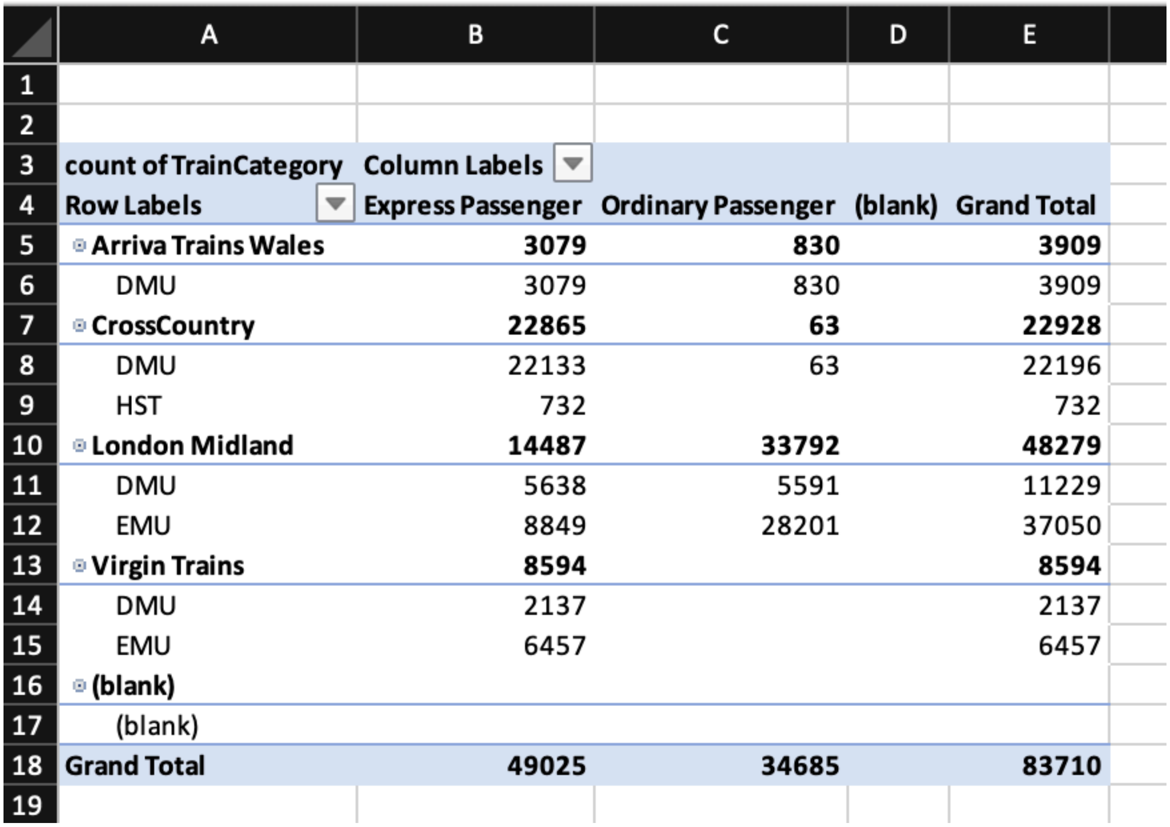
It is possible to use dims without end row. This way the entire column is used as input. This obviously is slower than using a fixed range, because the `wb_data()` object will contain each possible row. This is

```
# original pivot table as reference
library(pivottabler)

pt <- PivotTable$new()
pt$addData(bhmtrains)
pt$addColumnDataGroups("TrainCategory")
pt$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**

```r
# 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()
```



	A	B	C	D	E
1					
2					
3	**count of TrainCategory**	**Column Labels** ▾			
4	**Row Labels** ▾	**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					

24.1.6 Using number formats

```r
## 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 = "#")
  ))
```

24.2 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(). For this to work you have to provide a name for a pivot table name you are going to add and make sure that the slicer variable is actually 'activated' in the pivot table. Adding slicers to loaded pivot tables is not possible and the creation of slicers needs to go hand in hand with a pivot table.

It is possible to apply slicer styles with params = list(style = "SlicerStyleLight2")

```
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", style = "SlicerStyleLight2"))

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

It is possible to tweak the number of columns in a slicer using columnCount and to add a caption and change the sorting order to descending.

```
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
```

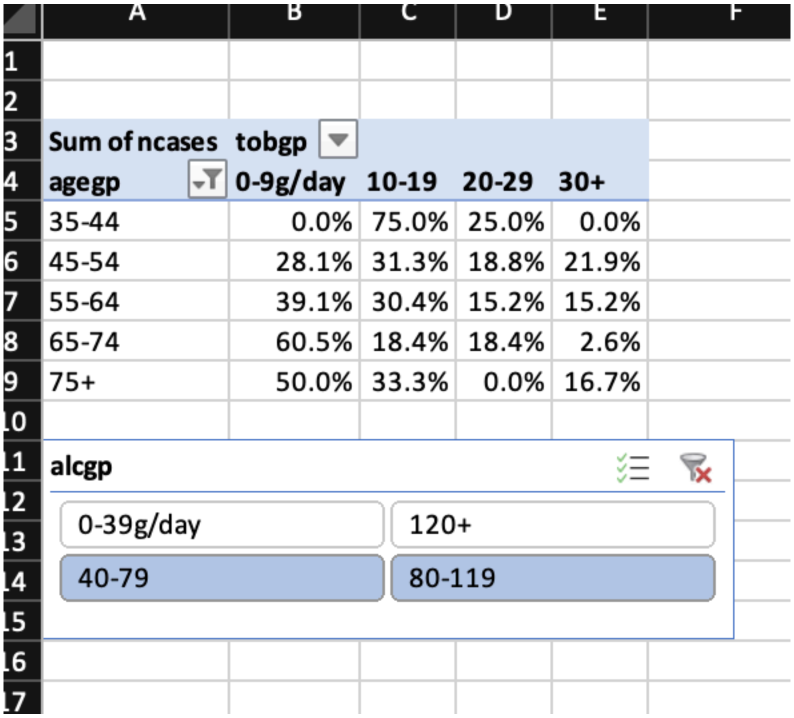
```
wb$
  # first pivot
  add_pivot_table(
    df, dims = "A3", slicer = varname, rows = "cyl", cols = "gear", data = "disp",
    pivot_table = "mtcars"
  )$
  add_slicer(x = df, sheet = current_sheet(), slicer = "vs", pivot_table = "mtcars")$
  add_slicer(x = df, dims = "B18:D24", sheet = current_sheet(),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

24.3 Choosing variable filters

Using the `choose` param argument it is possible to select subsets of the data. The code looks like this: `choose = c(agegp = 'x > "25-34"')`. The variable name as seen in the `wb_data()` object, `x` is mandatory and some expression that R understands. This can be something like `%in%`, `==`, `<`, `>`, or `!=`.

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

df <- wb_data(wb)
```

```r
# 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()
```



Sum of ncases	tobgp			
agegp	0-9g/day	10-19	20-29	30+
35-44	0.0%	75.0%	25.0%	0.0%
45-54	28.1%	31.3%	18.8%	21.9%
55-64	39.1%	30.4%	15.2%	15.2%
65-74	60.5%	18.4%	18.4%	2.6%
75+	50.0%	33.3%	0.0%	16.7%

24.4 Final remarks

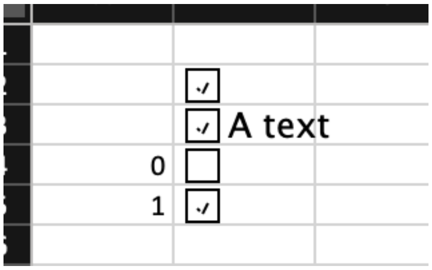
As of now it is not possible to add charts to pivot tables. This would require pivot table evaluation to construct the `wb_data()` object to use for and access to the area where the pivot table is stored on the sheet.

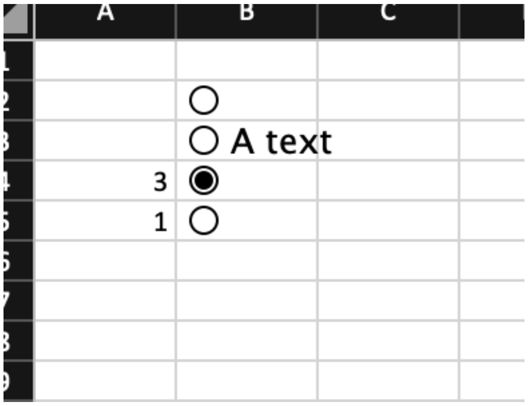
It is always a good idea to check that the constructed pivot table and the expected pivot table match. Either construct the pivot table manually or as shown here via `pivottabler` or maybe with either `data.table` or `dplyr`. It is a little tricky for `openxlsx2` to check if the pivot table works, when we have no real way to validate that it does.

There are still missing features such as `timelines` and it is currently not possible to calculate fields in pivot tables. Please note that this is also not something we are currently developing.

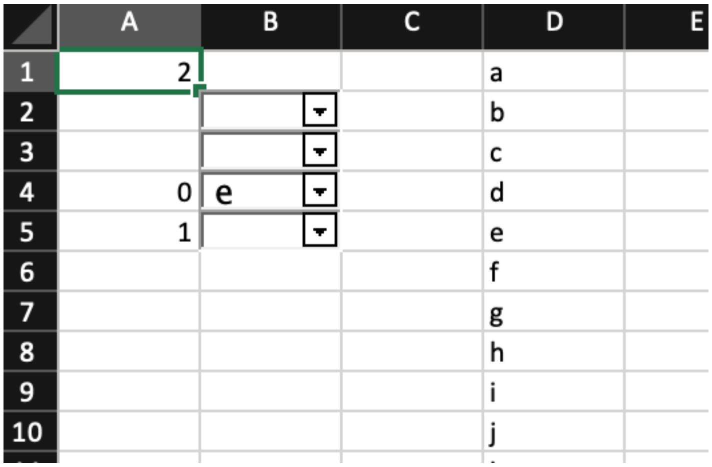
25 Form control

```
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)
```





	A	B	C
1			
2		○	
3		○ A text	
4	3	●	
5	1	○	
6			
7			
8			
9			



	A	B	C	D	E
1	2			a	
2				b	
3				c	
4	0	e		d	
5	1			e	
6				f	
7				g	
8				h	
9				i	
10				j	

26 Extending openxlsx2

```r
library(openxlsx2)
```

26.1 msoc - Encrypting / Decrypting workbooks

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

```r
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/RtmpdWjkcz/temp_xlsx_1ec07d2aa011.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/RtmpdWjkcz/temp_xlsx_1ec07d2aa011.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
```

26.2 `flexlsx` - Exporting `flextable` to workbooks

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

```r
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()
```

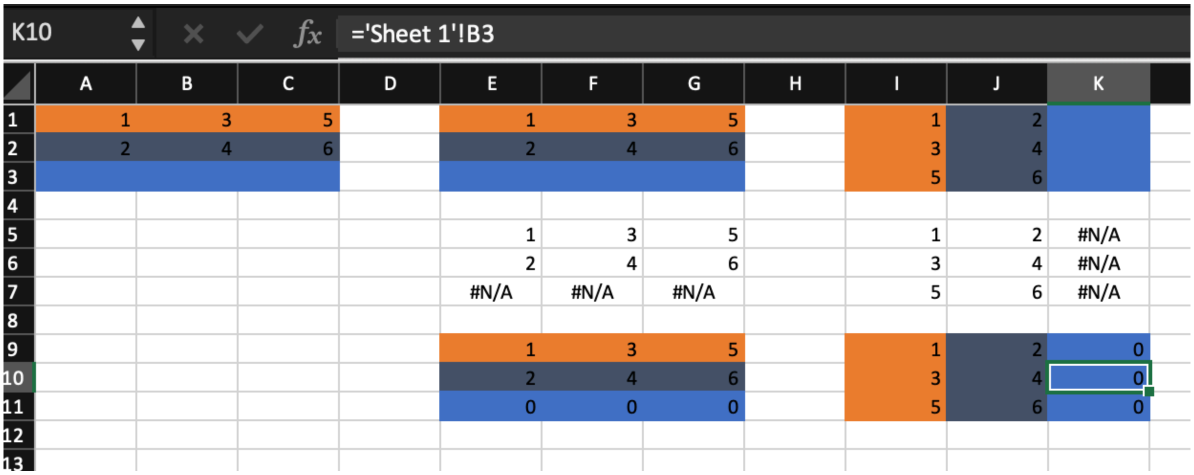
27 Cloning and copying

When using openxlsx2 there are multiple ways to modify the workbook including various ways to copy and clone sheets, cells and styles.

27.1 Copying cells

It is possible to copy cells into different regions of the worksheet using wb_copy_cells(). There are three ways to copy cells: (1) as is, including styles, (2) as value replacing all formulas and (3) as reference to the cell origin. This can be seen in the following image, the transposed cell contains a formula pointing to the original cell.

```r
mm <- matrix(1:6, 2)
wb <- wb_workbook()$add_worksheet()$
  add_data(x = mm, col_names = FALSE)$
  add_fill(dims = "A1:C1", color = wb_color(theme = 5))$
  add_fill(dims = "A2:C2", color = wb_color(theme = 3))$
  add_fill(dims = "A3:C3", color = wb_color(theme = 4))

dat <- wb_data(wb, dims = "A1:C3", col_names = FALSE)

wb$copy_cells(dims = "E1", data = dat)
wb$copy_cells(dims = "E5", data = dat, as_value = TRUE)
wb$copy_cells(dims = "E9", data = dat, as_ref   = TRUE)

wb$copy_cells(dims = "I1", data = dat, transpose = TRUE)
wb$copy_cells(dims = "I5", data = dat, transpose = TRUE, as_value = TRUE)
wb$copy_cells(dims = "I9", data = dat, transpose = TRUE, as_ref   = TRUE)

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



K10 ='Sheet 1'!B3

	A	B	C	D	E	F	G	H	I	J	K
1	1	3	5		1	3	5		1	2	
2	2	4	6		2	4	6		3	4	
3									5	6	
4											
5					1	3	5		1	2	#N/A
6					2	4	6		3	4	#N/A
7					#N/A	#N/A	#N/A		5	6	#N/A
8											
9					1	3	5		1	2	0
10					2	4	6		3	4	0
11					0	0	0		5	6	0
12											
13											

27.2 Cloning worksheets

Sometimes it is not enough to copy a cell range, sometimes you need to copy entire worksheets. This can be done using `wb_clone_worksheet()`. You can clone a worksheet in a workbook, but also across workbooks, though the first option is simpler and might provide more features. Cloning worksheets around that contain (pivot) tables and slicers for instance might be impossible and some other features of the workbook might also not be present. In addition it is not guaranteed that a clone will look identical to the original worksheet if relative theme colors are used. As always, be careful if you use this feature and test that it works, before you start cloning production worksheets.

```r
fl <- system.file("extdata", "oxlsx2_sheet.xlsx", package = "openxlsx2")
wb_from <- wb_load(fl)

# clone worksheet from SUM to NOT_SUM
wb_from$clone_worksheet(old = "SUM", new = "NOT_SUM")

# clone worksheet across workbooks including styles and shared strings
wb$clone_worksheet(old = "SUM", new = "SUM", from = wb_from)
```

28 Upgrade from openxlsx

28.1 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).

28.1.1 Read xlsx or xlsm 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.

28.2 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)
```

28.3 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.

28.3.1 Loading a workbook

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

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

In `openxlsx2` loading was changed to:

```r
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

28.3.2 Styles

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

```r
# 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:

```r
# 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.

28.3.3 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")
```

28.3.4 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)
  )
```

28.3.5 Saving

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

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