Study Guide: Data Manipulation with R

Main concepts

❒ **File management** – The table below summarizes the useful commands to make sure the working directory is correctly set:

Category	Action	Command
Paths	Change directory to another path	setwd(path)
	Get current working directory	getwd()
	Join paths	file.path(path_1, ..., path_n)
Files	List files and folders in a given directory	list.files(path, include.dirs=TRUE)
	Check if path is a file / folder	file_test('-f', path)
		file_test('-d', path)
	Read / write csv file	read.csv(path_to_csv_file)
		write.csv(df, path_to_csv_file)

❒ **Chaining** – The symbol %>%, also called "pipe", enables to have chained operations and provides better legibility. Here are its different interpretations:

- f(arg_1, arg_2, ..., arg_n) is equivalent to arg_1%>%f(arg_2, arg_3, ..., arg_n) , and also to:
  - arg_1%>%f(., arg_2, ..., arg_n)
  - arg_2%>%f(arg_1, ., arg_3, ..., arg_n)
  - arg_n%>%f(arg_1, ..., arg_n-1, .)
- A common use of pipe is when a dataframe df gets first modified by some_operation_1, then some_operation_2, until some_operation_nin a sequential way. It is done as follows:

R

```
# df gets some_operation_1, then some_operation_2, ..., # then
some_operation_n
df%>%
    some_operation_1%>%
    some_operation_2%>%
       ...          %>%
   some_operation_n
```

❒ **Exploring the data** – The table below summarizes the main functions used to get a complete overview of the data:

Category	Action	Command
Look at data	Select columns of interest	df%>%select(col_list)
	Remove unwanted columns	df%>%select(-col_list)
	Look at n first rows / last rows	df%>%head(n) / df%>%tail(n)
	Summary statistics of columns	df%>%summary()
Data types	Data types of columns	df%>%str()
	Number of rows / columns	df%>%NROW() / df%>%NCOL()

❒ **Data types** – The table below sums up the main data types that can be contained in columns:

Data type	Description	Example
character	String-related data	'teddy bear'
factor	String-related data that can be put in bucket, or ordered	'high'
numeric	Numerical data	24.0
int	Numeric data that are integer	24
Date	Dates	'2020-01-01'
POSIXct	Timestamps	'2020-01-01 00:01:00'

Data preprocessing

❒ **Filtering** – We can filter rows according to some conditions as follows:

R

```
df%>%
  filter(some_col some_operation some_value_or_list_or
```

where some_operation is one of the following:

Category	Operation	Command
Basic	Equality / non-equality	== / !=
	Inequalities	<, <=, >=, >
	And / or	& / |
Advanced	Check for missing value	is.na()
	Belonging	%in%(val_1, ..., val_n)
	Pattern matching	%like%'val'

Remark: we can filter columns with the select_if command.

❒ **Changing columns** – The table below summarizes the main columnoperations:

Action	Command
Add new columns on top of old ones	df%>%mutate(new_col=operation(other_cols))
Add new columns and discard old ones	df%>%transmute(new_col=operation(other_cols))
Modify several columns in-place	df%>%mutate_at(vars, funs)
Modify all columns in-place	df%>%mutate_all(funs)
Modify columns fitting a specific condition	df%>%mutate_if(condition, funs)
Unite columns	df%>%unite(new_merged_col, old_cols_list)
Separate columns	df%>%separate(col_to_separate, new_cols_list)

❒ **Conditional column** – A column can take different values with respect to a particular set of conditions with the case_when() command asfollows:

R

```
case_when(condition_1 ~ value_1, # If condition_1 then value_1
          condition_2 ~ value_2, # If condition_2 then value_2
          ...
          TRUE ~ value_n)          # Otherwise, value_n
```

Remark: the ifelse(condition_if_true, value_true, value_other) can be used and is easier to manipulate if there is only one condition.

❒ **Mathematical operations** – The table below sums up the main mathematical operations that can be performed on columns:

Operation	Command
$\sqrt{x}$	sqrt(x)
|x∫	floor(x)
|x|	ceiling(x)

❒ **Datetime conversion** – Fields containing datetime values can be stored in two different POSIXt data types:

Action	Command
Converts to datetime with seconds since origin	as.POSIXct(col, format)
Converts to datetime with attributes (e.g. time zone)	as.POSIXlt(col, format)

where formatis a string describing the structure of the field and using the commands summarized in the table below:

Category	Command	Description	Example
Year	'%Y' / '%y'	With / without century	2020 / 20
Month	'%B' / '%b' / '%m'	Full / abbreviated / numerical	August / Aug/ 8
Weekday	'%A' / '%a'	Full / abbreviated	Sunday / Sun
	'%u' / '%w'	Number (1-7) / Number (0-6)	7 / 0
Day	'%d' / '%j'	Of the month / of the year	09 / 222
Time	'%H' / '%M'	Hour / minute	09 / 40
Timezone	'%Z' / '%z'	String / Number of hours from UTC	EST / -0400

Remark: data frames only accept datetime in POSIXct format.

❒ **Date properties** – In order to extract a date-related property from a datetime object, the following command is used:

R

```
format(datetime_object, format)
```

where format follows the same convention as in the table above.

Data frame transformation

❒ **Merging data frames** – We can merge two data frames by a given field asfollows:

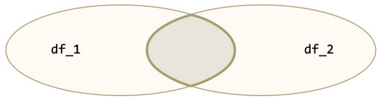
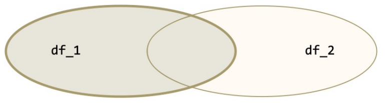
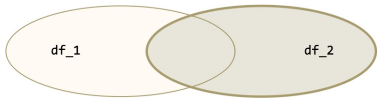
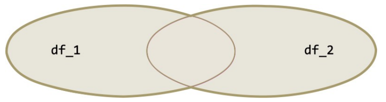
R

```
merge(df_1, df_2, join_field, join_type)
```

where join_field indicates fields where the join needs to happen:

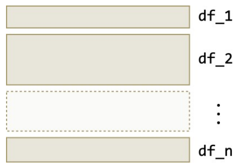
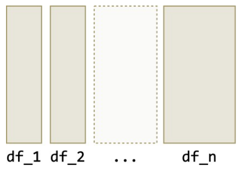
Case	Fields are equal	Different field names
Command	by='field'	by.x='field_1', by.y='field_2'

and where join_type indicates the join type, and is one of the following:

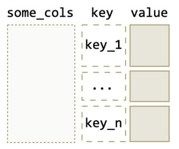
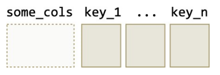
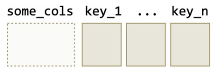
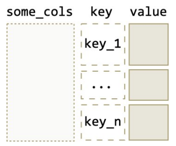
Join type	Option	Illustration
Inner join	default	
Left join	all.x=TRUE	
Right join	all.y=TRUE	
Full join	all=TRUE	

Remark: if the by *parameter is not specified, the merge will be a cross join.*

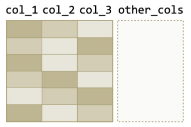
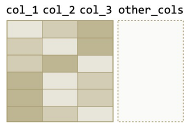
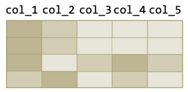
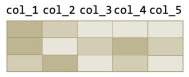
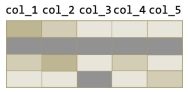
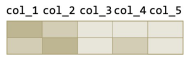
❒ **Concatenation** – The table below summarizes the different ways data frames can be con- catenated:

Type	Command	Illustration
Rows	rbind(df_1, ..., df_n)	
Columns	cbind(df_1, ..., df_n)	

❒ **Common transformations** – The common data frame transformations are summarized in the table below:

Type	Command	Illustration	
		Before	After
Long to wide	spread(df, key='key', value='value')		
Wide to long	gather(df, key='key' value='value', c(key_1, ..., key_n))		

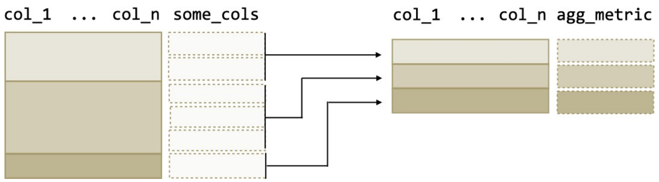
❒ **Row operations** – The following actions are used to make operations on rows of the data frame:

Action	Command	Illustration	
		Before	After
Sort with respect to columns	df%>% arrange(col_1, ..., col_n)		
Dropping duplicates	df%>%unique()		
Drop rows with at least a null value	df%>%na.omit()		

Remark: by default, the arrange command sorts in ascending order. If we want to sort it in descending order, the - command needs to be used before a column.

Aggregations

❒ **Grouping data** – Aggregate metrics are computed across groups asfollows:



The R command is as follows:

R

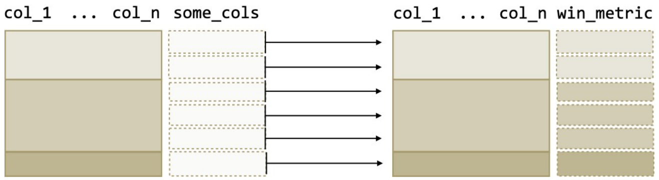
```
df%>%                                              # Ungrouped data frame
  group_by(col_1, ..., col_n)%>%                   # Group by some columns
summarize(agg_metric=some_aggregation(some_cols))  # Aggregation step
```

❒ **Aggregate functions**– The table below summarizes the main aggregate functions that can be used in an aggregation query:

Category	Action	Command
Properties	Count of observations	n()
Values	Sum of values of observations	sum()
	Max / min of values of observations	max() / min()
	Mean / median of values of observations	mean() / median()
	Standard deviation / variance across observations	sd() / var()

Window functions

❒ **Definition** – A window function computes a metric over groups and has the following structure:



The R command is as follows:

R

```
df%>%                                    # Ungrouped data frame
  group_by(col_1, ..., col_n)%>%         # Group by some columns
  mutate(win_metric=window_function(col))  # Window function
```

Remark: applying a window function will not change the initial number of rows of the data frame.

❒ **Row numbering** – The table below summarizes the main commands that rank each row across specified groups, ordered by a specific field:

Join type	Command	Example
row_number(x)	Ties are given different ranks	1, 2, 3, 4
rank(x)	Ties are given same rank and skip numbers	1, 2.5, 2.5, 4
dense_rank(x)	Ties are given same rank and do not skip numbers	1, 2, 2, 3

❒ **Values** – The following window functions allow to keep track of specific types of values with respect to the group:

Command	Description
first(x)	Takes the first value of the column
last(x)	Takes the last value of the column
lag(x, n)	Takes the n^{th} previous value of the column
lead(x, n)	Takes the n^{th} following value of the column
nth(x, n)	Takes the n^{th} value of the column