Study Guide: Data Visualization with R

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General structure

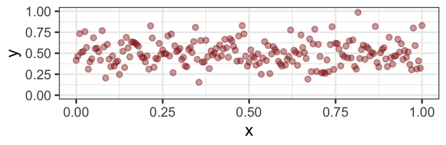
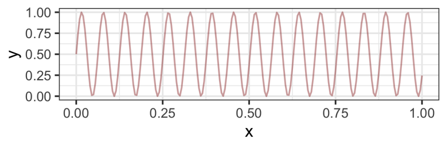
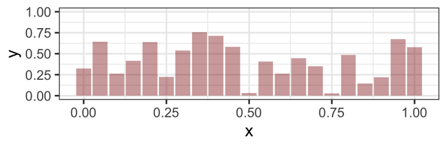
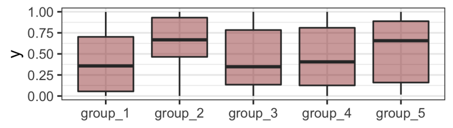
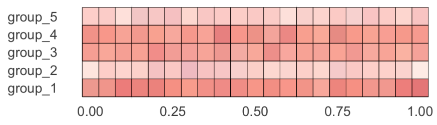
❒ **Overview** – The general structure of the code that is used to plot figures is as follows:

R
```
ggplot(...) +              # Initialization
  geom_function(...) +     # Main plot(s)
  facet_function(...) +    # Facets (optional)
  labs(...) +              # Legend (optional)
  scale_function(...) +    # Scales (optional)
  theme_function(...)      # Theme (optional)
```

We note the following points:

- The `ggplot()` layer is mandatory.
- When the `data` argument is specified inside the `ggplot()` function, it is used as default in the following layers that compose the plot command, unless otherwise specified.
- In order for features of a data frame to be used in a plot, they need to be specified inside the `aes()` function.

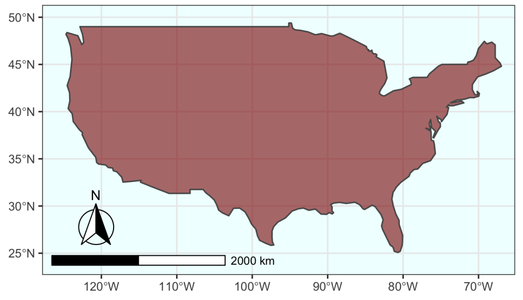
❒ **Basic plots** – The main basic plots are summarized in the table below:

Type	Command	Illustration
Scatter plot	`geom_point( x, y, color, size, fill, alpha )`	
Line plot	`geom_line( x, y, color, size, fill, alpha )`	
Bar chart	`geom_bar( x, y, color, size, fill, alpha )`	
Box plot	`geom_boxplot( x, y, color, size, fill, alpha )`	
Heatmap	`geom_tile( x, y, color, size, fill, alpha )`	

where the possible parameters are summarized in the table below:

Command	Description	Use case
`color`	Color of a line / point / border	`'red'`
`fill`	Color of an area	`'red'`
`size`	Size of a line / point	`4`
`shape`	Shape of a point	`4`
`linetype`	Shape of a line	`'dashed'`
`alpha`	Transparency, between 0 and 1	`0.3`

❒ **Maps** – It is possible to plot maps based on geometrical shapes as follows:



The following table summarizes the main commands used to plot maps:

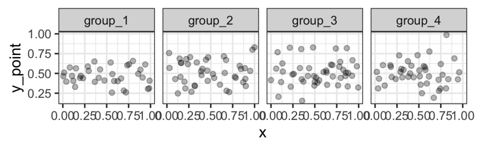
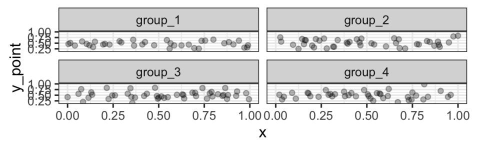
Category	Action	Command
Map	Draw polygon shapes from the `geometry` column	`geom_sf()`
Additional elements	Add and customize geographical directions	`annotation_north_arrow()`
	Add and customize distance scale	`annotation_scale()`
Range	Customize range of coordinates	`coord_sf()`

❒ **Animations** – Plotting animations can be made using the `gganimate` library. The following command gives the general structure of the code:

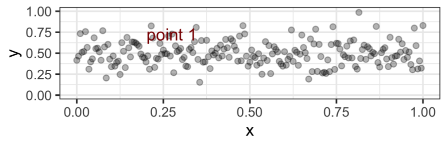
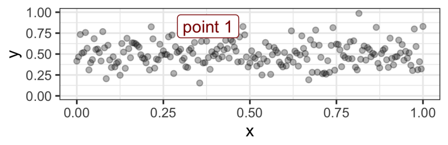
R
```
# Main plot
ggplot() +
  ... +
  transition_states(field, states_length)

# Generate and save animation
animate(plot, duration, fps, width, height, units, res, renderer)
anim_save(filename)
```

Advanced features

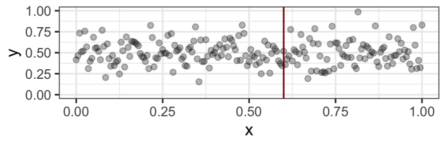
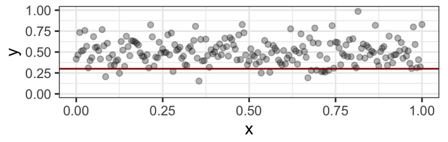
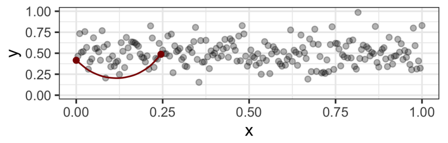
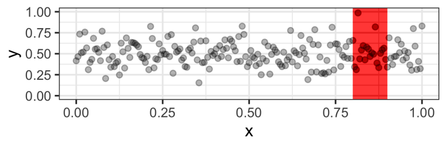
❒ **Facets** – It is possible to represent the data through multiple dimensions with facets using the following commands:

Type	Command	Illustration
Grid (1 or 2D)	`facet_grid( row_var ~ column_var )`	
Wrapped	`facet_wrap( vars(x1, ..., xn), nrow, ncol )`	

❒ **Text annotation** – Plots can have text annotations with the following commands:

Command	Illustration
`geom_text( x, y, label, hjust, vjust )`	
`geom_label_repel( x, y, label, nudge_x, nudge_y )`	

❒ **Additional elements** – We can add objects on the plot with the following commands:

Type	Command	Illustration
Line	`geom_vline( xintercept, linetype )`	
	`geom_hline( yintercept, linetype )`	
Curve	`geom_curve( x, y, xend, yend )`	
Rectangle	`geom_rect( xmin, xmax, ymin, ymax )`	

Last touch

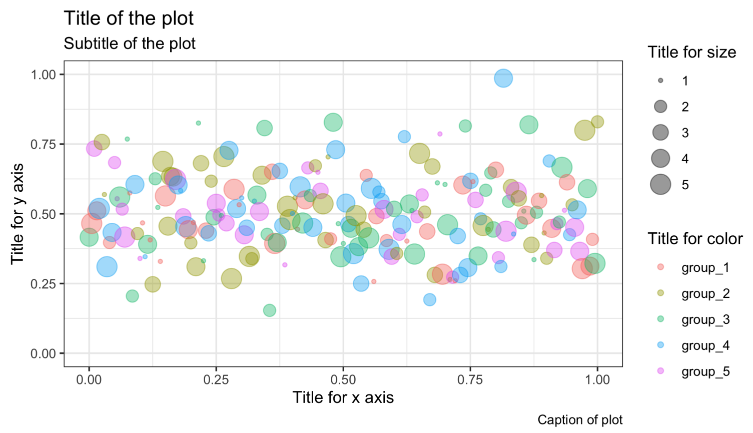
❒ **Legend** – The title of legends can be customized to the plot with the following command:

R
```
plot + labs(params)
```

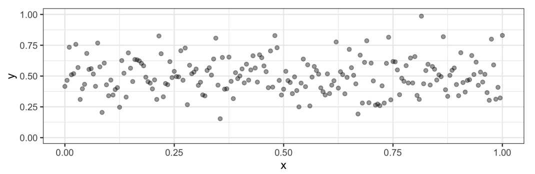
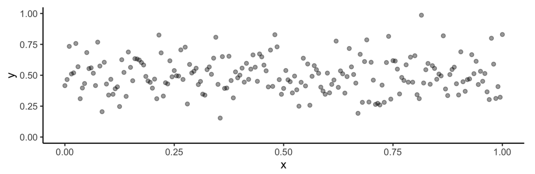
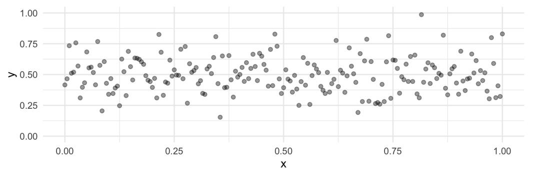
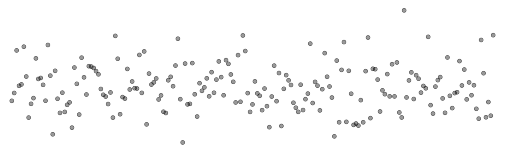
where the `params` are summarized below:

Element	Command
Title / subtitle of the plot	`title = 'text'` / `subtitle = 'text'`
Title of the x / y axis	`x = 'text'` / `y = 'text'`
Title of the size / color	`size = 'text'` / `color = 'text'`
Caption of the plot	`caption = 'text'`

This results in the following plot:



❒ **Plot appearance** – The appearance of a given plot can be set by adding the following command:

Type	Command	Illustration
Black and white	`theme_bw()`	
Classic	`theme_classic()`	
Minimal	`theme_minimal()`	
None	`theme_void()`	

In addition, `theme()` is able to adjust positions/fonts of elements of the legend.

Remark: in order to fix the same appearance parameters for all plots, the `theme_set()` *function can be used.*

❒ **Scales and axes** – Scales and axes can be changed with the following commands:

Category	Action	Command

Range	Specify range of x / y axis	`xlim(xmin, xmax)`
		`ylim(ymin, ymax)`

Nature	Display ticks in a customized manner	`scale_x_continuous()`
		`scale_x_discrete()`
		`scale_x_date()`

Magnitude	Transform axes	`scale_x_log10()`
		`scale_x_reverse()`
		`scale_x_sqrt()`

Remark: the `scale_x()` *functions are for the x axis. The same adjustments are available for the y axis with* `scale_y()` *functions.*

❒ **Double axes** – A plot can have more than one axis with the `sec.axis` option within a given scale function `scale_function()`. It is done as follows:

R
```
scale_function(sec.axis = sec_axis(~ .))
```

❒ **Saving figure** – It is possible to save figures with predefined parameters regarding the scale, width and height of the output image with the following command:

R
```
ggsave(plot, filename, scale, width, height)
```