



# Automated Visualisation of Experimental Designs

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## The Grammar of Experimental Designs

A computational framework that treats experimental design as an object that is declaratively defined by a series of composable functions.

Implemented in the **edibble** R-package.

```
library(edibble)
```

The final output is an **e**xperimental **d**esign table (or **tibble**).

## Completely Randomised Design

Suppose we have an experiment to compare high-carb and low-carb diets on the weight.

- We can gather twenty subjects in total.

```
crd <- design("Diet experiment") %>%  
  set_units(subject = 20) %>%  
  set_trts(diet = c("Low-carb", "High-carb")) %>%  
  allot_trts(diet ~ subject) %>%  
  assign_trts("random", seed = 2023) %>%  
  serve_table()
```

## Randomised Complete Block Design

We may recognise that sex is an influencing factor on the response.

- We may choose to block subjects by sex.
- We assign equal number of subjects for each sex.
- We modify the code to take this into account.

```
rcbdx <- design("Diet experiment by sex") %>%  
  set_units(sex = c("F", "M"),  
            subject = 20) %>%  
  allot_units(sex ~ subject) %>%  
  assign_units("systematic") %>%  
  set_trts(diet = c("Low-carb", "High-carb")) %>%  
  allot_trts(diet ~ subject) %>%  
  assign_trts("random", seed = 2023)
```

At this stage, the edibble design object is in a network form (a pair of directed acyclic graphs).

rcbdx

*Diet experiment by sex*

```
└sex (2 levels)  
  └subject (20 levels)  
    └diet (2 levels)
```

*Allotment:*

- diet ~ subject
- sex ~ subject

*Assignment:* random

- The same *unit structure* can alternatively be defined as below.

```
rcbd_alt <- design("Diet experiment by sex") %>%  
  set_units(sex = c("F", "M"),  
            subject = nested_in(sex, 10))
```

## Split-Plot Design

The experimenter may wish to also see the effect of exercise in addition to the diet.

- This means that we have two treatment factors with two levels.
- The *treatment structure* is then  $2 \times 2$  factorial.
- The experimenter has a constraint on allocation of exercise – it has to be done by session, which comprises of five subjects of one sex.
- Different diets can be assigned to each subject.
- The experimenter conducts two sessions for each sex.
- This constraint in the allocation of treatment results in a split-plot design.

```
spd <- design("Diet & exercise experiment") %>%  
  set_units(sex = c("F", "M"),  
            session = nested_in(sex, 2),  
            subject = nested_in(session, 5)) %>%  
  set_trts(diet = c("Low-carb", "High-carb"),  
            exercise = c("Intense", "Light")) %>%  
  allot_trts(diet ~ subject,  
            exercise ~ session) %>%  
  assign_trts("random", seed = 2023) %>%  
  serve_table()
```

The output here is in a tabular form.

spd

```
# Diet & exercise experiment  
# An edibble: 20 x 5  
  sex session  subject  diet exercise  
  <unit(2)> <unit(4)> <unit(20)> <trt(2)> <trt(2)>  
1     F session1 subject1 High-carb Light  
2     F session1 subject2 Low-carb  Light  
3     F session1 subject3 Low-carb  Light  
4     F session1 subject4 Low-carb  Light  
5     F session1 subject5 High-carb Light  
6     F session2 subject6 Low-carb  Intense  
7     F session2 subject7 High-carb Intense  
8     F session2 subject8 Low-carb  Intense  
9     F session2 subject9 Low-carb  Intense  
10    F session2 subject10 High-carb Intense  
# i 10 more rows  
# i Use `print(n = ...)` to see more rows
```

## Visualising Experimental Designs

We leverage the structure that is already specified in an edibble design object.

Implemented in the **deggust** R-package.

```
library(deggust)
```

To degust is to savor appreciatively.

To deggust is to visualise edibble design objects appreciatively.

The final output is a **d**esign of **e**xperiments as a **ggplot** object.

Visualise your edibble design using only  
one command:

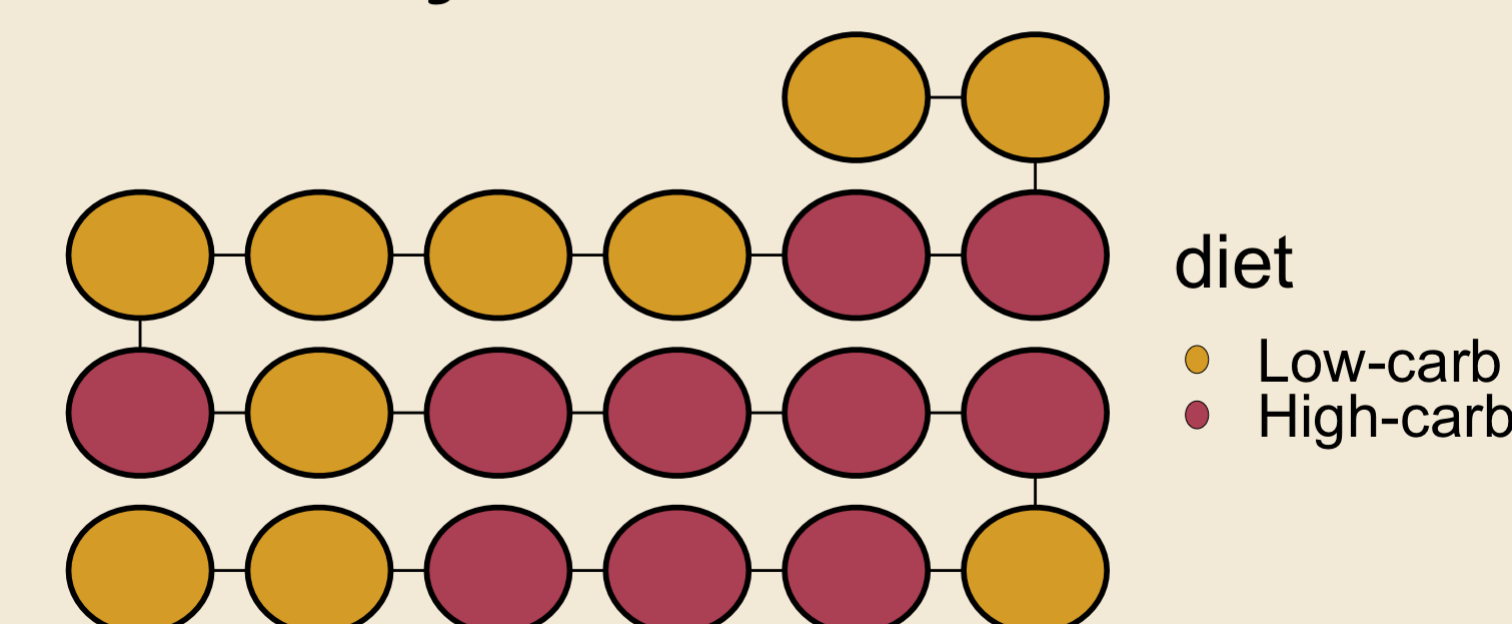
```
autoplot()
```

## Completely Randomised Design

```
autoplot(crd)
```

**Diet experiment**

Unit: subject



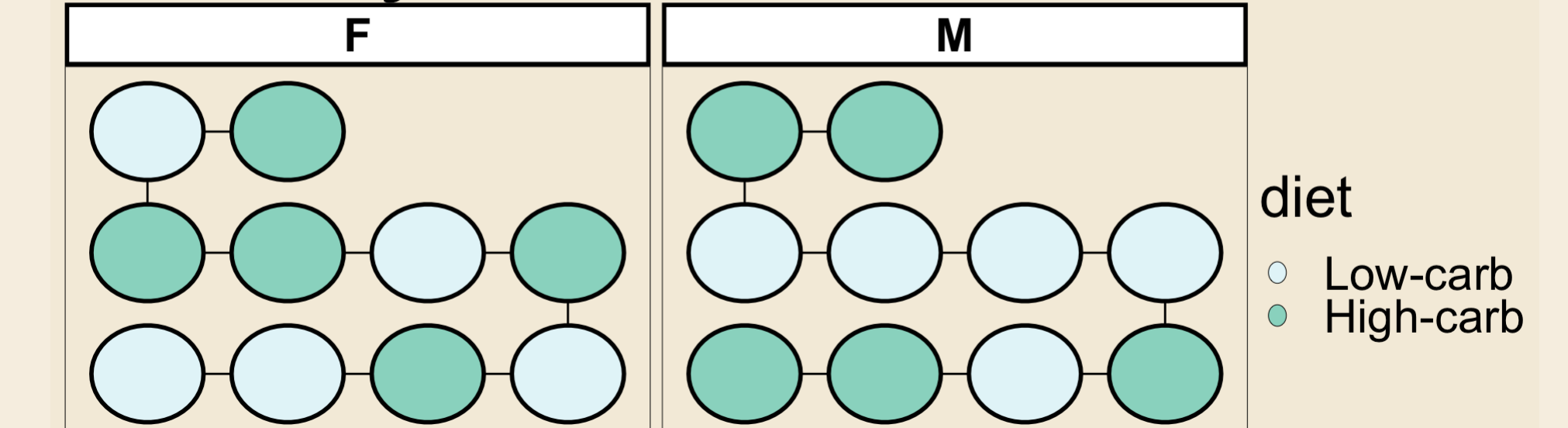
## Randomised Complete Block Design

- Customise using **ggplot2** functions!

```
autoplot(serve_table(rcbdx)) +  
  ggplot2::scale_fill_brewer(palette = 2)
```

**Diet experiment by sex**

Unit: subject

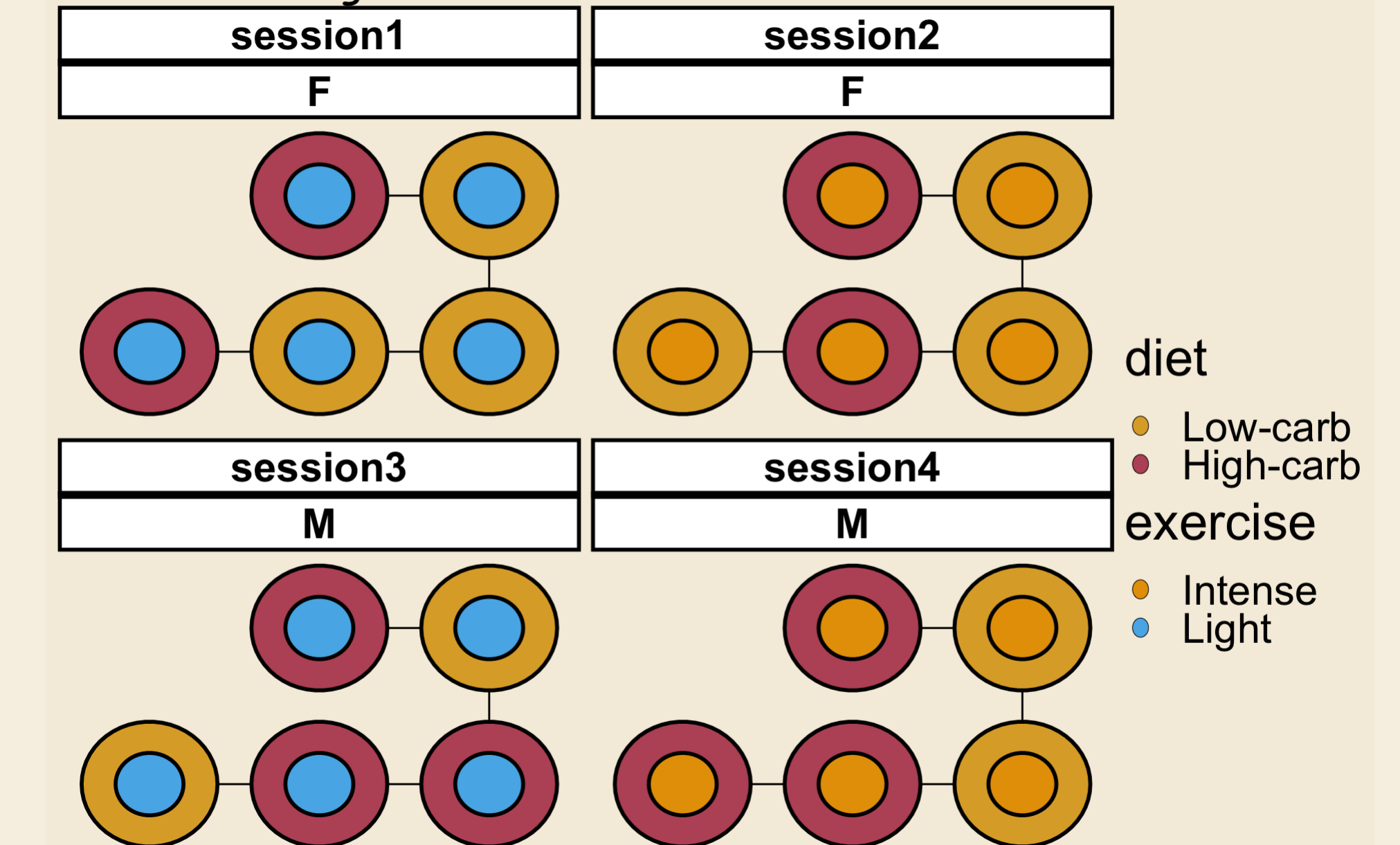


## Split-Plot Design

```
autoplot(spd)
```

**Diet & exercise experiment**

Unit: subject



## See More

- **edibble** and **deggust** R-packages are available on CRAN or get the latest development at [emitanaka/edibble](https://github.com/emitanaka/edibble) and [emitanaka/deggust](https://github.com/emitanaka/deggust).
- Find the HTML version of this poster at <https://emitanaka.org/JSM2023poster>.
- For more information and references, see <https://emitanaka.org/research/edibble-design>.

## Acknowledgement

This poster was made using **posterdown** R-package.



