Activity feedback

I gave at least a half mark for any submission, but next time, incomplete submissions will receive a **zero**.

- You need to use the template from the `isdas` **package**.
- You need to submit knitted **PDFs**.
- You should finish **all** the coding parts in the lab activities submission.
- You need to answer **all** the questions in the activity sections (highlights and threshold concepts are optional) in the in-class activity submission.
- Some submissions have errors in the YAML header, causing the PDF to not use the correct template.
- We have **two** activities each week, and you need to submit both in each submission.
- You need to submit both PDFs in the **same** submission.

Line breaks in markdown

Simply changing a line in Markdown won't create a line break.

Unlike $\LaTeX$ (`\newline`) or HTML (`<br>`), Markdown does not have explicit line break syntax.

The following example would produce a single line sentence after knitting:

```
first line of text
still the first line of text
```

In Markdown, line breaks are created implicitly using empty lines.

The following example would produce two lines after knitting:

```
first line of text

second line of text
```

Packages we use today

Load the following three packages.

```
library(isdas)
library(sf)
library(tidyverse)
library(spatstat)
```

If you have trouble restoring the reproducible environment, you need to manually install the packages first.

```
install.packages("remotes")
remotes::install_github("paezha/isdas")

install.packages("sf")

install.packages("tidyverse")

install.packages("spatstat")
```

New package for today: `spatstat`

`spatstat` is an R package for spatial statistics with a strong focus on analyzing spatial point patterns in 2D.

You can find documentation for this package at:

- https://spatstat.org/
- https://spatstat.org/resources/spatstatQuickref.pdf

Random vs. deterministirc process

Let's denote the probability of an event occurring at point (x, y) as $Prob(Event_{(x,y)})$. The points are located within a unit square ranging from 0 to 1.

- A random process:
  $Prob(Event_{(x,y)}) = B(n = 1, p = 0.5)$
- A deterministic process:
  $Prob(Event_{(x,y)}) = x$
- A stochastic process:
  $Prob(Event_{(x,y)}) = x - x \cdot B(n = 1, p = 0.5)$

Generate random values from a distribution

There is a family of functions that start with `r*` capable of generating random values from a given distribution.

From a nomral distribution:

```r
rnorm(n = 5, mean = 0, sd = 1)
```

```
[1]  0.5185718 -0.5801848  1.7541242 -1.4321465 -1.3573983
```

From a binomial distribution:

```r
rbinom(n = 5, size = 1, prob = 0.5)
```

```
[1] 0 1 0 1 0
```

These functions are very useful for simulations.

Random number generator and seed

In computers, there is no true random number generator; they all use pseudo-random number generators. This means that the random numbers produced by computers are just the output of a very complex function based on an input, or seed.

As a result, if we know the seed, we can perfectly predict the random numbers generated by a computer's random number generator.

Typically, computers use the current time as the seed (R uses this approach).

Setting a seed in R

You can control the random number generation algorithm by setting a seed value in R.

```r
set.seed(437988)
rbinom(n = 5, size = 1, prob = 0.5)
```

```
[1] 1 0 0 0 1
```

```r
set.seed(437988)
rbinom(n = 5, size = 1, prob = 0.5)
```

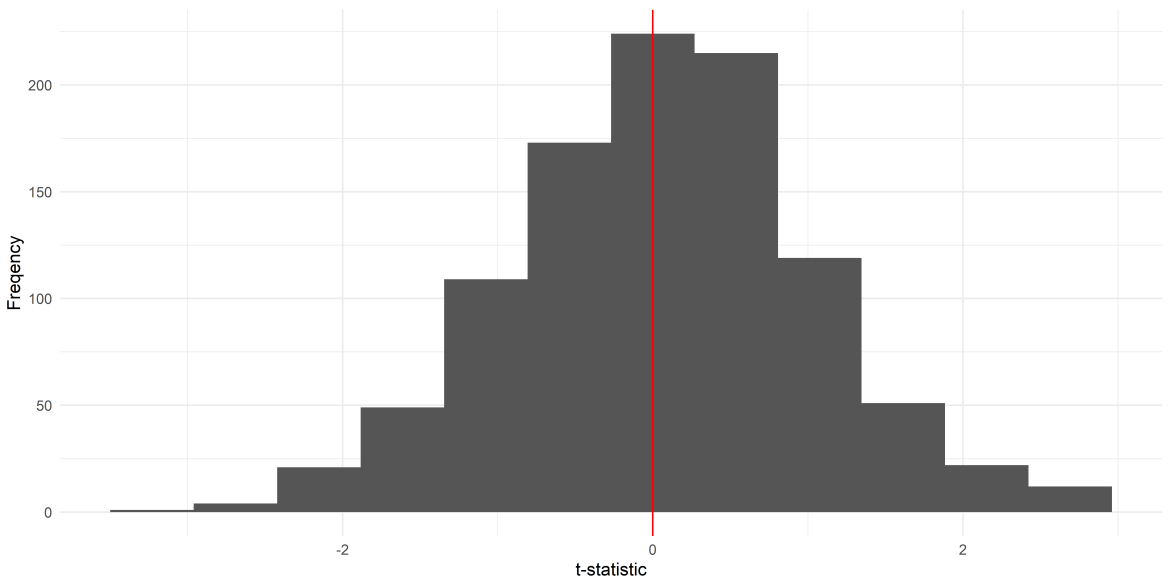
```
[1] 1 0 0 0 1
```

Note that the seed in R is actually a vector, a sequence of values, and `set.seed` changes this vector to a particular state.

If you do not set the seed again before rerunning the second `rbinom`, it will produce different results.

What is p-value?

Let's say we have two samples from two different distributions. We want to perform a statistical test to compare their means ($H_1 : \overline{x_1} \neq \overline{x_2}$). The p-value is the area under the curve that is more extreme than the test statistic, multiplied by 2.



Activities for today

- We will work on the following chapter from the textbook:
  - Chapter 8: Activity 3: Maps as Processes
  - Chapter 10: Activity 4: Point Pattern Analysis I
- The hard deadline is **Friday**, **January 31** (**12:00 pm**).