

# Activity feedback

- Assignments are evaluated as Satisfactory / Partially Satisfactory / Not Satisfactory, corresponding to full, half, or zero marks.
  - Late submissions more than one hour past the deadline were penalized according to the syllabus (**20%** on the first day, **10%** for each additional day).
- Knit your document regularly as you work so that errors can be identified and corrected early.
  - For this activity, submissions that did not knit successfully incurred a **20%** penalty (this will increase to **50%** next time).
- Choose colour schemes carefully:
  - Use a diverging colour scheme only when there is a meaningful neutral or zero reference level.
- We have **two** activities each week, and you need to submit both in each submission.
- A small  $p$ -value ( $< 0.05$ ) in the  $\chi^2$  test indicates that the point pattern is not random and shows spatial dependence.

# Mathematical notation remainder

Summation notation ( $\sum$ ):

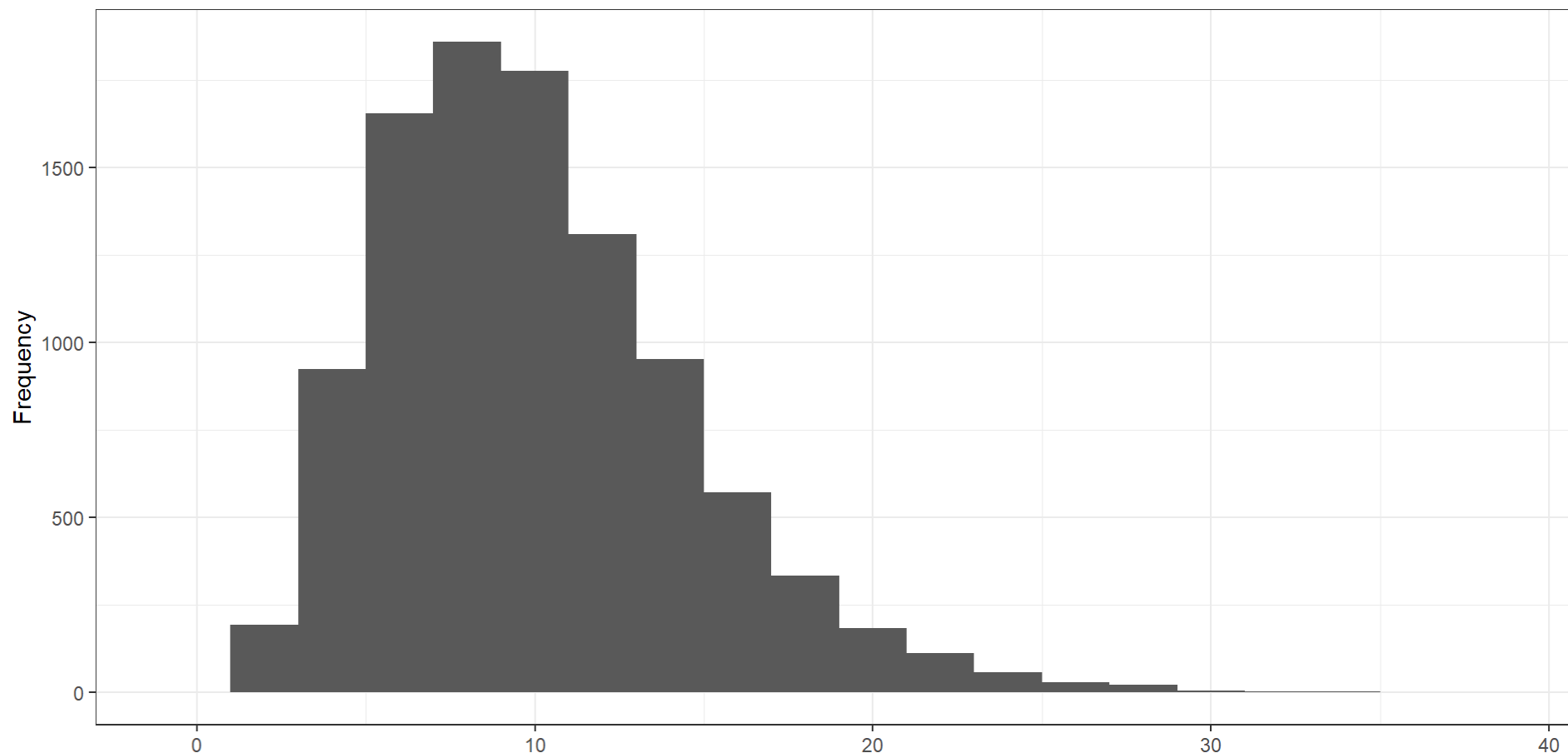
$$\sum_{i=1}^Q x_i = x_1 + x_2 + \cdots + x_Q$$

For all notation ( $\forall$ ):

$$x_k = 1 \forall k \rightarrow x = 1$$

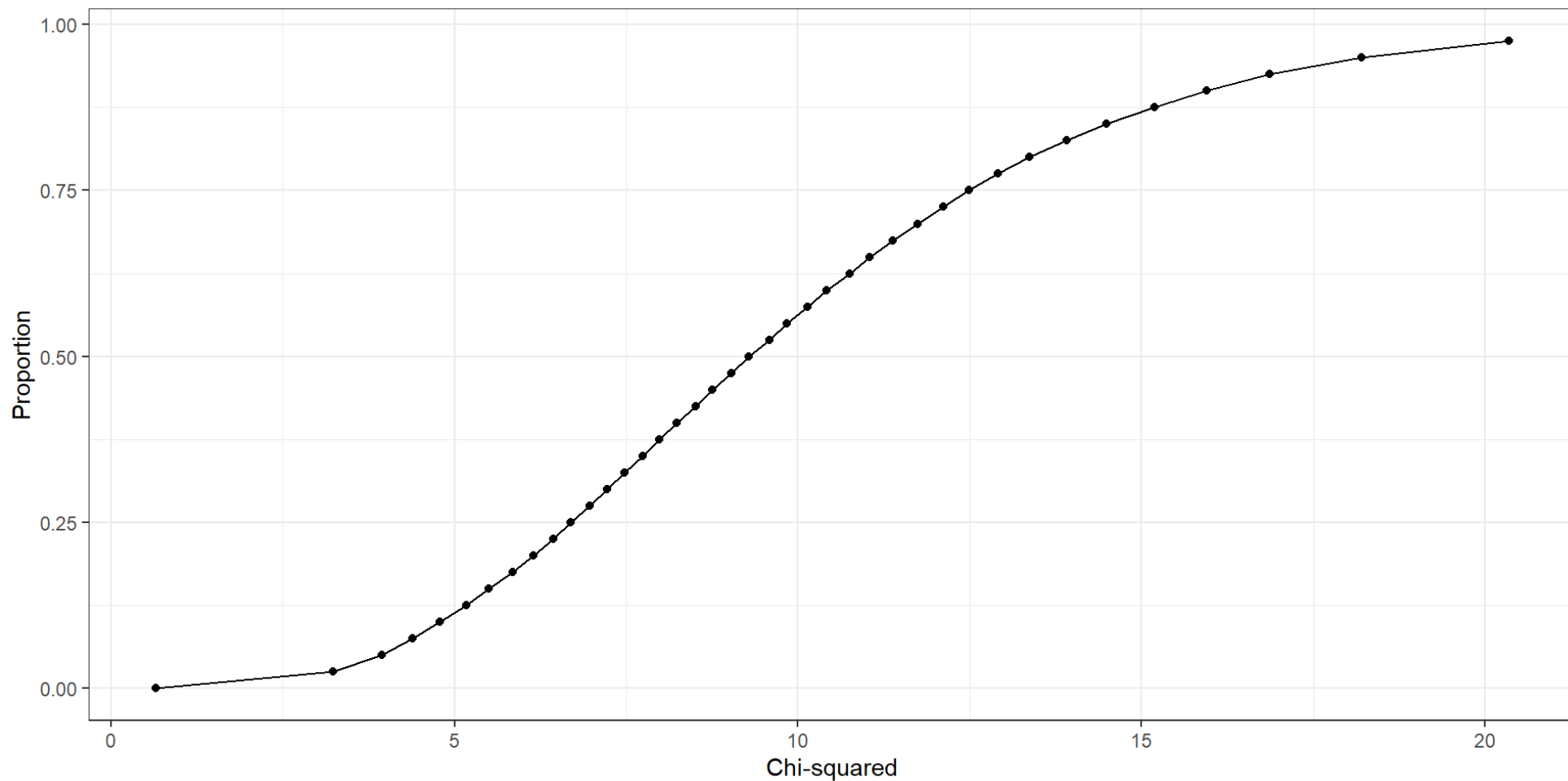
# $\chi^2$ distribution

Strictly non-negative, right-skewed, and non-symmetric.



# Cumulative distribution function

$$F_X(x) = P(X \leq x)$$



# $\hat{G}$ -function

$$\hat{G}(r) = \frac{1}{n(\mathbf{x})} \sum_i \mathbf{1}\{d_i \leq r\}$$

The  $\hat{G}$  function represents the number of elements in the set of distances up to some threshold  $r$ , normalized by the total number of points  $n$  in point pattern  $\mathbf{x}$ .

# Pipe operator in R

The `|>` is the native pipe operator introduced in R 4.1.0.

The old pipe operator is `%>%` from `magrittr` package.

It allows chained expressions in place of nested expressions to improve code readability.

```
1 v <- c(1, 2, 3, 4, 5)
2 sum(sqrt(v))
```

```
[1] 8.382332
```

```
1 v |>
2   sqrt() |>
3   sum()
```

```
[1] 8.382332
```

Do not confuse it with `+` in `ggplot2`; they are **not** the same thing.

# Packages we use today

Load the following three packages.

```
1 library(isdas)
2 library(sf)
3 library(tidyverse)
4 library(spatstat)
```

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

```
1 install.packages("remotes")
2 remotes::install_github("paezha/isdas")
3
4 install.packages("sf")
5
6 install.packages("tidyverse")
7
8 install.packages("spatstat")
```

# Activities for today

- We will work on the following chapter from the textbook:
  - Chapter 12: Activity 5: Point Pattern Analysis II
  - Chapter 14: Activity 6: Point Pattern Analysis III
- The hard deadline is **Tuesday, February 3 (8:00 am)**.



# Reference

- <https://www.geo.fu-berlin.de/en/v/soga-r/Advances-statistics/Spatial-Point-Patterns/Analysis-of-Spatial-Point-Patterns/Interactions-in-Point-Pattern-Analysis/index.html>