Activity feedback

- Assignments are evaluated as Satisfactory / Partially Satisfactory / Not Satisfactory, corresponding to full, half, or zero marks.
  - Late submissions will be penalized (next time) 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 χ^2 test indicates that the point pattern is not random and shows spatial dependence.

Mathematical notation remainder

Summation notation ($\sum$):

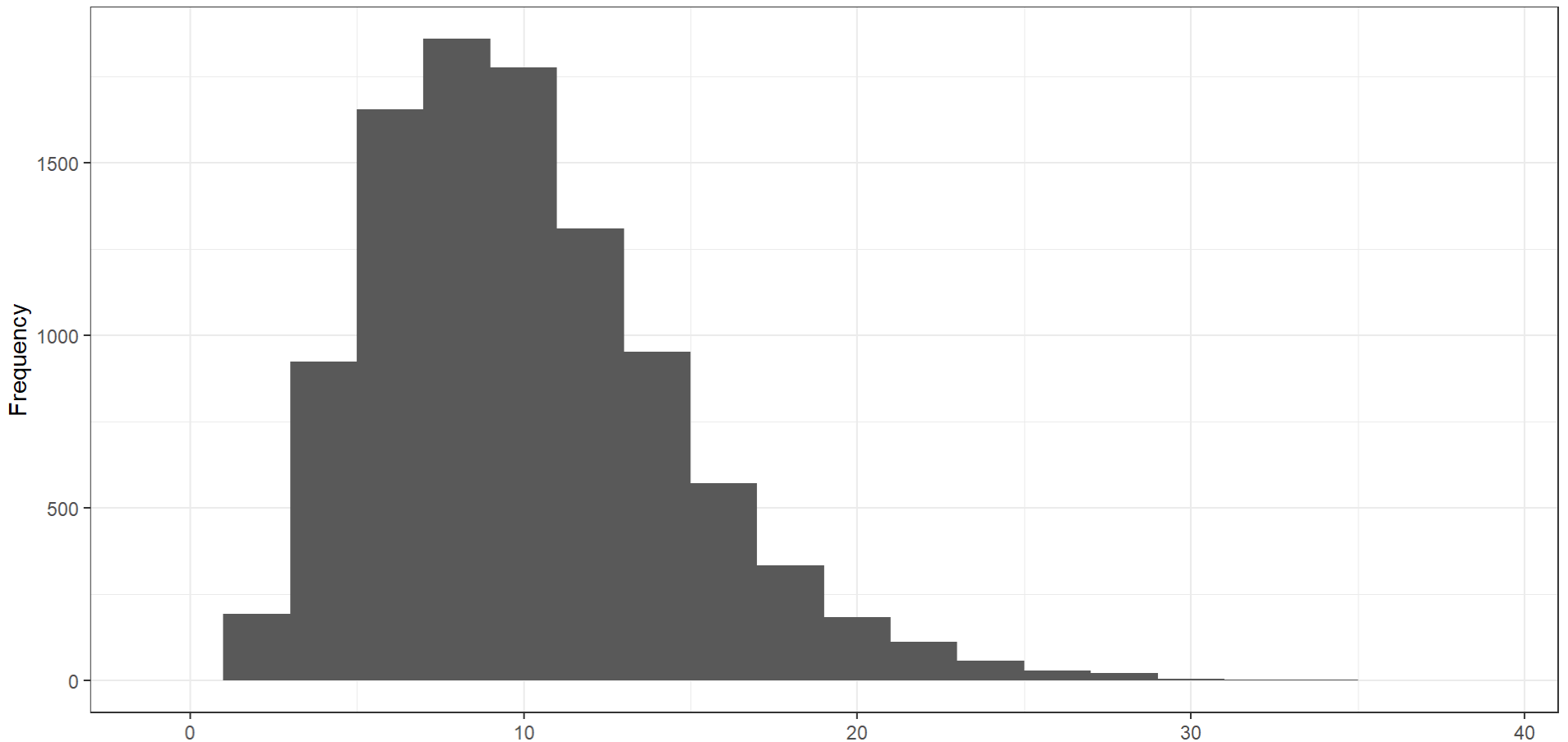
$$\sum_{i=1}^{Q} x_i = x_1 + x_2 + \cdots + x_Q$$

For all notation ($\forall$):

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

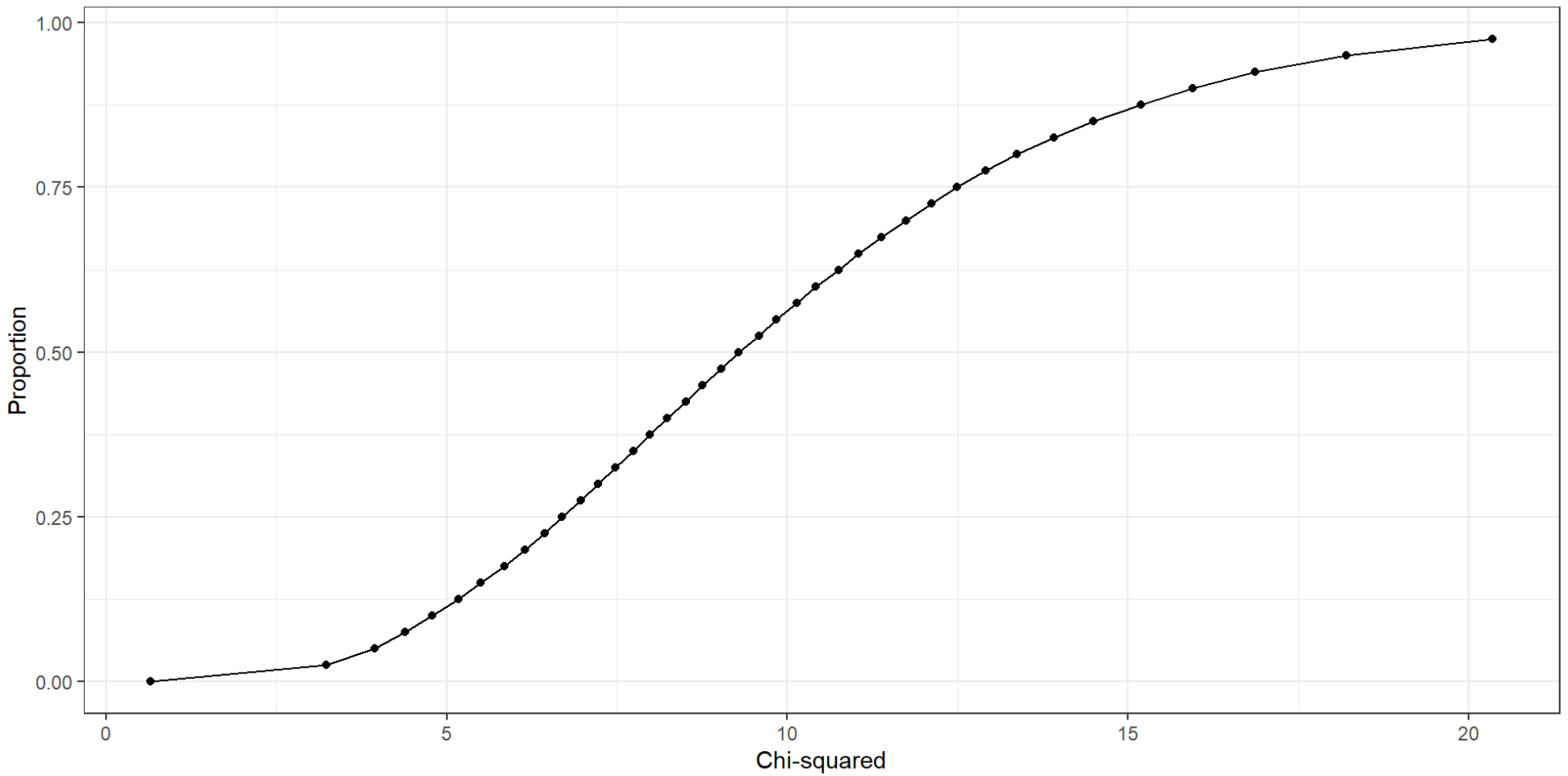
χ^2 distribution

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



Cumulative distribution function

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



$\hat{G}$-function

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

where $d_i = \min_{j \neq i} \|x_i - x_j\|$

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.

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

```
[1] 8.382332
```

```r
v |>
  sqrt() |>
  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.

```
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")
```

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