Drawing graphs

Our data

- To illustrate making graphs, we need some data.
- Data on 202 male and female athletes at the Australian Institute of Sport.
- Variables:
  - categorical: Sex of athlete, sport they play
  - quantitative: height (cm), weight (kg), lean body mass, red and white blood cell counts, haematocrit and haemoglobin (blood), ferritin concentration, body mass index, percent body fat.
- Values separated by tabs (which impacts reading in).

Packages for this section

Reading data into R

- Use `read_tsv` ("tab-separated values"), like `read_csv`.
- Data in `ais.txt`:

The data (some)

```
# A tibble: 202 x 13
   Sex    Sport      RCC   WCC    Hc    Hg  Ferr   BMI   SSF
   <chr>  <chr>    <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
 1 female Netball  4.56  13.3  42.2  13.6    20  19.2  49
 2 female Netball  4.15   6    38    12.7    59  21.2 110.
 3 female Netball  4.16   7.6  37.5  12.3    22  21.4  89
 4 female Netball  4.32   6.4  37.7  12.3    30  21.0  98.3
 5 female Netball  4.06   5.8  38.7  12.8    78  21.8 122.
 6 female Netball  4.12   6.1  36.6  11.8    21  21.4  90.4
 7 female Netball  4.17   5    37.4  12.7   109  21.5 107.
 8 female Netball  3.8    6.6  36.5  12.4   102  24.4 157.
 9 female Netball  3.96   5.5  36.3  12.4    71  22.6 101.
10 female Netball  4.44   9.7  41.4  14.1    64  22.8 126.
# i 192 more rows
# i 4 more variables: `%Bfat` <dbl>, LBM <dbl>, Ht <dbl>,
#   Wt <dbl>
```

Types of graph

Depends on number and type of variables:

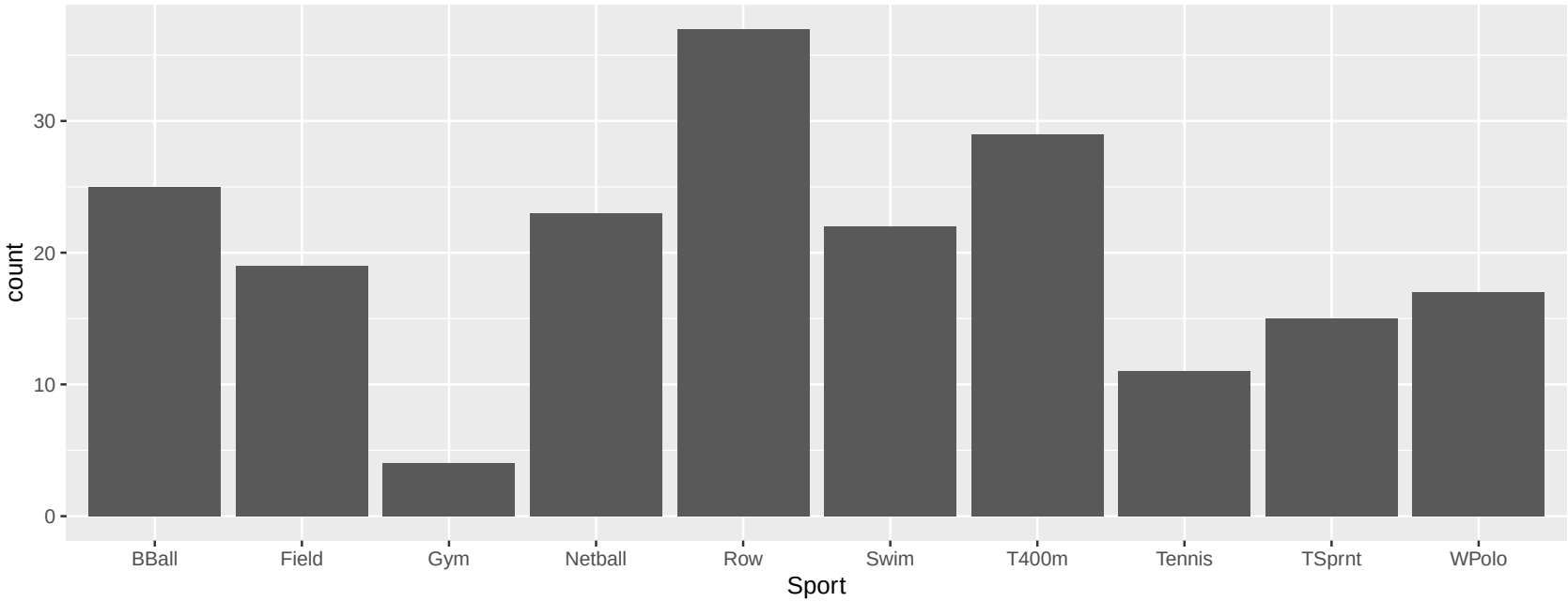
Categorical	Quantitative	Graph
1	0	bar chart
0	1	histogram
2	0	grouped bar charts
1	1	side-by-side boxplots
0	2	scatterplot
2	1	grouped boxplots
1	2	scatterplot with points identified by group (eg. by colour)

With more (categorical) variables, might want *separate plots by groups*. This is called `facetting` in R.

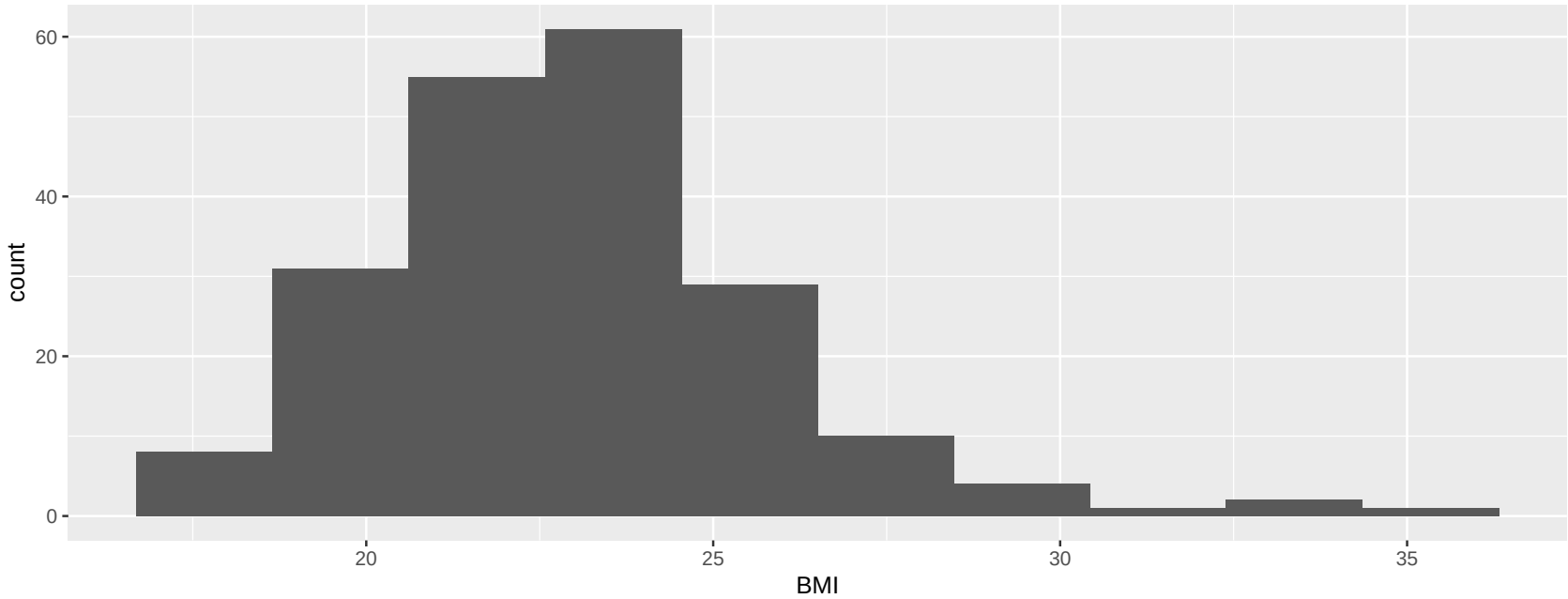
ggplot

- R has a standard graphing procedure `ggplot`, that we use for all our graphs.
- Use in different ways to get precise graph we want.
- Let's start with bar chart of the sports played by the athletes.

Bar chart

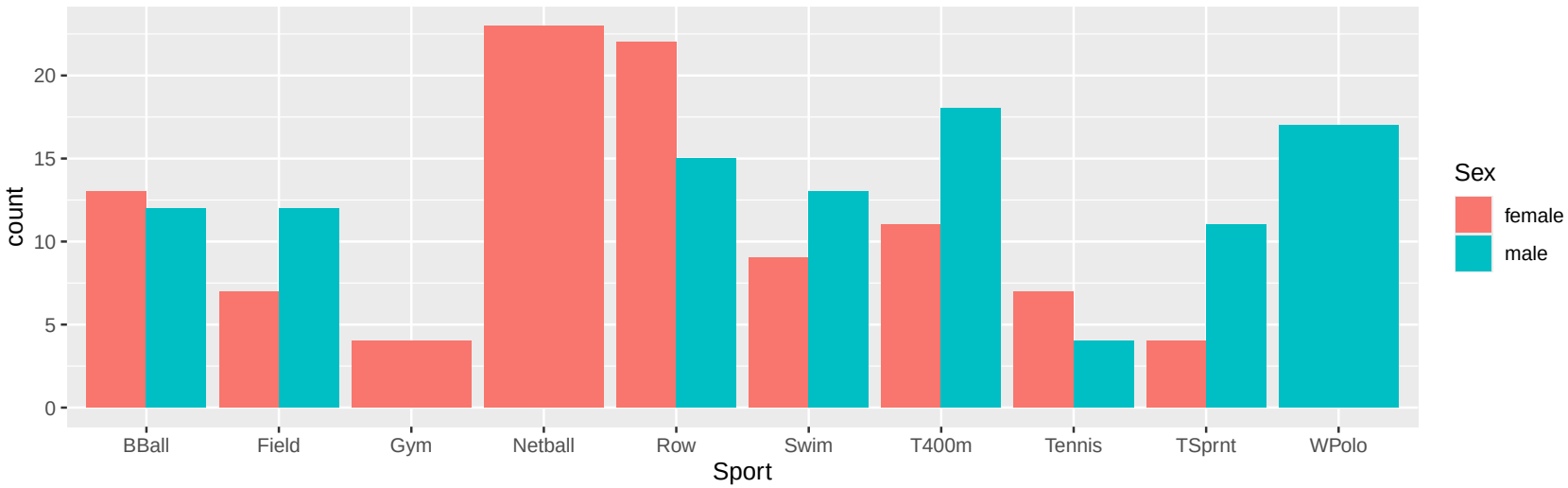

count
30
20
10
0
BBall
Field
Gym
Netball
Row
Swim
T400m
Tennis
TSprnt
WPolo
Sport

Histogram of body mass index

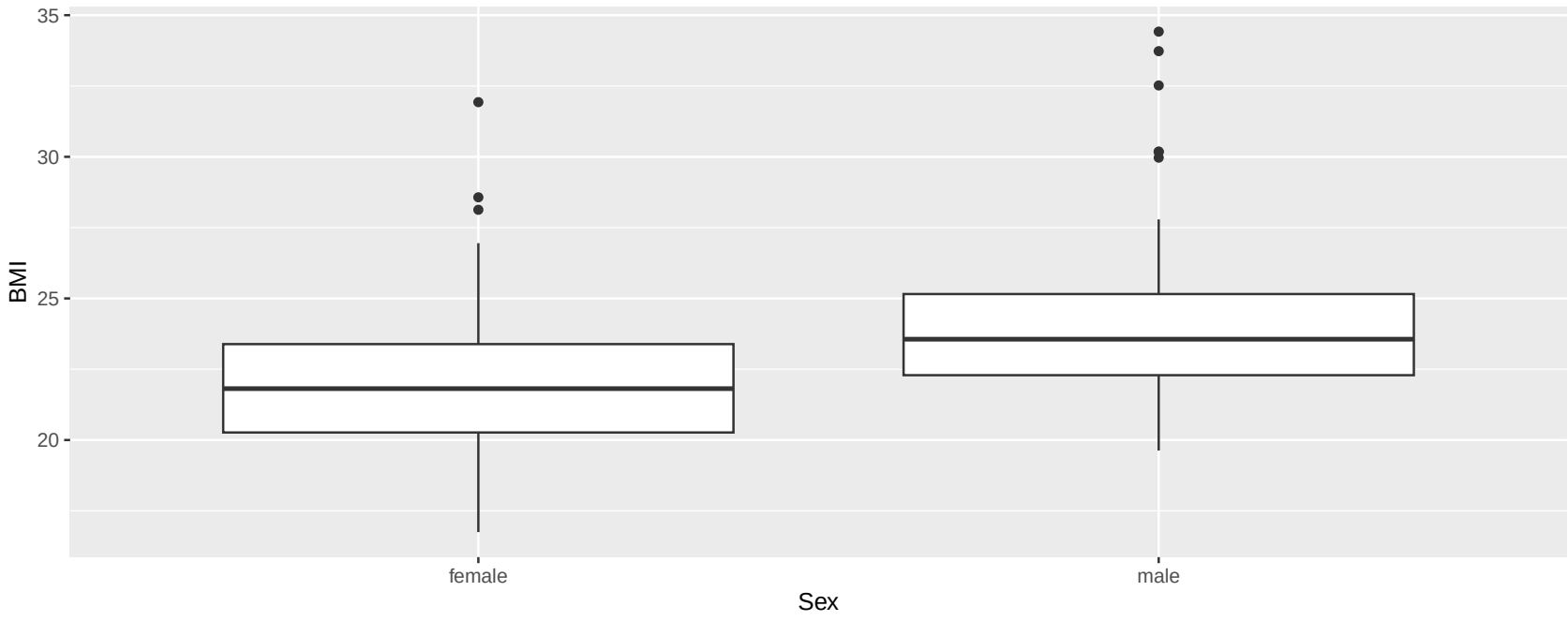


Which sports are played by males and females?

Grouped bar chart:

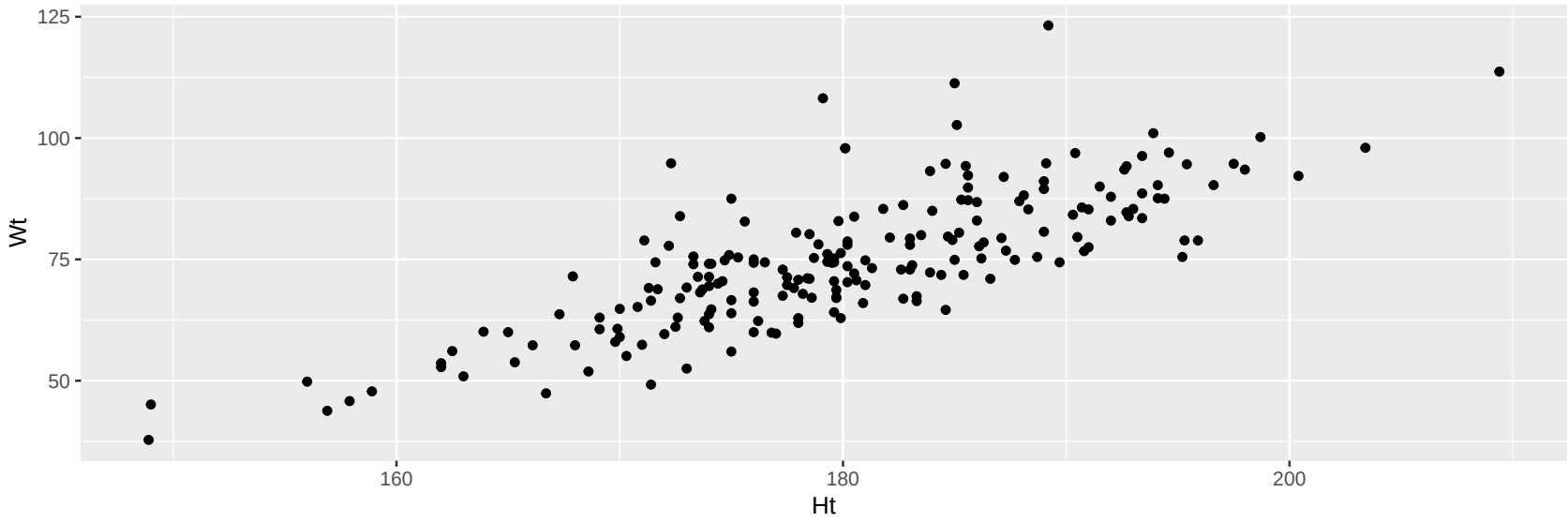


BMI by gender

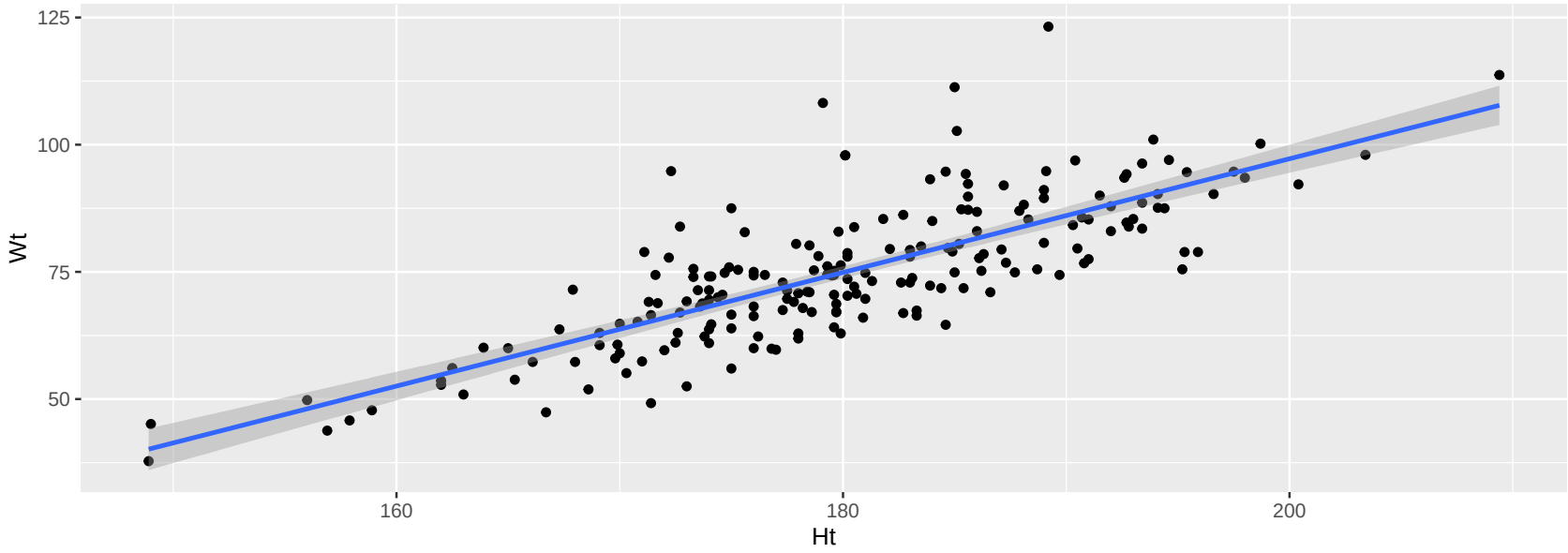


Height vs. weight

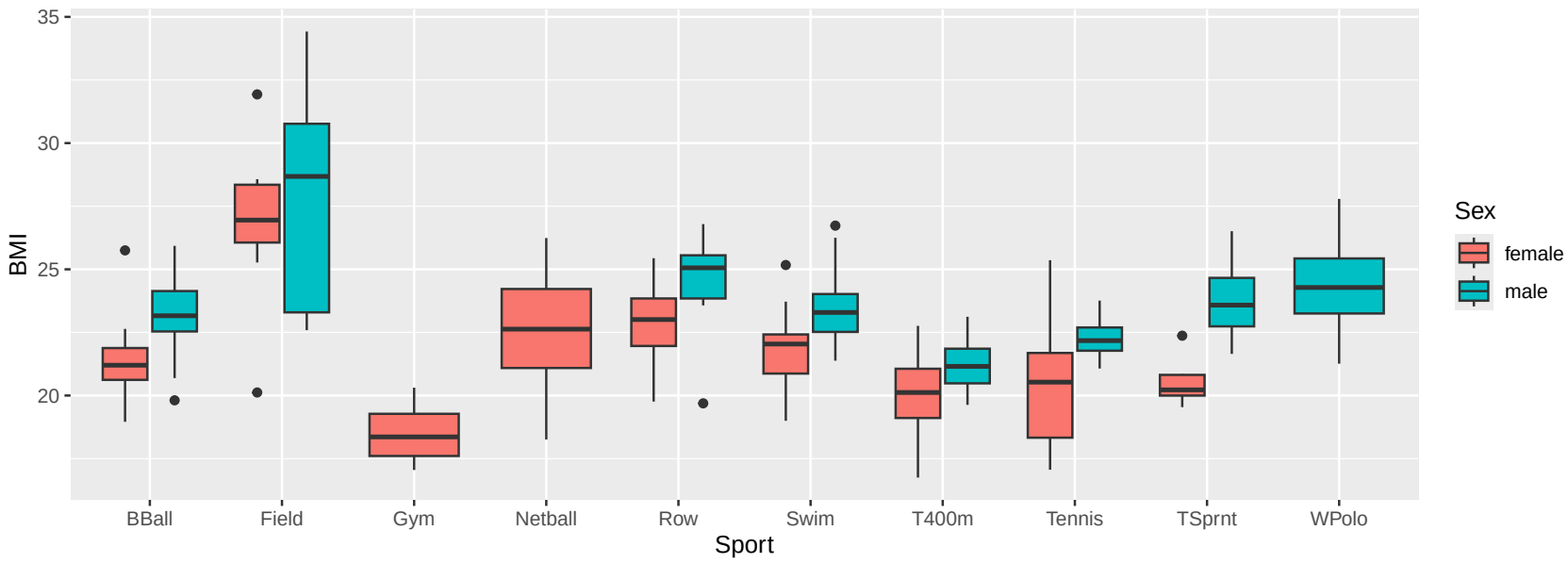
Scatterplot:



With regression line

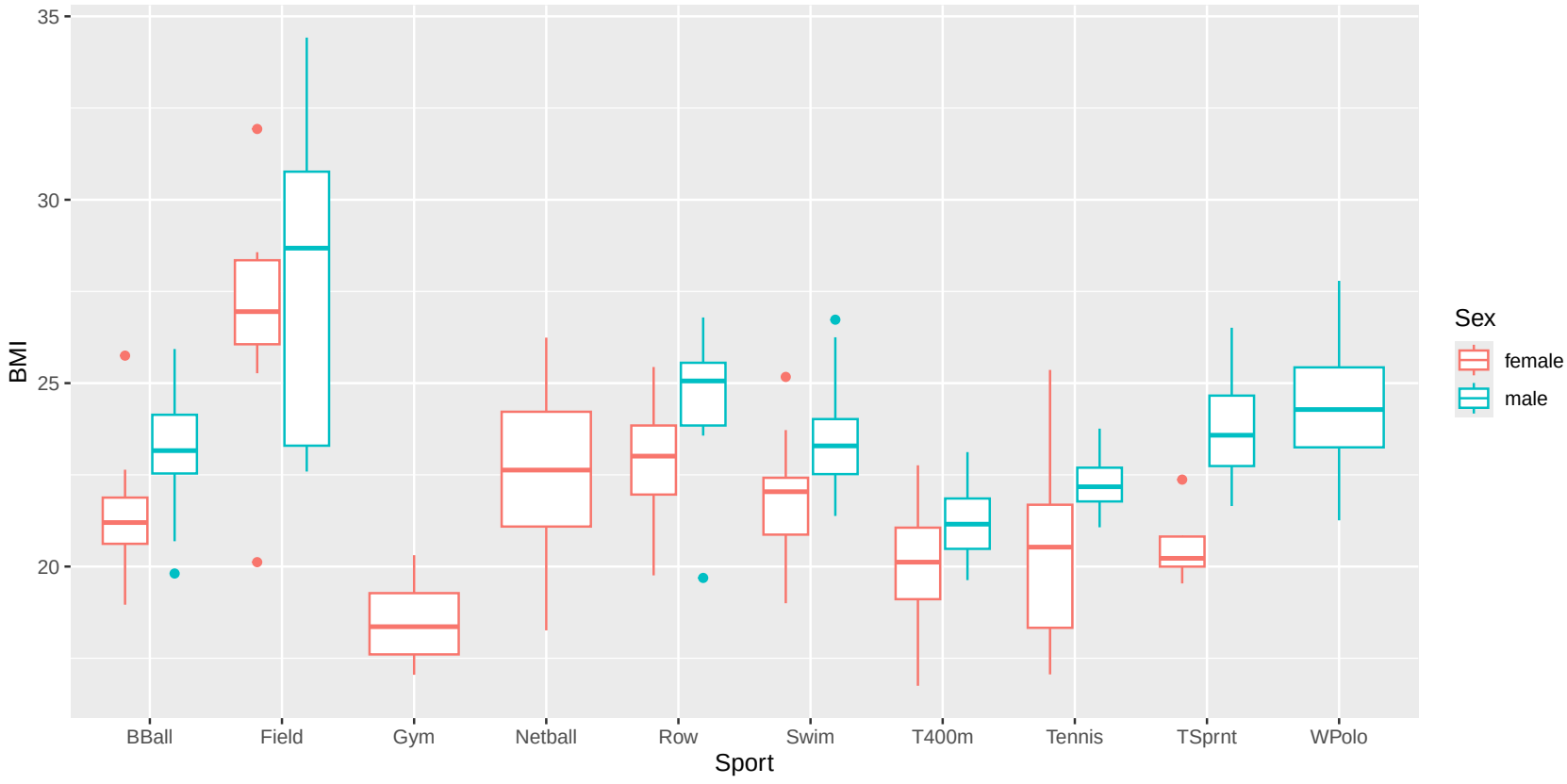


BMI by sport and gender

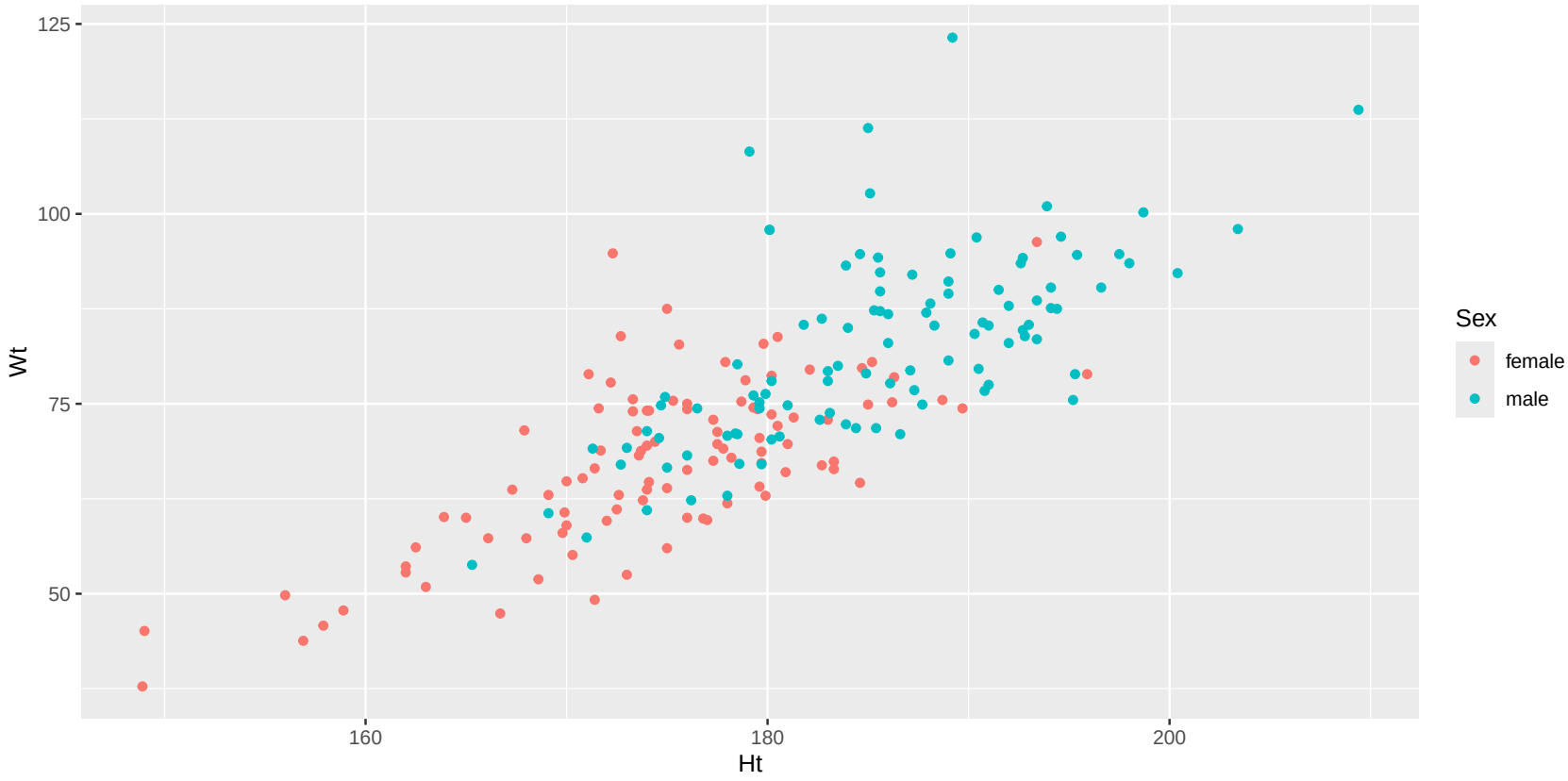


Or...

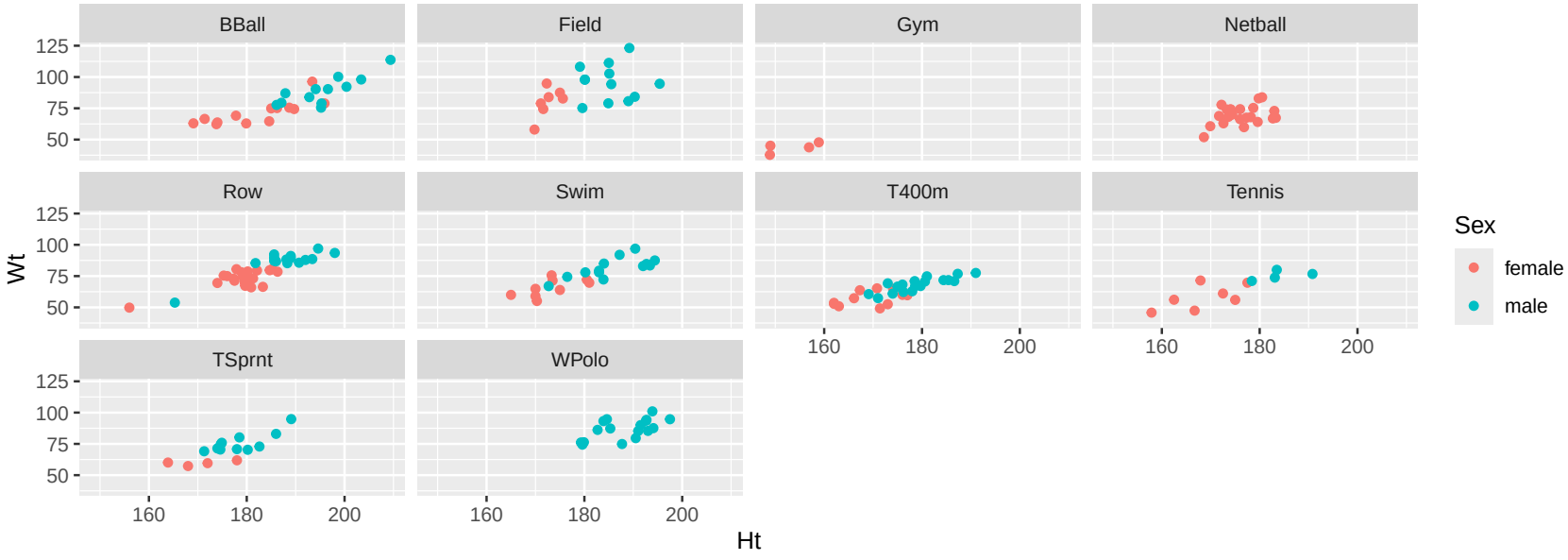
A variation that uses `colour` instead of `fill`:



Height and weight by gender

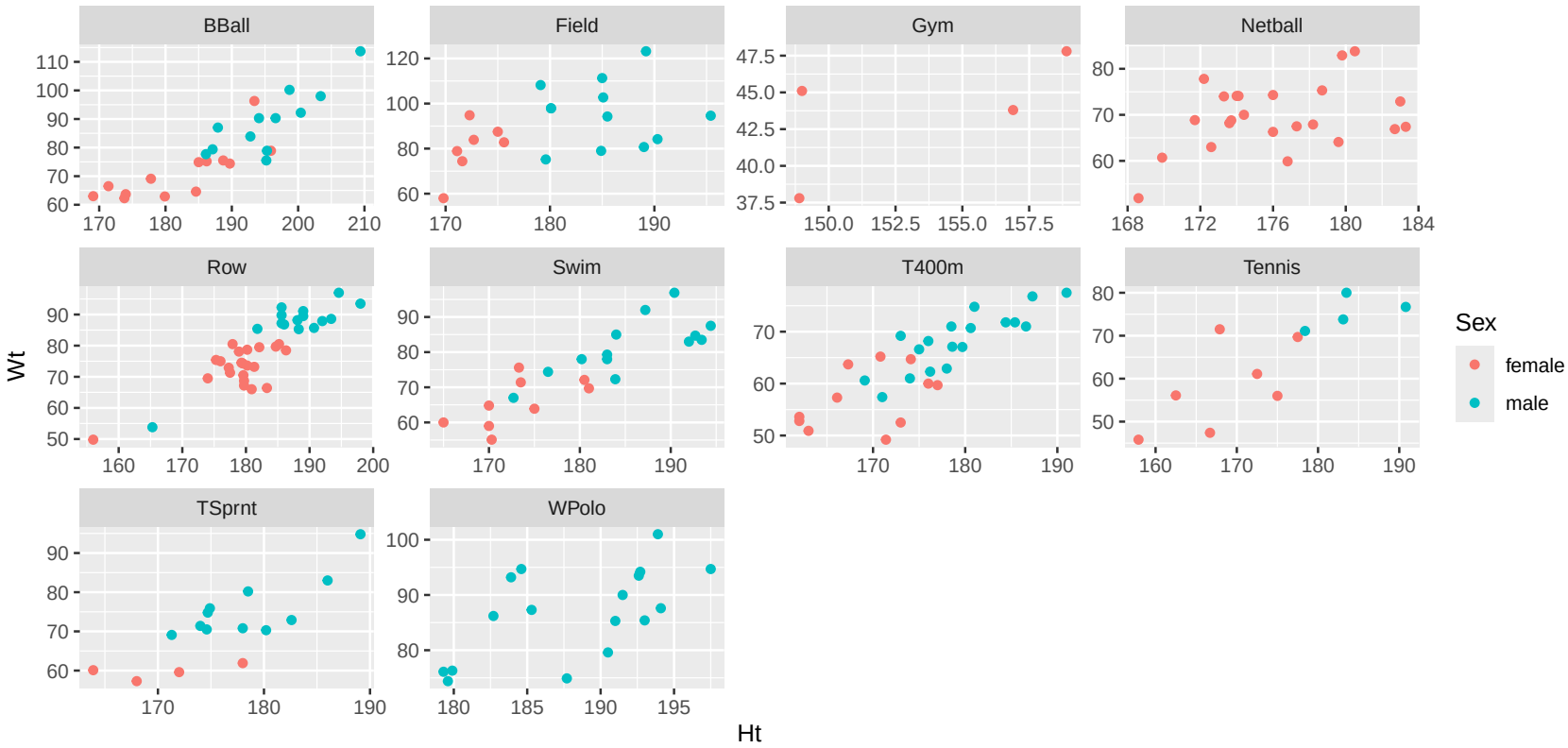


Height by weight by gender for each sport, with facets

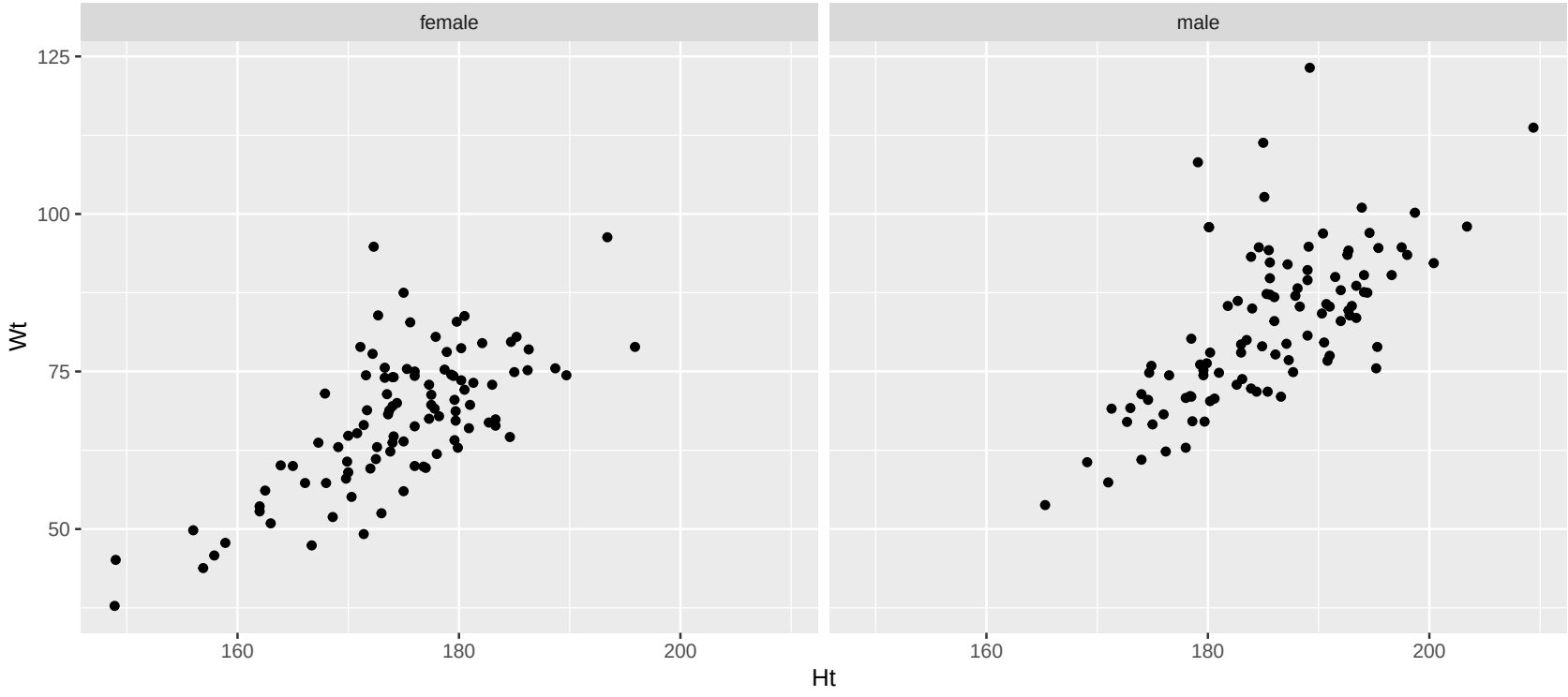


Filling each facet

Default uses same scale for each facet. To use different scales for each facet, this:

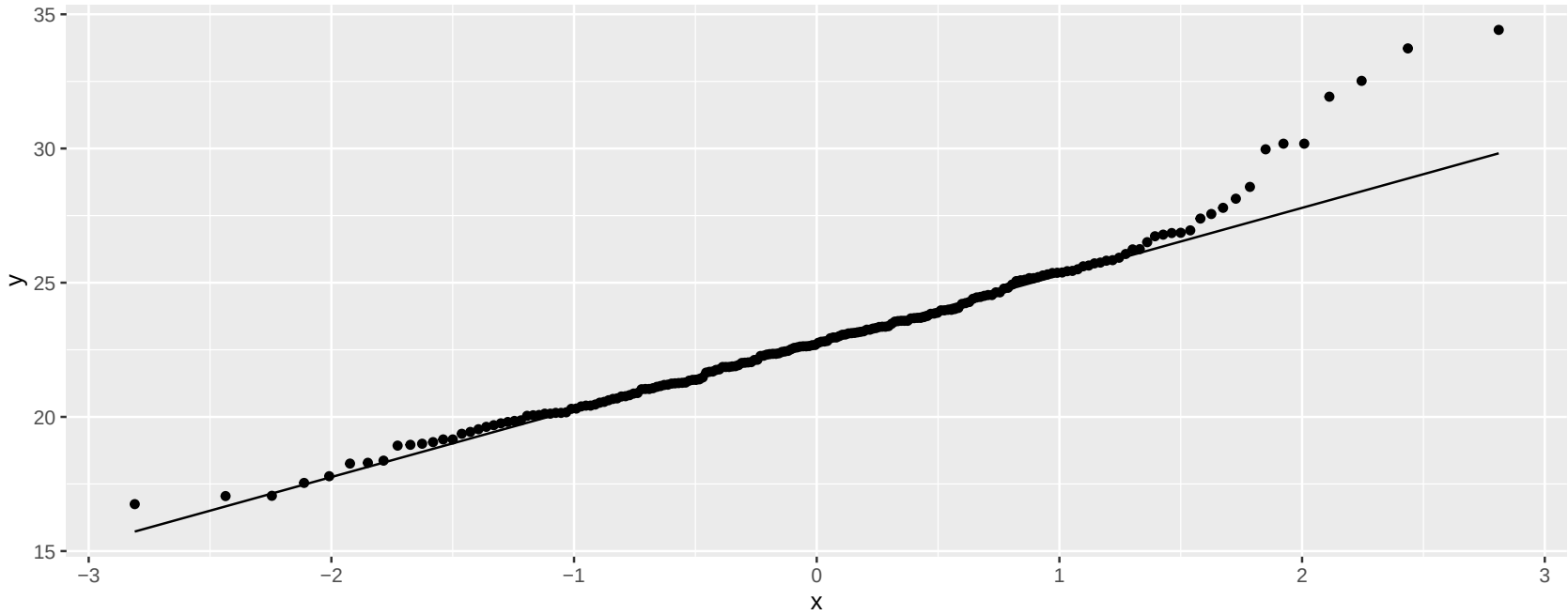


Another view of height vs weight



Normal quantile plot

For assessing whether a column has a normal distribution or not:

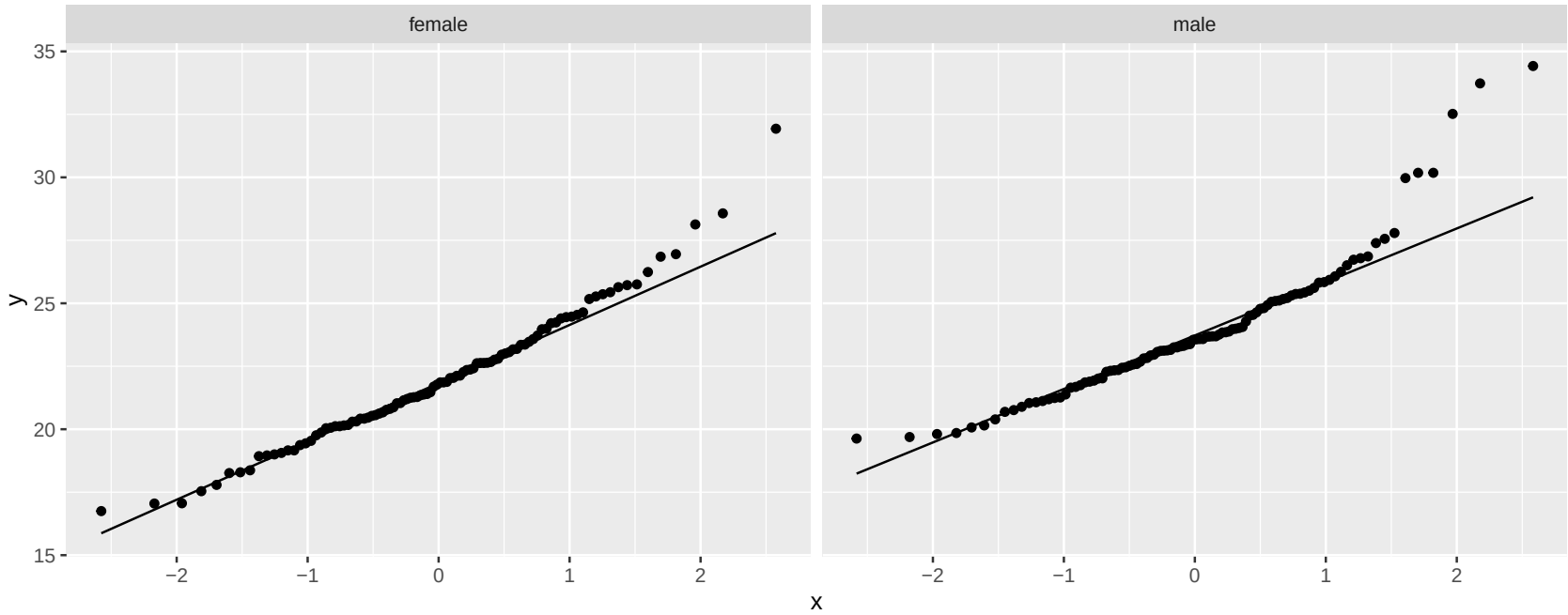


Comments

- Data on y-axis
- on x-axis, the z-scores you would expect if normal distribution correct
- if the points follow the line, distribution is normal
- the way in which the points *don't* follow line tell you about how the distribution is not normal
- in this case, the highest values are too high (long upper tail).

Facetting

Male and female athletes' BMI separately:



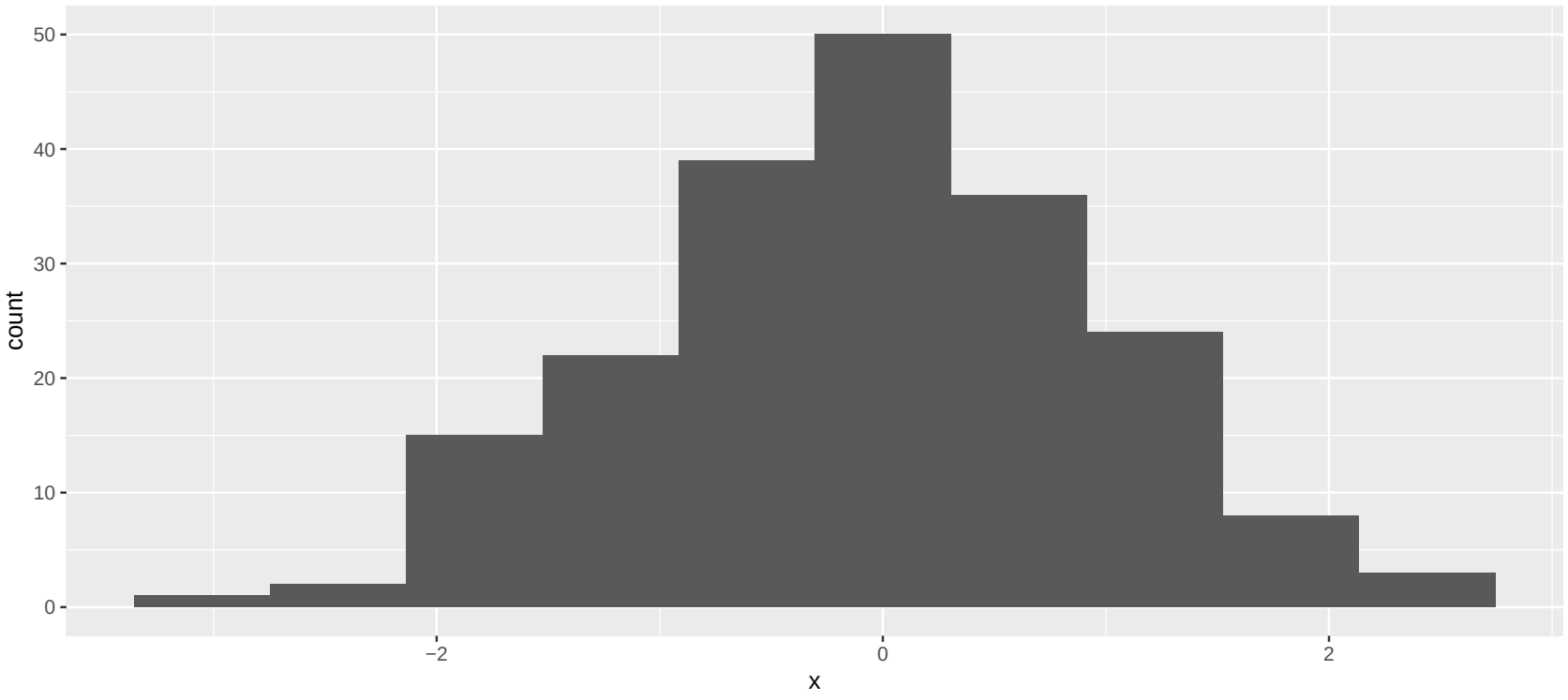
Comments

- The distribution of BMI for females is closer to normal, with only the highest few values being too high
- The distribution of BMI values for males might even be right-skewed: not only are the upper values too high, but some of the lowest ones are not low enough.

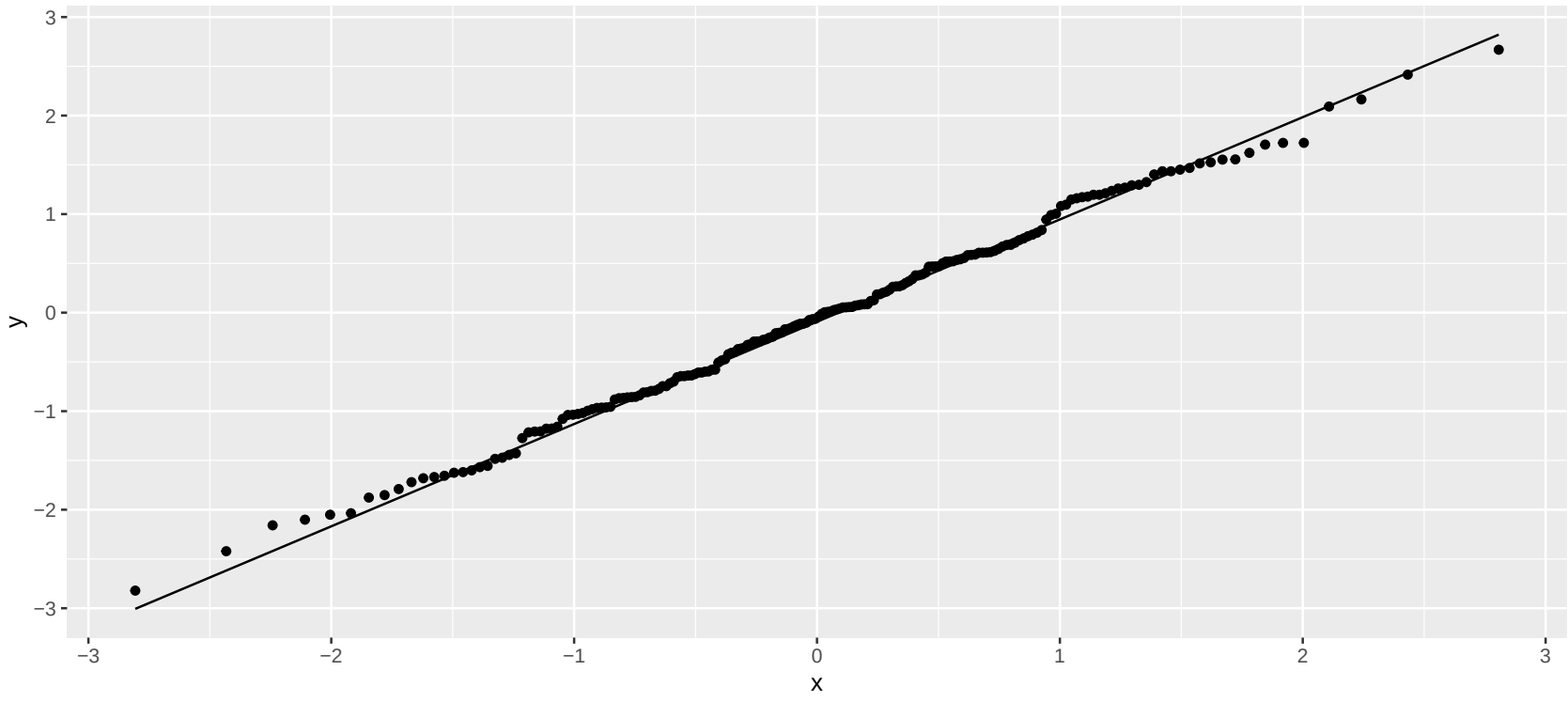
More normal quantile plots

- How straight does a normal quantile plot have to be?
- There is randomness in real data, so even a normal quantile plot from normal data won't look perfectly straight.
- With a small sample, can look not very straight even from normal data.
- Looking for systematic departure from a straight line; random wiggles ought not to concern us.
- Look at some examples where we know the answer, so that we can see what to expect.

Normal data, large sample

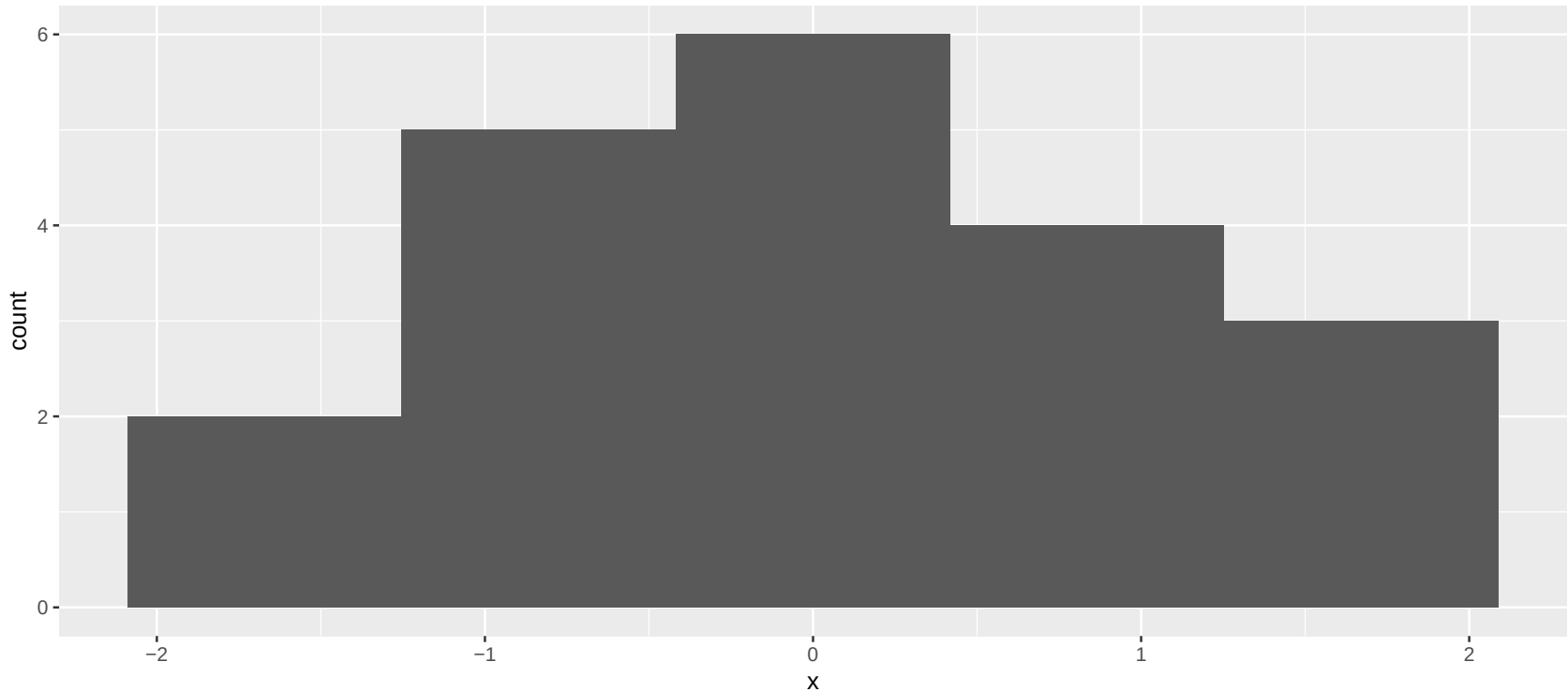


The normal quantile plot



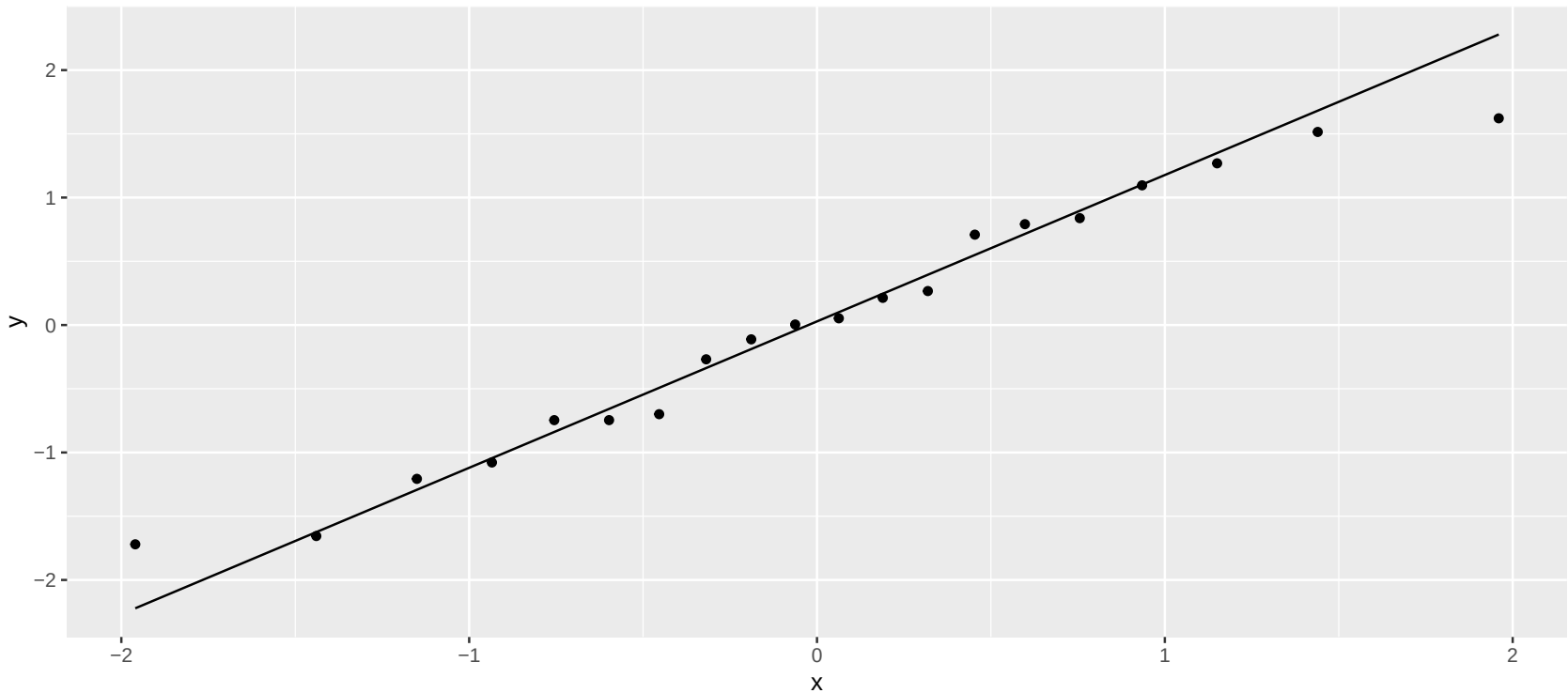
Normal data, small sample

- Not so convincingly normal, but not obviously skewed:



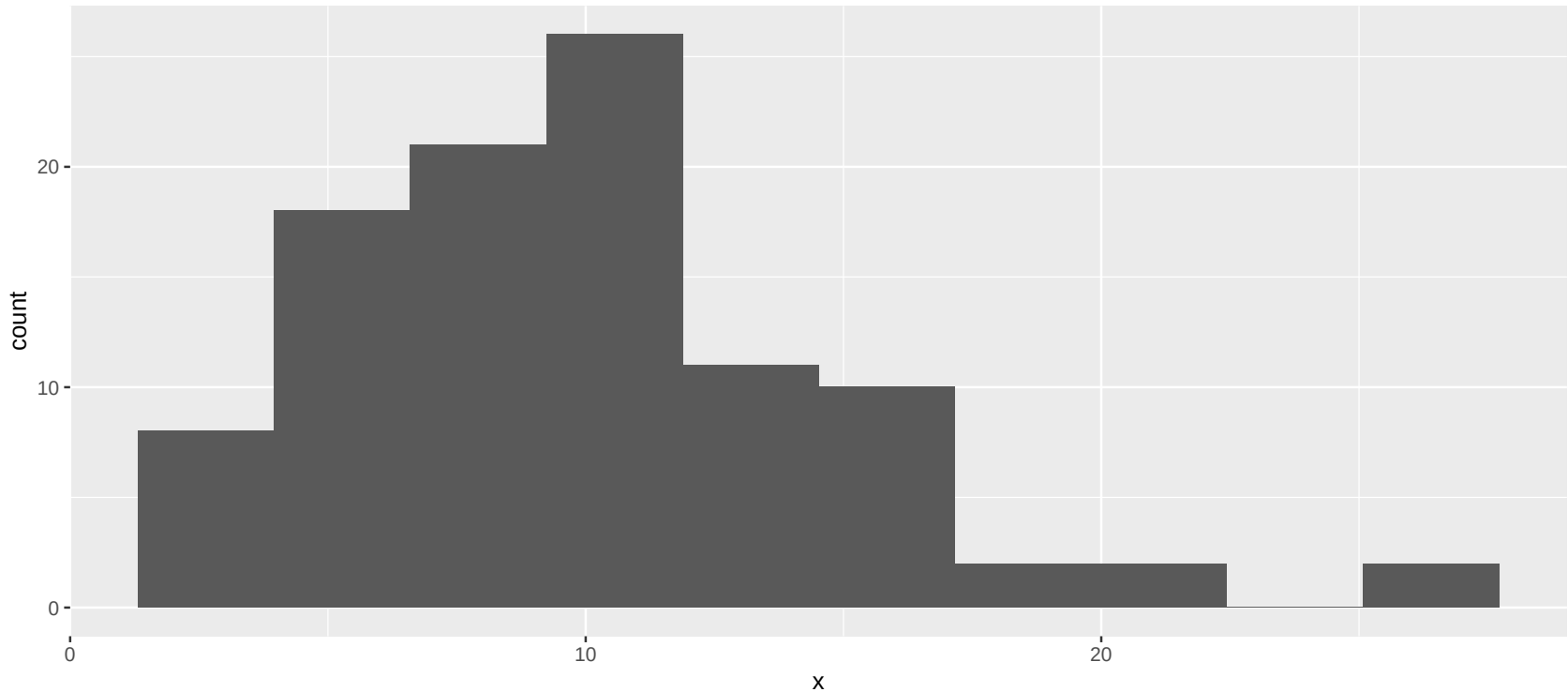
The normal quantile plot

Good, apart from the highest and lowest points being slightly off. I'd call this good:



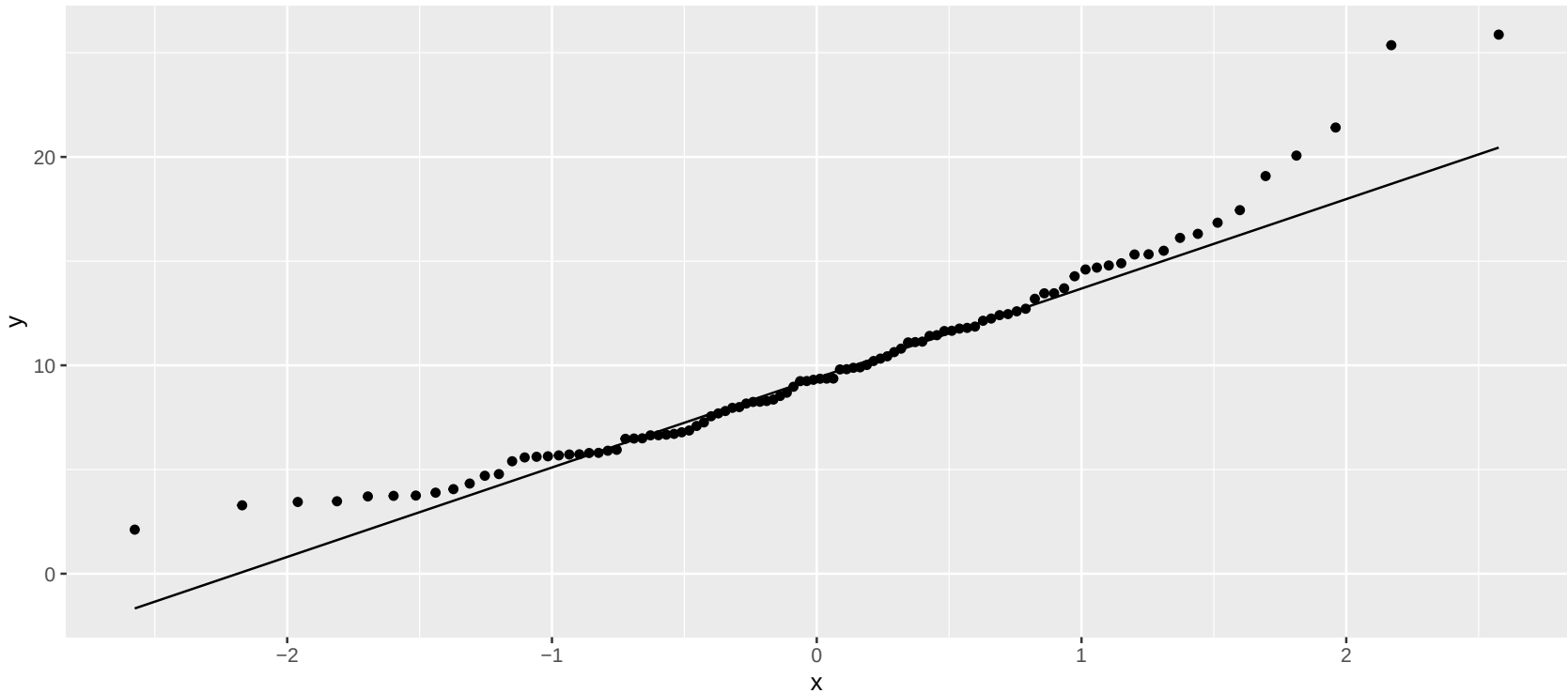
Chi-squared data, $df = 10$

Somewhat skewed to right:



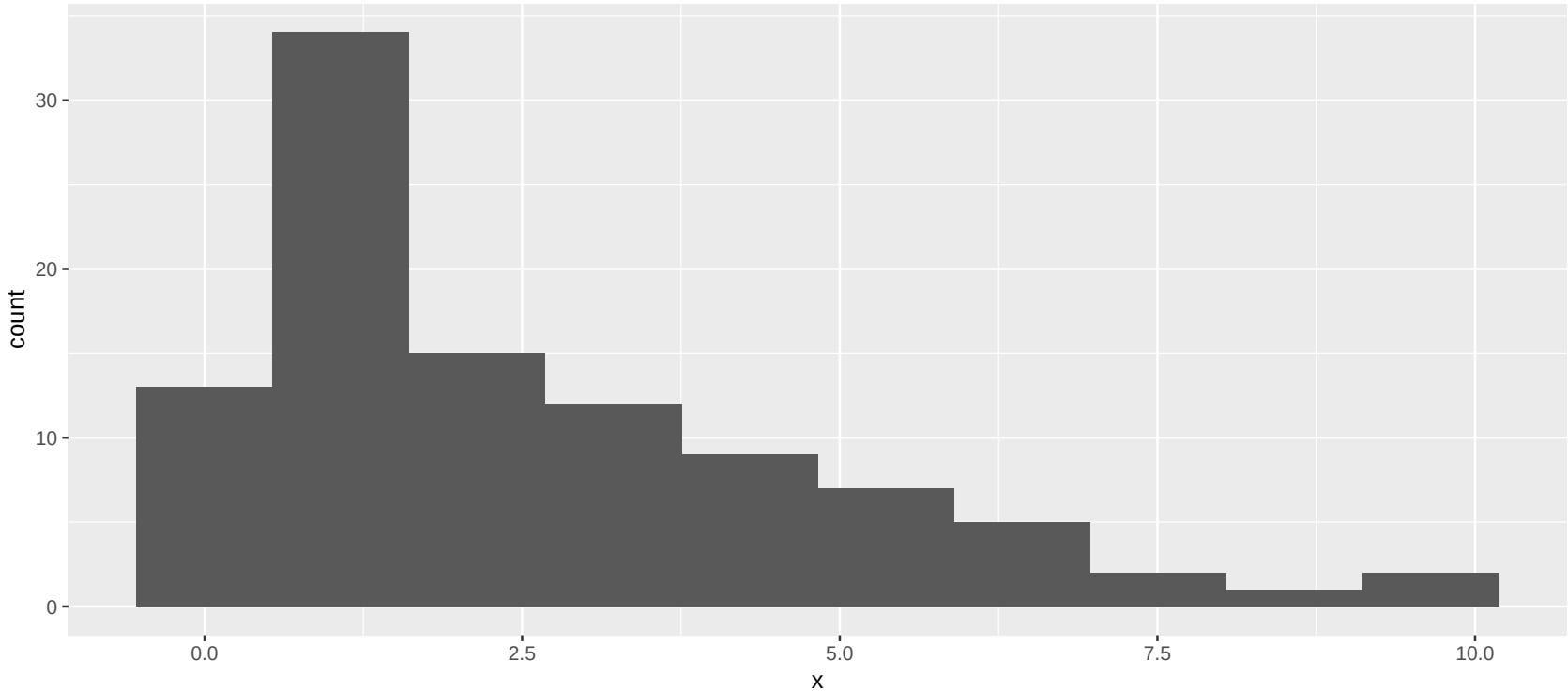
The normal quantile plot

Somewhat opening-up curve:



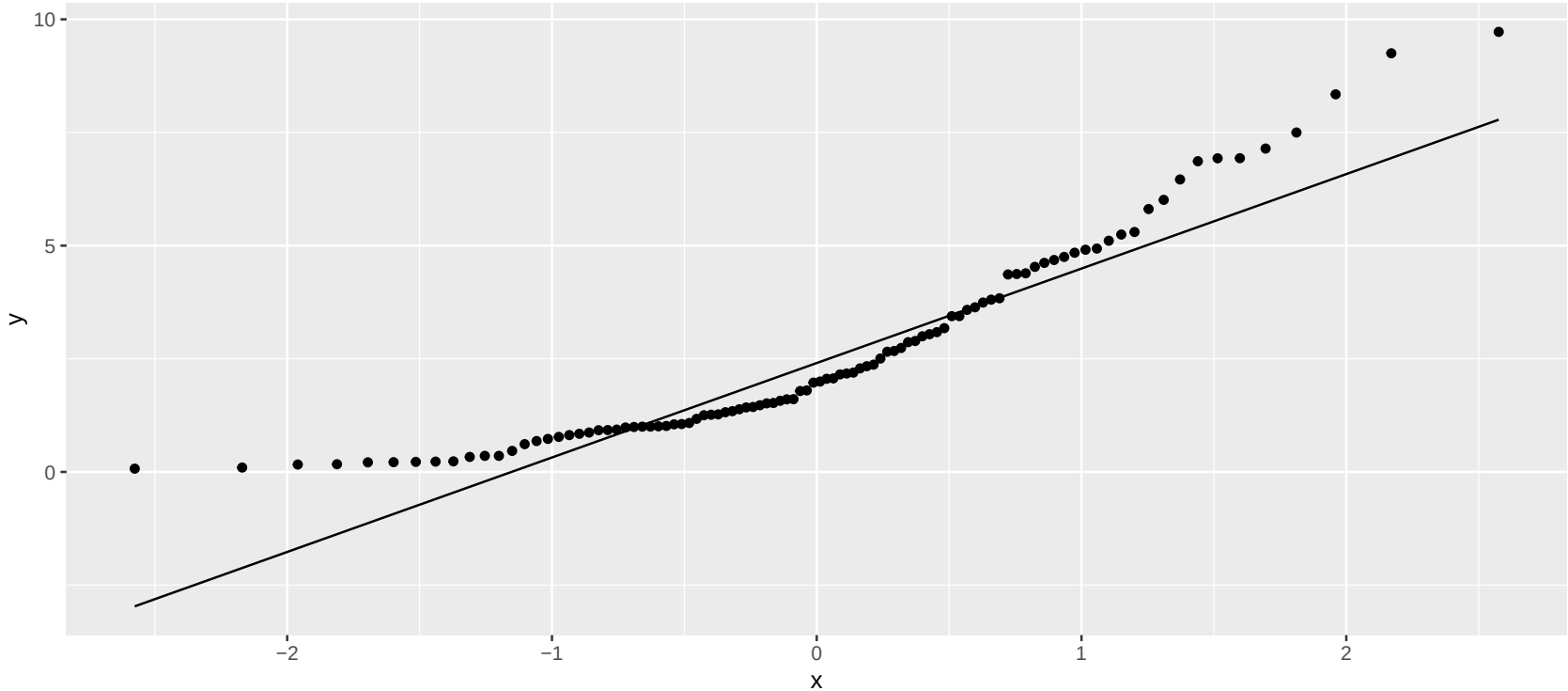
Chi-squared data, df = 3

Definitely skewed to right:



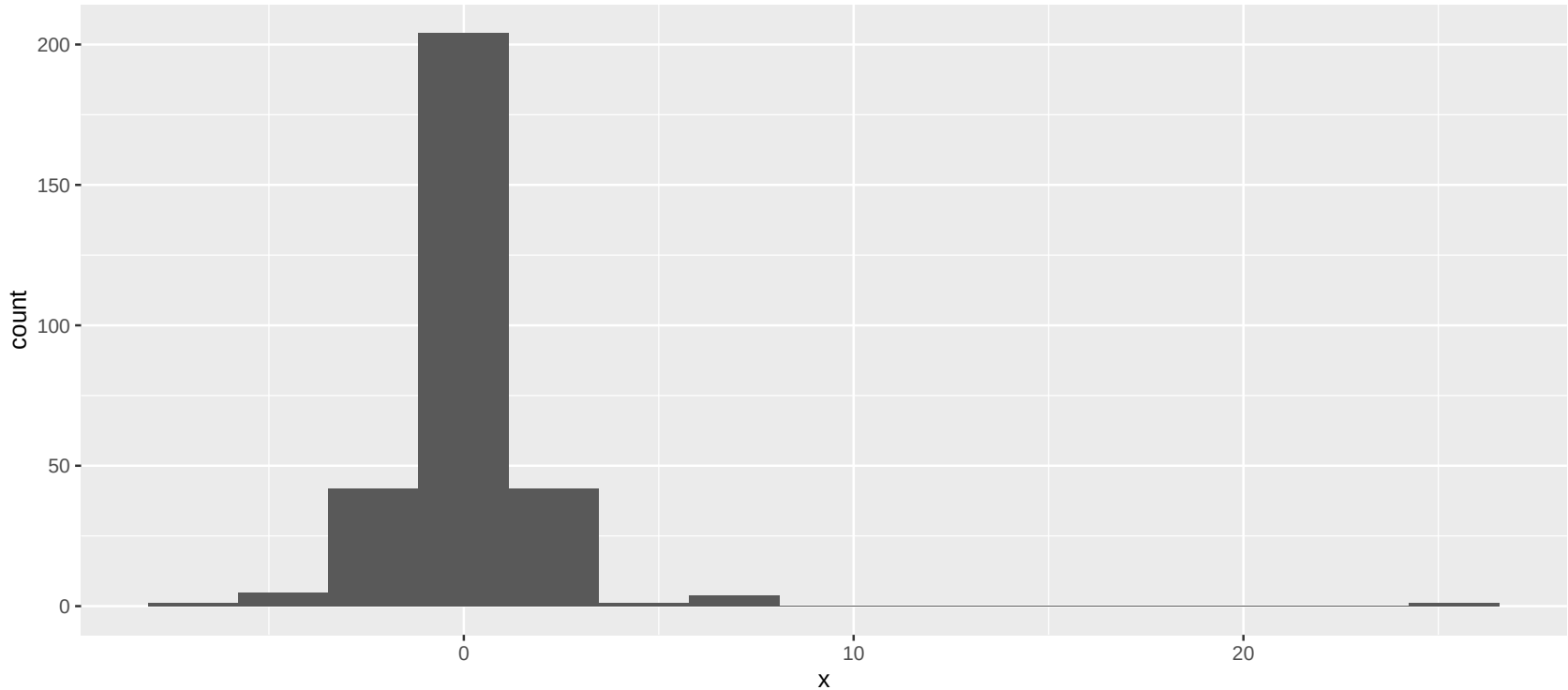
The normal quantile plot

Clear upward-opening curve:



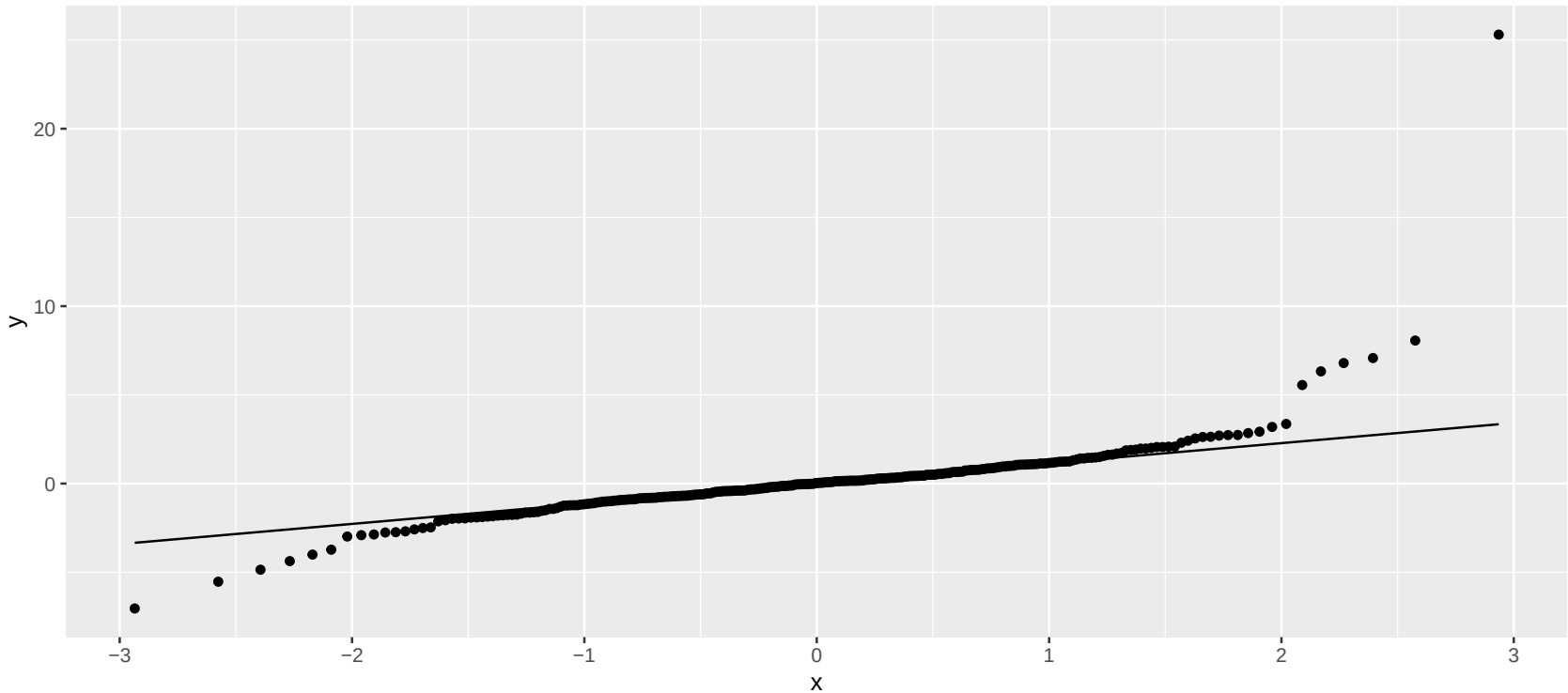
t-distributed data, df = 3

Long tails (or a very sharp peak):



The normal quantile plot

Low values too low and high values too high for normal.



Summary

On a normal quantile plot:

- points following line (with some small wiggles): normal.
- kind of deviation from a straight line indicates kind of nonnormality:
  - a few highest point(s) too high and/or lowest too low: outliers
  - else see how points at each end off the line:

	High points	
Low points	**Too low**	**Too high**
Too low	Skewed left	Long tails
Too high	Short tails	Skewed right