Summaries and visualization of relationships

Reflection on the last lecture

Objectives

At the end of the lecture, you will know how to...

- Describe relationship of quantitative and qualitative variable.
- Create and read **box plots** and **violin plots**.

- Understand relationship of two quantitative variables.
- Count and interpret **correlation**.
- Create and understand **scatterplots**.
- Assess what **relationship** (covariation) occurs between your variables.

Relationship of quantitative and qualitative variables

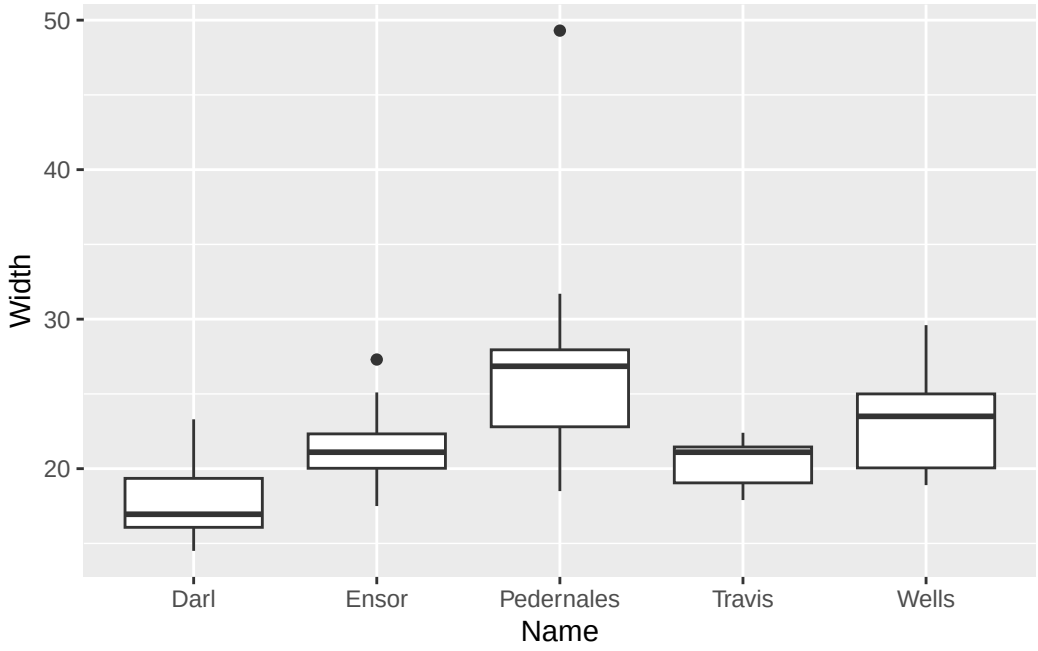
Boxplot

```
g <- ggplot(dartpoints) +
  aes(x = Name, y = Width)
```

Boxplot

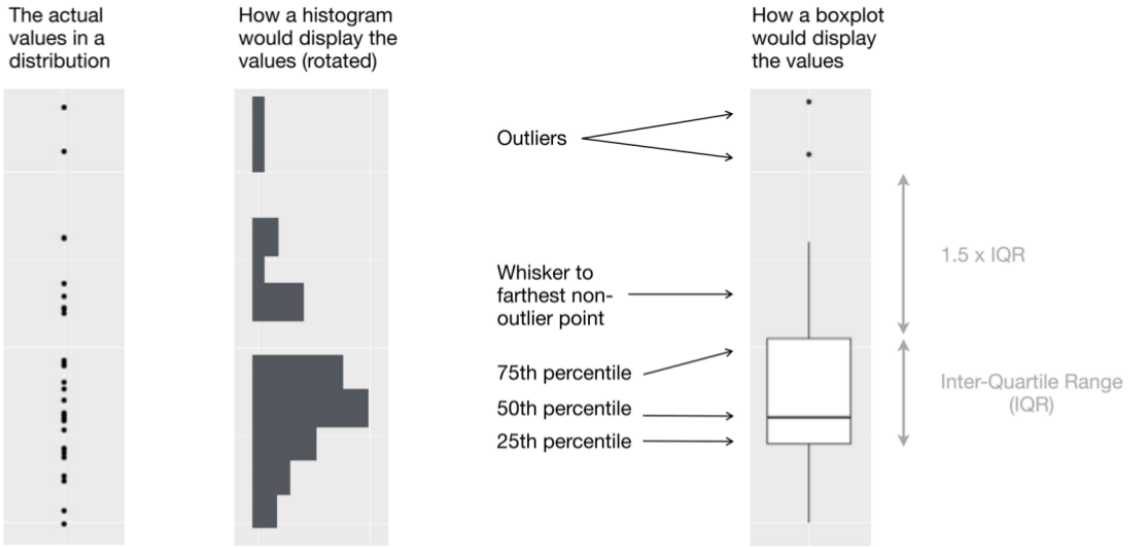
```
g <- ggplot(dartpoints) +
  aes(x = Name, y = Width)

g + geom_boxplot()
```



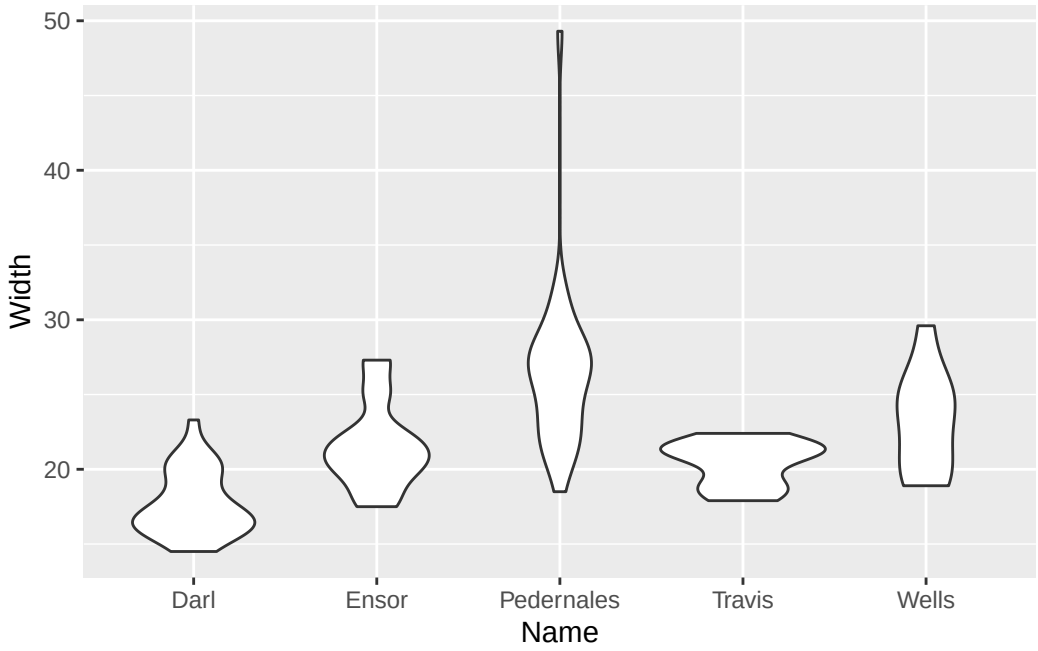
Boxplot

Also *box and whisker plot*, displays *five-number summary*.



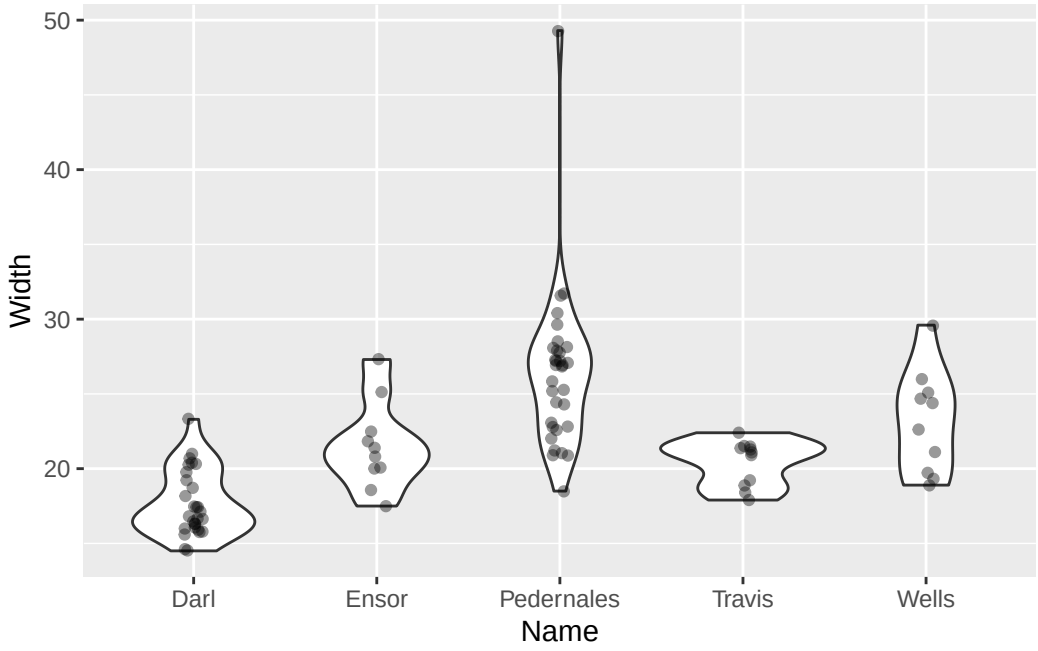
Violin plot

```
g + geom_violin()
```



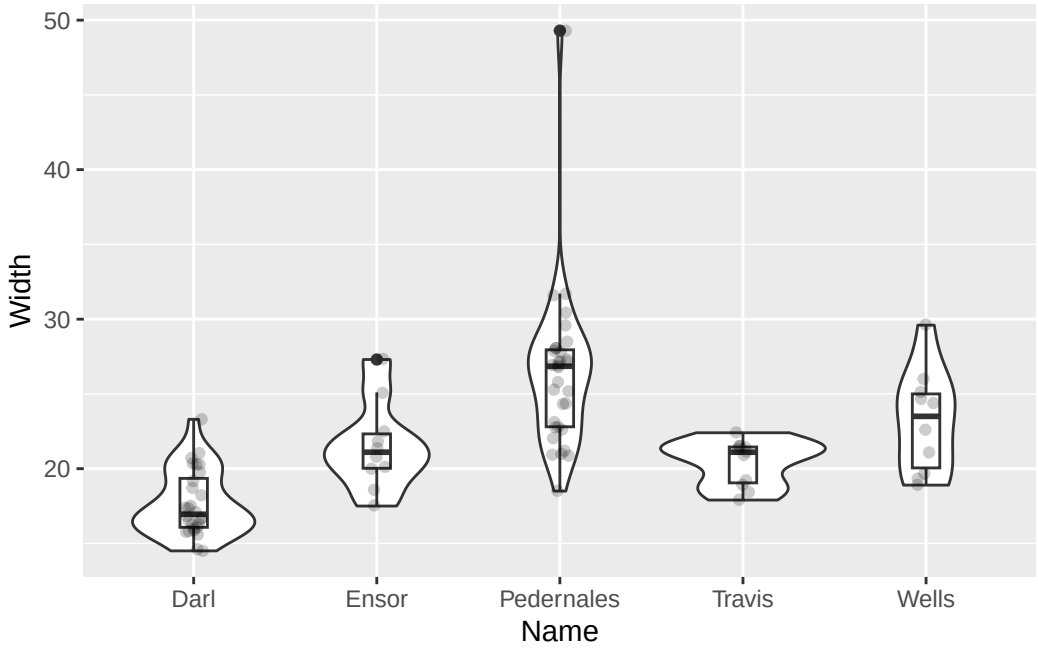
Violin plot

```
g + geom_violin() +
  geom_jitter(width = 0.05, alpha = 0.4)
```



Violin plot

```
g + geom_violin() +
  geom_boxplot(width = 0.15) +
  geom_jitter(width = 0.05, alpha = 0.2)
```



Relationship of two quantitative variables

Correlation

- A statistic describing a relationship between two continuous variables.
- To what degree is a variable y explained by x?
- Correlation coefficient **r**, from **-1 to +1**.
- **Correlation does not imply causation!**
- r = 1 – strong positive correlation
- r = 0.5 – moderately strong positive correlation
- r = 0 – variables are not correlated
- r = -0.2 – weak negative correlation
- r = -1 – strong negative correlation

Function `cor()`

```
cor(dartpoints$Length, dartpoints$Width)
```

```
[1] 0.7689932
```

```
cor(dartpoints$Length, dartpoints$Weight)
```

```
[1] 0.879953
```

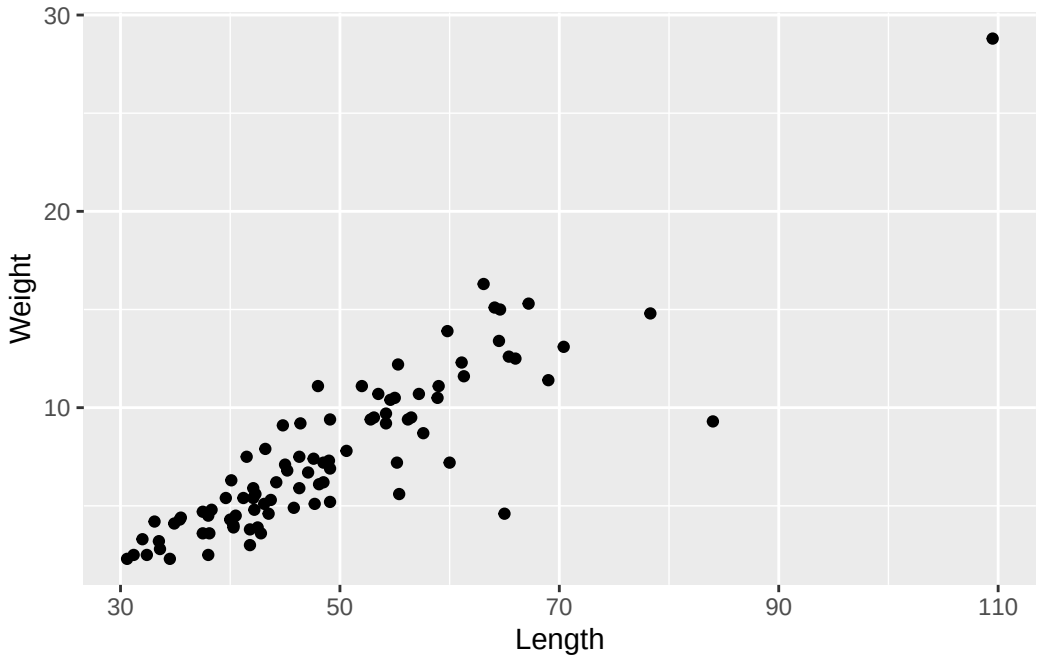
```
cor(dartpoints$Width, dartpoints$Thickness)
```

```
[1] 0.5459291
```

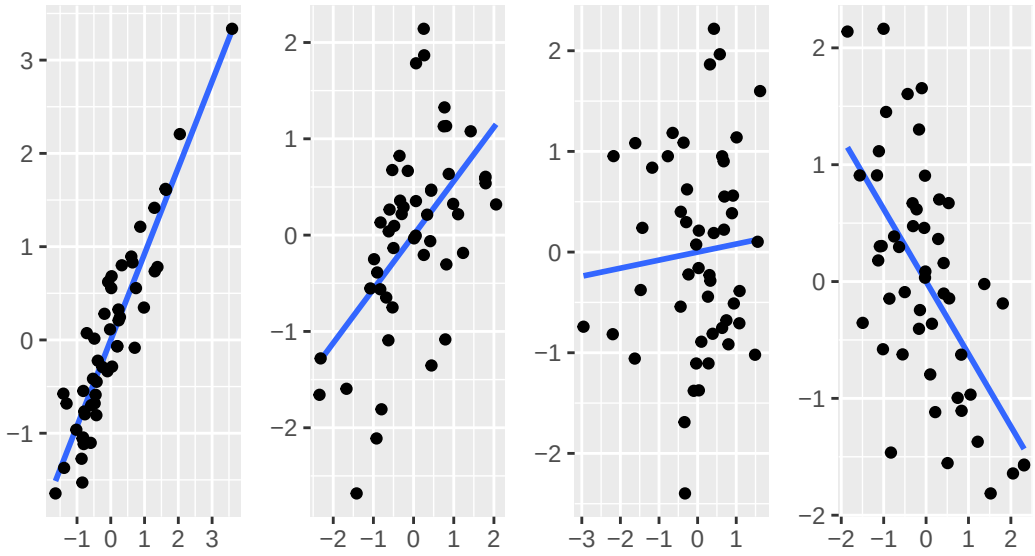
Scatter plot

- Plot displying **two continuous** variables, x and y.
- *x axis*: explanatory variable, independent, predictor.
- *y axis*: dependent variable, response.

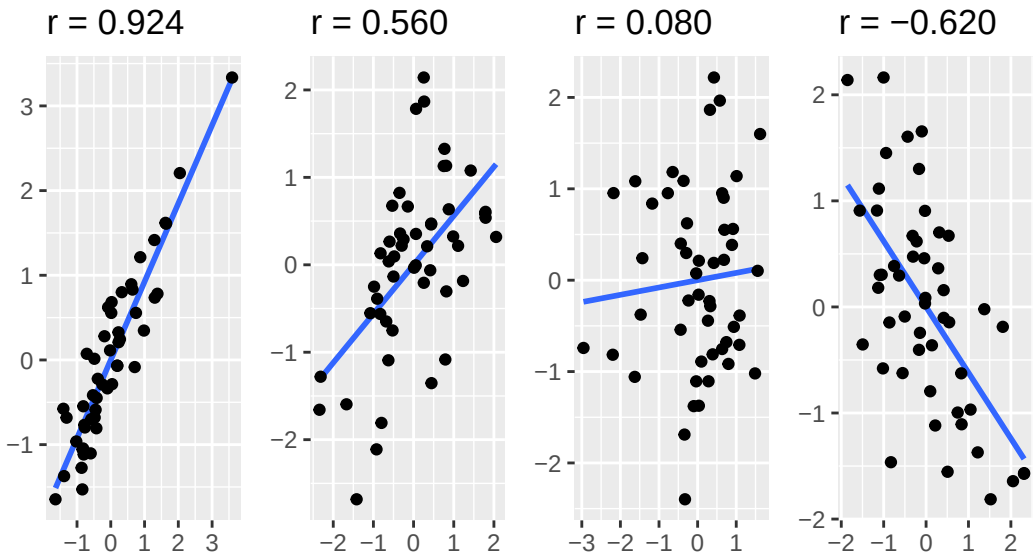
```
ggplot(dartpoints) +
  aes(x = Length, y = Weight) +
  geom_point()
```



Correlation examples

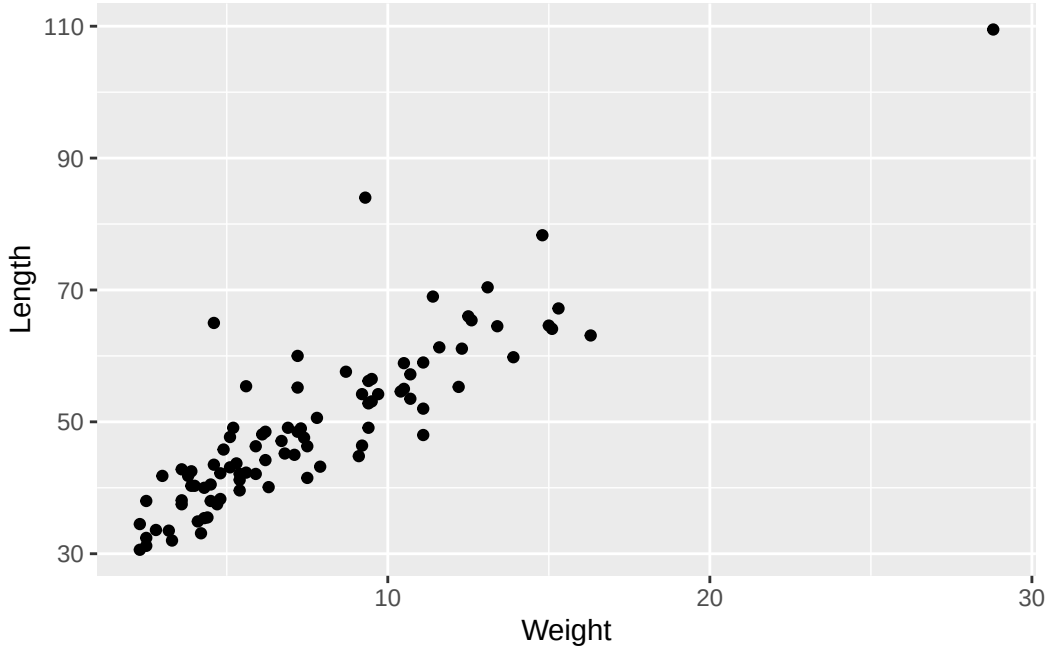


Correlation examples



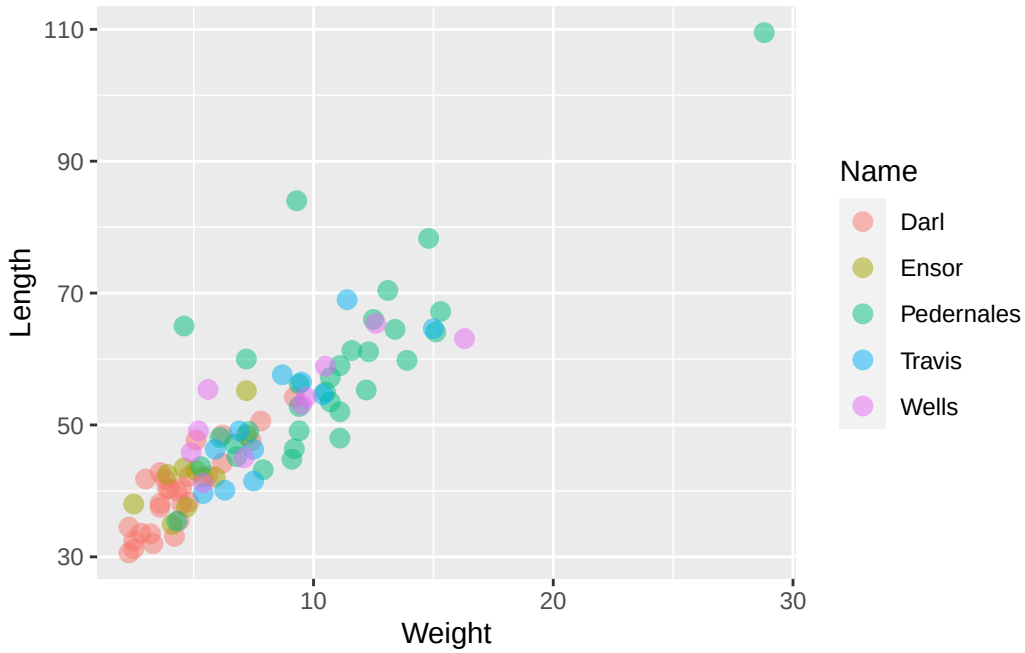
Scatter plots

```
ggplot(data = dartpoints) +
  aes(x = Weight, y = Length) +
  geom_point()
```



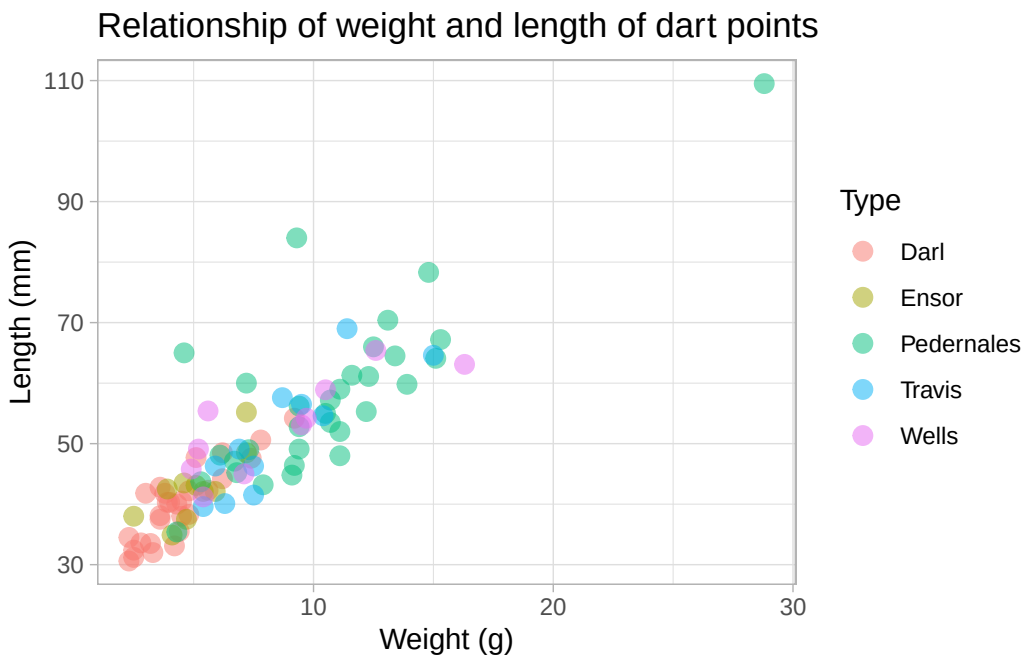
Scatter plots

```
ggplot(data = dartpoints) +
  aes(x = Weight, y = Length, color = Name) +
  geom_point(size = 3, alpha = 0.5)
```



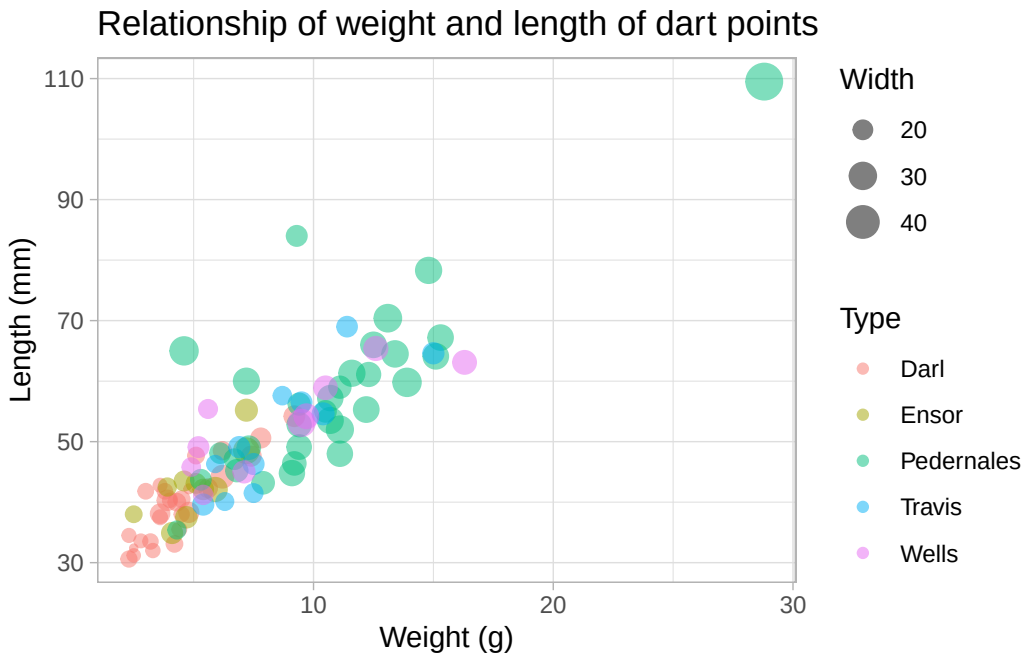
Scatter plots

```
ggplot(data = dartpoints) +
  aes(x = Weight, y = Length, color = Name) +
  geom_point(size = 3, alpha = 0.5) +
  labs(x = "Weight (g)", y = "Length (mm)", color = "Type",
       title = "Relationship of weight and length of dart points") +
  theme_light()
```



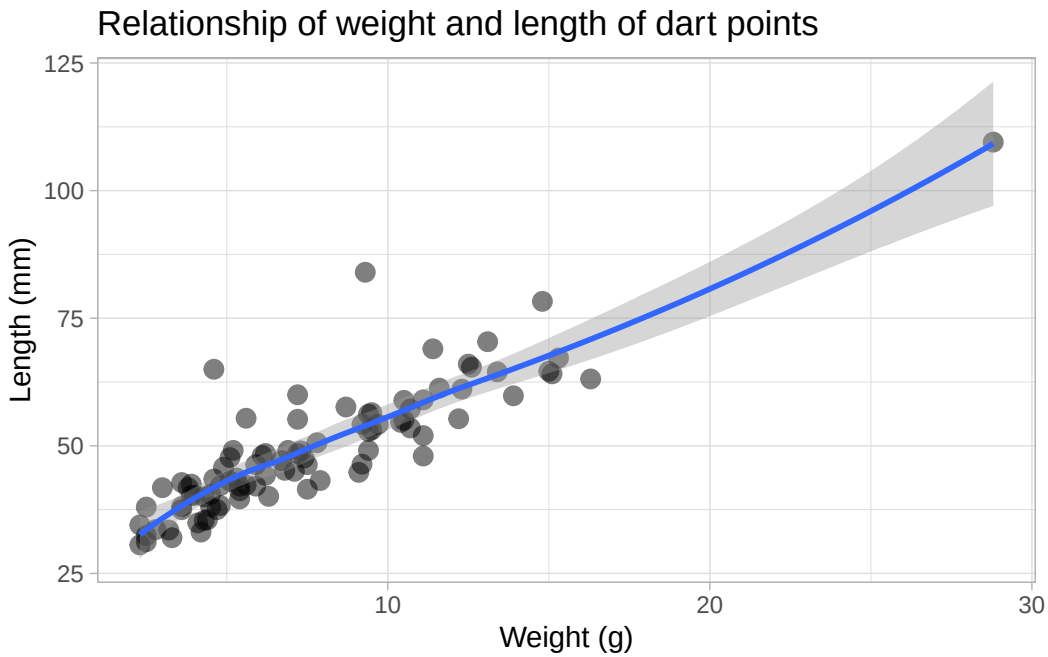
Scatter plots

```
ggplot(data = dartpoints) +
  aes(x = Weight, y = Length, size = Width, color = Name) +
  geom_point(alpha = 0.5) +
  labs(x = "Weight (g)", y = "Length (mm)", color = "Type",
       title = "Relationship of weight and length of dart points") +
  theme_light()
```



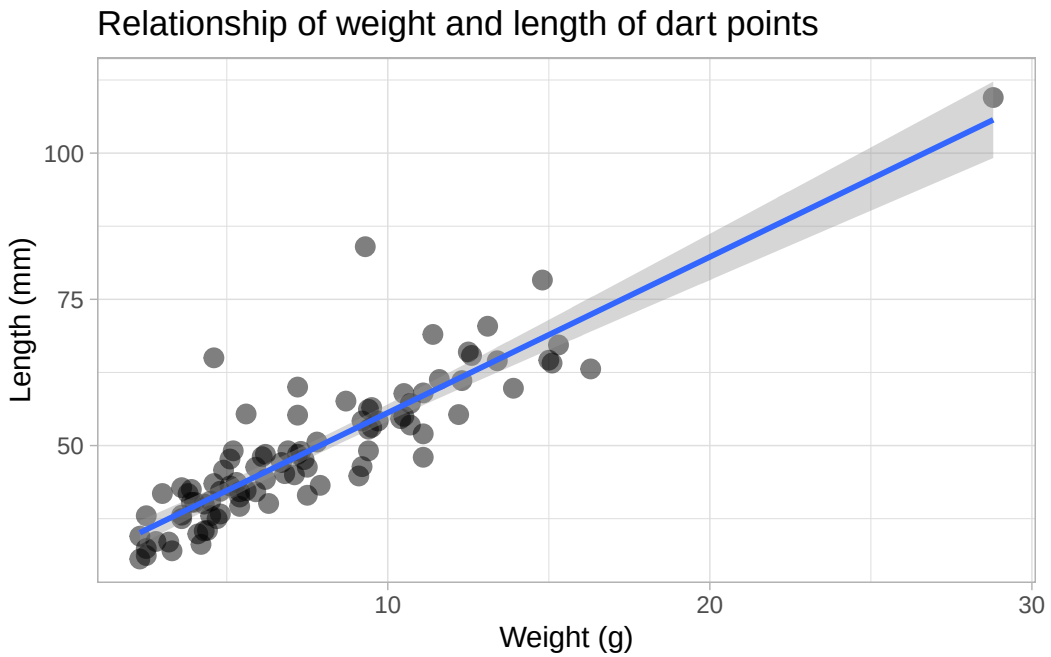
Trends

```
ggplot(data = dartpoints) +
  aes(x = Weight, y = Length) +
  geom_point(size = 3, alpha = 0.5) +
  geom_smooth() +
  labs(x = "Weight (g)", y = "Length (mm)", color = "Type",
       title = "Relationship of weight and length of dart points") +
  theme_light()
```



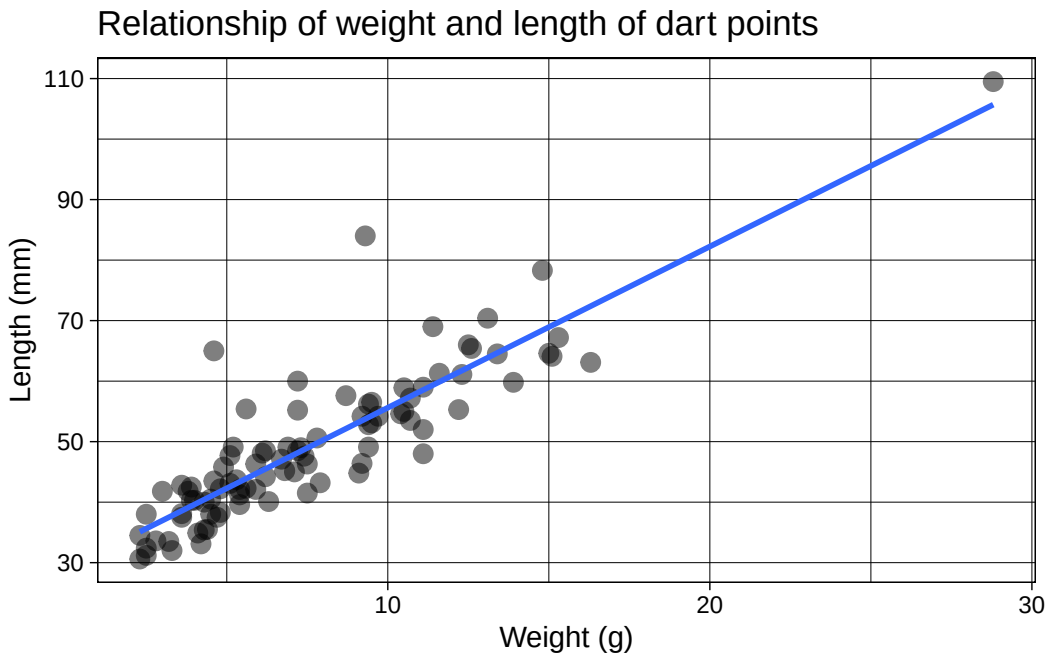
Trends

```
ggplot(data = dartpoints) +
  aes(x = Weight, y = Length) +
  geom_point(size = 3, alpha = 0.5) +
  geom_smooth(method = "lm") +
  labs(x = "Weight (g)", y = "Length (mm)", color = "Type",
       title = "Relationship of weight and length of dart points") +
  theme_light()
```



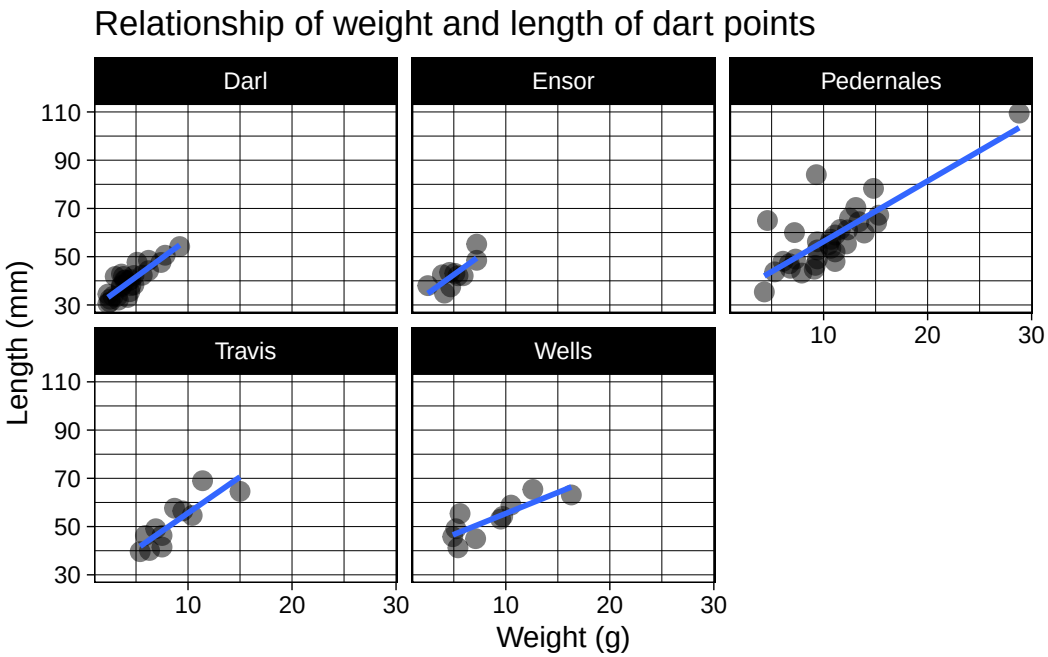
Trends

```
ggplot(data = dartpoints) +
  aes(x = Weight, y = Length) +
  geom_point(size = 3, alpha = 0.5) +
  geom_smooth(method = "lm", se = FALSE) +
  labs(x = "Weight (g)", y = "Length (mm)", color = "Type",
       title = "Relationship of weight and length of dart points") +
  theme_linedraw()
```



Small multiples

```
ggplot(data = dartpoints) +
  aes(x = Weight, y = Length) +
  geom_point(size = 3, alpha = 0.5) +
  geom_smooth(method = "lm", se = FALSE) +
  labs(x = "Weight (g)", y = "Length (mm)", color = "Type",
       title = "Relationship of weight and length of dart points") +
  theme_linedraw() +
  facet_wrap(~Name)
```



Exercise

- Download data set with bronze age cups (bacups.csv).
- Create a project in RStudio and load the data set.
- Explore the data set and its structure.
- What are the observations?
- What types of variables are there?
- Create a plot showing distribution of cup heights (`H`).
- Create a boxplot for cup heights divided by phases (`Phase`).
- Are there any outliers?
- Count correlation between cup height (`H`) and rim diameter (`RD`).
- Create a plot showing relationship between cup height and its rim diameter.
- Color cups from different phases (`Phase`) by differently.
- Describe the relationship, add a linear model to the plot.
- Label the axes sensibly.

Hints:
`read.csv()`,
`str()`,
`colnames()`,
`summary()`,
`cor()`,

```
ggplot() +
aes() +
geom_* + stat_*
```