ASMAS SS2024 - Solution 1

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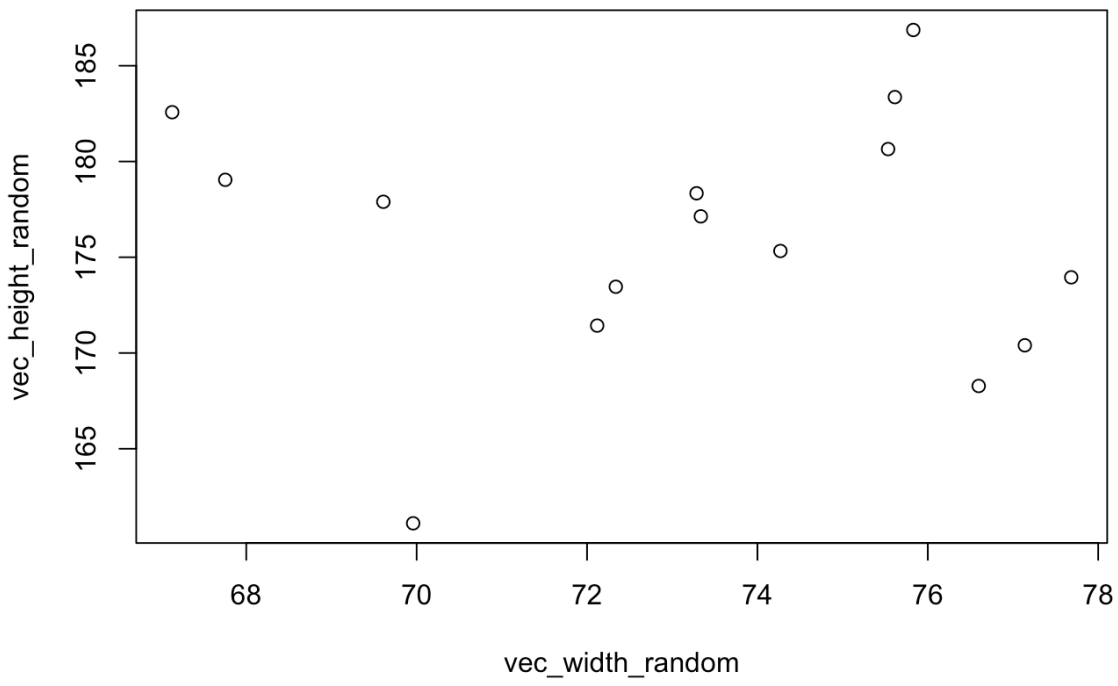
WEBR STATUS
Ready!

Problem 1: Data Collection and First Inspection

Measure width of your left hand in mm and your height in cm and enter that data into a table. From that table create a simple plot using the function `plot()`. As a demo, we are first running that with random numbers. After that run the same with the collected data

```
set.seed(1902)
n_nr_obs <- 15
vec_width_random <- rnorm(n_nr_obs, mean = 73, sd = 2.5)
vec_height_random <- rnorm(n_nr_obs, mean = 175, sd = 7.9)
plot(vec_width_random, vec_height_random)
```

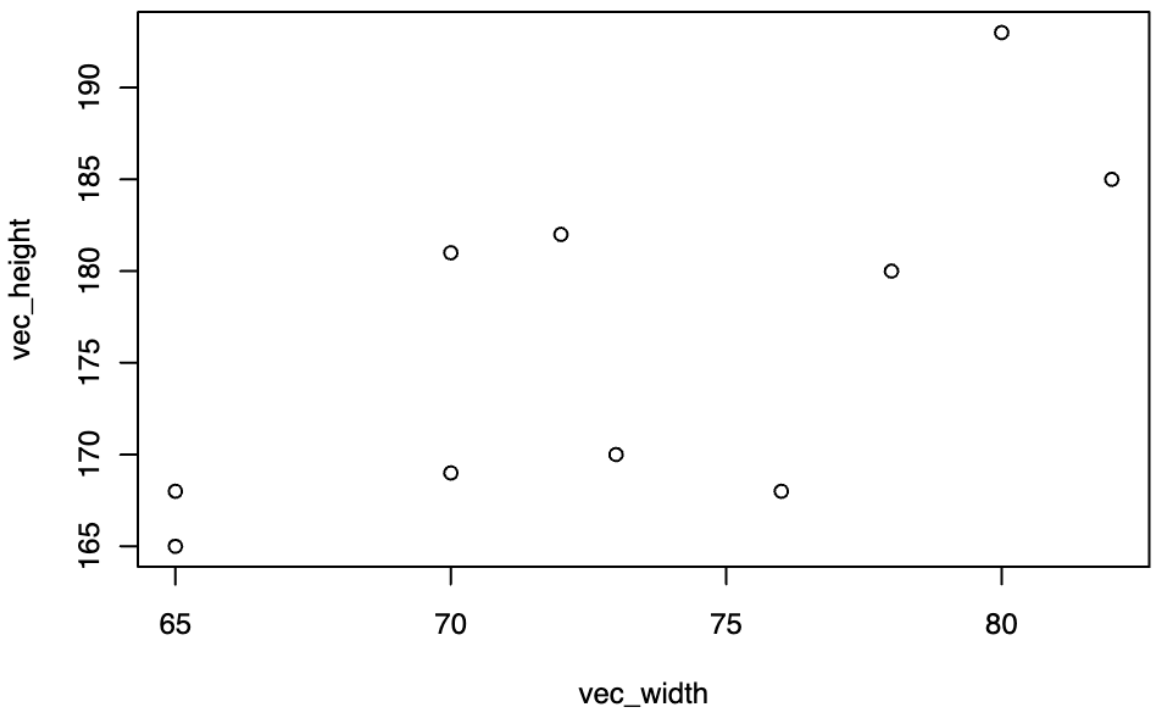


Do the same with the collected data

Run Code

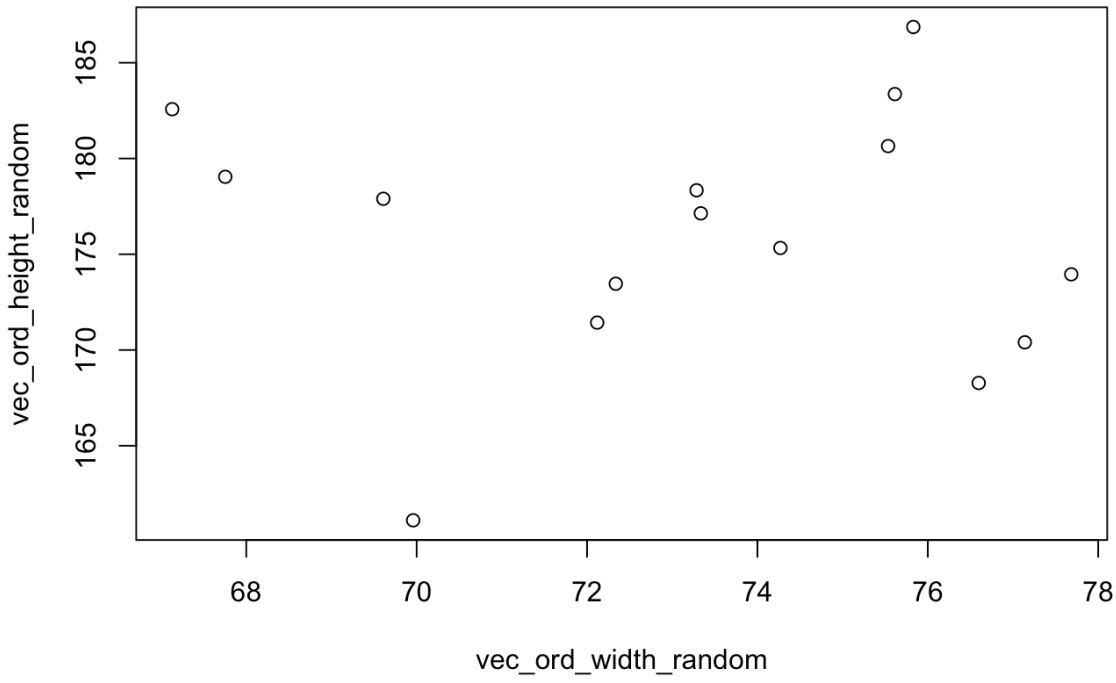
```
# enter data
vec_width <- c(82,65,76,80,78,70,72,70,65,73)
vec_height <-c(185,168,168,193,180,181,182,169,165,170)

# plot
plot(vec_width, vec_height)
```



Order both variables (width and height) in the data according to the width of the left hand, then repeat the plot

```
vec_order_random <- order(vec_width_random)
vec_ord_width_random <- vec_width_random[vec_order_random]
vec_ord_height_random <- vec_height_random[vec_order_random]
plot(vec_ord_width_random, vec_ord_height_random)
```

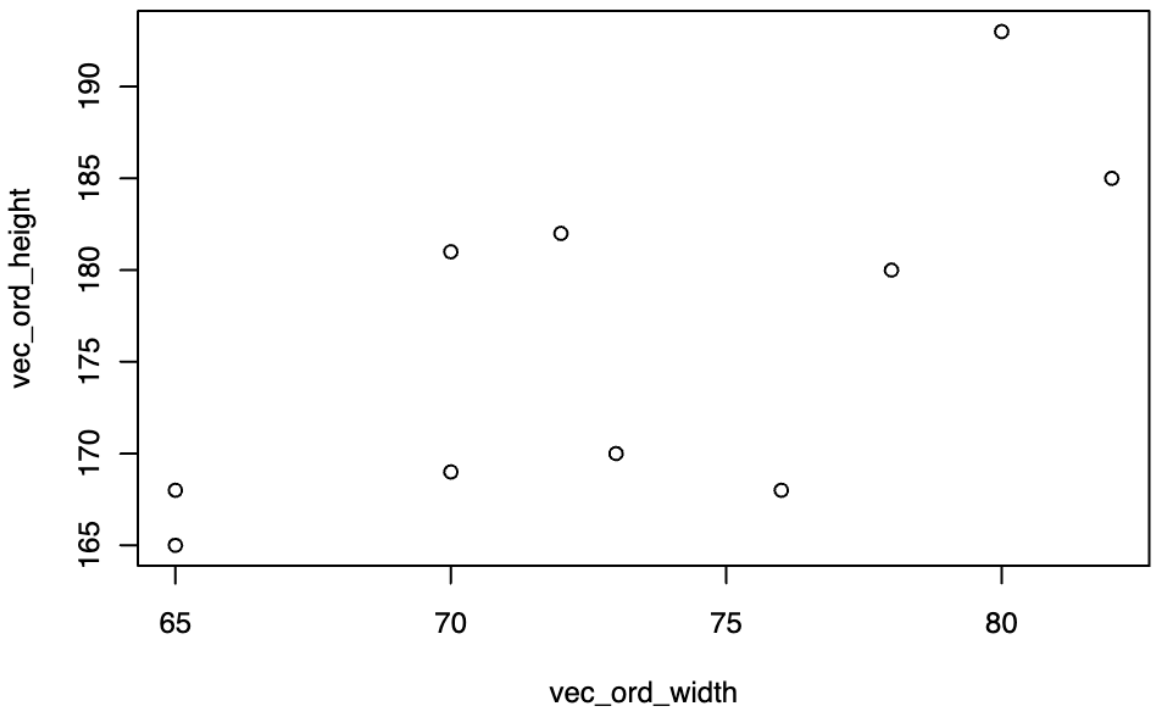


Do the ordered version of the plot

Run Code

```
# order the data according to width
vec_order_width <- order(vec_width)
vec_ord_width <- vec_width[vec_order_width]
vec_ord_height <- vec_height[vec_order_width]

# plot ordered data
plot(vec_ord_width, vec_ord_height)
```



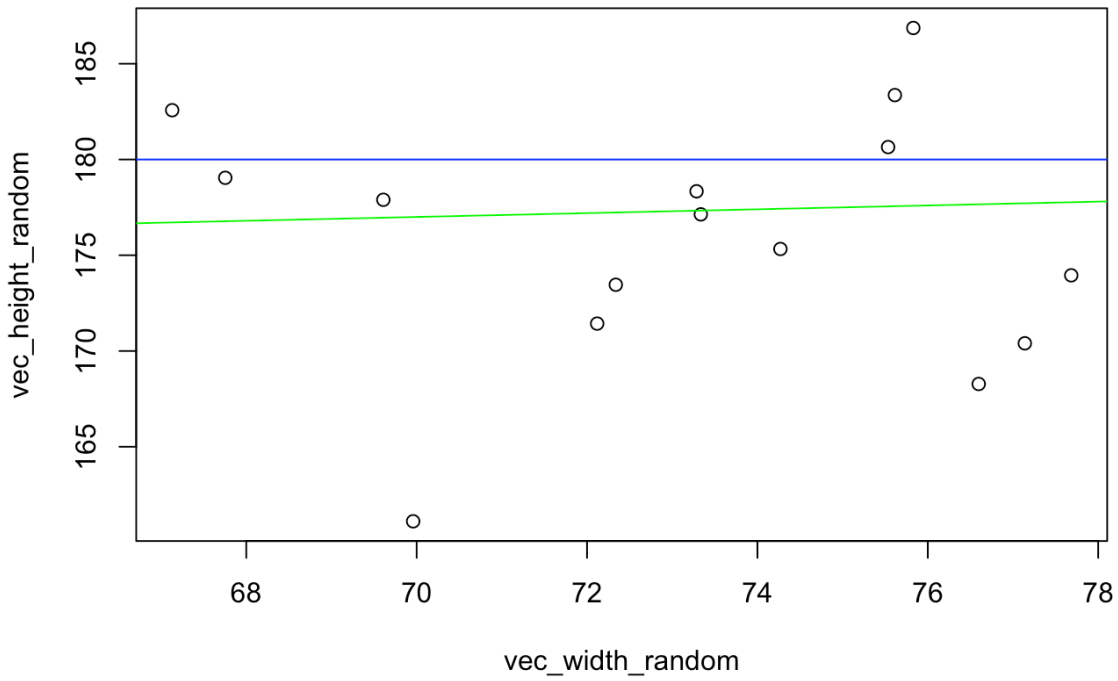
Problem 2: Line Fitting

- Based on the plotted points above what would be a good description of the relationship of width and height?
- How well would a straight line describe the relationship?
- Why do we want to use a straight line?
- What is the meaning of a linear relationship?
- Try to fit different straight lines throught the plotted points by trial and error.

Fitting different lines through the demo

- Try to make statements about how well a given straight line fits the points.

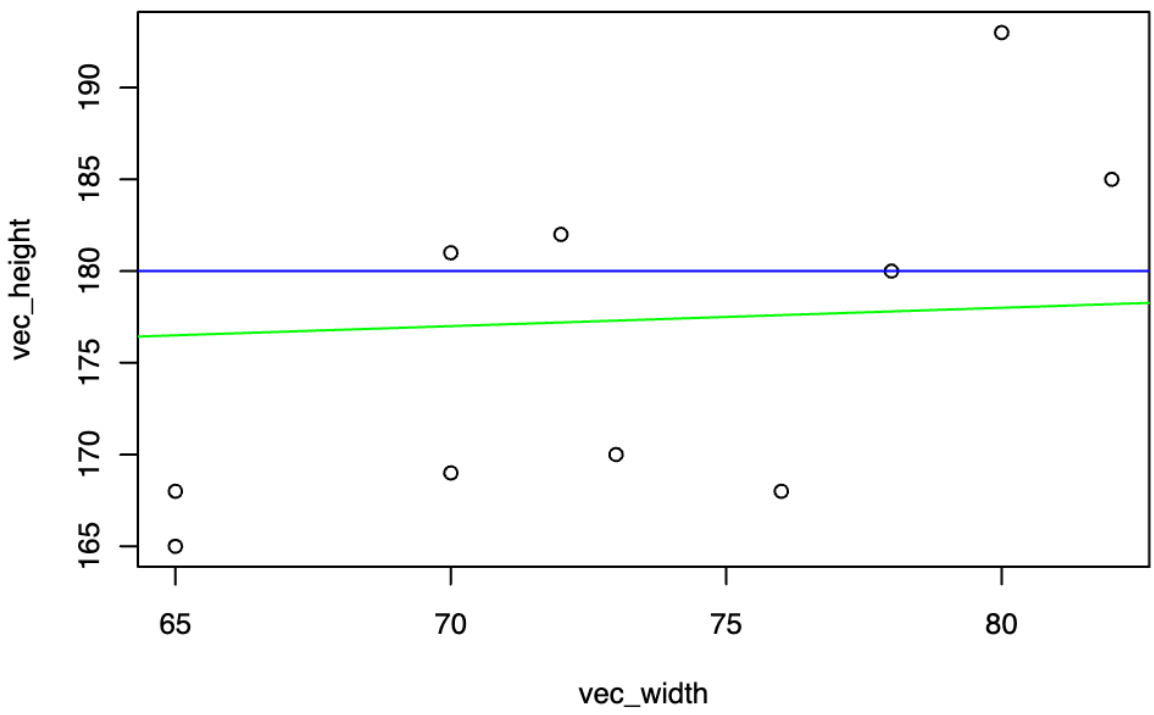
```
plot(vec_width_random, vec_height_random)
abline(180, 0, col="blue")
abline(170, 0.1, col = "green")
```



Try to fit some plots for the collected data

Run Code

```
# plot the points again
plot(vec_width, vec_height)
# use abline to do some line fitting
abline(180, 0, col = "blue")
abline(170, 0.1, col = "green")
```



- Do some computations related to how well the lines fit the data

Start with blue line

Run Code

```
# compute distance of points from  lines
# blue line
a <- 180
b <- 0
vec_y_hat <- a + b * vec_width
(ssq_blue <- sum((vec_height - vec_y_hat)^2))
```

```
[1] 933
```

Green line

Run Code

```
a <- 170
b <- 0.1
vec_y_hat <- a + b * vec_width
(ssq_green <- sum((vec_height - vec_y_hat)^2))
```

```
[1] 729.07
```

Additional Problem: Fit a Series of Lines

The following code chunk fits a series of lines and finds the minimum sum of squared residuals

Run Code

```
ssq_min <- .Machine$double.max.exp
a_min <- NULL
```

```
b_min <- NULL
for (a in c(min(vec_height):max(vec_height))){
  for (b in seq(0.1,0.5,0.1)){
    vec_y_hat <- a + vec_width * b
    vec_dist_y <- vec_height - vec_y_hat
    ssq <- sum(vec_dist_y^2)
    if (ssq < ssq_min) {
      ssq_min <- ssq
      a_min <- a
      b_min <- b
    }
  }
}
cat(" * Minimum SSQ Residuals: ", ssq_min, "\n")
cat(" * Intercept:             ", a_min, "\n")
cat(" * Slope:                 ", b_min, "\n")
```

```
* Minimum SSQ Residuals:  714.87
* Intercept:             169
* Slope:                 0.1
```