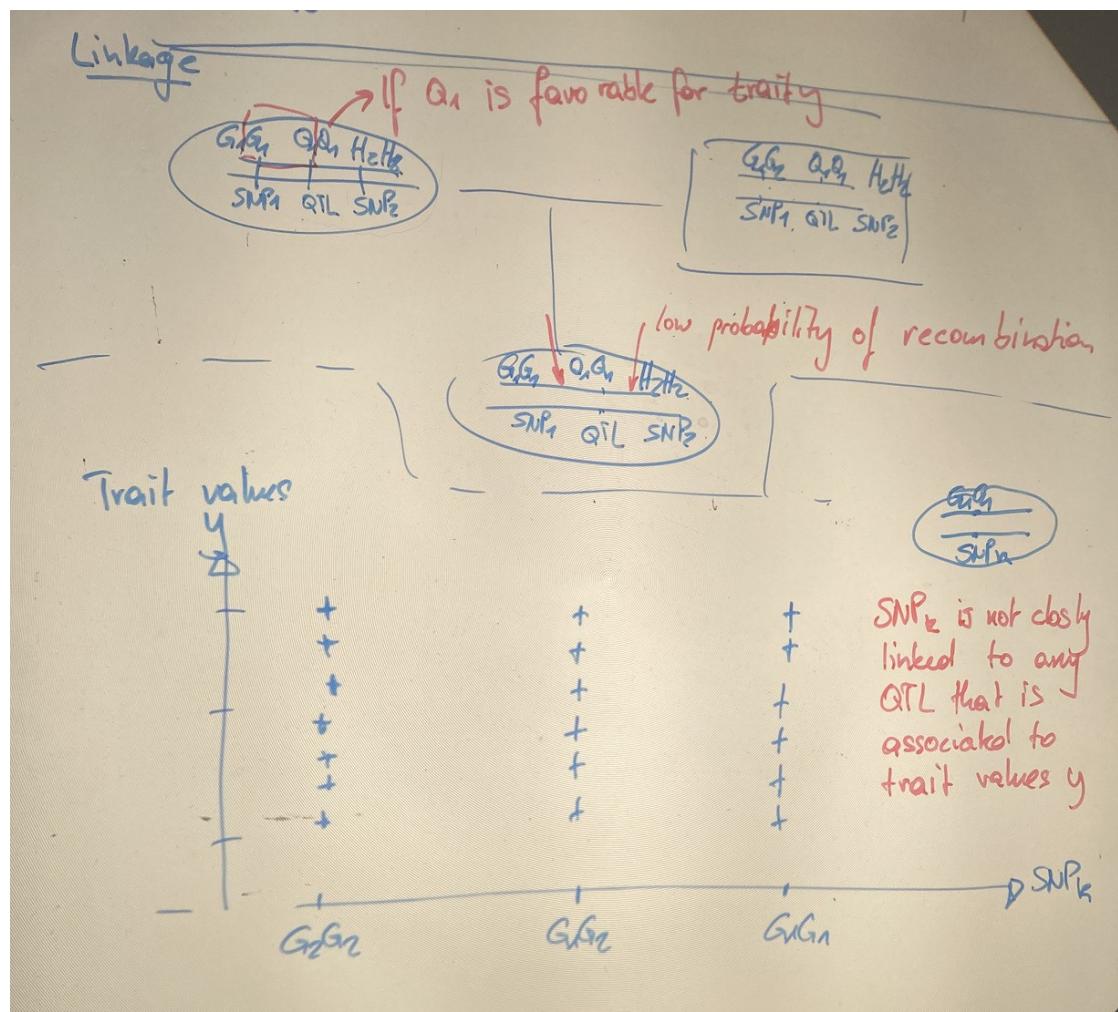
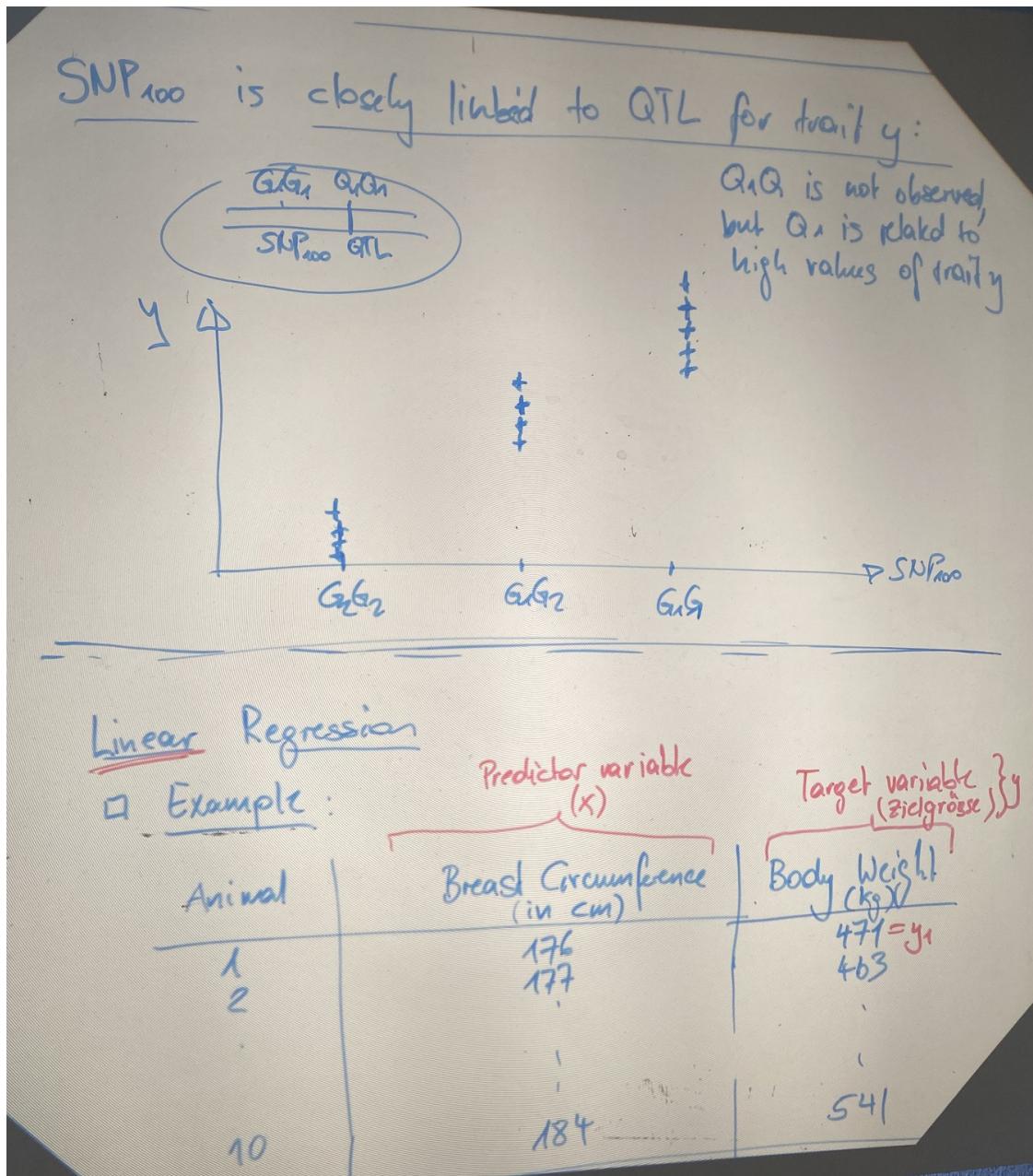


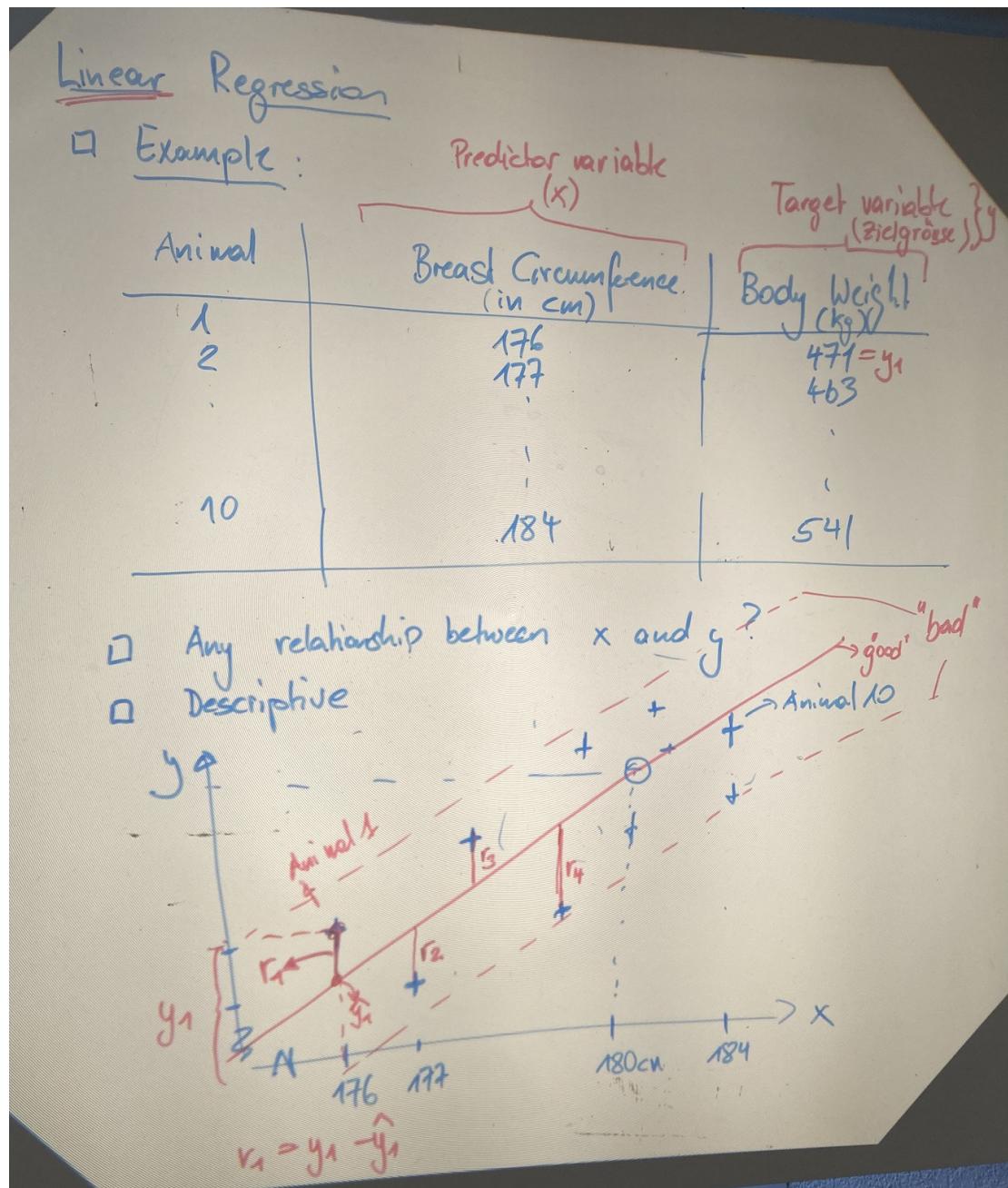
OHP Picture 1



OHP Picture 2



OHP Picture 3



OHP Picture 4

How to find the red-line (Regression line)

- Red-line gives the expected body weight ($E(y)$) based on a given value of breast circumference x

$$\hat{y} = E(y) = b_0 + b_1 \cdot x$$

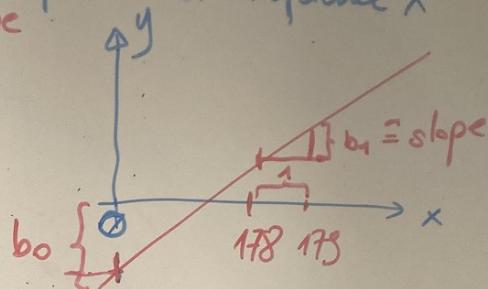
$\xrightarrow{\text{slope}}$
 $\xrightarrow{\text{intercept}}$

Every observation

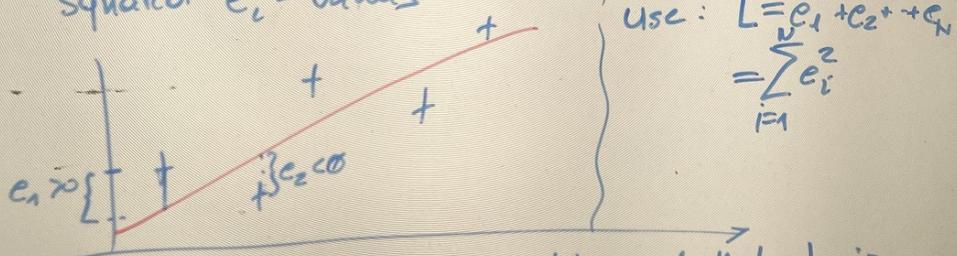
$$y_i = E(y) + e_i$$

$$= b_0 + b_1 \cdot x_i + e_i$$

$\xrightarrow{\text{known}}$ $\xrightarrow{\text{Unknown}}$ $\xrightarrow{\text{Observed, known}}$



- Regression Line (defined by b_0 and b_1) is determined by minimizing the sum of the squared e_i -values



Goal: Determine b_0 and b_1 such that L is minimal

Use $y_i = b_0 + b_1 x_i + e_i$

OHP Picture 5

$$\text{Minimize } L : \quad \text{Use } y_i = b_0 + b_1 x_i + e_i$$

$$L = \sum_{i=1}^N e_i^2 = \sum_{i=1}^N [y_i - b_0 - b_1 x_i]^2$$

$$\frac{\partial L}{\partial b_0} = \sum_{i=1}^N 2 \cdot [y_i - b_0 - b_1 x_i], \quad (1)$$

$$= -2 \sum_{i=1}^N [y_i - b_0 - b_1 x_i] = -2 \left[\sum_{i=1}^N (y_i) - N b_0 \right]$$

$$\frac{\partial L}{\partial b_1} = \sum_{i=1}^N -2 [y_i - b_0 - b_1 x_i] x_i - b_1 \sum_{i=1}^N x_i$$

$$= -2 \left[\sum_{i=1}^N (x_i y_i) - \sum_{i=1}^N (b_0 x_i) - \sum_{i=1}^N (b_1 x_i^2) \right]$$

$$= -2 \left[\sum_{i=1}^N (x_i y_i) - b_0 \sum_{i=1}^N (x_i) - b_1 \sum_{i=1}^N (x_i^2) \right]$$

Determine b_0 and b_1 where $\frac{\partial L}{\partial b_0} = 0$ and $\frac{\partial L}{\partial b_1} = 0$

$$\frac{\partial L}{\partial b_0} = -2 \left[\underbrace{y_{\cdot} - N b_0 - b_1 x_{\cdot}}_{=0} \right] = 0$$

$$\frac{\partial L}{\partial b_1} = -2 \left[\underbrace{(x y)_{\cdot} - b_0 x_{\cdot} - b_1 (x^2)_{\cdot}}_{=0} \right] = 0$$

OHP Picture 6

$$y_{\cdot} - N b_0 - b_1 x_{\cdot} = \emptyset$$

$$b_0 = \frac{y_{\cdot} - b_1 x_{\cdot}}{N}$$

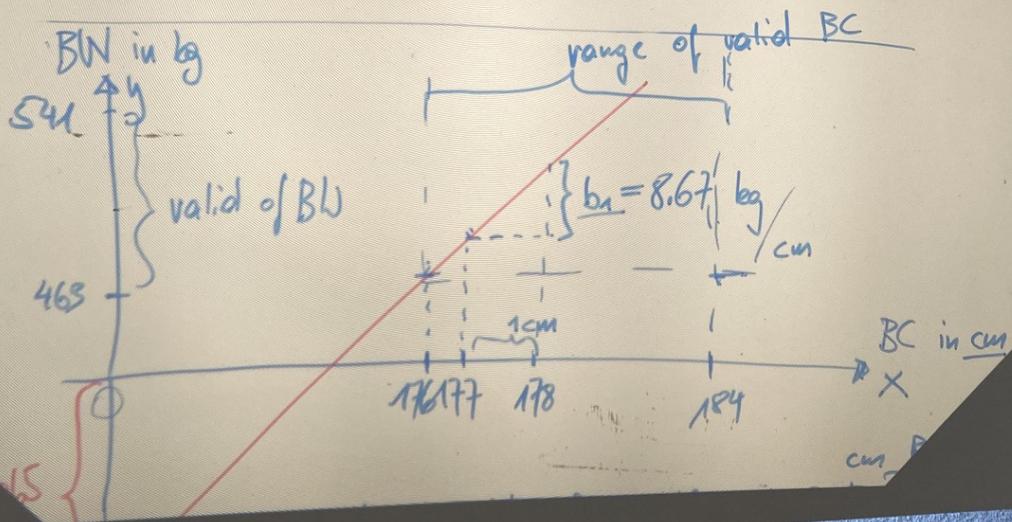
$$(x_{\cdot}y_{\cdot}) - b_0 x_{\cdot} - b_1 (x^2)_{\cdot} = \emptyset$$

$$(x_{\cdot}y_{\cdot}) - \frac{(y_{\cdot} - b_1 x_{\cdot}) x_{\cdot}}{N} - b_1 x_{\cdot} = \emptyset$$

$$N(x_{\cdot}y_{\cdot}) - x_{\cdot}y_{\cdot} + b_1 (x_{\cdot})^2 - b_1 x_{\cdot} = \emptyset$$

$$N(x_{\cdot}y_{\cdot}) - x_{\cdot}y_{\cdot} + b_1 [(x_{\cdot})^2 - x_{\cdot}] = \emptyset$$

$$b_1 = \frac{x_{\cdot}y_{\cdot} - N(x_{\cdot}y_{\cdot})}{(x_{\cdot})^2 - x_{\cdot}}$$



OHP Picture 7

