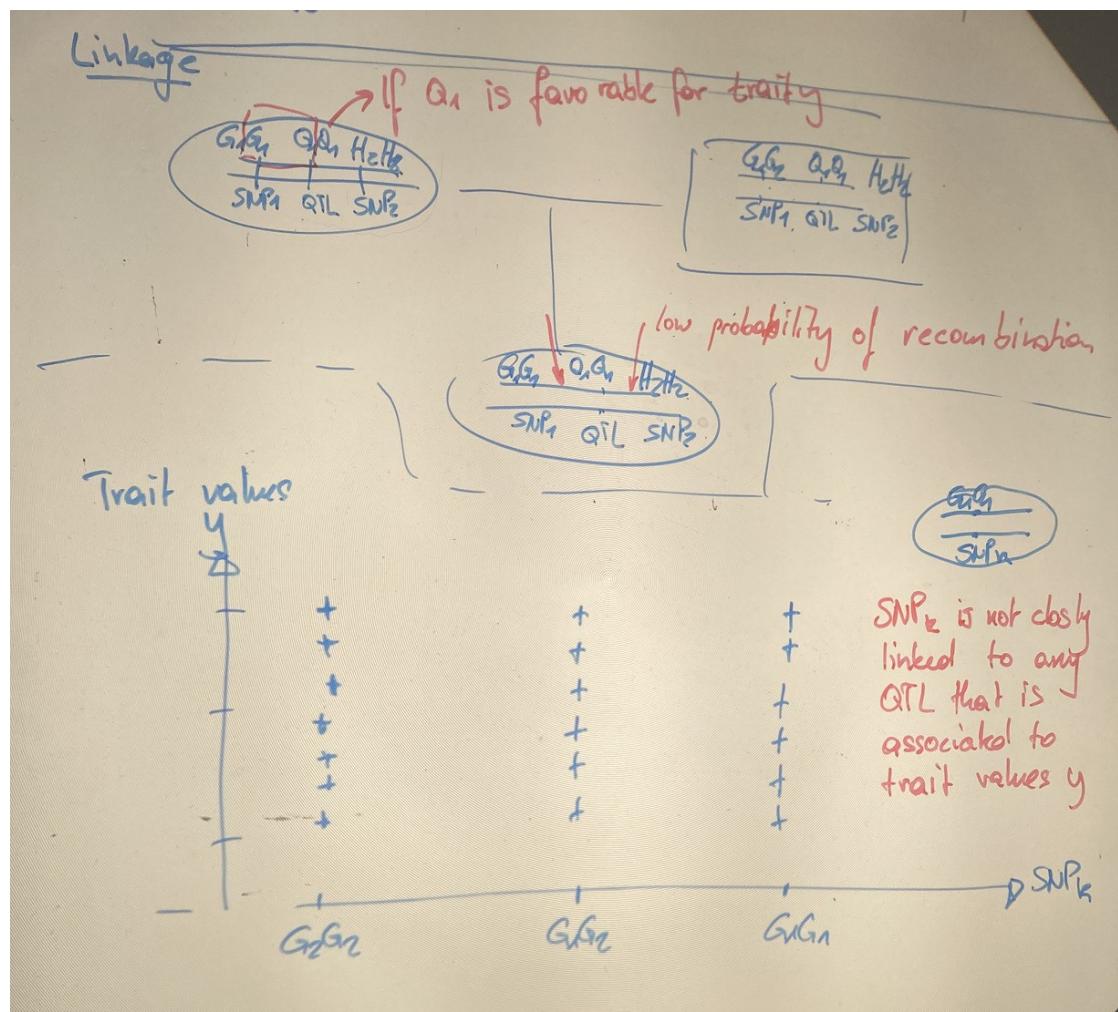
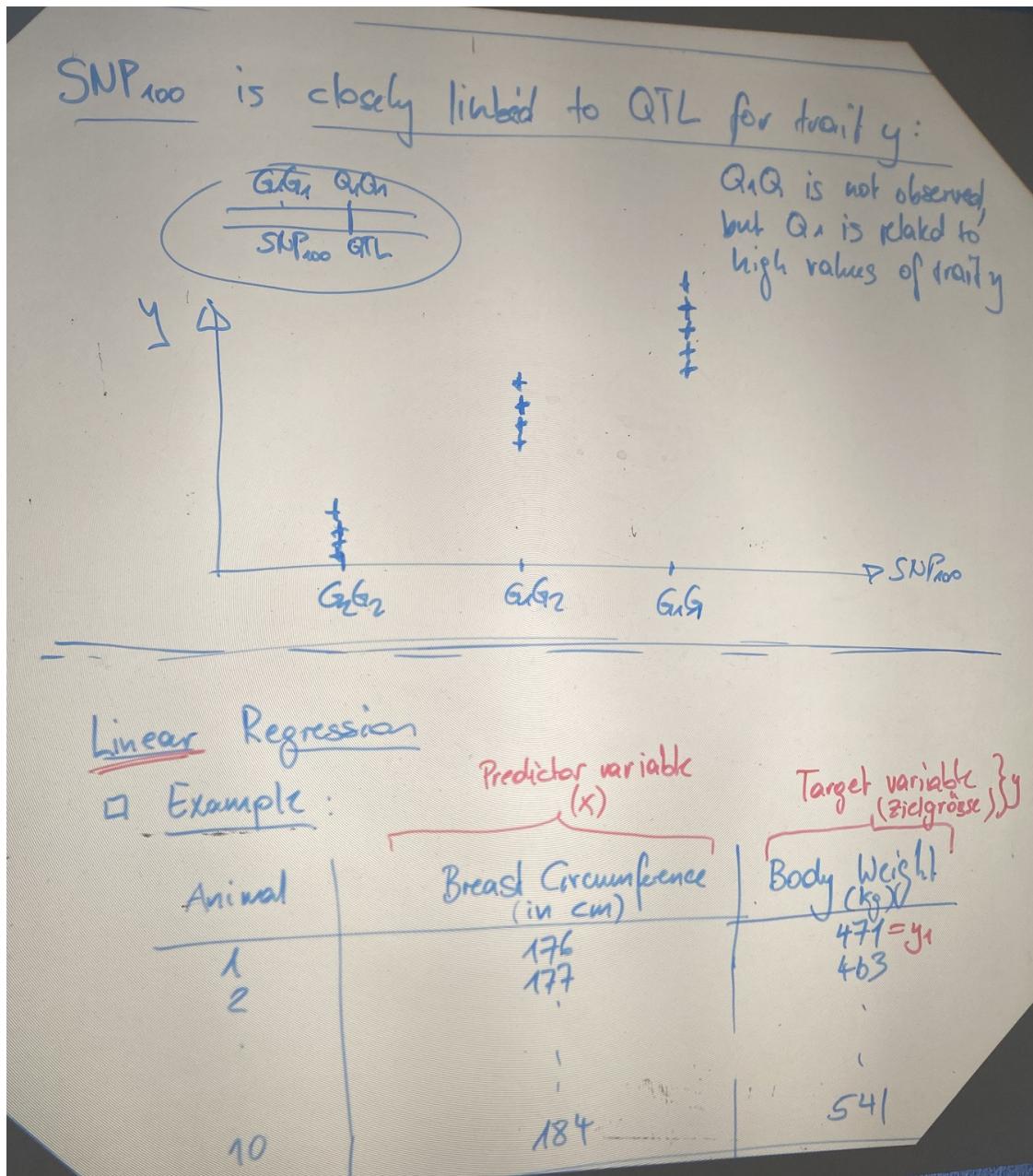




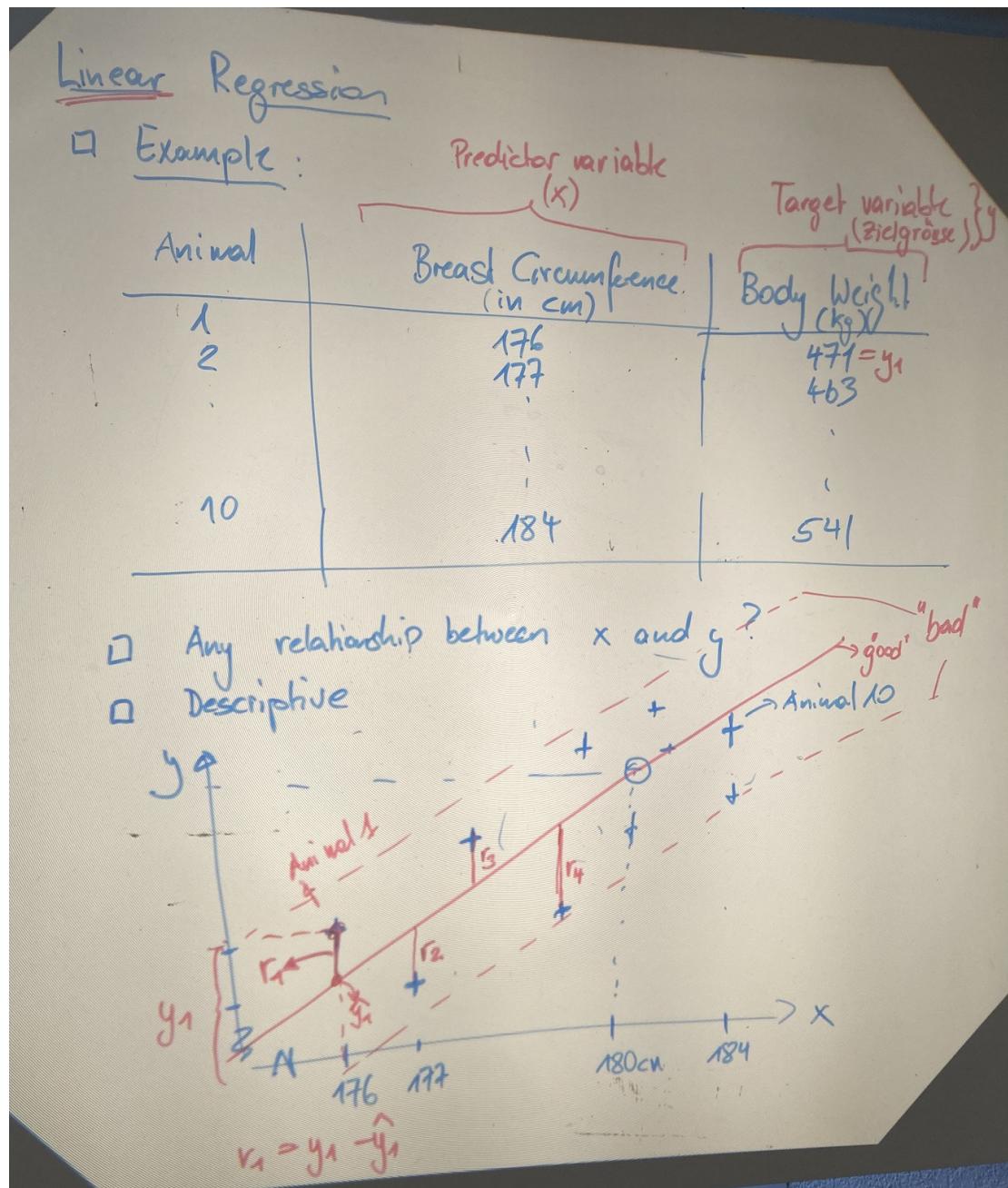
## OHP Picture 1



## 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  $x$

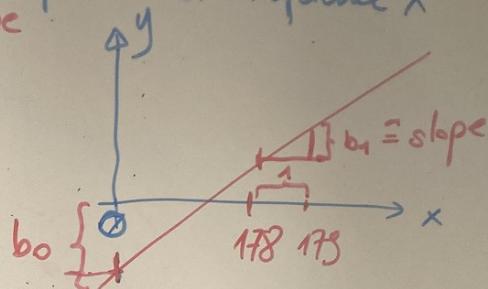
$$\hat{y} = E(y) = b_0 + b_1 \cdot x$$

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

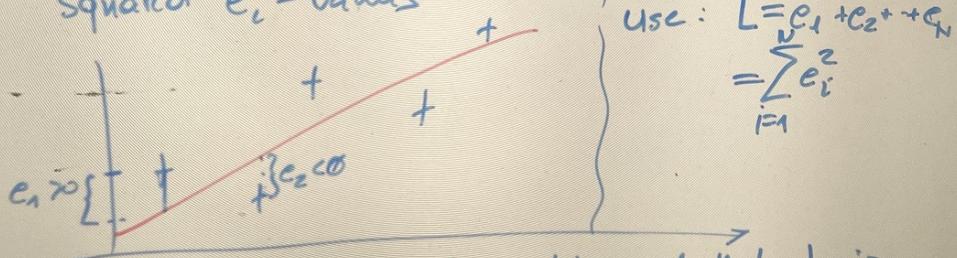
Every observation

$$\begin{aligned} y_i &= E(y) + e_i \\ &= b_0 + b_1 \cdot x_i + e_i \end{aligned}$$

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



- 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

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

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

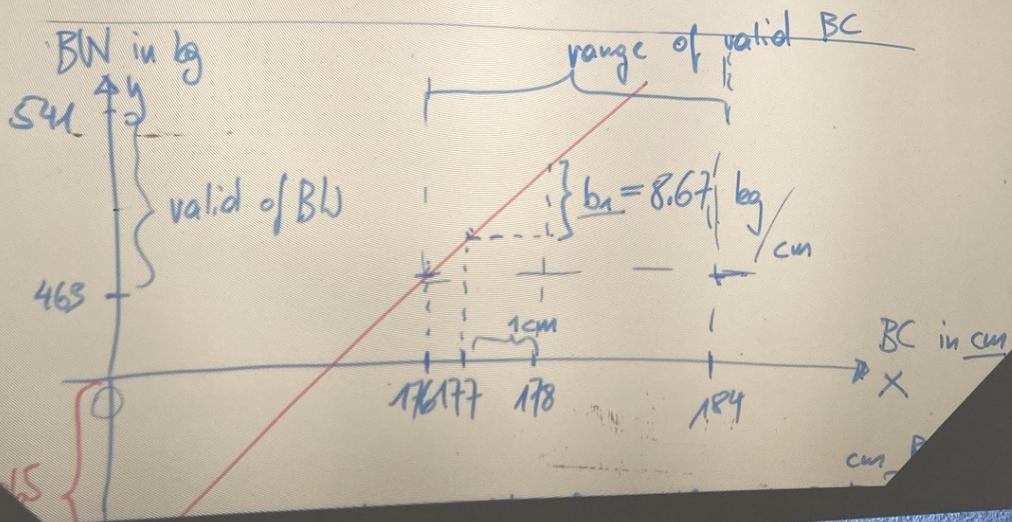
$$(xy)_{\cdot} - b_0 x_{\cdot} - b_1 (x^2)_{\cdot} = \emptyset$$

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

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

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

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



## OHP Picture 7

