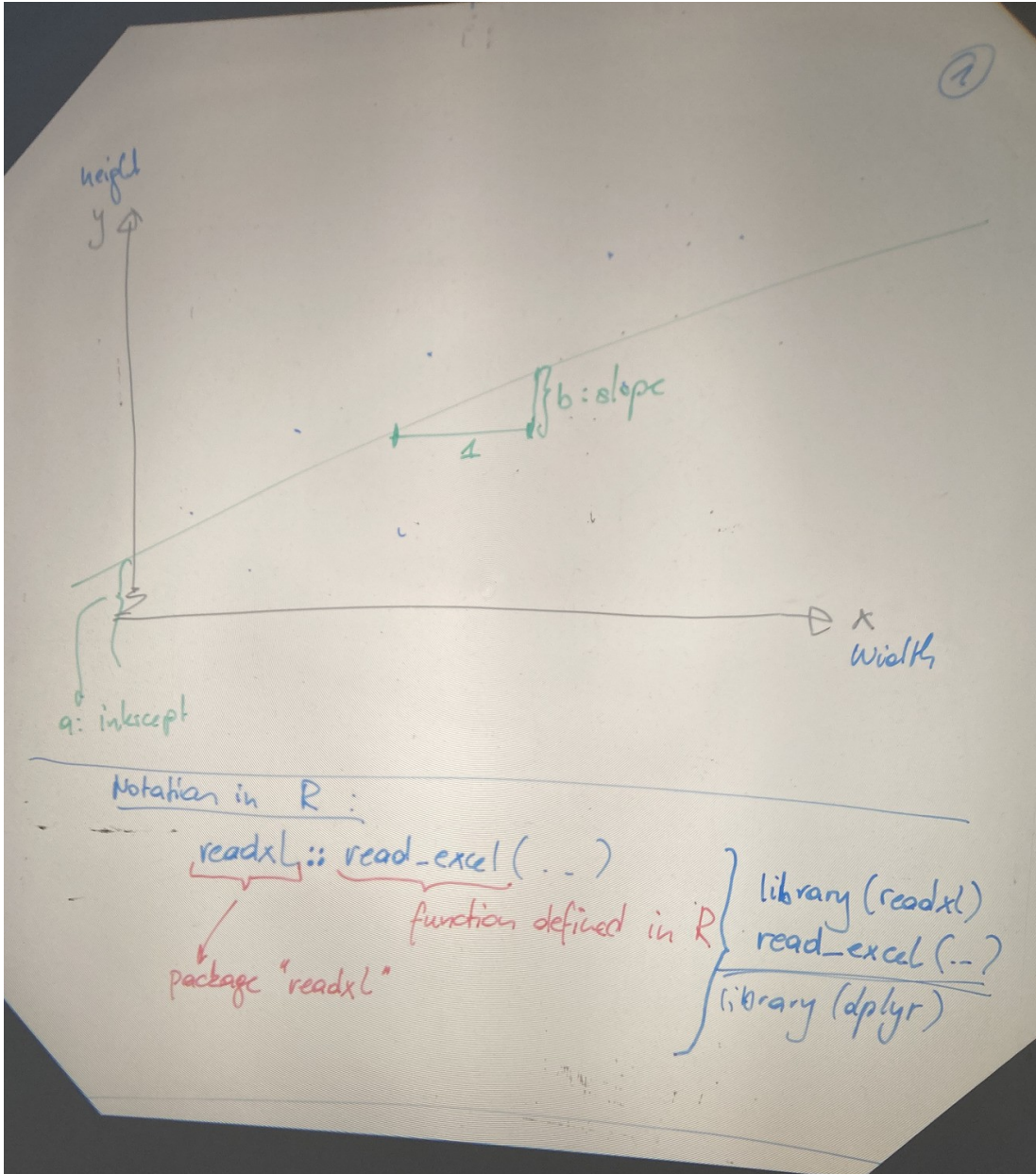
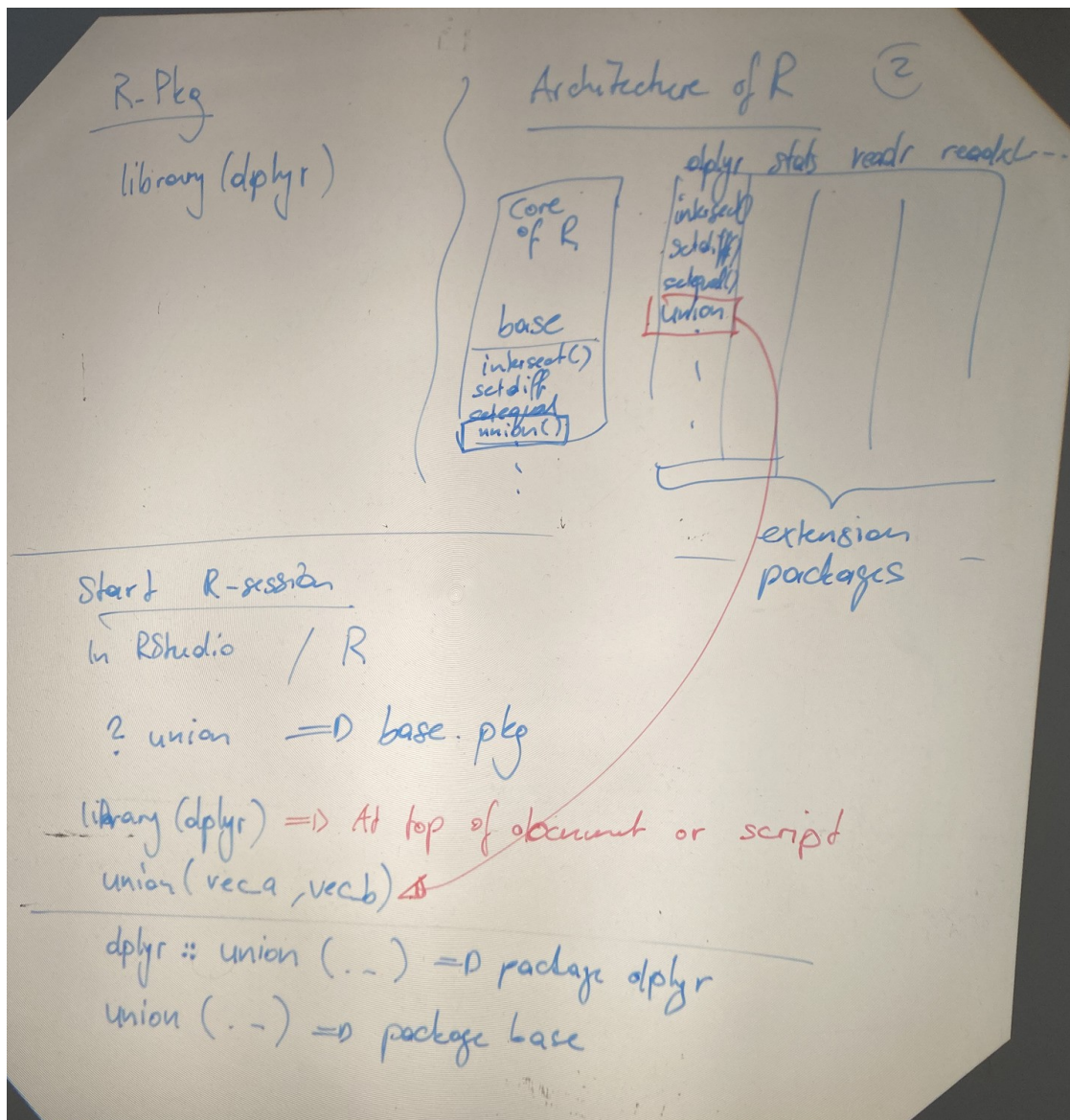


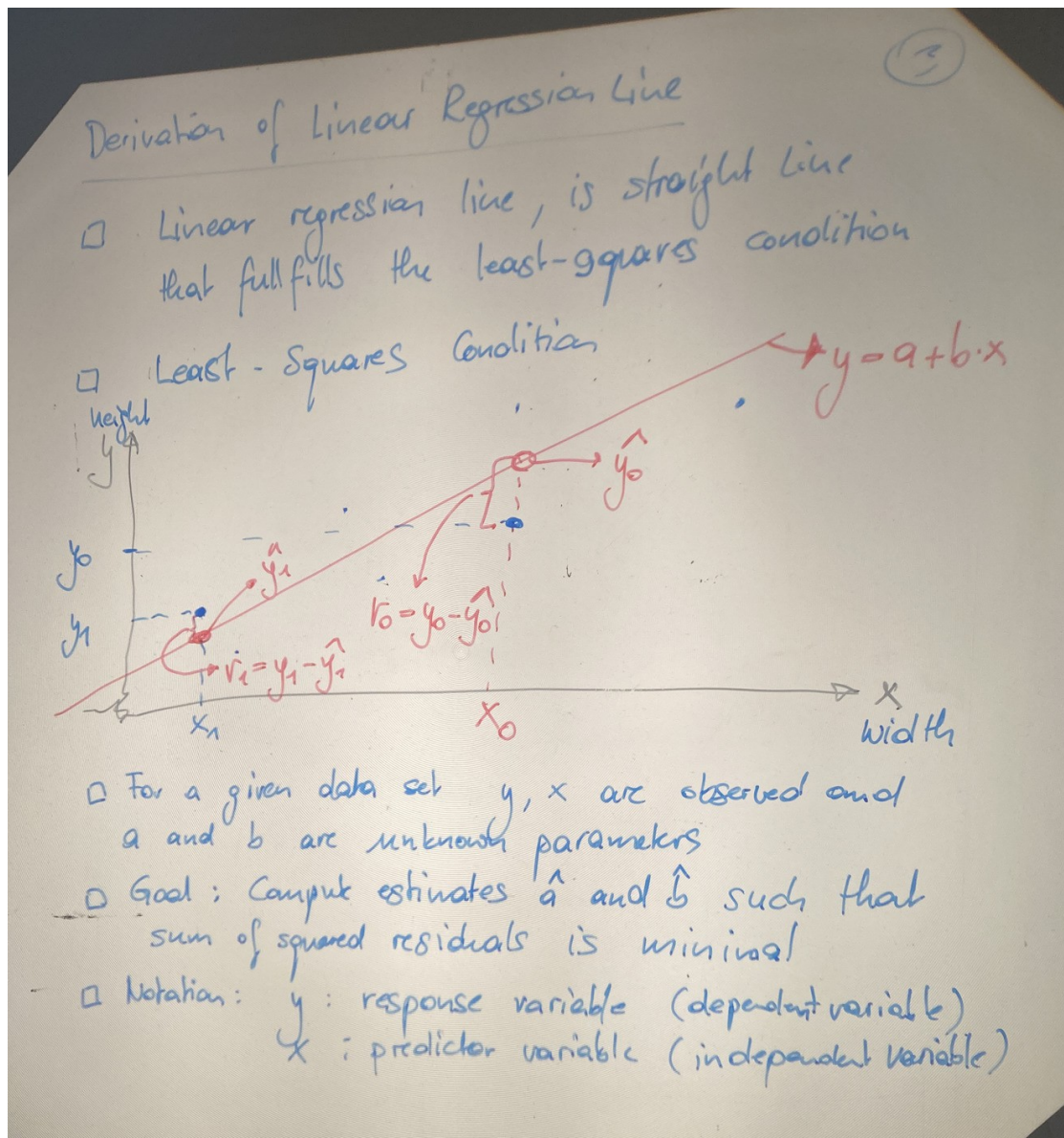
OHP Picture 1



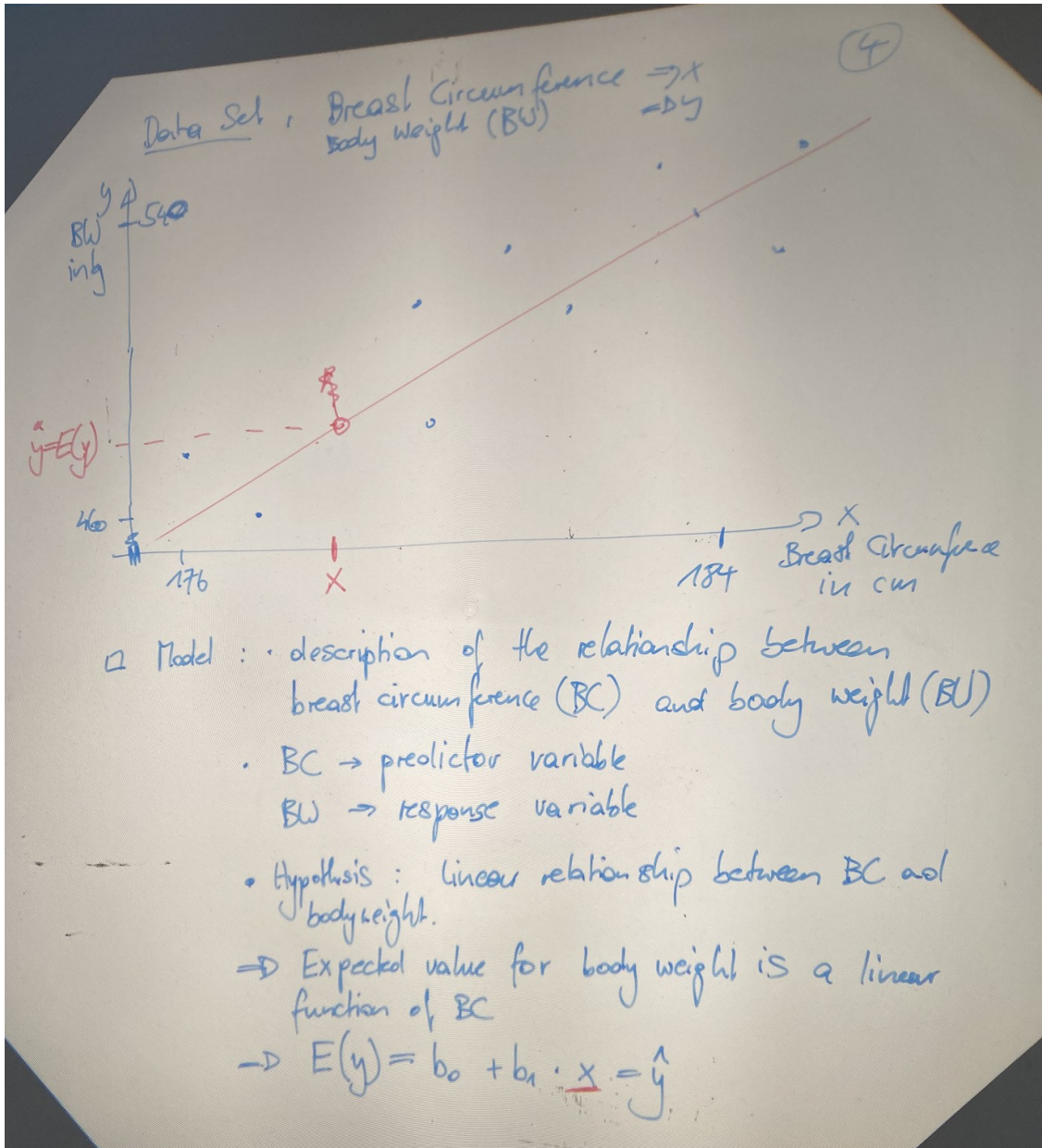
OHP Picture 2



### OHP Picture 3



OHP Picture 4



OHP Picture 5

⑤

Residuals  $r_i$  or  $e_i$

for animals with BW  $y_i$  and BC  $x_i$

$$r_i = e_i = y_i - E(y_i) = y_i - \hat{y}_i$$
$$= y_i - [b_0 + b_1 \cdot x_i] = y_i - b_0 - b_1 x_i$$
  
$$e_1 = y_1 - b_0 - b_1 x_1 = 471 - b_0 - b_1 \cdot 176$$
$$e_2 = y_2 - b_0 - b_1 x_2 = 463 - b_0 - b_1 \cdot 177$$
  
$$e_{10} = y_{10} - b_0 - b_1 x_{10} = 541 - b_0 - b_1 \cdot 184$$

Sum of squares of Residuals (SSQR)

$$SSQR = e_1^2 + e_2^2 + \dots + e_{10}^2$$
$$= (y_1 - b_0 - b_1 x_1)^2 + (y_2 - b_0 - b_1 x_2)^2 + \dots + (y_{10} - b_0 - b_1 x_{10})^2$$

OHP Picture 6

⑥

Notation  
 $SSQR = e_1^2 + e_2^2 + \dots + e_n^2$   
 $= \sum_{i=1}^n e_i^2$

Summation  
 $X_1 + X_2 + X_3 = \sum_{i=1}^3 X_i$   
 $X_1 + X_2 + \dots + X_N = \sum_{i=1}^N X_i$

$= \sum_{i=1}^{10} e_i^2 = \sum_{i=1}^{10} [y_i - E(y_i)]^2$   
 $= \sum_{i=1}^{10} [y_i - b_0 - b_1 x_i]^2$

$y_i = E(y_i) = b_0 + b_1 x_i$

Least Squares Criterion: SSQR is minimal:

- Finding minimum of SSQR is done by derivative with respect to unknown parameters  $b_0$  and  $b_1$
- $\frac{\partial SSQR}{\partial b_0} = -2 \sum_{i=1}^{10} [y_i - b_0 - b_1 x_i]$   
 $= -2 \sum_{i=1}^{10} [y_i - b_0 - b_1 x_i]$   
 $= -2 \left[ \sum_{i=1}^{10} y_i - \sum_{i=1}^{10} b_0 - \sum_{i=1}^{10} b_1 x_i \right]$   
 $= -2 \left[ \sum_{i=1}^{10} y_i - N b_0 - \sum_{i=1}^{10} b_1 x_i \right]$

OHP Picture 7

(7)

$$SSQR = \sum_{i=1}^N (y_i - b_0 - b_1 x_i)^2$$

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

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


---

$x_0 = \sum_{i=1}^N x_i$  ;  $\bar{x} = \frac{x_0}{N}$  ;  $y_0 = \sum_{i=1}^N y_i$  ;  $\bar{y} = \frac{y_0}{N}$   
 $(x^2)_0 = \sum_{i=1}^N x_i^2$  ;  $(xy)_0 = \sum_{i=1}^N x_i y_i$

---

①  $\frac{\partial SSQR}{\partial b_0} = [y_0 - N b_0 - b_1 x_0] \cdot (-2)$   
 ②  $\frac{\partial SSQR}{\partial b_1} = -2 [(xy)_0 - b_0 x_0 - b_1 (x^2)_0]$

} find values  $b_0$  and  $b_1$  such that

from ① :  $y_0 - N \hat{b}_0 - \hat{b}_1 x_0 = 0 \Leftrightarrow N \hat{b}_0 + \hat{b}_1 x_0 = y_0$   
 from ② :  $(xy)_0 - \hat{b}_0 x_0 - \hat{b}_1 (x^2)_0 = 0 \Leftrightarrow \hat{b}_0 x_0 + \hat{b}_1 (x^2)_0 = (xy)_0$

OHP Picture 8

