

$$X \sim N(\mu, \sigma) \Leftrightarrow Z = \frac{X - \mu}{\sigma} \sim N(0, 1)$$

$$\bar{X} \sim N\left(\mu, \frac{\sigma}{\sqrt{n}}\right) \Rightarrow Z = \frac{\bar{X} - \mu}{\frac{\sigma}{\sqrt{n}}} \sim N(0, 1)$$

Ex. 1. The CPU for 10 tasks is: 70 36 43 69 82 48 34 62 35 15  
 Compute the sample mean.

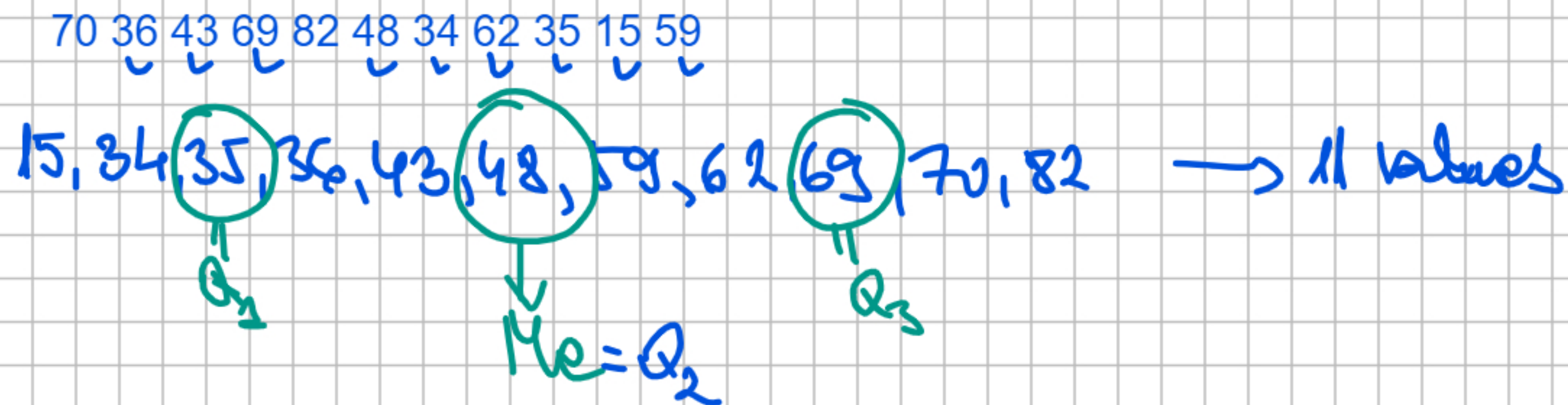
$$\bar{X} = \frac{70 + 36 + 43 + \dots + 15}{10} = 49.4$$

In R: mean(CPU)  
 median(CPU)

Sort the values in an ascending order: 15, 34, 35, 36, 43, 48, 62, 69, 70, 82.

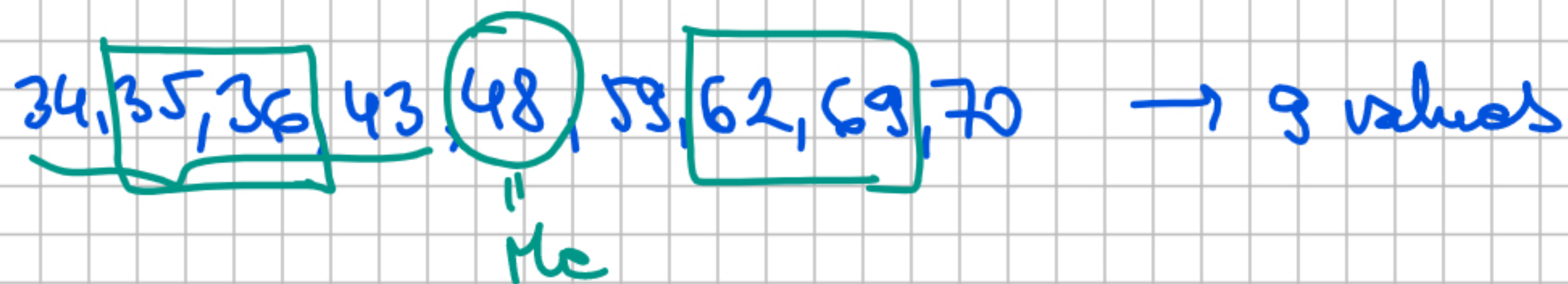
$Q_1 = \frac{43 + 48}{2} = \frac{91}{2} = \underline{45.5}$

$Q_3 = \frac{62 + 69}{2} = \frac{131}{2} = 65.5$



$Q_1$  = the median of the first half of the values

$Q_3$  = — " — last — " —



$$Q_1 = \frac{35 + 36}{2} = 35.5, \quad Q_3 = \frac{62 + 69}{2} = \frac{131}{2} = 65.5$$

70, 36, 43, 69, 82, 48, 34, 62, 35, 15

$$\bar{X} = 49.4$$

$$s^2 = \frac{1}{n-1} \left( \sum_{i=1}^n x_i^2 - n\bar{X}^2 \right) = \frac{1}{9} \left( \sum_{i=1}^n x_i^2 - 10 \cdot 49.4^2 \right) = \frac{1}{9} (28284 - 10 \cdot 49.4^2) = 431.156$$

sample variance  
 $n=10$

$$\sum_{i=1}^n x_i^2 = 70^2 + 36^2 + \dots + 15^2 = 28284$$

$$S = \sqrt{s^2} = \sqrt{431.156} = 20.764$$

sample standard deviation

In R: var(CPU)  
sd(CPU)

Outliers = values outside the interval  $[Q_1 - 1.5 \cdot IQR, Q_3 + 1.5 \cdot IQR]$ .

$$IQR = Q_3 - Q_1 = 69 - 35 = 34 //$$

$$Q_1 - 1.5 \cdot IQR = 35 - 1.5 \cdot 34 = -16$$

$$Q_3 + 1.5 \cdot IQR = 69 + 1.5 \cdot 34 = 120$$

$\Rightarrow$  no outliers.