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

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

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

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

In R: mean(CPU)
median(CPU)

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

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

70 36 43 69 82 48 34 62 35 15 59

15, 34, 35, 36, 43, 48, 59, 62, 69, 70, 82 → 11 values

Q_1 Q_3 $Me = Q_2$

Q_1 = the median of the first half of the values

Q_3 = — " — last — " —

34, 35, 36, 43, 48, 59, 62, 69, 70 → 9 values

Me

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

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

$\bar{X} = 49.4$

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

sample variance

$n = 10$

$$\sum_{i=1}^{10} x_i^2 = 70^2 + 36^2 + \ldots + 15^2 = 28284$$

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

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.