

# Question 2

The above data collects the mean flow ( $m^3/s$ ) of the Fraser River (Canada) from 1912 to 1999

## 1. Compute the mean and median.

Let the number of sample be:

$$n = 88$$

Let the data in time order be:

$$x_1 = 3\,360, \quad x_2 = 2\,884, \quad \dots, \quad x_i, \quad \dots, \quad x_n = 3\,465, \quad i \in \{1, 2, \dots, n\}$$

Then we have the mean:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i = \frac{238\,719}{88} \approx 2\,712.716$$

Let the data in ascending order be:

$$x_{a_1} = 2\,012, \quad x_{a_2} = 2\,027, \quad \dots, \quad x_{a_{i_a}}, \quad \dots, \quad x_{a_n} = 3\,715, \quad i_a \in \{1, 2, \dots, n\}$$

Then we have the index of the median:

$$i_{a_m} = \frac{n+1}{2} = 44.5 = \frac{44+45}{2}$$

Then we have the median:

$$m = x_{a_{i_{a_m}}} = \frac{x_{a_{44}} + x_{a_{45}}}{2} = 2\,664.5$$

## Answer

- $\bar{x} = \frac{238\,719}{88} \approx 2\,712.716$
- $m = 2\,664.5$

## 2. Is it possible to understand if the mean flow is increasing or decreasing in time? How to you suggest to proceed?

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Let the time be:

$$t_1 = 1\,912, t_2 = 1\,913, \dots, t_i, t_n = 1\,999, \quad i \in \{1, 2, \dots, n\}$$

Then we have the mean of  $t$ :

$$\bar{t} = \frac{1}{n} \sum_{i=1}^n t_i = \frac{172\,084}{88} \approx 1\,955.5$$

Then we have the covariance of  $t$  and  $x$ :

$$\sigma_{tx} = \frac{1}{n} \sum_{i=1}^n t_i x_i - \bar{t} \bar{x} = \frac{1\,103\,545}{880} \approx 1\,254.028 > 0$$

Then we can say that the mean flow is increasing in time.

### Answer

- Increasing
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