**Flood Frequency Analysis (FFA)**

In order to carry out the frequency analysis to estimate the flood peak discharges for the different return periods (10y, 20y, 50y and 100y), we employed different statistical methods i.e. Gumbel and Normal law methods. This was performed on an observed data of daily discharge of the river Var from 1975 to 2018.

1. Gumbel method

The Gumbel’s distribution is often used to estimating flood events. The Gumbel’s distribution function is expressed as follows;

… equation 1

Assuming, , equation 1 becomes

and

a: mean – b\*Euler constant

b: standard deviation\*sqrt(6)/ π

The peak discharges were ranked and the Hazen formula (Hazen and Williams, 1920) was used to obtain the probability of non-exceedance. The frequency is then used to calculate the reduced variate u.

𝐹 (𝑋𝑖) = 𝑟 − 0.5 / 𝑛

1. Normal distribution

The two parameters on the Normal law are the mean (μ) and standard deviation (σ). The means and standard deviations for the different period (monthly) considered are shown on the table below;

|  |  |  |
| --- | --- | --- |
| Monthly discharge period | Mean | Standard deviation |
| Over 30 years (1975-2018) | 140 | 174 |
| 1994 | 293 | 420.5 |
| 2006 - 2013 | 148.5 | 152.3 |

The formula used to calculate the standard deviation was as follows;

n: number of sample.

The return period (T) of an event is defined as the inverse of the occurrence rate.

This is then aided in drawing the graphs of discharges against the reduced variate u of the normal distribution. At the same time, Henry’s line (Armatte and Gibrat, 1995) is used in drawing the lines to adjust the Gaussian distribution. This permitted us to quickly identify the discharges of the return periods represented by the red dots on the graphs.