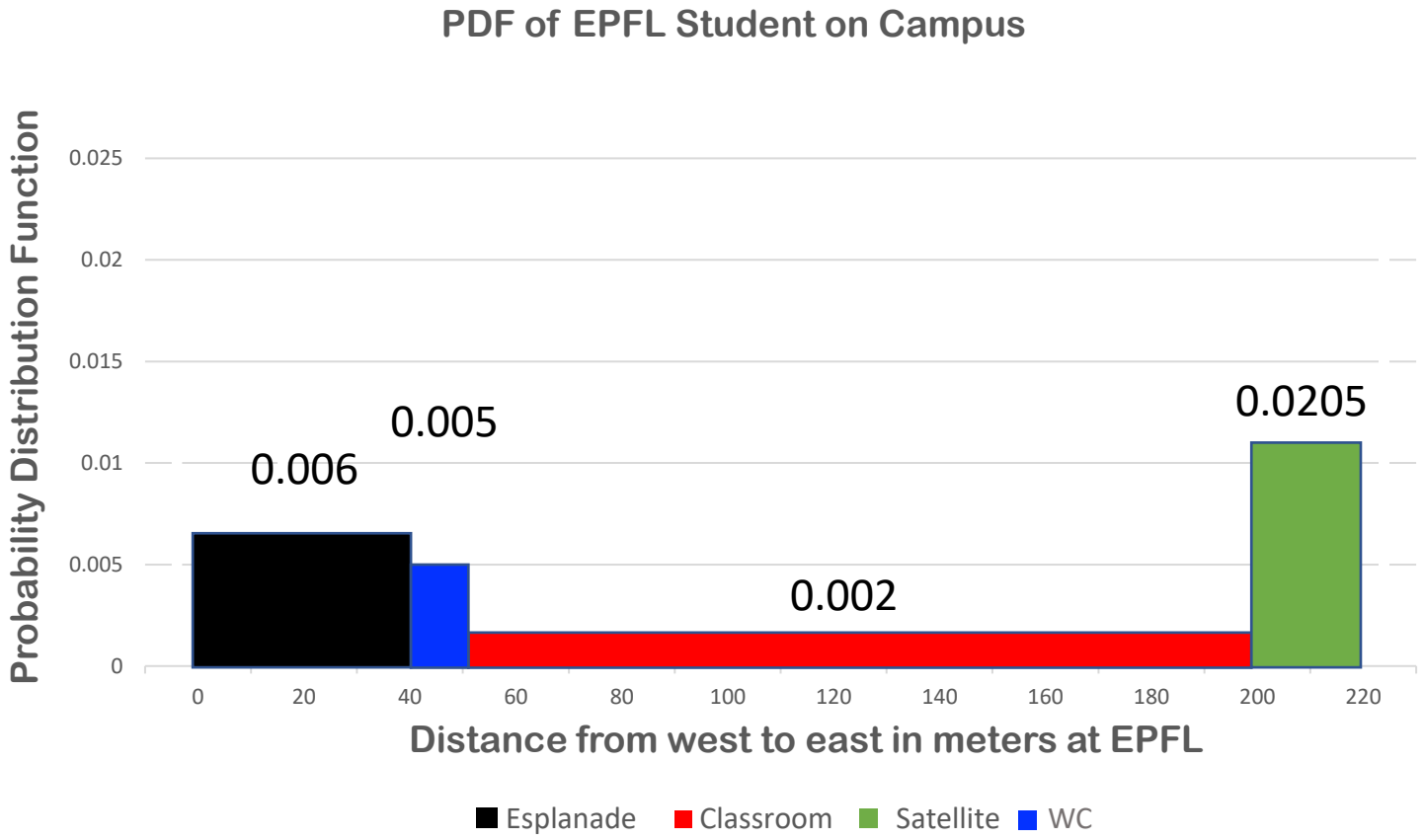
Exercise on Monte Carlo simulations: Location of EPFL students

Exercise for week 9

Consider the following normalized probability distribution function (PDF) describing the location of a typical EPFL student across four “major” locations inside CM-EPFL.



a) Compute and plot (by hand) the cumulative density function (CDF) from the given PDF.

b) Use this random generator (http://www.random.org/decimal-fractions/) to determine the probability of you being in a classroom when you are at EPFL (steps explained in next slide)!

c) What do you deduce comparing the results obtained with 10 or 100 runs.

d) How is the PDF given in slide 1 different (qualitatively) from the PDF of a random number generating function (which generates 'completely random' numbers between 0 and 1)? In other words, what does the CDF of a random number generator look like and how is it different (qualitatively) from the CDF you obtained in part (a)?

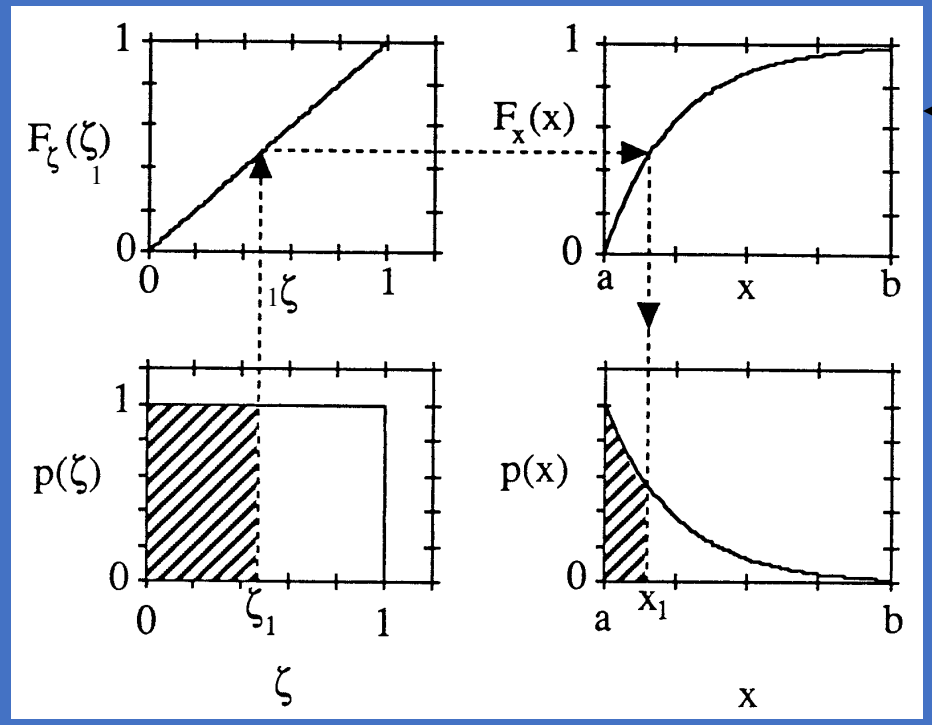
Using the Random Number Generator:

- Use the link given in the question to generate a random position between 0 and 1.
- Check, while probing the CDF, if this obtained number ‘x’ lies in the ranges corresponding to the classroom.
- Repeat these two steps until you have a list of 10 such values of ‘x’.
- Compute the ratio: (No. of times ‘x’ lies between 50 to 200) / (Total no. of runs = 10).
- Compute again the ratio: (No. of times ‘x’ lies between 50 to 200) / (Total no. of runs = 100).

Hint!

How to deduce x_1 from ξ_1

$$\int_0^{\xi_1} p(\xi)d\xi = \xi_1$$



$$F_x(x_1) = \int_a^{x_1} p(x)dx$$

CDF

PDF

This process is equivalent to **equating the hatched areas** under the p(ξ) and p(x) curves in the figure.
The total areas under the p(ξ) curve from 0 to 1 and under the p(x) curve from a to b are both equal to 1.

Hint!

Definitions of:

Probability density function:

http://en.wikipedia.org/wiki/Probability_density_function

Cumulative distribution function:

http://en.wikipedia.org/wiki/Cumulative_distribution_function

Random number generator:

http://en.wikipedia.org/wiki/Random_number_generation