Final project of PCSC: Monte-Carlo

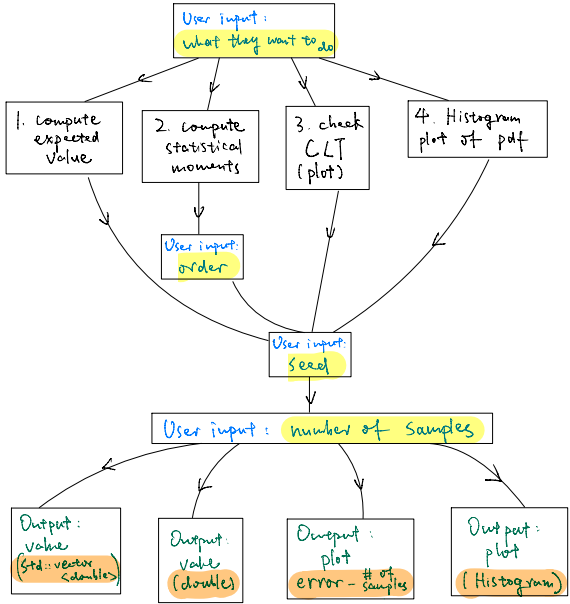
Jiaye Wei[1]

19.12.2023

[1]Together with Christian N'Guessan

Table of Contents

The flow diagram



Polymorphism

- RNG (virtual)
  - Uniform RNG
  - Normal RNG (virtual)
    - Box-Muller
    - Inverse transform sampling
- Computations
  - Expected value
    - Statistical moments

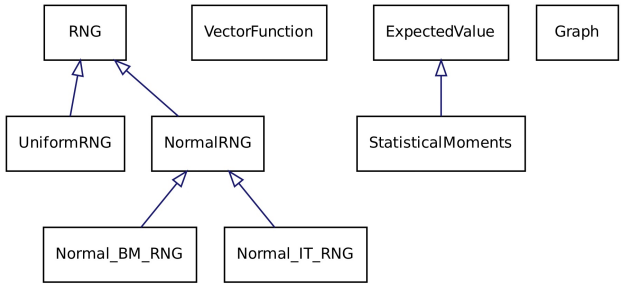


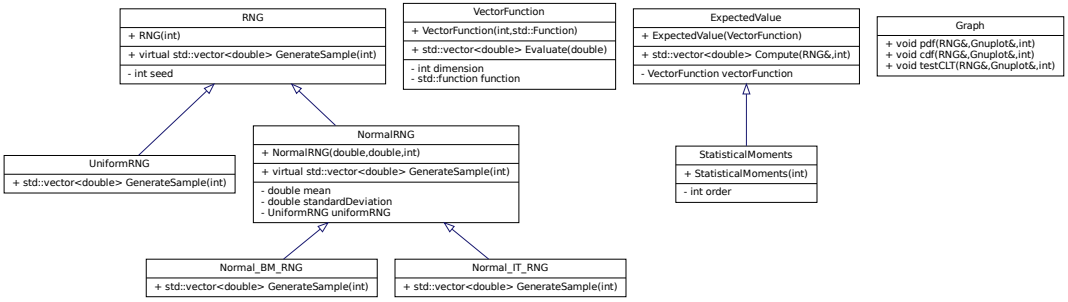
Table of Contents

Data structures

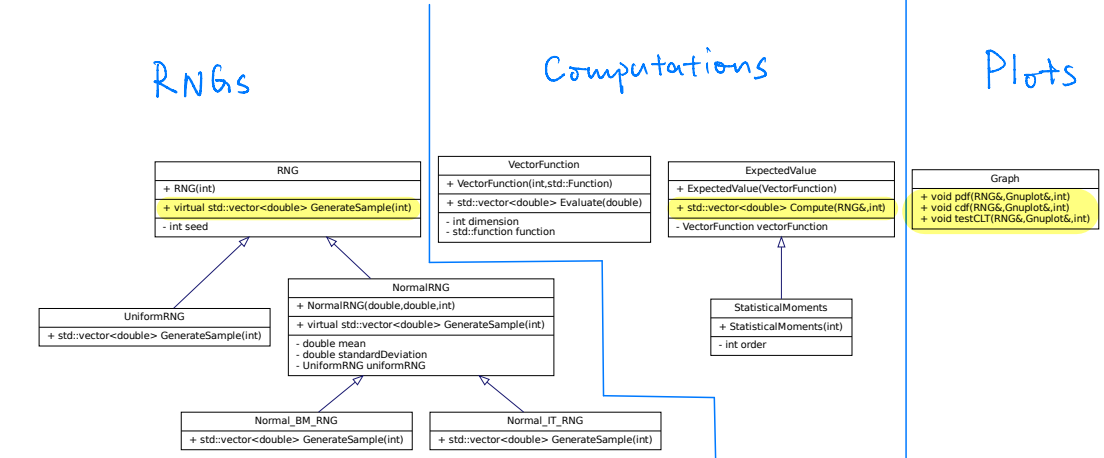
Two key objects of our project are

- generated random samples: std::vector<double>
- user specified functions for computing expected value: std::function<std::vector<double>(double)>

Class diagram



Class diagram



Implemented features

1. Generate random samples: uniform, normal using Box-Muller, normal using inverse transform sampling.
2. Compute the expected value of a user-specified function.
3. Compute the statistical moments.
4. Verify CLT by the plot of "mean error - number of samples".
5. Make a histogram plot of empirical pdf.

Tests

Unit tests include:

- Statistical tests for RNGs
  1. Hypothesis test for UniformRNG,
  2. Confidence interval tests for NormalRNGs (Box-Muller and Inverse transform sampling).
- Computation tests
  1. Expected value
  2. Statistical moments

Table of Contents

Possible improvements

Our project can be improved in terms of following.

- In the main execution, allow user to specify the RNG they want to use. (fixed in the latest commit: add a switch statement)
- Modify .gitignore: cmake-build-debug, .idea (fixed in the latest commit)
- Better use of git: git log, merge.
- Readability of the code, in particular graph and test parts.
- Others? (de-allocation of memory?)