STATS 202A: Assignment #1
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NOTE: All the random seeds are generated using system time.

Problem 1

Write R and Python code for the following random number generators.

Part A

Uniform[0, 1], using the linear congruential method.

- Result for R code

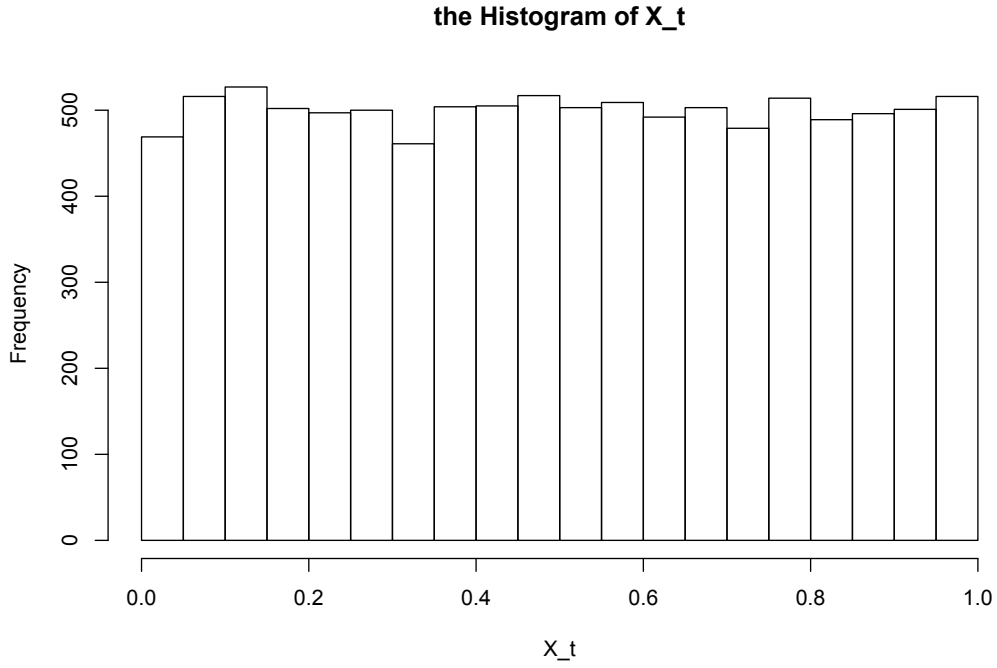

Figure 1: R code - Histogram of X_t using the linear conguential method

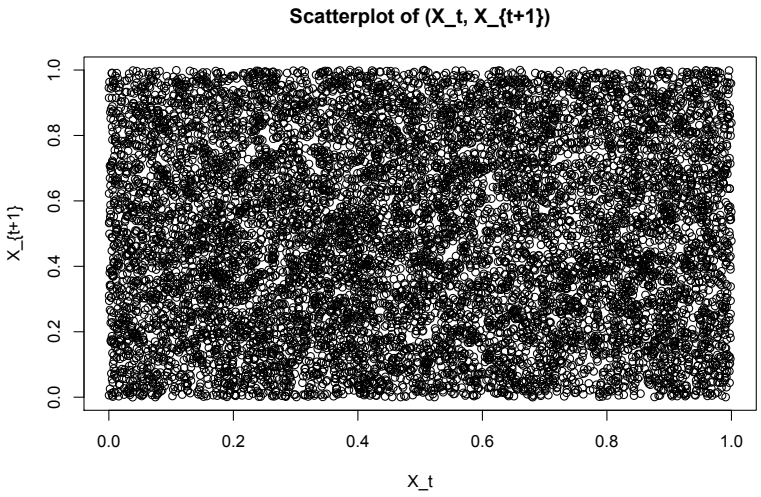

Figure 2: R code - Scatterplot of $(X_t,\ X_{t+1})$ using the linear conguential method

- Result for Python code

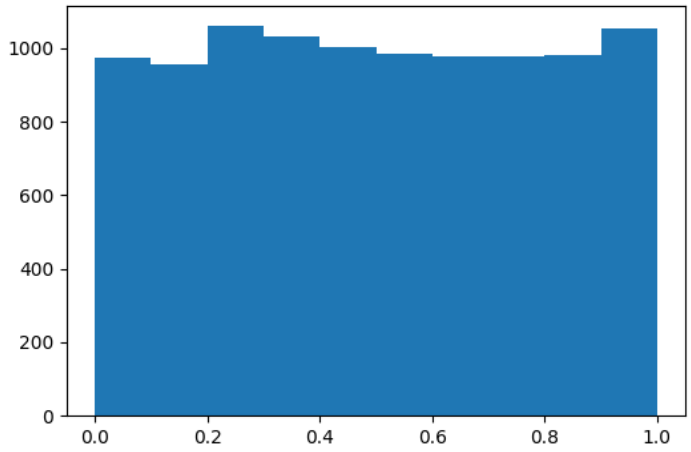

Figure 3: Python code - Histogram of X_t using the linear conguential method

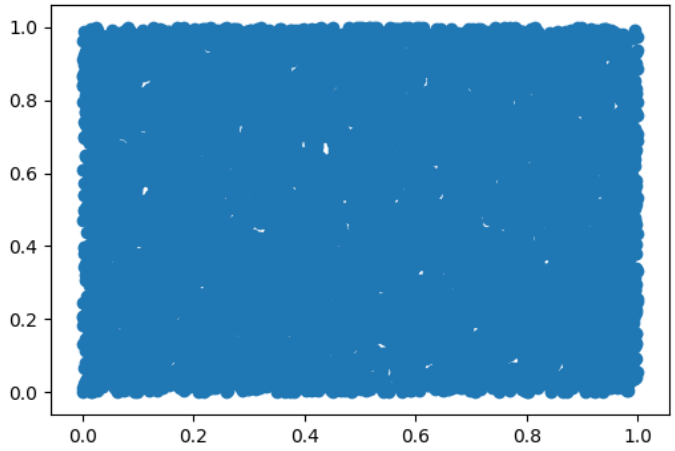

Figure 4: Python code - Scatterplot of (X_t, X_{t+1}) using the linear conguential method

Part B

Exponential(1), using the inversion method.

- Result for R code:

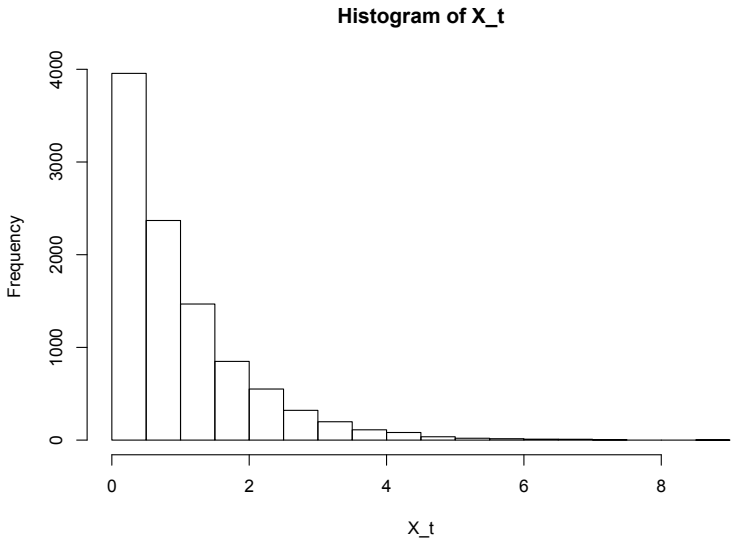

Figure 5: R code - Histogram of X_t using the inversion method

- Result for Python code:

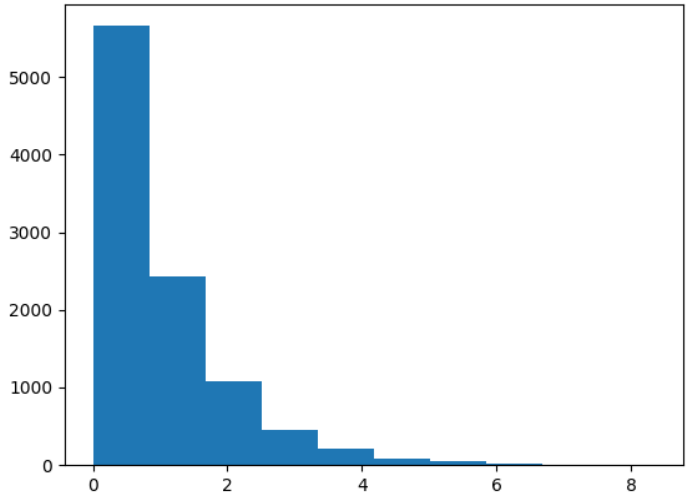

Figure 6: Python code - Histogram of X_t using the inversion method

Part C

Normal(0, 1), using the Polar method.

- Result for R code:

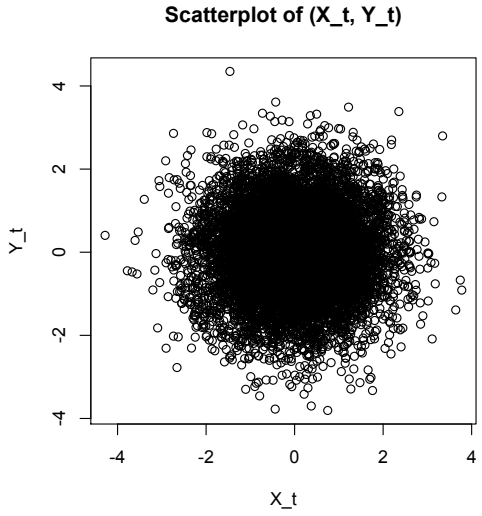

Figure 7: Scatterplot of (X_t, Y_t) using the Polar method

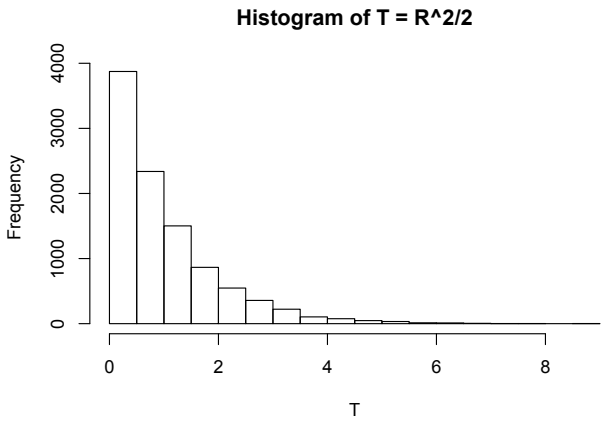

Figure 8: Histogram of $T = R^2/2$

- Result for Python code:

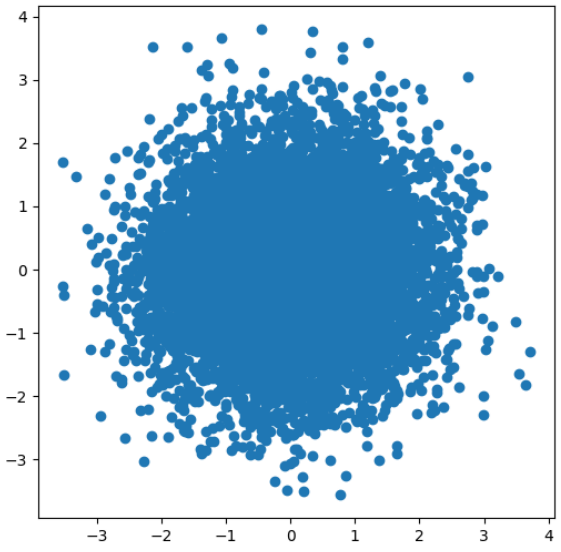

Figure 9: Scatterplot of (X_t, Y_t) using the Polar method

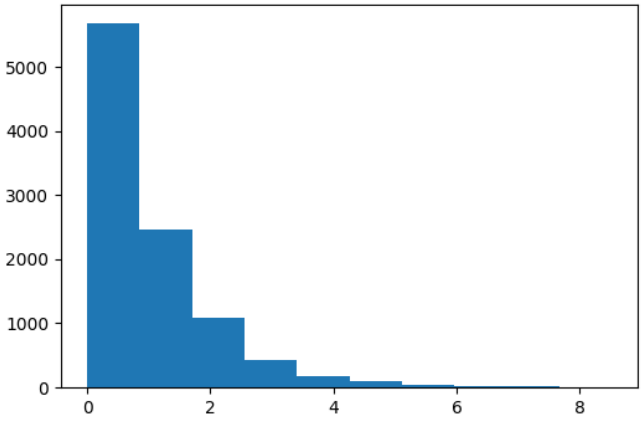

Figure 10: Histogram of $T = R^2/2$

Note that the mean and the variance can be changed in this code. For example, if we set mean = 6, var = 4, the results are as follows.

- Histogram for R code if mean = 6, var = 4:

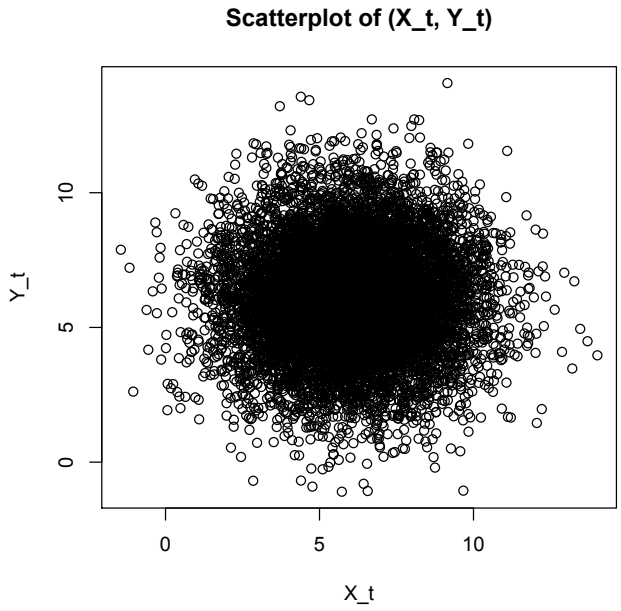

Figure 11: R - Scatterplot of (X_t, Y_t) using the Polar method if mean = 6, var = 4

- Histogram for python code if mean = 6, var = 4:

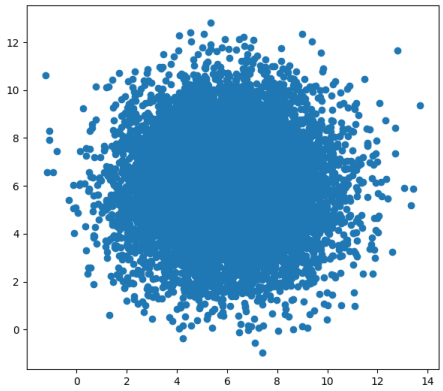

Figure 12: Python - Scatterplot of (X_t, Y_t) using the Polar method if mean = 6, var = 4

Problem 2

Write R and Python code for Monte Carlo computation of pi, by generating (X_t, Y_t) from unit square $[0, 1]^2$, and computing the frequency that the points fall below $x^2 + y^2 = 1$. Please also use Monte Carlo method to compute the volume of d-dimensional unit ball, for d = 5 and 10.

- Result for R code:
  $\pi = 3.140448$ (dependent on system time)
  When d = 5, the volume is 5.255168 (dependent on system time)
  When d = 10, the volume is 2.522112 (dependent on system time)

- Result for python code:
  $\pi = 3.14112$ (dependent on system time)
  When d = 5, the volume is 5.26128 (dependent on system time)
  When d = 10, the volume is 2.53952 (dependent on system time)