Program II
CS355/555
Spring, 2023

Background

Non Deterministic Shuffling

Program I produced completely deterministic new deals from a deck of 52 (or 104) cards. This is unrealistic for real life since it is very difficult to shuffle cards exactly one from each half of the deck sequentially. Realistically, shuffling may take two or more cards from the same half before taking one or more from the other half.

Assignment

Analysis

Modifying your program from Program I, and repeating the correlation analysis using the same formula

$$r = \frac{n\sum_{i=1}^{n}(iy_i) - (\sum_{i=1}^{n} i)\,(\sum_{i=1}^{n} y_i)}{\sqrt{(n\sum_{i=1}^{n} i^2 - (\sum_{i=1}^{n} i)^2)\,(n\sum_{i=1}^{n} y_i^2 - (\sum_{i=1}^{n} y_i)^2)}}$$

Keep shuffling the card deck for a total of 15 times, produce the same statistics, and answer the same questions (see Program 1) using each of the following shuffling methods:

1. When shuffling, pick the next card at random from the top card of the first half of the deck (1-26) or the top card of the second half (27-52) of the deck, picking from one deck or the other with equal probability. When either half of the deck is empty, there is no need to be complicated but simply take the rest of the cards from the non-empty half.

2. When shuffling, pick the next card at random from the first half deck, using the probability:

   $$\frac{\text{Number of cards in the first half deck}}{\text{Total number of cards left}}$$

   and pick the next card at random from the second half deck, using the probability:

   $$\frac{\text{Number of cards in the second half deck}}{\text{Total number of cards left}}$$

   .

3. Repeat method 1 for a 104 card deck.

4. Repeat method 2 for a 104 card deck.

Deliverables

1. A well written project report
    - Briefly explain the workflow of your code
    - Based on the statistics of r, answer the 4 questions (see Program 1) for each of the four runs
    - Put the screenshots of your outputs if necessary
2. Working version of your python code
3. Independent completion form