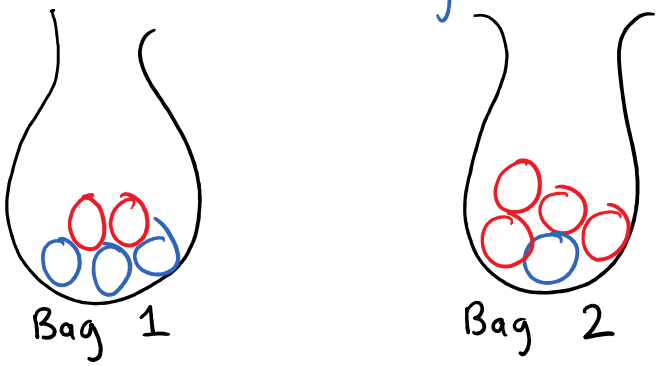
#1

2022年1月17日 20:11

1. You should be able to readily find cogent proofs to Bayes' Theorem on line or in our texts. Please do so and reproduce it in your homework. (Of course you could just copy it, but you ought to understand it, right?) Make sure you understand conditional probability.

Consider two bags with marbles



A bag is chosen randomly to pick out of

$P(1) = P(2) = 0.5$ → Probability of picking a bag

The probability of picking red AND picking from bag 1:

$$P(R \cap 1) = P(R)\,P(1|R) = P(1 \cap R) = P(1)\,P(R|1)$$

Total probability of picking red:

$$P(R) = P(R \cap 1) + P(R \cap 2) = P(1)\,P(R|1) + P(2)\,P(R|2) =$$

$$= \left(\tfrac{1}{2}\right)\left(\tfrac{2}{5}\right) + \tfrac{1}{2}\left(\tfrac{4}{5}\right) = 3/5 = 6/10$$

Equating the expressions for $P(1 \cap R) = P(R \cap 1)$

$$P(R)\,P(1|R) = P(1)\,P(R|1)$$

$$\rightarrow \boxed{P(1|R) = \frac{P(1)\,P(R|1)}{P(R)}} = \frac{\left(\tfrac{1}{2}\right)\left(\tfrac{2}{5}\right)}{3/5} = \frac{10}{30} = \frac{1}{3}$$

This was not as easily guessable from just counting, it is the probability that you picked from bag 1 given that you drew a red marble from one of the bags.

#2

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Results:
Total number of combinations: 1296
Total number of ordered combinations: 126
Total number of combinations that add to 17: 104
Total number of ordered combinations that add to 17: 9
Probability of getting 17: 0.08
Probability of getting 17 out of ordered combinations: 0.071
The ordered solutions: [1, 4, 6, 6], [1, 5, 5, 6], [2, 3, 6, 6],
[2, 4, 5, 6], [2, 5, 5, 5], [3, 3, 5, 6],
[3, 4, 4, 6], [3, 4, 5, 5], [4, 4, 4, 5]

From <https://github.com/ryry013/phys 252c/blob/main/HW/HW1/HW1%20Problems%202-4.py>

#3

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2 b-tagged jets

If both the b-jets are tagged then there's no mystery which jets are which. Call the b-jets number 1 and 2 and you get for the jets:

[True, True, False, False] → True = b-jet
→ False = not b-jet

1 b-tagged jet

It's slightly hard if you were only able to tag one b-jet. Assign the b-jet to the first jet and you get possibilities of:

[T, T, F, F] [T, F, T, F] [T, F, F, T]

0 b-tagged jets

Now it can be anything. The possibilities are

[True, True, False, False] [True, False, True, False] [True, False, False, True]
[False, True, True, False] [False, True, False, True] [False, False, True, True]

From <https://github.com/ryry013/phys_252c/blob/main/HW/HW1/HW1%20Problems%202-4.py>

4

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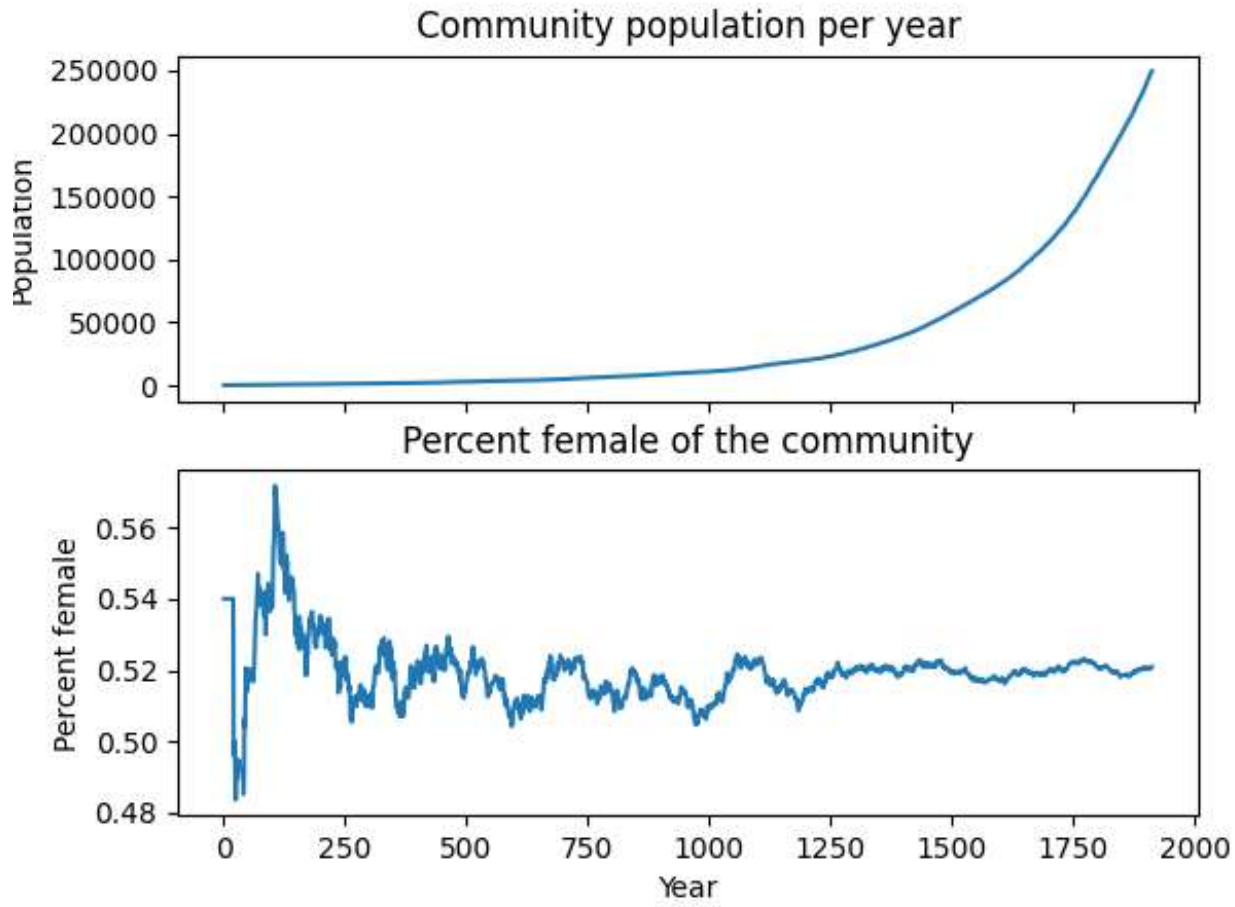
After many generations, the percentage of the community that is female tends to whatever the percentage chance of a female birth is. In this problem, a 52% chance of giving birth to a girl means that over time the population becomes 52% female.

Additionally, because of the condition that birthing stops after a female gives birth to a male, in a world where you only give birth to females a low percent of the time like 10%, communities die off very quickly as the number of people available to give birth quickly decreases to zero.

From <https://github.com/ryry013/phys_252c/blob/main/HW/HW1/HW1%20Problems%202-4.py>

Below is a graph of the population and the percentage of the population that is female over 2000 years of growth. This simulation assumes women will start giving birth every year once they turn 20 with a 52% chance of giving birth a female, and then they'll stop having children once they give birth to a male. In addition, all males and females die when they turn 80.



5

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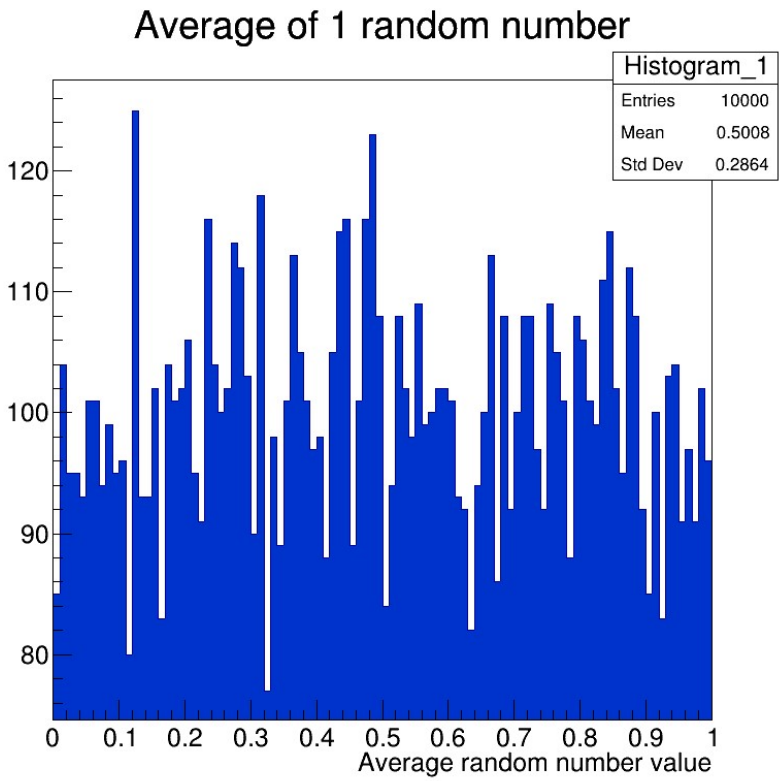
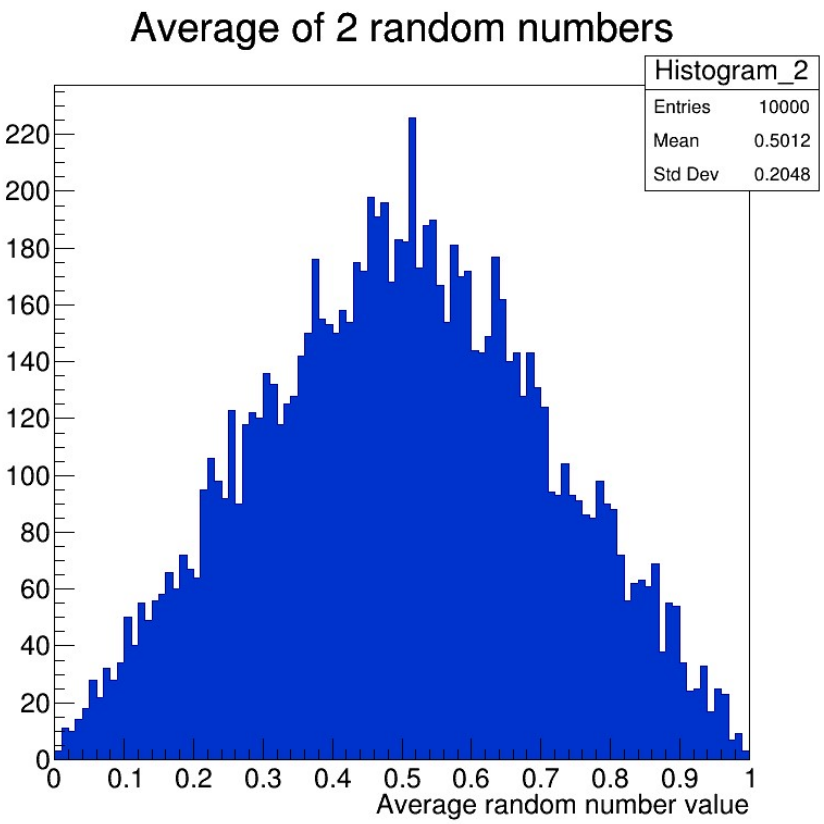
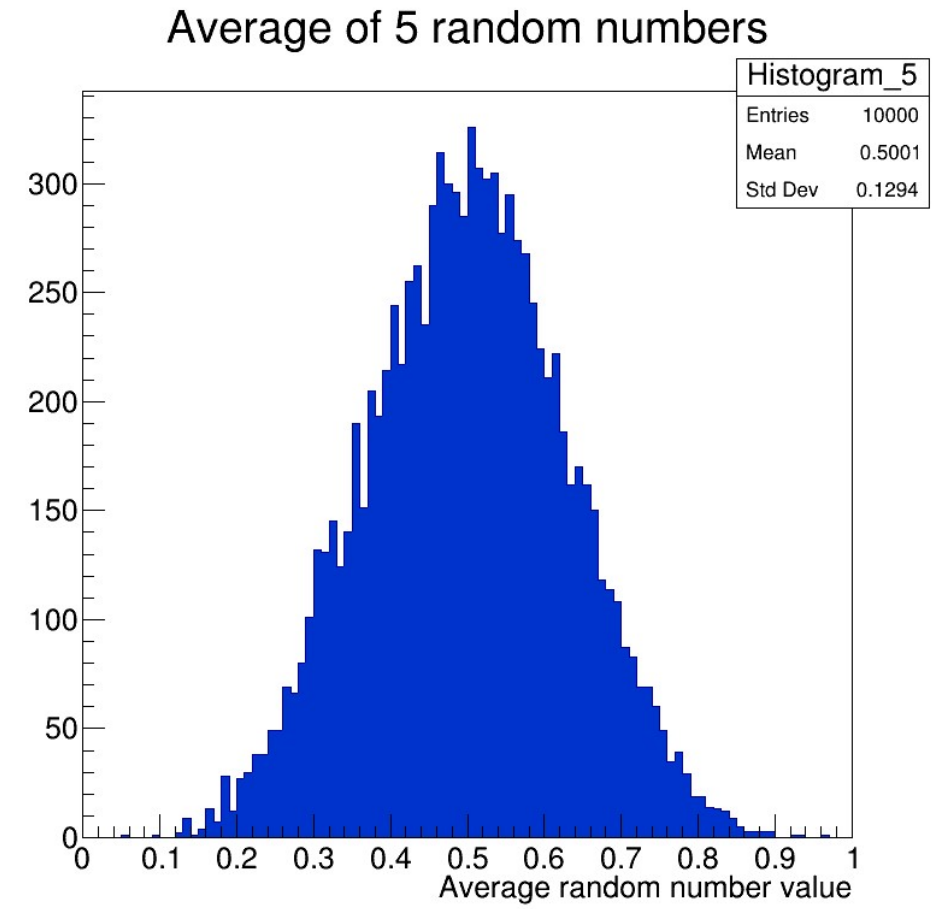
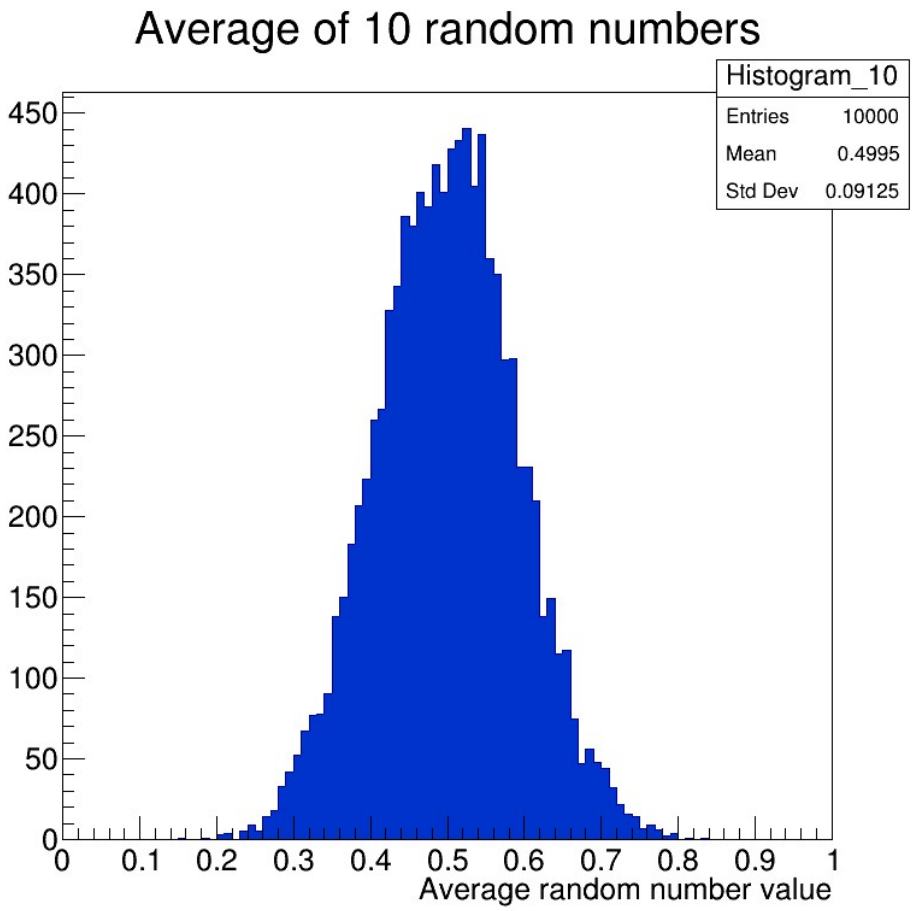
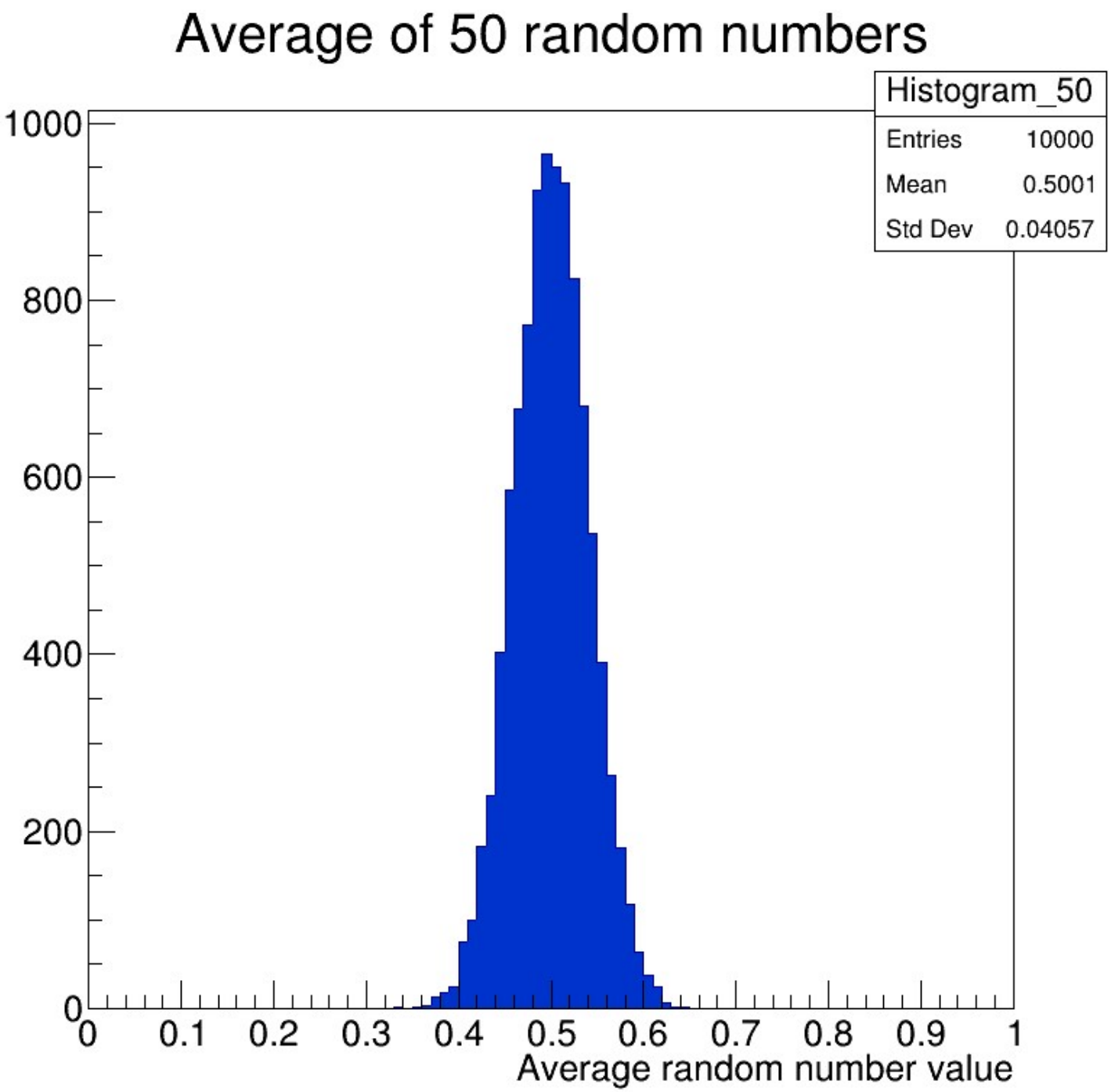
Code for this problem:
https://github.com/ryry013/phys_252c/blob/main/HW/HW1/problem_5.cpp






Average of 5 random numbers
Histogram_5
Entries 10000
Mean 0.5001
Std Dev 0.1294
300
250
200
150
100
50
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Average random number value


Average of 10 random numbers
Histogram_10
Entries 10000
Mean 0.4995
Std Dev 0.09125
450
400
350
300
250
200
150
100
50
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Average random number value


Average of 50 random numbers
Histogram_50
Entries 10000
Mean 0.5001
Std Dev 0.04057
1000
800
600
400
200
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Average random number value