PH301 – Course project

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Title - Simulating an ecosystem and drawing comparisons between population growth of different species and a random walk

Aim

- Running a computer simulation that creates a simple ecosystem and evolves the population following a particular food chain.
- Integrating randomness into the simulation.
- Running this simulation very many times to get in an ensemble of the system
- Observing the distribution of the final population

Random walk

- In mathematics, a random walk is a random process that describes a path that consists of a succession of random steps on some mathematical space.
- An elementary example of a random walk is the random walk on the integer number line which starts at 0, and at each step moves +1 or −1 with equal probability.
- The larger the number of times the random walk is performed, the more the frequency distribution of the final position approaches a gaussian distribution.

Population growth

Fundamental steps involved in the evolution of an ecosystem

- Reproduction
- Survival
- Random Mutations
- Death

Simulation

- Coding language – Python
- Functions
  1. Reproduction
  2. Mutation
  3. Nutrition
  4. Death
- Species involved – Tigers, Bears, Grass, Trees, Bugs, Buffaloes, Birds, Chickens
- The initial population and genetic code for each species is kept constant before each simulation

Initial State of the system

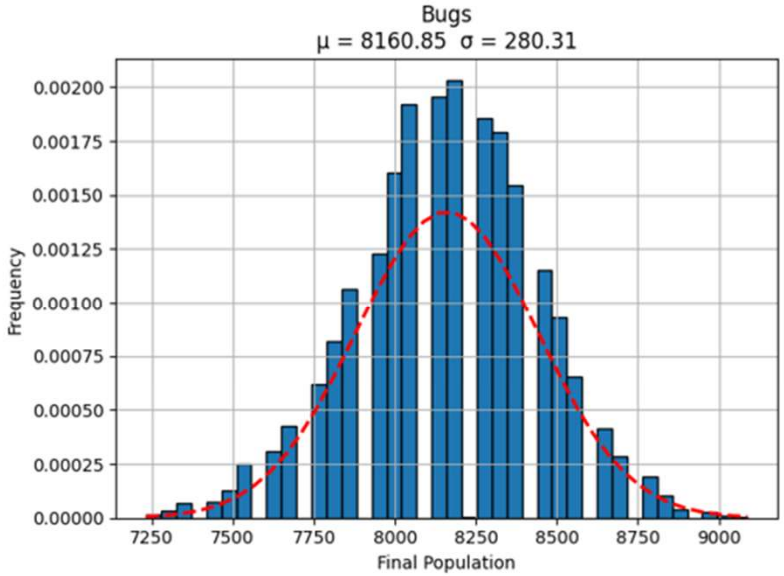
	grass	trees	birds	bugs	tigers	bears	chicken	buffaloes
taste	32	32	40	48	-1	-1	32	48
speed	-1	-1	48	24	68	56	32	40
visibility	-1	-1	56	64	36	52	40	52
luminosity	-1	-1	-1	0	-1	-1	-1	-1
strength	-1	-1	-1	-1	72	60	-1	48
neck_length	-1	-1	-1	-1	-1	-1	-1	24
no_of_offsprings	40	16	8	64	8	8	12	8
reproduction_frequency	60	25	28	68	14	14	52	14
growth_rate	50	30	-1	-1	-1	-1	-1	-1
size	10	60	8	2	25	25	10	20
permanent_attributes								
plant	1	1	0	0	0	0	0	0
time_since_reproduced	30	30	30	30	30	30	30	30
hunger	-1	-1	40	40	40	40	40	40
sexual_reproduction	0	0	1	1	1	1	1	1
lifespan	12	70	16	5	50	50	13	30
index	0	1	2	3	4	5	6	7
age	0	0	0	0	0	0	0	0
initial_population	200	15	40	100	3	3	20	15

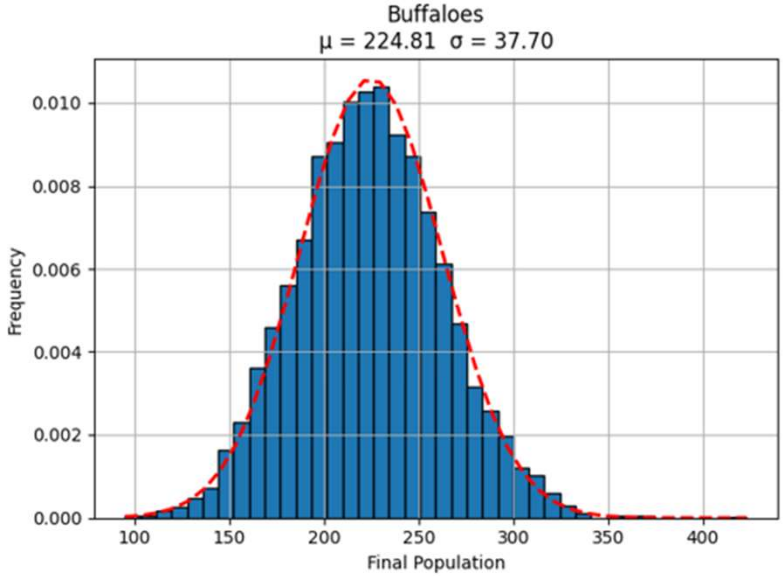
Code

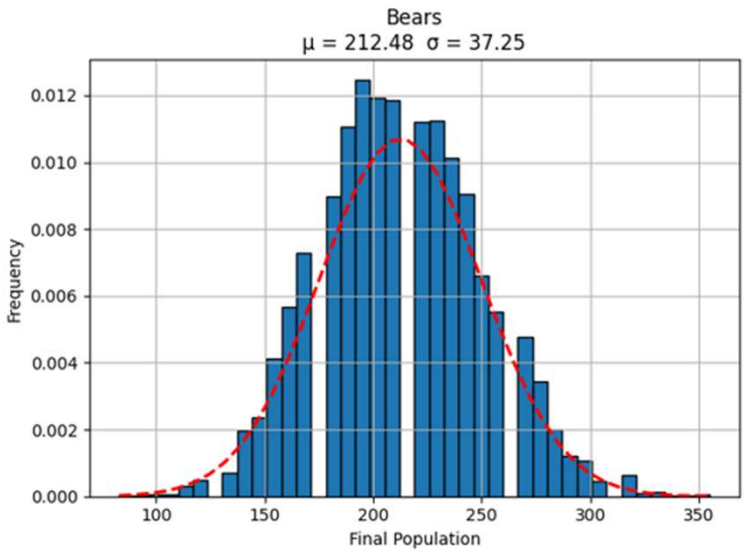
```
104
105 > def reproduction(popu):…
119
120
121 > def mutator(a):…
139
140
141 > def eating(preda, pre):…
164
165
166 > def death():…
173
174
175 > def step():…
212
```

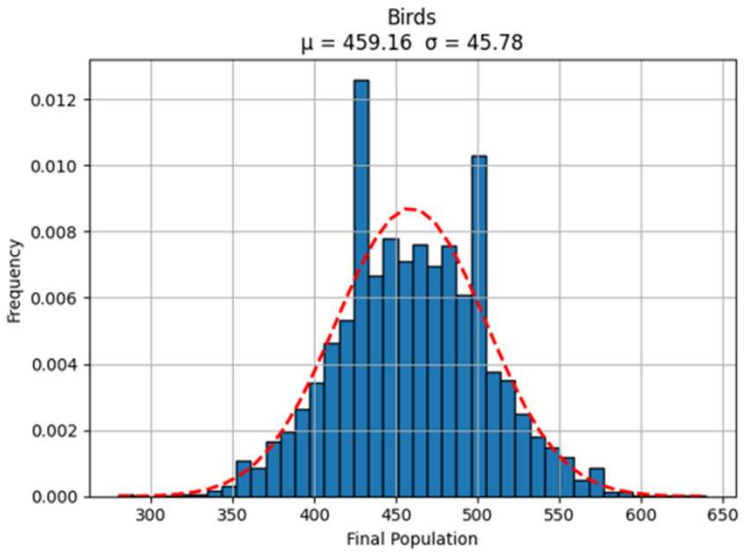
Observations

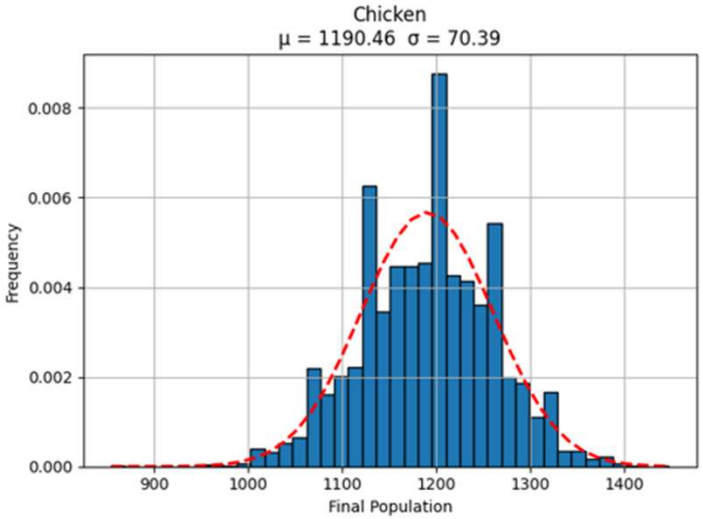
- Number of iterations per run – 30
- Number of simulations run – 6000
- Plots of final populations distribution

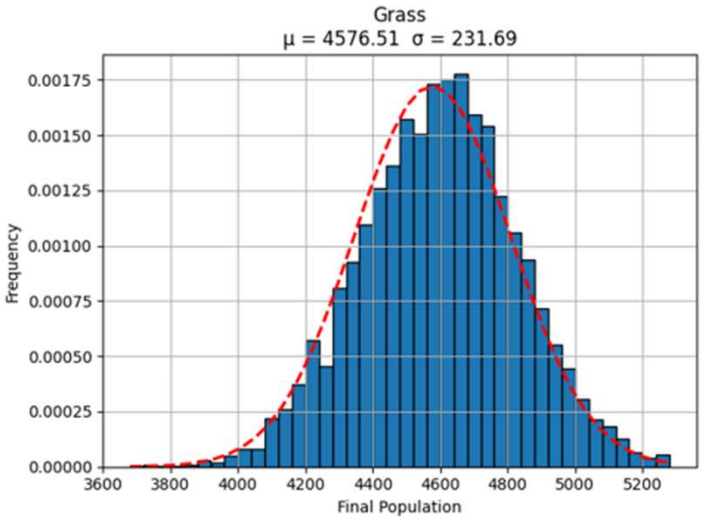


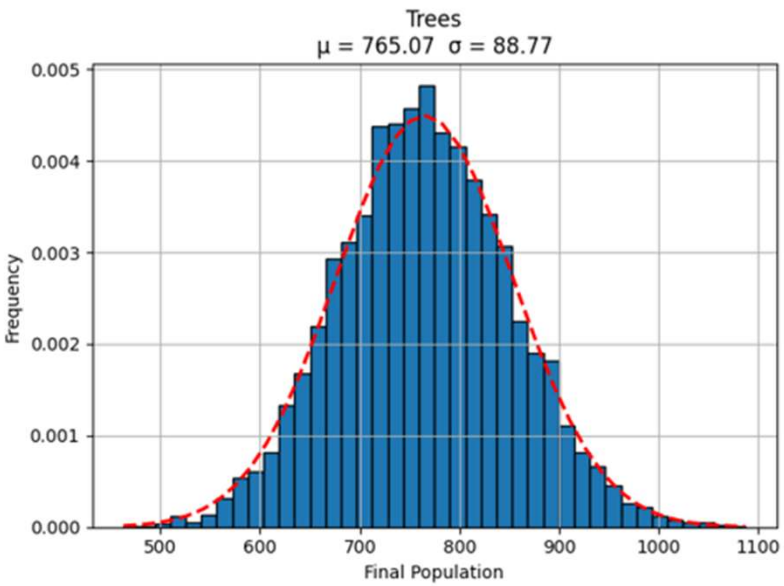


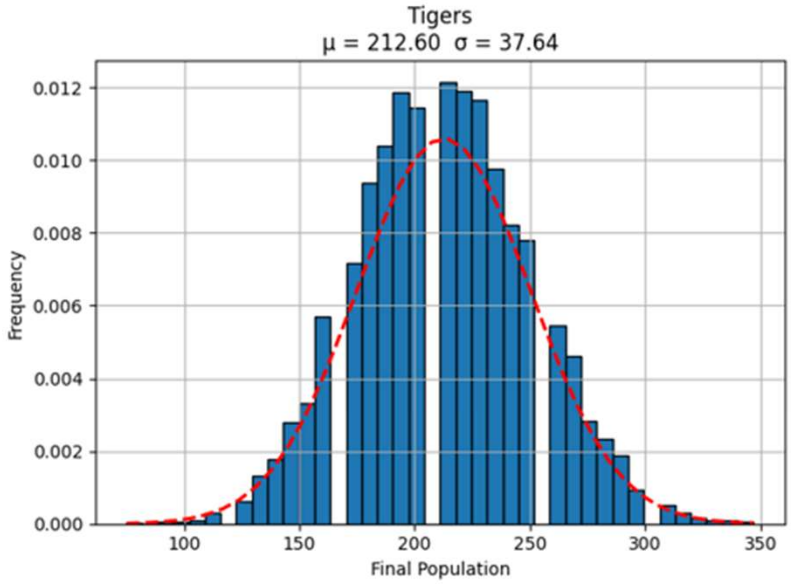

Bears
μ = 212.48 σ = 37.25
Frequency
Final Population


Birds
μ = 459.16 σ = 45.78
Frequency
Final Population


Chicken
μ = 1190.46 σ = 70.39
Frequency
Final Population


Grass
μ = 4576.51 σ = 231.69
Frequency
Final Population


Trees
μ = 765.07 σ = 88.77
Frequency
Final Population
0.000
0.001
0.002
0.003
0.004
0.005
500
600
700
800
900
1000
1100


Tigers
μ = 212.60 σ = 37.64
Frequency
Final Population
0.000
0.002
0.004
0.006
0.008
0.010
0.012
100
150
200
250
300
350

Results

1. We get the plots of the final population distribution similar to a random walk problem
2. The complicated mutual interactions of different species in the ecosystem gives rise to a simple Gaussian distribution of observed quantities.

Thank You