COMP 5560 Fall 2022 Assignment 1b

Will Humphlett (wah0028)

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1. Green Plots

In this assignment, an evolutionary algorithm is implemented with 5000 evaluations and 30 runs. For each run, the highest fitness encountered is recorded. For the run that produced the highest fitness, the bridge plot (Figure 1) is given and the stair-step plot (Figure 2) of evaluations v. fitness per generation of all runs is given. Overall, the highest fitness recorded was 75,000,000.

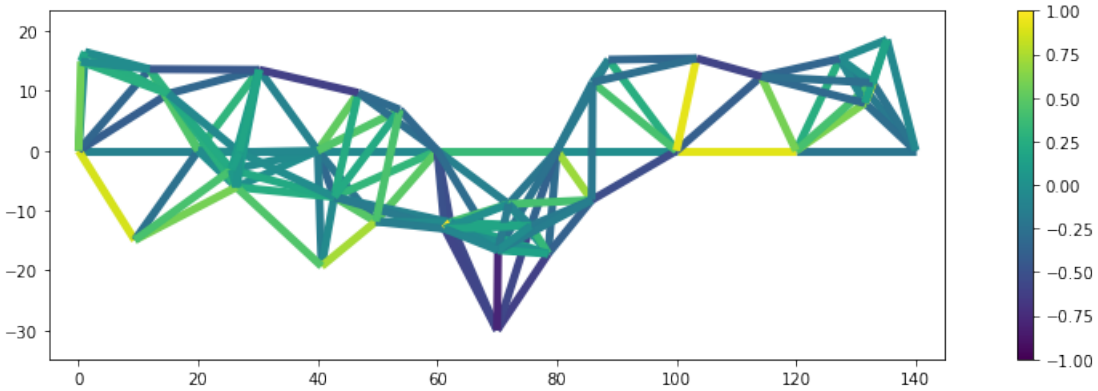

Figure 1: Bridge Plot of the Best Run

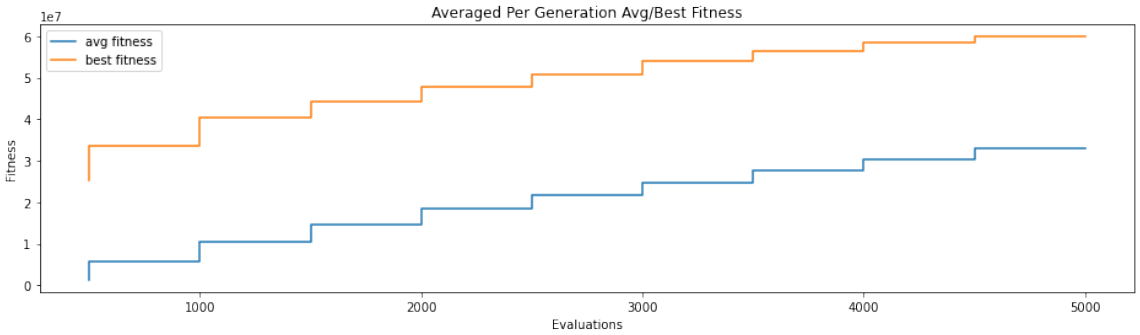

Figure 2: Stair-step Plot of the Averaged Per Generation Avg/Best Fitness

2. Analysis using F-Test and t-Test

A two-sample F-Test for equality of variances is used to determine if the variances of the uniform random algorithm (data/uniformRandomResults.txt) and the evolutionary algorithm (data/evolutionaryAlgorithmResults.txt) are equal. Given that $F < 1$ and $F < F\ Critical\ one\text{-}tail$, the null hypothesis of equal variances is rejected and it is determined that the two populations have significantly unequal variances. This prompts the use of a two-sample t-Test assuming unequal variances.

F-Test Two-Sample for Variances	uniform	evolutionary
Mean	33950000	59900000
Variance	2.8506E+13	6.19724E+13
Observations	30	30
df	29	29
α	**0.025**	
F	0.459979412	
P(F<=f) one-tail	0.020276751	
F Critical one-tail	0.475964774	

Table 1: F-Test of Uniform Random and Evolutionary Algorithms

A two-sample t-Test is used to determine if the means of the uniform random algorithm (data/uniformRandomResults.txt) and the evolutionary algorithm (data/evolutionaryAlgorithmResults.txt) are equal. Given that $t\ Stat < 0$ and $t\ Stat < -t\ Critical\ two\text{-}tail$, the null hypothesis of equal means is rejected and it is determined that the two populations have significantly unequal means. The evolutionary algorithm can be assumed to perform better than the uniform random algorithm.

t-Test: Two-Sample Assuming Unequal Variances	uniform	evolutionary
Mean	33950000	59900000
Variance	2.8506E+13	6.19724E+13
Observations	30	30
Hypothesized Mean Difference	0	
df	51	
α	**0.05**	
t Stat	-14.94257408	
P(T<=t) one-tail	1.4351E-20	
t Critical one-tail	1.67528495	
P(T<=t) two-tail	2.87021E-20	
t Critical two-tail	2.00758377	

Table 2: t-Test of Uniform Random and Evolutionary Algorithms

3. Yellow Plots

The yellow objectives tasked the evolutionary algorithm to use stochastic universal sampling to accomplish parent selection. The following plots demonstrate the results of doing so. For the run that produced the highest fitness, the bridge plot (Figure 3) is given and the stair-step plot (Figure 4) of evaluations v. fitness per generation of all runs is given. Overall, the highest fitness recorded was 70,500,000.

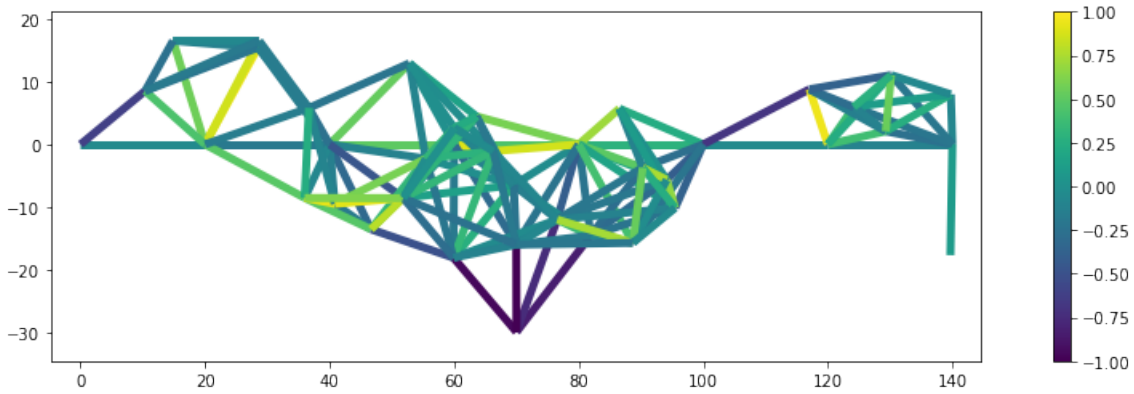

Figure 3: Bridge Plot of the Best Run

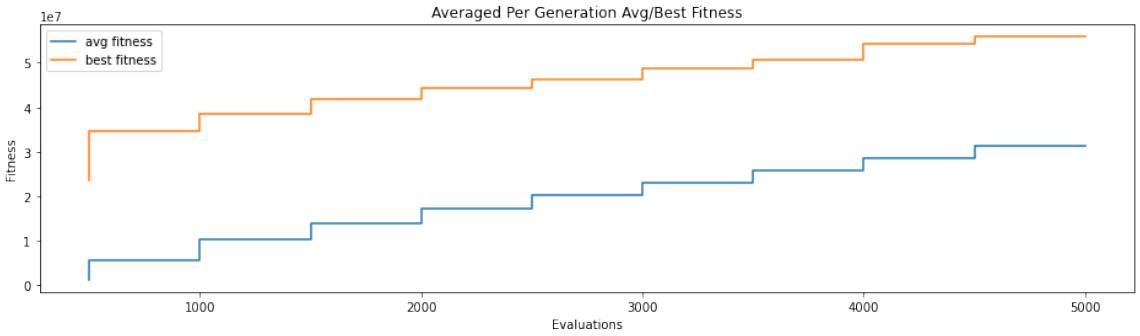

Figure 4: Stair-step Plot of the Averaged Per Generation Avg/Best Fitness

4. Analysis using F-Test and t-Test

A two-sample F-Test for equality of variances is used to determine if the variances of the base evolutionary algorithm (data/evolutionaryAlgorithmResults.txt) and the evolutionary algorithm using SUS (data/evolutionarySusAlgorithmResults.txt) are equal. Given that $F > 1$ but $F < F\ Critical\ one\text{-}tail$, the null hypothesis of equal variances fails to be rejected and it is assumed that the two populations have equal variances. This prompts the use of a two-sample t-Test assuming equal variances.

F-Test Two-Sample for Variances	base	sus
Mean	59900000	55866666.67
Variance	6.19724E+13	4.84126E+13
Observations	30	30
df	29	29
α	**0.025**	
F	1.280087371	
P(F<=f) one-tail	0.255159259	
F Critical one-tail	2.100995817	

Table 3: F-Test of Base Search and SUS Algorithms

A two-sample t-Test is used to determine if the means of the base evolutionary algorithm (data/evolutionaryAlgorithmResults.txt) and the evolutionary algorithm using SUS (data/evolutionarySusAlgorithmI are equal. Given that $t\ Stat > 0$ and $t\ Stat > -t\ Critical\ two\text{-}tail$, the null hypothesis of equal means is rejected and it is determined that the two populations have significantly unequal means. The base evolutionary algorithm can be assumed to perform better than the evolutionary algorithm using SUS.

t-Test: Two-Sample Assuming Unequal Variances	base	sus
Mean	59900000	55866666.67
Variance	6.19724E+13	4.84126E+13
Observations	30	30
Pooled Variance	5.51925E+13	
Hypothesized Mean Difference	0	
df	58	
α	**0.05**	
t Stat	2.102662643	
P(T<=t) one-tail	0.019922911	
t Critical one-tail	1.671552762	
P(T<=t) two-tail	0.039845822	
t Critical two-tail	2.001717484	

Table 4: t-Test of Base Search and SUS Algorithms