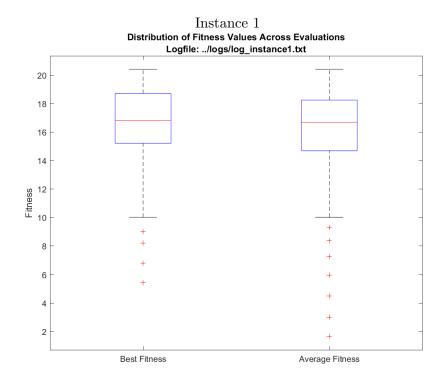
COMP SCI 5401 FS2017 Assignment 1b

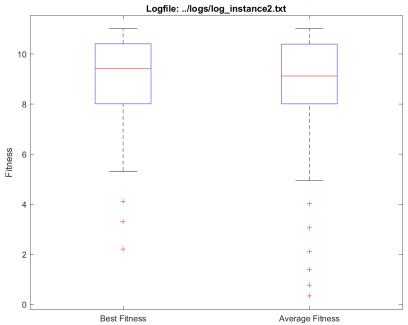
Stuart Miller sm67c@mst.edu

September 24, 2017

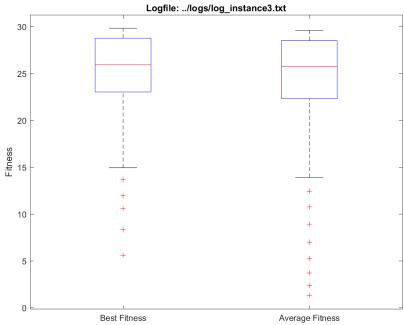
1 Fitness Plots



Instance 2
Distribution of Fitness Values Across Evaluations



Instance 3
Distribution of Fitness Values Across Evaluations
Logfile: ../logs/log_instance3.txt



2 Statistical Analysis

| 7 | г | | | | | |
|---|---|---|----|---|----|--|
| | n | C | t٠ | n | ce | |
| | | | | | | |

| F-Test Two-Sample for Variances | | |
|---|---|--|
| | | |
| | Variable 1 | Variable 2 |
| Mean | 3.428571429 | 18.8289899 |
| Variance | 6.952380952 | 26.47215938 |
| Observations | 7 | 198 |
| df | 6 | 197 |
| F | 0.262629914 | |
| P(F<=f) one-tail | 0.046377354 | |
| F Critical one-tail | 0.270947267 | |
| | | |
| | | |
| t-Test: Two-Sample Assuming Une | qual Variances | 5 |
| | | |
| | Variable 1 | Variable 2 |
| Mean | 3.428571429 | 18.8289899 |
| Variance | 6.952380952 | 26.47215938 |
| Observations | 7 | 198 |
| Hypothesized Mean Difference | 0 | |
| df | 8 | |
| t Stat | -14.5074401 | |
| P(T<=t) one-tail | 2.49526E-07 | |
| t Critical one-tail | 1.859548038 | |
| P(T<=t) two-tail | 4.99053E-07 | |
| t Critical two-tail | 2.306004135 | |
| | | |
| Instance | e 2 | |
| | | |
| F-Test Two-Sample for Variances | | |
| F-Test Two-Sample for Variances | | |
| F-Test Two-Sample for Variances | Variable 1 | Variable 2 |
| F-Test Two-Sample for Variances Mean | Variable 1 | |
| · | | 8.997777778 |
| Mean | 1 | 8.997777778 5.01318793 |
| Mean Variance | 1 | 8.997777778 5.01318793 198 |
| Mean Variance Observations | 1 1 3 | 8.997777778 5.01318793 198 197 |
| Mean Variance Observations df | 1 1 3 2 | 8.99777778 5.01318793 198 197 |
| Mean Variance Observations df F P(F<=f) one-tail | 1 1 3 2 0.199473871 | 8.997777778 5.01318793 198 197 |
| Mean Variance Observations df F | 1 3 2 0.199473871 0.180673128 | 8.997777778 5.01318793 198 197 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail | 1 3 2 0.199473871 0.180673128 0.051306652 | 8.997777778 5.01318793 198 197 |
| Mean Variance Observations df F P(F<=f) one-tail | 1 3 2 0.199473871 0.180673128 0.051306652 | 8.997777778 5.01318793 198 197 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail | 1 3 2 0.199473871 0.180673128 0.051306652 | 8.997777778 5.01318793 198 197 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail t-Test: Two-Sample Assuming Equ | 1 3 2 0.199473871 0.180673128 0.051306652 al Variances Variable 1 | 8.99777778 5.01318793 198 197 Variable 2 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail t-Test: Two-Sample Assuming Equ | 1 3 2 0.199473871 0.180673128 0.051306652 al Variances Variable 1 | 8.99777778 5.01318793 198 197 Variable 2 8.997777778 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail t-Test: Two-Sample Assuming Equ Mean Variance | 1 3 2 0.199473871 0.180673128 0.051306652 al Variances Variable 1 1 | 8.99777778 5.01318793 198 197 Variable 2 8.99777778 5.01318793 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail t-Test: Two-Sample Assuming Equ Mean Variance Observations | 1 3 2 0.199473871 0.180673128 0.051306652 al Variances Variable 1 1 | 8.99777778 5.01318793 198 197 Variable 2 8.997777778 5.01318793 198 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail t-Test: Two-Sample Assuming Equ Mean Variance Observations Pooled Variance | 1 3 2 0.199473871 0.180673128 0.051306652 al Variances Variable 1 1 1 3 4.972854383 | 8.99777778 5.01318793 198 197 Variable 2 8.997777778 5.01318793 198 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail t-Test: Two-Sample Assuming Equ Mean Variance Observations Pooled Variance Hypothesized Mean Difference | 1 3 2 0.199473871 0.180673128 0.051306652 al Variances Variable 1 1 1 3 4.972854383 | 8.99777778 5.01318793 198 197 Variable 2 8.997777778 5.01318793 198 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail t-Test: Two-Sample Assuming Equ Mean Variance Observations Pooled Variance Hypothesized Mean Difference df | 1 3 2 0.199473871 0.180673128 0.051306652 al Variances Variable 1 1 1 3 4.972854383 0 199 | 8.99777778 5.01318793 198 197 Variable 2 8.997777778 5.01318793 198 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail t-Test: Two-Sample Assuming Equ Mean Variance Observations Pooled Variance Hypothesized Mean Difference df t Stat | 1 3 2 0.199473871 0.180673128 0.051306652 al Variances Variable 1 1 1 4.972854383 0 199 -6.16540564 | 8.99777778 5.01318793 198 197 Variable 2 8.99777778 5.01318793 198 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail t-Test: Two-Sample Assuming Equ Mean Variance Observations Pooled Variance Hypothesized Mean Difference df t Stat P(T<=t) one-tail | 1 3 2 0.199473871 0.180673128 0.051306652 al Variances Variable 1 1 3 4.972854383 0 199 -6.16540564 1.92261E-09 | 8.99777778 5.01318793 198 197 Variable 2 8.99777778 5.01318793 198 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail t-Test: Two-Sample Assuming Equ Mean Variance Observations Pooled Variance Hypothesized Mean Difference df t Stat P(T<=t) one-tail t Critical one-tail | 1 3 2 0.199473871 0.180673128 0.051306652 al Variances Variable 1 1 3 4.972854383 0 199 -6.16540564 1.92261E-09 1.652546746 | 8.99777778 5.01318793 198 197 Variable 2 8.99777778 5.01318793 198 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail t-Test: Two-Sample Assuming Equ Mean Variance Observations Pooled Variance Hypothesized Mean Difference df t Stat P(T<=t) one-tail t Critical one-tail P(T<=t) two-tail | 1 3 2 0.199473871 0.180673128 0.051306652 al Variances Variable 1 1 3 4.972854383 0 199 -6.16540564 1.92261E-09 1.652546746 3.84522E-09 | 8.99777778 5.01318793 198 197 Variable 2 8.99777778 5.01318793 198 |
| Mean Variance Observations df F P(F<=f) one-tail F Critical one-tail t-Test: Two-Sample Assuming Equ Mean Variance Observations Pooled Variance Hypothesized Mean Difference df t Stat P(T<=t) one-tail t Critical one-tail | 1 3 2 0.199473871 0.180673128 0.051306652 al Variances Variable 1 1 3 4.972854383 0 199 -6.16540564 1.92261E-09 1.652546746 | 8.99777778 5.01318793 198 197 Variable 2 8.99777778 5.01318793 198 |

Instance 3

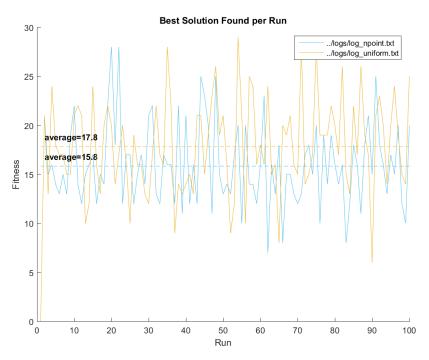
| F-Test Two-Sample for Variances | | |
|--|---|----------------------------|
| | | |
| | Variable 1 | Variable 2 |
| Mean | 2.75 | 24.00818182 |
| Variance | 7.583333333 | 40.83395505 |
| Observations | 4 | 198 |
| df | 3 | 197 |
| F | 0.185711458 | |
| P(F<=f) one-tail | 0.09396887 | |
| F Critical one-tail | 0.117090126 | |
| t-Test: Two-Sample Assuming Equ | al Variances | |
| t-Test: Two-Sample Assuming Equ | al Variances | |
| t-Test: Two-Sample Assuming Equ | | Variable 2 |
| t-Test: Two-Sample Assuming Equ | al Variances Variable 1 2.75 | Variable 2 24.00818182 |
| . <u> </u> | Variable 1 | |
| Mean | Variable 1 2.75 | 24.00818182 |
| Mean Variance | Variable 1 2.75 7.583333333 | 24.00818182 40.83395505 |
| Mean Variance Observations | Variable 1 2.75 7.583333333 4 | 24.00818182 40.83395505 |
| Mean Variance Observations Pooled Variance | Variable 1 2.75 7.583333333 4 40.33519573 | 24.00818182 40.83395505 |
| Mean Variance Observations Pooled Variance Hypothesized Mean Difference | Variable 1 2.75 7.583333333 4 40.33519573 0 | 24.00818182 40.83395505 |
| Mean Variance Observations Pooled Variance Hypothesized Mean Difference df | Variable 1 2.75 7.583333333 4 40.33519573 0 200 | 24.00818182 40.83395505 |
| Mean Variance Observations Pooled Variance Hypothesized Mean Difference df t Stat P(T<=t) one-tail | Variable 1 2.75 7.583333333 4 40.33519573 0 200 -6.62782357 | 24.00818182 40.83395505 |
| Mean Variance Observations Pooled Variance Hypothesized Mean Difference df t Stat | Variable 1 2.75 7.583333333 4 40.33519573 0 200 -6.62782357 1.54754E-10 | 24.00818182 40.83395505 |

3 Bonus 1 - Operator Comparison

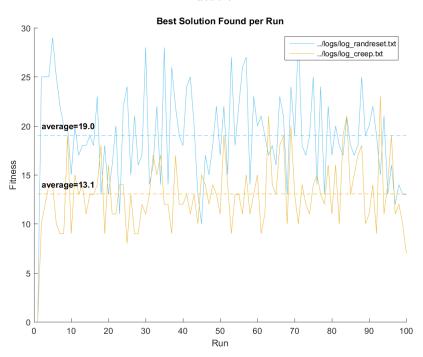
For the operator comparison, both n-point and uniform crossover methods were implemented for the recombination stage and random reset and creep methods were implemented for the mutation stage. The parameters were set to 3 crossover points (for n-point crossover), 50% distribution (for uniform crossover), creep distance of 2 (for creep mutation), and a 20% mutation chance. The limit of 10,000 fitness evaluations was kept, but increased to 100 runs for more data. The best solution from each run was kept and plotted as show below. Trendlines and labels were added to show averages for each.

As shown in the plots below, uniform crossover tends to perform slightly better, while random reset mutation consistently outperforms creep mutation.

Recombination



Mutation



4 Bonus 2 - Repair Function

For repair function analysis, the same configuration was used as Bonus 1. Recombination was set to uniform and mutation was set to random reset and these were determined to be best performing. In initial testing, the repair function always outperformed random placements, so a configuration option was not added to turn it off. For the control in this experiment, the code was manually altered to assign random placements until valid instead of attempting a repair.

As you can see, the non-repairing version performs much worse.

