Applying the Triple Parameter Hypothesis to Maintenance Scheduling

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1. Introduction

- Choice of values for evolutionary parameters impacts quality of results
- Many attempts to find "right" values
- None exist for all problems
- Values can change as evolution progresses
- Manual setting is computationally impractical
- Triple Parameter Hypothesis (TPH) has been proposed to help find "good" values

2. Motivation

- TPH uses schema theorem to classify parameter values
- Initial work used schema lengths of 1 and N
- Results were very positive
- Are results still positive for lengths in between
- Chose problem domain with length of $N/2$

3. Maintenance Scheduling

- N power generators with different output levels
- Consider M time periods
- Must be taken offline for maintenance
- Maintenance takes $M/2$ time periods
- Want to provide consistent power
- What is the best schedule?

4. Schema Theorem and The Triple Parameter Hypothesis

- Schema length is length of solution building blocks
- Parameter tuples include:
  1. Crossover probability
  2. Mutation probability
  3. Selection pressure
- Want to identify tuples which *generally* lead to better performance
- Previous work only used crossover and selection pressure as factors [Goldberg & Sastry, 2001]:

$$f_{gs}(P_c, S_p) \geq 0 \tag{1}$$

- Triple Parameter Hypothesis adds mutation as a factor [Diaz-Gomez & Hougen, 2007]:

$$f_d(P_c, P_m, S_p) \geq 0 \tag{2}$$

- Tuple satisfying Equation 2 is in set U, otherwise tuple is in set V

5. Experiments

- Experiments used 25, 50, 75, & 100 generators
- Each generator produces randomly assigned power output
- Fitness was negative of variance of power output

$$F = -\frac{\sum(X - \mu)^2}{N} \tag{3}$$

- Used parameter tuples for both U and V

6. Results

Figure: 25 Generators

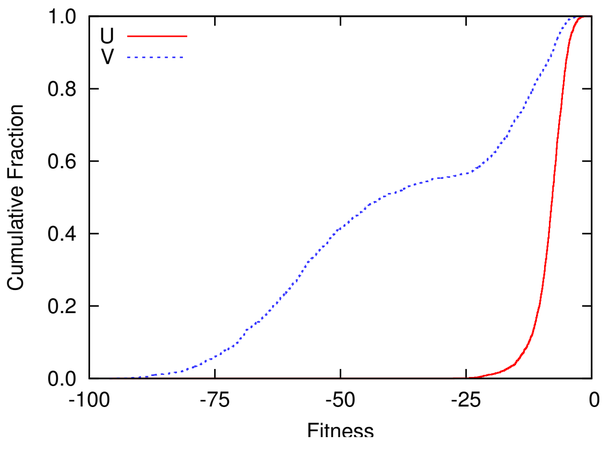


Figure: 50 Generators

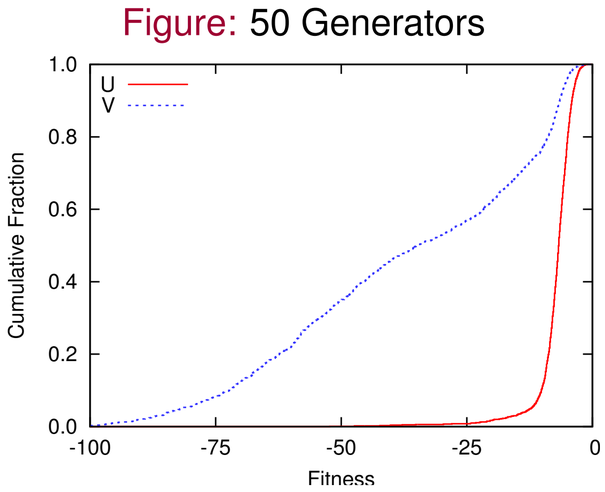


Figure: 75 Generators

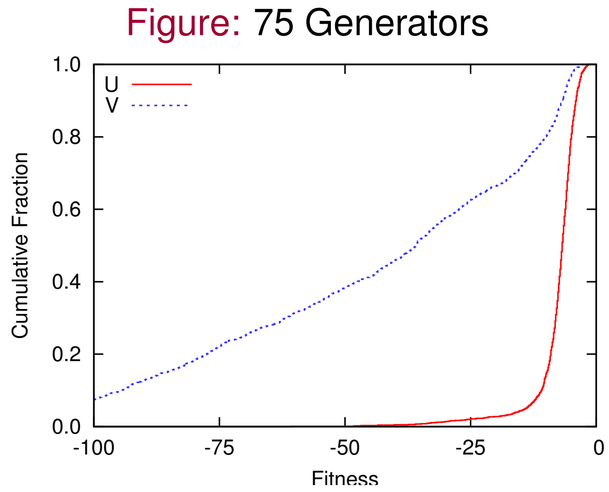
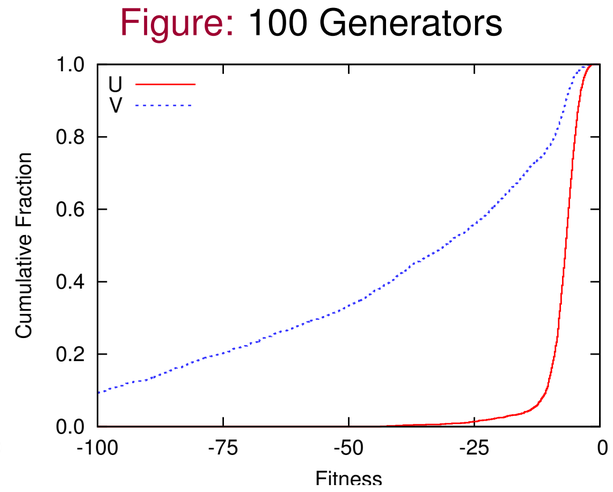


Figure: 100 Generators



Where U are tuples which satisfy Equation 2 and V are tuples that do not

7. Discussion

- Kolmogorov-Smirnov tests show that U and V are statistically significant at 99.9% confidence
- Number of generators affects V, but not U
- Good results even with relatively high mutation

8. Conclusions

- Results indicate TPH works with schema length of $N/2$
- Helps identify "good" parameter values
- May be an effective general process
- Want to apply to problems where length is approximate

This material is based upon work supported by the National Science Foundation under Grant No. IIS/REU/0755462.