

# Exploration and Fairness in Infinite Armed Bandit Problems

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## Abstract

## 1 Introduction

(Parikh, 2019) (Parikh, 2010) (Blum et al., 2020)

## 2 Related Work and Preliminary Concepts

### 2.1 Infinite Multi-Armed-Bandit

### 2.2 Regret Bound

### 2.3 UCB

### 2.4 Thompson Sampling

### 2.5 Fairness

## 3 Proposed Method

### 3.1 Curiosity

### 3.2 Surplus

## 4 Experiments and Discussion

### 4.1 The Agents

1. Random Agent
2. Always New Arm Agent
3. Naive UCB Agent
4. Naive Thompson Sampling Agent
5. Fair UCB Agent
6. Fair TS Agent
7. Surplus Curiosity UCB Agent
8. Surplus Curiosity TS Agent

### 4.2 Environments

1. Uniform Environment
2. Increasingly Better Environment
3. Progressively Worse Environment

## 4.3 Results

### 4.3.1 Uniform Environment

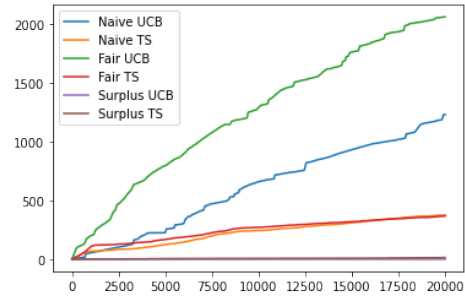


Figure 1: Uniform Environment. Linear-Linear Graph

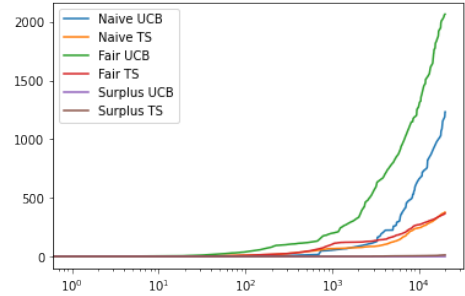


Figure 2: Uniform Environment. Log-Linear Graph

### 4.3.2 Increasingly Better Environment

### 4.3.3 Progressively Worse Environment

## 4.4 Discussion

## 5 Conclusion

## References

- Avrim Blum, John Hopcroft, and Ravindran Kannan. 2020. *Foundations of Data Science*. Cambridge University Press, Cambridge.
- Prashant Parikh. 2010. *Language and Equilibrium*. MIT Press.

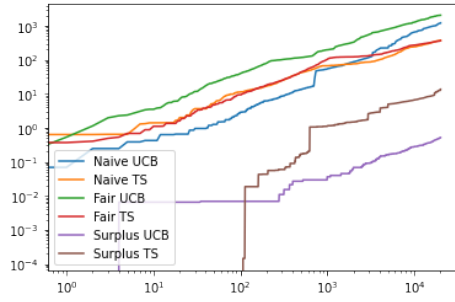


Figure 3: Uniform Environment. Log-Log Graph

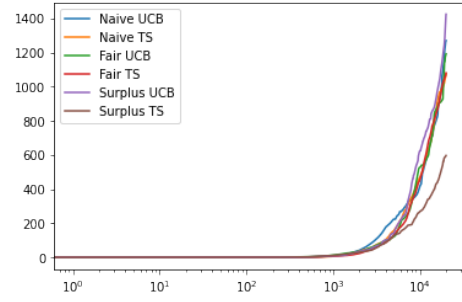


Figure 5: Increasingly Better Environment. Log-Linear Graph

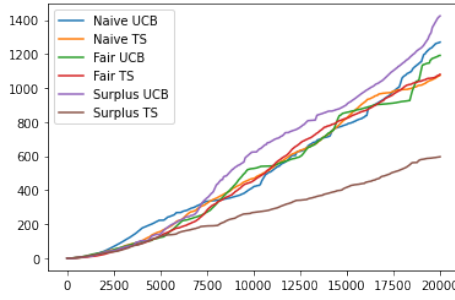


Figure 4: Increasingly Better Environment. Linear-Linear Graph

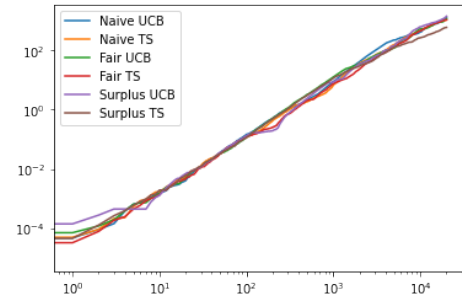


Figure 6: Increasingly Better Environment. Log-Log Graph

Prashant Parikh. 2019. *Communication and content*. Number 4 in Topics at the Grammar-Discourse Interface. Language Science Press, Berlin.

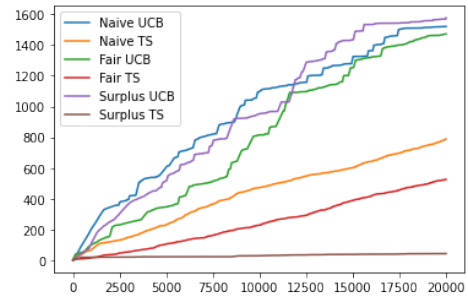


Figure 7: Progressively Worse Environment. Linear-Linear Graph

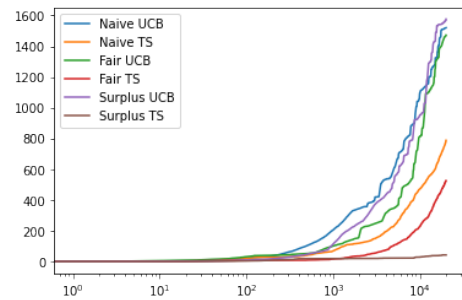


Figure 8: Progressively Worse Environment. Log-Linear Graph

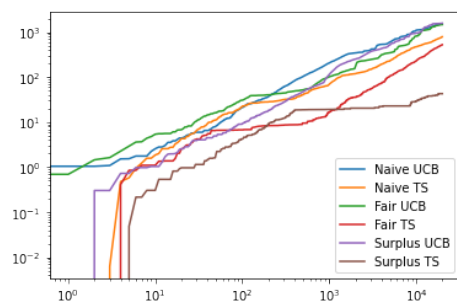


Figure 9: Progressively Worse Environment. Log-Log Graph