Online Learning for Min Sum Set Cover and Pandora's Box

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Introduction

Context: Stochastic optimization problems
Focus: Online version of Min Sum Set Cover (MSSC) and Pandora's Box
Key Question: How to minimize regret in online settings?

Problem Definitions

Pandora's Box:

- Selection with unknown costs.
- Goal: Minimize selection and exploration costs.

MSSC:

- Minimize the weighted sum of covering times for scenarios.

Online Challenges:

- Adversarially chosen scenarios.
- Regret minimization.

Methodology

Framework: Online Convex Optimization (OCO) [1]

Steps:

1. Convex relaxation of problem instances [2].
2. Fractional solutions obtained via OCO.
3. Rounding fractional solutions to integral solutions [3].

Key Results

- **Single Box:** 9.22-approximation no-regret algorithm [4].
- **Multiple Boxes:** $O(1)$-approximation no-regret algorithm [4].
- **Matroid Constraints:** $O(\log k)$-approximation no-regret algorithm [4].
- **Efficiency:** Computationally efficient Algorithms.

Bandit Setting

Key Features:

- Limited feedback: Only revealed values for opened boxes.
- Approximation guarantees similar to the full information setting.
- Practical for real-world scenarios.

Comparison with Previous Work

Improvements over [CGT+20]:

- Simpler algorithms.
- Broader applicability.

Advances over [FLPS20]:

- Extends to bandit settings.
- Handles more complex constraints.

Applications and Open Questions

Applications:

- Resource allocation.
- Decision-making under uncertainty.

Open Problems:

- Tight bounds for MSSC.
- Extensions to dynamic settings.

Conclusion

Summary of Contributions:

- Framework for online learning with MSSC and Pandora's Box [4].
- Approximation guarantees for various settings.
- Computationally Efficient Algorithms.

Acknowledgments:

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