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No-Regret Learning in Bilateral Trade via Global Budget Balance

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0. Abstract

- Problem description:

  - *Bilateral trade* - problem of facilitating trade between a buyer and a seller, each of whom contain a private valuation of the item for sale.

  - *Online bilateral trade* - online learning problem in which a new buyer and seller are introduced at each time step, and the learner has no prior knowledge of their preferences.

- **Problem** - there does not exist a no-regret algorithm that is budget balanced at each timestep.
  - This is a proven result.

- **Solution** - instead of requiring the learner to budget balance at each timestep, enforce a balanced budget over the entire time horizon.

- **Result** - first no-regret algorithms for adversarial bilateral trade.

  - Full feedback model - show $\tilde{O}(\sqrt{T})$ regret against the best fixed prices in hindsight.
    - This is an optimal bound (up to poly-logarithmic terms).

  - One-bit feedback model - show $\tilde{O}(T^{3/4})$ regret upper bound and $\Omega(T^{5/7})$ lower bound.

- An alternative, stronger benchmark is introduced, inspired by the literature on bandits with knapsacks.