

Feedback-Aware Social Event-Participant Arrangement

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Introduction

- Event-Based Social Networks
 - Online platforms that facilitate offline event organization and participation, e.g. Meetup
- Motivation
 - The satisfaction scores are hard to learn
 - Different factors, e.g. price and distance, have different weights, which are hard to know
 - Users may not accept the arrangements
 - Alex who likes rock and roll may reject the arrangement of a piano concert
 - Feedbacks of users should be considered to improve quality of services

The FASEA Problem

- Given
 - A set of events V
 - Each $v \in V$ with capacity c_v .
 - A set of conflicting event pairs CF
- Each time step t , a user u arrives
 - Capacity c_u and a context $\mathbf{x}_{t,v}$ for each $v \in V$ are revealed.
 - Arrange at most c_u feasible events A_t .
 - Receive feedbacks of accepting/rejecting the arranged event, i.e. observe rewards $\{r_{t,v} = 0 \text{ or } 1 | v \in A_t\}$, where $E[r_{t,v} | \mathbf{x}_{t,v}] = \mathbf{x}_{t,v}^T \boldsymbol{\theta}$ and $\boldsymbol{\theta}$ is fixed but unknown.
- Goal
 - Find an arrangement A_t for each user u_t such that the total number of accepted events is maximized and the following constraints are satisfied:
 - Invariable constraint.
 - Capacity constraint.
 - Conflict constraint.

Background: MAB

- Given a set of m arms
 - Each arm is associated with an unknown distribution of rewards
- Repeatedly play one arm in T rounds
 - Observe the reward of the arm played
- Maximize the total rewards: exploration and exploitation trade-off
- A variant: contextual combinatorial bandit
 - Combinatorial: play a subset of arms in each round
 - Contextual: before playing, a context (feature vector) of each arm is observed in each round
 - The reward of an arm depends on the context
 - Linear payoff: mean of reward is a linear combination of the features with unknown weights

Problem Reduction

- Contextual combinatorial bandit \rightarrow event-participant arrangement
- Each round (for each new-coming user)
 - Values of factors are observed \rightarrow contexts are observed
 - Arrange a set of events \rightarrow play a subset of arms
 - User chooses to accept the arranged events or not \rightarrow observe rewards

Thompson Sampling Based Solution

- At each time step
 - Sample $\tilde{\boldsymbol{\theta}} \sim N(Y^{-1}\mathbf{b}, q^2 Y^{-1})$.
 - Estimated reward of each v : $\hat{r}_{t,v} = \mathbf{x}_{t,v}^T \tilde{\boldsymbol{\theta}}$
 - Arrange at most c_u feasible events A_t greedily based on $\{\hat{r}_{t,v} | v \in V\}$

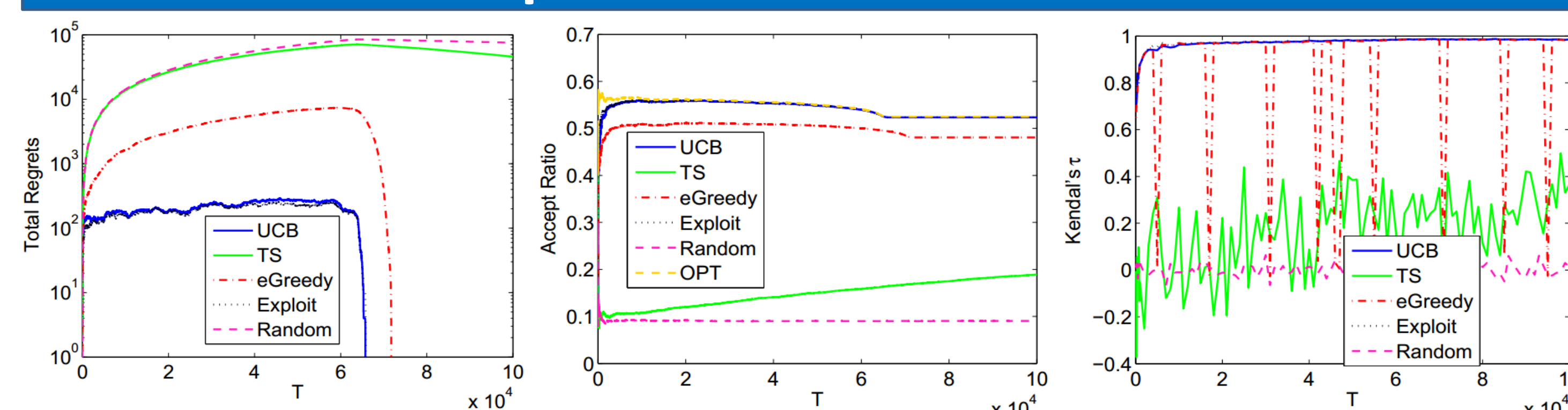
	Round 1 ($c_u = 2$)	Round 2 ($c_u = 1$)	Conflicts
v_1	$\mathbf{x}_{1,v_1} = \langle 0.1, 0, 0.5, 0.2 \rangle$	$\hat{r}_{1,v_1} = -3.94$	v_2
v_2	$\mathbf{x}_{1,v_2} = \langle 0.2, 0.1, 0, 0.1 \rangle$	$\hat{r}_{1,v_2} = -0.30$	v_1
v_3	$\mathbf{x}_{1,v_3} = \langle 0.2, 0.3, 0, 0.2 \rangle$	$\hat{r}_{1,v_3} = 1.74$	NA
v_4	$\mathbf{x}_{1,v_4} = \langle 0, 0, 1, 0 \rangle$	$\hat{r}_{1,v_4} = -13.07$	NA

Upper Confidence Bound (UCB) Based Solution

- At each time step
 - Estimate $\hat{\boldsymbol{\theta}} = Y^{-1} \mathbf{b}$
 - Upper confidence bound of each v
 - $\hat{r}_{t,v} = \mathbf{x}_{t,v}^T \hat{\boldsymbol{\theta}} + \alpha \sqrt{\mathbf{x}_{t,v}^T Y^{-1} \mathbf{x}_{t,v}}$
 - Arrange at most c_u non-conflicting events A_t greedily based on $\{\hat{r}_{t,v} | v \in V\}$

	Round 1 ($c_u = 2$)	Round 2 ($c_u = 1$)	Conflicts
v_1	$\mathbf{x}_{1,v_1} = \langle 0.1, 0, 0.5, 0.2 \rangle$	$\hat{r}_{1,v_1} = 1.10$	v_2
v_2	$\mathbf{x}_{1,v_2} = \langle 0.2, 0.1, 0, 0.1 \rangle$	$\hat{r}_{1,v_2} = 0.49$	v_1
v_3	$\mathbf{x}_{1,v_3} = \langle 0.2, 0.3, 0, 0.2 \rangle$	$\hat{r}_{1,v_3} = 0.82$	NA
v_4	$\mathbf{x}_{1,v_4} = \langle 0, 0, 1, 0 \rangle$	$\hat{r}_{1,v_4} = 2.00$	NA

Experimental Evaluation



Experimental finding: TS that is reported to work well under basic multi-armed bandit does not perform well under FASEA while UCB is the best in overall

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