Personalized Fairness-aware Re-ranking for Microlending

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Motivation

- Microlending can lead to improved access to capital in impoverished countries.
- Loan recommender systems assist lenders in looking for promising borrowers. However, purely optimizing personalization may result in fairness issues.
- A desirable fairness property in microlending is to give borrowers from different demographic groups a fair chance of being recommended.

![Kiva.org provides an intermediary service for lenders and borrowers.](image1)

Method

We propose to formulate this recommendation scenario as a Multi-sided Recommender System (MRS) [2].

![Multi-sided Recommender System (MRS)](image2)

- **Fairness-aware Re-ranking (FAR)**
  For any user $u$, given the initial ranking score $P(v|u)$, we iteratively select the next item to the re-ranking list $S(u)$ by solving:
  $$
  \max_v \lambda P(v|u) + (1 - \lambda) \sum_c P(V_c|u) \prod_{i \notin S(u)} I(i \notin V_c),
  $$
  where $\lambda$ is the hyper-parameter, and $V_c$ denotes the item group with protected attribute $c$.

- **Personalized Fairness-aware Re-ranking (PFAR)**
  We further take into consideration that lenders may differ in their receptivity to the diversification of recommended loans and develop a Personalized Fairness-Aware Re-ranking (PFAR):
  $$
  \max_v \lambda P(v|u) + (1 - \lambda) \sum_c P(V_c|u) \prod_{i \notin S(u)} I(i \notin V_c).
  $$
  We use the information entropy to identify the lender diversity tolerance:
  $$
  \tau_u = \sum_c P(V_c|u) \log P(V_c|u).
  $$

![Experiment: We define Average Coverage Rate (ACR) and use nDCG [3] to measure accuracy and fairness respectively, where](image3)

$$
ACR = \frac{\sum_{u \in U} N_u(S(u))}{N_u(U)},
$$

where $N_u(S(u))$ is the number of borrowers groups covered in the list $S(u)$.

We apply our proposed re-ranking algorithms on four representative recommenders. Experimental results show that our proposed algorithms can achieve a balance between accuracy and fairness.

![Tendencies of ACR and nDCG with increasing $\lambda$.](image4)

![Recommendation percentage of each region.](image5)