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Introduction

- Problem and goal: Popularity bias is a long-standing problem in recommender systems. However, the conventional concept of popularity bias is aligned with the concept of statistical parity, and so inherit its limitations. In this paper, we re-examine popularity bias from the perspective of the concept of equal opportunity, which evaluate the bias with ground truth of user-item matching into consideration.

- Contributions:
  (i) We propose to study the popularity-opportunity bias and from the views of both user-side and item-side.
  (ii) We conduct a comprehensive data-driven study over four datasets to investigate the presence of the popularity-opportunity bias.
  (iii) We theoretically analyze the impact of item popularity on ranking by MF and BPR to confirm the existence of the bias in both methods.
  (iv) We investigate the potential of a post-processing approach to reduce this bias. Through experiments on four datasets, we explore the trade-offs between debiasing effectiveness and recommendation utility, showing the more effective debiasing performance of the proposed method over existing debiasing baselines designed for conventional popularity bias.

Conventional Popularity Bias

- Investigate whether popular items are recommended more frequently than less popular items (a statistical parity based concept), leading to rich-get-richer.

Drawback: conventional popularity bias is NOT always harmful

- Recommendation showing conventional popularity bias is not necessarily problematic. Yet, enforcing zero conventional popularity bias may bring issues.

Popularity-Opportunity Bias

We propose to investigate the popularity-opportunity bias, which compares the probability of being recommended to matched users (i.e., true positive rate) for items of different popularity.

- Conventional popularity bias does not consider the ground truth of user-item matching.
- Proposed popularity-opportunity bias takes account of the ground truth of user-item matching.

Two Views of the Bias

- User-view popularity-opportunity bias (uPO bias)
Given user-u likes a popular item i and a less popular item j, whether i will be ranked higher than j?

- Item-view popularity-opportunity bias (iPO bias)
Whether popular items have higher expected ranking to matched users than less popular items?

Prevalence of the Bias

Table: Measuring uPO bias (PRU) and iPO bias (PRI) for MF and BPR on four datasets.

Debiasing: Popularity Compensation (PC)

- Promote less popular items by adding compensation to predicted scores

- All of the proposed method and two baselines can reduce the bias from both user-view and item-view, but also sacrifice recommendation utility at the same time;
- Proposed PC reduce the bias to similar degree as the two baselines; Proposed PC preserve the recommendation utility better than the two baselines.

Conclusion

- Propose the study of popularity-opportunity bias;
- Empirically show the prevalence of the bias;
- Theoretically show how two models inherently produce bias on both user and item sides (refer to the paper);
- Propose the Popularity Compensation debiasing method, and empirically show the effectiveness of the proposed method.