

**RQ4: Is there any fairness-aware method that is not based on re-ranking (which can update the model parameters under fairness constraint)?**

	Top-5			Top-10			Top-20		
	NDCG	CV	ESG	NDCG	CV	ESG	NDCG	CV	ESG
LTP-MMF	0.9200	0.0257	1.0000	0.9041	0.1325	1.0000	0.9228	0.2364	1.0000
<b>RPF(ours)</b>	<b>0.9641</b>	<b>0.001091</b>	1.0000	<b>0.9919</b>	<b>0.0004865</b>	1.0000	<b>0.9927</b>	<b>0.0004068</b>	1.0000

Note that higher NDCG is better and lower CV is better. As the experiment result shows, RPF outperformed LTP-MMF in both accuracy and robustness. This is because :(1) the long training and learning process of LTP-MMF cause non-robustness while RPF do not need any learning phase; (2) LTP-MMF does not consider the influence of user traffic.

## Reference

- [1] <https://uxmag.com/articles/being-predictable>
- [2] Craik, KJW 1943, The Nature of Explanation, Cambridge University Press, London.
- [3] Krylov, Sergey. "Target financial forecasting as an instrument to improve company financial health." Cogent Business & Management 5.1 (2018): 1540074.
- [4] Lau, Geok Theng, and Sook Han Lee. "Consumers' trust in a brand and the link to brand loyalty." Journal of market-focused management 4 (1999): 341-370.
- [5] Biega, Asia J., Krishna P. Gummadi, and Gerhard Weikum. "Equity of attention: Amortizing individual fairness in rankings." The 41st international acm sigir conference on research & development in information retrieval. 2018.
- [6] Li, Yunqi, et al. "User-oriented fairness in recommendation." Proceedings of the web conference 2021. 2021.
- [7] Xu, Chen, et al. "LTP-MMF: Towards Long-term Provider Max-min Fairness Under Recommendation Feedback Loops." arXiv preprint arXiv:2308.05902 (2023).