

Appendix

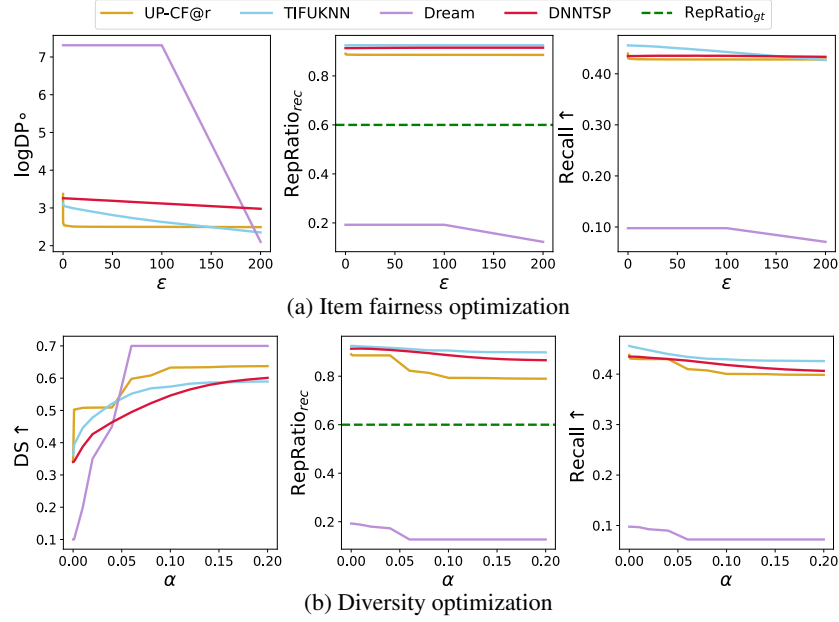


Fig. 3: Performance of item fairness and diversity optimization without considering $RepRatio_{rec}$ on Instacart.

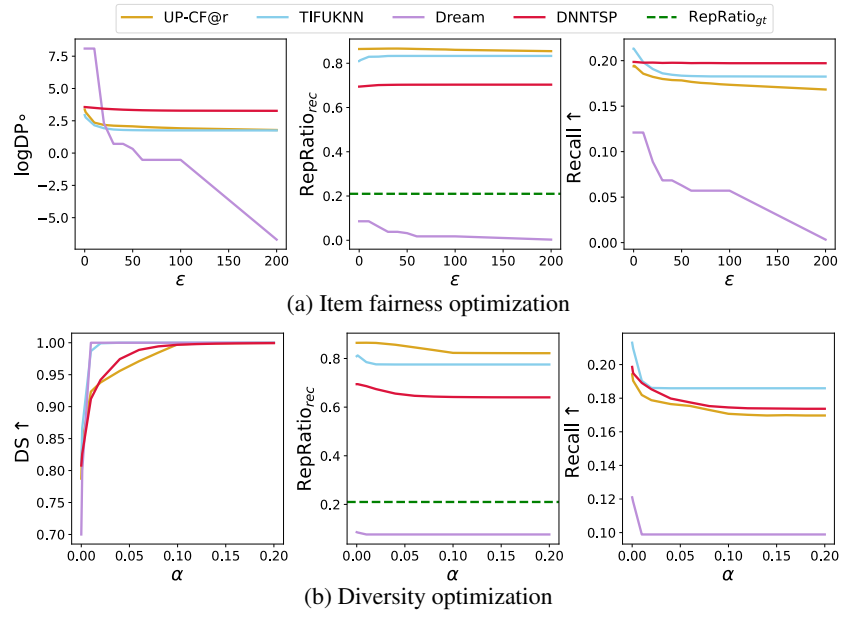


Fig. 4: Performance of item fairness and diversity optimization without considering $RepRatio_{rec}$ on TaFeng.

Table 4: The performance of RADiv and RAIF algorithms on Dunnhumby ($RepRatio_{gt} = 0.43$). *Ori.* indicates the original baskets obtained from each method. *RD* indicates RADiv. *RF* refers to RAIF. In ablation study, *D*, *F*, *R* indicate optimizing only for diversity, item fairness, and repeat bias, respectively. RepR indicates $RepRatio_{rec}$ (best close to $RepRatio_{gt}$). RepBias and logDP (best close to zero).

Meth.	Diversity optimization						Item fairness optimization					
	Type	Recall↑	DS↑	RepR	RepBias	mDR↑	Type	Recall↑	logDP	RepR	RepBias	mFR↓
TIFUKNN	N	0.2219	0.2661	0.8693	0.4393	-0.0866	N	0.2224	3.6726	0.8691	0.4391	2.0559
	D	0.2101	0.5024	0.8157	0.3857	0.0583	F	0.2205	3.4719	0.8740	0.4440	1.9580
	R	0.2088	0.2755	0.7131	0.2873	-0.0059	R	0.2213	3.6793	0.8632	0.4332	2.0563
	RD	0.2040	0.5024	0.7045	0.2745	0.1139	RF	0.2194	3.481	0.8686	0.4386	1.9598
UP-CF@r	N	0.2148	0.2296	0.9945	0.5645	-0.1675	N	0.2173	3.463	0.9945	0.5645	2.0138
	D	0.2153	0.4276	0.9692	0.5392	-0.0558	F	0.2049	2.5224	0.9945	0.5645	1.5435
	R	0.2104	0.2321	0.9411	0.5111	-0.1395	R	0.2132	3.4776	0.9187	0.4887	1.9832
	RD	0.2123	0.4280	0.9358	0.5058	-0.0389	RF	0.2037	2.4892	0.9747	0.5447	1.5170
DNNTSP	N	0.1465	0.2512	0.9416	0.5116	-0.1302	N	0.1465	3.1376	0.9416	0.5116	1.8246
	D	0.1466	0.4548	0.9143	0.4843	-0.0148	F	0.1292	2.3589	0.9494	0.5194	1.4392
	R	0.1434	0.2519	0.916	0.4860	-0.1170	R	0.1411	3.1769	0.8639	0.4339	1.8054
	RD	0.1453	0.4548	0.8981	0.4681	-0.0067	RF	0.1244	2.3727	0.9055	0.4755	1.4241
Dream	N	0.1085	0.2000	0.3618	-0.0682	0.0659	N	0.1085	7.0173	0.3618	-0.0682	3.5428
	D	0.1063	0.5503	0.3098	-0.1202	0.2151	F	0.0745	1.0075	0.1127	-0.3173	0.6624
	R	0.1275	0.2157	0.6321	0.2021	0.0068	R	0.1341	6.9063	0.7440	0.3140	3.6102
	RD	0.1133	0.5503	0.4505	0.0205	0.2649	RF	0.1006	1.9855	0.3830	-0.0470	1.0163
TReX	N	0.2257	0.2325	0.9953	0.5653	-0.1664	N	0.2257	3.3947	0.9953	0.5653	1.9800
	D	0.2209	0.4079	0.9953	0.5653	-0.0787	F	0.2258	3.3116	0.9953	0.5653	1.9385
	R	0.2033	0.2224	0.6920	0.2620	-0.0198	R	0.2006	3.7244	0.6443	0.2143	1.9694
	RD	0.1954	0.4948	0.6920	0.2620	0.1164	RF	0.1988	3.1603	0.6443	0.2143	1.6873

Table 5: The performance of RADiv and RAIF algorithms on TaFeng ($RepRatio_{gt} = 0.21$). *Ori.* indicates the original baskets obtained from each method. *RD* indicates RADiv. *RF* refers to RAIF. In ablation study, *D*, *F*, *R* indicate optimizing only for diversity, item fairness, and repeat bias, respectively. RepR indicates $RepRatio_{rec}$ (best close to $RepRatio_{gt}$). RepBias and logDP (best close to zero).

Meth.	Diversity optimization						Item fairness optimization					
	Type	Recall↑	DS↑	RepR	RepBias	mDR↑	Type	Recall↑	logDP	RepR	RepBias	mFR↓
TIFUKNN	N	0.2130	0.8102	0.8094	0.5994	0.1054	N	0.2130	2.9426	0.8094	0.5994	1.7710
	D	0.1903	0.9869	0.7851	0.5752	0.2059	F	0.1906	1.9240	0.8299	0.6199	1.2720
	R	0.2128	0.8048	0.7792	0.5692	0.1178	R	0.2001	3.2601	0.5851	0.3751	1.8176
	RD	0.1895	0.9897	0.7522	0.5422	0.2238	RF	0.1841	1.9128	0.7417	0.5317	1.2223
UP-CF@r	N	0.1941	0.7874	0.8644	0.6544	0.0665	N	0.1941	3.3743	0.8644	0.6544	2.0144
	D	0.1730	0.9846	0.8346	0.6246	0.1800	F	0.1733	1.9177	0.8608	0.6508	1.2843
	R	0.1942	0.7872	0.8638	0.6538	0.0667	R	0.1861	3.6144	0.5908	0.3808	1.9976
	RD	0.1732	0.9870	0.8318	0.6218	0.1826	RF	0.1712	1.8187	0.7600	0.5500	1.1844
DNNTSP	N	0.1986	0.8079	0.6944	0.4844	0.1617	N	0.1986	3.5654	0.6944	0.4844	2.0249
	D	0.1891	0.9121	0.6863	0.4763	0.2179	F	0.1972	3.2709	0.7033	0.4933	1.8821
	R	0.1951	0.8050	0.6164	0.4064	0.1993	R	0.1781	3.7944	0.4217	0.2117	2.0031
	RD	0.1853	0.9265	0.6059	0.3959	0.2653	RF	0.1801	3.2350	0.4752	0.2652	1.7501
Dream	N	0.1210	0.7000	0.0858	-0.1242	0.2879	N	0.1210	8.0904	0.0858	-0.1242	4.1073
	D	0.0989	1.0000	0.0764	-0.1336	0.4332	F	0.0888	2.3133	0.0617	-0.1483	1.2308
	R	0.1400	0.6985	0.2163	0.0063	0.3461	R	0.1398	7.3774	0.2143	0.0043	3.6908
	RD	0.1194	0.9932	0.1984	-0.0116	0.4908	RF	0.1219	2.8182	0.2148	0.0048	1.4115
TReX	N	0.1971	0.7979	0.8703	0.6603	0.0688	N	0.1971	2.8936	0.8703	0.6603	1.7770
	D	0.1941	0.8243	0.8703	0.6603	0.0820	F	0.1843	2.1799	0.8703	0.6603	1.4201
	R	0.1818	0.7251	0.3980	0.1880	0.2686	R	0.2018	3.1900	0.7496	0.5396	1.8648
	RD	0.1779	0.8350	0.3980	0.1880	0.3235	RF	0.1875	2.2036	0.7496	0.5396	1.3716