Table 1: Experimental results on BC(homo) Dataset. The top result is highlighted in bold, and the runner-up is underlined. / means not applicable.

	$\varepsilon_{average}$						$\varepsilon_{individual}$					
	Within Sample			Out-of Sample			Within Sample			Out-of Sample		
Methods	AME	ASE	ATE	AME	ASE	ATE	IME	ISE	ITE	IME	ISE	ITE
TARNET+z	$0.1573_{\pm 0.0405}$	$0.0824_{\pm 0.0149}$	$0.2046_{\pm 0.0193}$	$0.1492_{\pm 0.0370}$	$0.0855_{\pm 0.0147}$	$0.1982_{\pm 0.0380}$	$0.2096_{\pm 0.0250}$	$0.1161_{\pm 0.0159}$	$0.2444_{\pm 0.0239}$	$0.2809_{\pm 0.0507}$	$0.1209_{\pm 0.0152}$	$0.3062_{\pm 0.0627}$
CFR+z	$\underline{0.0788}_{\pm 0.0096}$	$0.1157_{\pm 0.0076}$	$0.2323_{\pm 0.0106}$	$\underline{0.0770}_{\pm 0.0099}$	$0.1157_{\pm 0.0075}$	$0.2306_{\pm 0.0106}$	$\underline{0.0796}_{\pm 0.0091}$	$0.1158_{\pm 0.0076}$	$0.2325_{\pm 0.0106}$	$\underline{0.1000}_{\pm 0.0388}$	$0.1157_{\pm 0.0075}$	$0.2405_{\pm 0.0166}$
GEst	$0.1872_{\pm 0.0672}$	$0.2369_{\pm 0.0607}$	$0.1422_{\pm 0.0562}$	$0.1955_{\pm 0.0611}$	$0.2391_{\pm 0.0617}$	$0.1302_{\pm 0.0524}$	$0.2307_{\pm 0.0493}$	$0.2603_{\pm 0.0586}$	$0.1877_{\pm 0.0495}$	$0.2388_{\pm 0.0431}$	$0.2623_{\pm 0.0592}$	$0.1790_{\pm 0.0440}$
ND+z	$0.2375_{\pm 0.0450}$	$0.0316_{\pm 0.0104}$	$0.0790_{\pm 0.0226}$	$0.2380_{\pm 0.0458}$	$0.0323_{\pm 0.0122}$	$0.0768_{\pm 0.0254}$	$0.2377_{\pm 0.0448}$	$\underline{0.0321}_{\pm 0.0101}$	$0.0792_{\pm 0.0226}$	$0.2477_{\pm 0.0460}$	$\underline{0.0379}_{\pm 0.0099}$	$0.1068_{\pm 0.0172}$
NetEst	$0.1059_{\pm 0.0609}$	$\underline{0.0284}_{\pm 0.0297}$	$\underline{0.0387}_{\pm 0.0288}$	$0.0987_{\pm 0.0663}$	$\underline{0.0257}_{\pm 0.0276}$	$\mathbf{0.0356}_{\pm 0.0268}$	$0.1366_{\pm 0.0481}$	$0.0631_{\pm 0.0205}$	$0.0994_{\pm 0.0214}$	$0.1680_{\pm 0.0620}$	$0.0920_{\pm 0.0316}$	$0.1507_{\pm 0.0647}$
TNet	$0.1045_{\pm 0.0610}$	$0.0502_{\pm 0.0559}$	$0.0473_{\pm 0.0229}$	$0.1045_{\pm 0.0610}$	$0.0502_{\pm 0.0559}$	$0.0473_{\pm 0.0229}$	$0.1045_{\pm 0.0610}$	$0.0502_{\pm 0.0559}$	$\underline{0.0473}_{\pm 0.0229}$	$0.1045_{\pm 0.0610}$	$0.0502_{\pm 0.0559}$	$0.0473_{\pm 0.0229}$
RRNet	$0.0884_{\pm 0.0495}$	$0.0445_{\pm 0.0158}$	$0.0768_{\pm 0.0239}$	$0.0892_{\pm 0.0505}$	$0.0447_{\pm 0.0160}$	$0.0782_{\pm 0.0253}$	$0.0915_{\pm 0.0462}$	$0.0452_{\pm 0.0153}$	$0.0865_{\pm 0.0260}$	$0.0917_{\pm 0.0491}$	$0.0453_{\pm 0.0159}$	$0.0887_{\pm 0.0282}$
SPNet+z	$0.0802_{\pm 0.0632}$	$0.0446_{\pm 0.0155}$	$0.0570_{\pm 0.0188}$	$0.0931_{\pm 0.0607}$	$0.0394_{\pm 0.0215}$	$0.0385_{\pm 0.0183}$	$0.1153_{\pm 0.0482}$	$0.0741_{\pm 0.0109}$	$0.1094_{\pm 0.0274}$	$0.1358_{\pm 0.0566}$	$0.0604_{\pm 0.0145}$	$0.0933_{\pm 0.0342}$
Ours	$\mathbf{0.0532}_{\pm 0.0500}$	$\mathbf{0.0253}_{\pm 0.0266}$	$\mathbf{0.0377}_{\pm 0.0243}$	$\mathbf{0.0557}_{\pm 0.0535}$	$\mathbf{0.0259}_{\pm 0.0273}$	$\underline{0.0384}_{\pm 0.0218}$	$\mathbf{0.0542}_{\pm 0.0502}$	$\mathbf{0.0257}_{\pm 0.0266}$	$\mathbf{0.0431}_{\pm 0.0196}$	$\mathbf{0.0561}_{\pm 0.0535}$	$\mathbf{0.0260}_{\pm 0.0273}$	$\mathbf{0.0400}_{\pm 0.0208}$

Table 2: Experimental results on BC(hete) Dataset. The top result is highlighted in bold, and the runner-up is underlined. / means not applicable.

	$\varepsilon_{average}$						$\varepsilon_{individual}$					
	Within Sample			Out-of Sample			Within Sample			Out-of Sample		
Methods	AME	ASE	ATE	AME	ASE	ATE	IME	ISE	ITE	IME	ISE	ITE
TARNET+z	$0.2538_{\pm 0.1127}$	$0.1657_{\pm 0.0563}$	$0.3866_{\pm 0.0711}$	$0.2619_{\pm 0.1054}$	$0.1701_{\pm 0.0594}$	$0.4044_{\pm 0.1334}$	$0.3455_{\pm 0.0654}$	$0.2122_{\pm 0.0558}$	$0.4605_{\pm 0.0720}$	$0.5590_{\pm 0.2643}$	$0.2207_{\pm 0.0510}$	$0.6349_{\pm 0.3280}$
CFR+z	$0.1580_{\pm 0.0189}$	$0.2071_{\pm 0.0237}$	$0.4067_{\pm 0.0407}$	$0.1559_{\pm 0.0203}$	$0.2076_{\pm 0.0245}$	$0.4061_{\pm 0.0449}$	$0.1825_{\pm 0.0129}$	$0.2092_{\pm 0.0233}$	$0.4316_{\pm 0.0351}$	$0.2058_{\pm 0.0432}$	$0.2098_{\pm 0.0242}$	$0.4422_{\pm 0.0456}$
GEst	$0.2734_{\pm 0.1240}$	$0.4257_{\pm 0.0973}$	$0.2916_{\pm 0.1119}$	$0.2722_{\pm 0.1308}$	$0.4277_{\pm 0.1012}$	$0.2873_{\pm 0.1220}$	$0.3334_{\pm 0.1082}$	$0.4592_{\pm 0.0934}$	$0.3546_{\pm 0.0947}$	$0.3832_{\pm 0.1474}$	$0.4612_{\pm 0.0972}$	$0.3958_{\pm 0.1486}$
ND+z	$0.4124_{\pm 0.0702}$	$0.0451_{\pm 0.0201}$	$0.1330_{\pm 0.0205}$	$0.4111_{\pm 0.0737}$	$0.0486_{\pm 0.0206}$	$0.1326_{\pm 0.0261}$	$0.4226_{\pm 0.0673}$	$\underline{0.0562}_{\pm 0.0146}$	$0.1941_{\pm 0.0246}$	$0.4330_{\pm 0.0662}$	$0.0666_{\pm 0.0137}$	$0.2211_{\pm 0.0321}$
NetEst	$0.1643_{\pm 0.1337}$	$0.0450_{\pm 0.0180}$	$0.0594_{\pm 0.0262}$	$0.1857_{\pm 0.1168}$	$\underline{0.0405}_{\pm 0.0252}$	$\mathbf{0.0343}_{\pm 0.0179}$	$0.2199_{\pm 0.1039}$	$0.0667_{\pm 0.0171}$	$0.1731_{\pm 0.0368}$	$1.5595_{\pm 2.5329}$	$1.1347_{\pm 1.9028}$	$1.0924_{\pm 1.7278}$
TNet	$0.1216_{\pm 0.0864}$	$0.0537_{\pm 0.0524}$	$\underline{0.0429}_{\pm 0.0301}$	$0.1257_{\pm 0.0727}$	$0.0537_{\pm 0.0511}$	$0.0481_{\pm 0.0269}$	$\underline{0.1731}_{\pm 0.0450}$	$0.0655_{\pm 0.0465}$	$\underline{0.1458}_{\pm 0.0175}$	$0.1915_{\pm 0.0542}$	$0.0650_{\pm 0.0458}$	$\underline{0.1740}_{\pm 0.0621}$
RRNet	$0.1628_{\pm 0.1183}$	$\underline{0.0476}_{\pm 0.0416}$	$0.0919_{\pm 0.0581}$	$0.1636_{\pm 0.1162}$	$0.0474_{\pm 0.0424}$	$0.0961_{\pm 0.0640}$	$0.1967_{\pm 0.0979}$	$0.0591_{\pm 0.0364}$	$0.1719_{\pm 0.0485}$	$0.1974_{\pm 0.0960}$	$\underline{0.0595}_{\pm 0.0365}$	$0.1764_{\pm 0.0505}$
SPNet+z	$\underline{0.0706}_{\pm 0.0738}$	$0.0714_{\pm 0.0256}$	$0.1169_{\pm 0.0317}$	$\underline{0.0805}_{\pm 0.0716}$	$0.0671_{\pm 0.0230}$	$0.0841_{\pm 0.0419}$	$0.1743_{\pm 0.0338}$	$0.1054_{\pm 0.0138}$	$0.2209_{\pm 0.0288}$	$\underline{0.1901}_{\pm 0.0480}$	$0.0906_{\pm 0.0190}$	$0.2012_{\pm 0.0480}$
Ours	$\mathbf{0.0434}_{\pm 0.0213}$	$\mathbf{0.0337}_{\pm 0.0160}$	$\mathbf{0.0370}_{\pm 0.0292}$	$\mathbf{0.0380}_{\pm 0.0206}$	$\mathbf{0.0320}_{\pm 0.0172}$	$\underline{0.0401}_{\pm 0.0212}$	$\mathbf{0.1033}_{\pm 0.0136}$	$\mathbf{0.0465}_{\pm 0.0095}$	$\underline{0.1472}_{\pm 0.0272}$	$\mathbf{0.0976}_{\pm 0.0181}$	$\mathbf{0.0455}_{\pm 0.0096}$	$\mathbf{0.1475}_{\pm 0.0259}$

Table 3: Experimental results on Flickr(homo) Dataset. The top result is highlighted in bold, and the runner-up is underlined. / means not applicable.

	$\varepsilon_{average}$						$\varepsilon_{individual}$					
	Within Sample			Out-of Sample			Within Sample			Out-of Sample		
Methods	AME	ASE	ATE	AME	ASE	ATE	IME	ISE	ITE	IME	ISE	ITE
TARNET+z	$0.0783_{\pm 0.0418}$	$0.0874_{\pm 0.0213}$	$0.2025_{\pm 0.0396}$	$0.0976_{\pm 0.0506}$	$0.0724_{\pm 0.0184}$	$0.1356_{\pm 0.0587}$	$0.1362_{\pm 0.0254}$	$0.1103_{\pm 0.0194}$	$0.2358_{\pm 0.0383}$	$1.0869_{\pm 1.2258}$	$0.1011_{\pm 0.0185}$	$1.0889_{\pm 1.2270}$
CFR+z	$0.0579_{\pm 0.0247}$	$0.0785_{\pm 0.0070}$	$0.1651_{\pm 0.0121}$	$0.0507_{\pm 0.0192}$	$0.0783_{\pm 0.0070}$	$0.1581_{\pm 0.0097}$	$0.0599_{\pm 0.0240}$	$0.0786_{\pm 0.0070}$	$0.1654_{\pm 0.0120}$	$0.3465_{\pm 0.4615}$	$0.0786_{\pm 0.0069}$	$0.4102_{\pm 0.4278}$
GEst	$0.1551_{\pm 0.0130}$	$0.2475_{\pm 0.0476}$	$0.0805_{\pm 0.0325}$	$0.1511_{\pm 0.0137}$	$0.2494_{\pm 0.0470}$	$0.0805_{\pm 0.0278}$	$0.1779_{\pm 0.0122}$	$0.2656_{\pm 0.0378}$	$0.1268_{\pm 0.0160}$	$0.2867_{\pm 0.2172}$	$0.2677_{\pm 0.0372}$	$0.2471_{\pm 0.2352}$
ND+z	$0.1416_{\pm 0.0240}$	$0.0204_{\pm 0.0093}$	$0.0478_{\pm 0.0216}$	$0.1435_{\pm 0.0364}$	$0.0226_{\pm 0.0101}$	$0.0485_{\pm 0.0236}$	$0.1427_{\pm 0.0246}$	$0.0221_{\pm 0.0090}$	$0.0501_{\pm 0.0178}$	$0.3849_{\pm 0.2395}$	$0.0348_{\pm 0.0078}$	$0.3453_{\pm 0.2772}$
NetEst	$0.0515_{\pm 0.0538}$	$0.0355_{\pm 0.0317}$	$0.0715_{\pm 0.0381}$	$0.0470_{\pm 0.0500}$	$0.0338_{\pm 0.0330}$	$0.0529_{\pm 0.0395}$	$0.0844_{\pm 0.0406}$	$0.0566_{\pm 0.0253}$	$0.1043_{\pm 0.0312}$	$0.2934_{\pm 0.3001}$	$0.2809_{\pm 0.3387}$	$0.3068_{\pm 0.1860}$
TNet	$0.0319_{\pm 0.0249}$	$0.0274_{\pm 0.0309}$	$0.0735_{\pm 0.0240}$	$0.0299_{\pm 0.0231}$	$0.0277_{\pm 0.0313}$	$0.0715_{\pm 0.0214}$	$0.0347_{\pm 0.0282}$	$0.0276_{\pm 0.0313}$	$0.0752_{\pm 0.0263}$	$0.0561_{\pm 0.0648}$	$0.0286_{\pm 0.0331}$	$0.0918_{\pm 0.0555}$
RRNet	$\underline{0.0296}_{\pm 0.0123}$	$\underline{0.0251}_{\pm 0.0172}$	$\mathbf{0.0199}_{\pm 0.0179}$	$\underline{0.0296}_{\pm 0.0123}$	$\underline{0.0251}_{\pm 0.0172}$	$\mathbf{0.0199}_{\pm 0.0179}$	$\underline{0.0296}_{\pm 0.0123}$	$\underline{0.0251}_{\pm 0.0172}$	$\mathbf{0.0199}_{\pm 0.0179}$	$\underline{0.0296}_{\pm 0.0123}$	$\underline{0.0251}_{\pm 0.0172}$	$\mathbf{0.0199}_{\pm 0.0179}$
SPNet +z	$0.0366_{\pm 0.0359}$	$0.0604_{\pm 0.0371}$	$0.1267_{\pm 0.0655}$	$0.0451_{\pm 0.0332}$	$0.0445_{\pm 0.0300}$	$0.0865_{\pm 0.0410}$	$0.0639_{\pm 0.0273}$	$0.0980_{\pm 0.0269}$	$0.1877_{\pm 0.0546}$	$0.0834_{\pm 0.0342}$	$0.0694_{\pm 0.0234}$	$0.1309_{\pm 0.0500}$
Ours	$\mathbf{0.0238}_{\pm 0.0096}$	$\mathbf{0.0092}_{\pm 0.0080}$	$\underline{0.0312}_{\pm 0.0191}$	$\mathbf{0.0235}_{\pm 0.0096}$	$\mathbf{0.0091}_{\pm 0.0081}$	$\underline{0.0314}_{\pm 0.0190}$	$\mathbf{0.0241}_{\pm 0.0094}$	$\mathbf{0.0094}_{\pm 0.0080}$	$\underline{0.0315}_{\pm 0.0193}$	$\mathbf{0.0249}_{\pm 0.0100}$	$\mathbf{0.0108}_{\pm 0.0070}$	$\underline{0.0329}_{\pm 0.0195}$

Table 4: Experimental results on Flickr(hete) Dataset. The top result is highlighted in bold, and the runner-up is underlined. / means not applicable.

	$\varepsilon_{average}$						$\varepsilon_{individual}$					
	Within Sample			Out-of Sample			Within Sample			Out-of Sample		
Methods	AME	ASE	ATE	AME	ASE	ATE	IME	ISE	ITE	IME	ISE	ITE
TARNET+z	$0.1315_{\pm 0.0740}$	$0.1673_{\pm 0.0423}$	$0.3590_{\pm 0.0785}$	$0.1554_{\pm 0.1110}$	$0.1319_{\pm 0.0307}$	$0.2728_{\pm 0.1321}$	$0.2320_{\pm 0.0432}$	$0.2042_{\pm 0.0479}$	$0.4254_{\pm 0.0892}$	$1.5274_{\pm 1.6256}$	$0.1760_{\pm 0.0351}$	$1.5957_{\pm 1.5779}$
CFR+z	$0.1131_{\pm 0.0476}$	$0.1437_{\pm 0.0081}$	$0.2960_{\pm 0.0182}$	$0.0998_{\pm 0.0458}$	$0.1412_{\pm 0.0085}$	$0.2789_{\pm 0.0309}$	$0.1445_{\pm 0.0407}$	$0.1463_{\pm 0.0083}$	$0.3242_{\pm 0.0224}$	$0.5946_{\pm 0.7379}$	$0.1448_{\pm 0.0087}$	$0.7104_{\pm 0.6761}$
GEst	$0.3283_{\pm 0.0426}$	$0.4717_{\pm 0.1336}$	$0.1074_{\pm 0.0255}$	$0.3356_{\pm 0.0270}$	$0.4723_{\pm 0.1312}$	$0.0969_{\pm 0.0099}$	$0.3697_{\pm 0.0386}$	$0.5123_{\pm 0.1231}$	$0.2178_{\pm 0.0214}$	$0.7124_{\pm 0.6463}$	$0.5144_{\pm 0.1202}$	$0.5914_{\pm 0.7073}$
ND+z	$0.2420_{\pm 0.0330}$	$0.0293_{\pm 0.0113}$	$0.0852_{\pm 0.0365}$	$0.2433_{\pm 0.0539}$	$0.0318_{\pm 0.0134}$	$0.0785_{\pm 0.0422}$	$0.2571_{\pm 0.0348}$	$0.0430_{\pm 0.0040}$	$0.1607_{\pm 0.0188}$	$0.5156_{\pm 0.2180}$	$0.0669_{\pm 0.0059}$	$0.4720_{\pm 0.2580}$
NetEst	$0.0530_{\pm 0.0423}$	$0.0452_{\pm 0.0351}$	$0.0723_{\pm 0.0319}$	$0.0466_{\pm 0.0322}$	$0.0565_{\pm 0.0454}$	$0.0818_{\pm 0.0379}$	$0.1145_{\pm 0.0278}$	$0.0667_{\pm 0.0267}$	$0.1660_{\pm 0.0163}$	$0.6855_{\pm 0.2607}$	$0.5353_{\pm 0.2507}$	$0.5625_{\pm 0.1367}$
TNet	$\underline{0.0411}_{\pm 0.0238}$	$0.0206_{\pm 0.0073}$	$\mathbf{0.0282}_{\pm 0.0297}$	$\underline{0.0417}_{\pm 0.0237}$	$\underline{0.0196}_{\pm 0.0098}$	$\mathbf{0.0268}_{\pm 0.0314}$	$\underline{0.0936}_{\pm 0.0170}$	$\underline{0.0338}_{\pm 0.0065}$	$\underline{0.1360}_{\pm 0.0210}$	$\underline{0.0950}_{\pm 0.0157}$	$\underline{0.0361}_{\pm 0.0074}$	$\underline{0.1415}_{\pm 0.0223}$
RRNET	$0.0441_{\pm 0.0196}$	$0.0280_{\pm 0.0153}$	$\underline{0.0367}_{\pm 0.0243}$	$0.0446_{\pm 0.0183}$	$0.0292_{\pm 0.0165}$	$0.0329_{\pm 0.0255}$	$0.0940_{\pm 0.0166}$	$0.0401_{\pm 0.0105}$	$0.1373_{\pm 0.0188}$	$0.0952_{\pm 0.0153}$	$0.0436_{\pm 0.0100}$	$0.1419_{\pm 0.0202}$
SPNet+z	$0.0429_{\pm 0.0461}$	$0.0885_{\pm 0.0509}$	$0.2359_{\pm 0.0724}$	$0.0509_{\pm 0.0404}$	$0.0555_{\pm 0.0264}$	$0.1483_{\pm 0.0573}$	$0.1296_{\pm 0.0241}$	$0.1593_{\pm 0.0314}$	$0.3538_{\pm 0.0513}$	$0.1827_{\pm 0.1051}$	$0.1053_{\pm 0.0208}$	$0.2879_{\pm 0.0823}$
Ours	$\mathbf{0.0329}_{\pm 0.0282}$	$\mathbf{0.0094}_{\pm 0.0050}$	$0.0368_{\pm 0.0107}$	$\mathbf{0.0339}_{\pm 0.0289}$	$\mathbf{0.0084}_{\pm 0.0056}$	$\underline{0.0329}_{\pm 0.0152}$	$\mathbf{0.0925}_{\pm 0.0102}$	$\mathbf{0.0284}_{\pm 0.0038}$	$0.1362_{\pm 0.0132}$	$\mathbf{0.0942}_{\pm 0.0088}$	$\mathbf{0.0310}_{\pm 0.0040}$	$\mathbf{0.1412}_{\pm 0.0140}$