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	$0.1573_{\pm0.0405}$	$0.0824_{\pm0.0149}$	$0.2046_{\pm0.0193}$	$0.1492_{\pm0.0370}$	$0.0855_{\pm0.0147}$	$0.1982_{\pm0.0380}$	$0.2096_{\pm0.0250}$	$0.1161_{\pm0.0159}$	$0.2444_{\pm0.0239}$	$0.2809_{\pm0.0507}$	$0.1209_{\pm0.0152}$	$0.3062_{\pm0.0627}$
CFR+z	$\underline{0.0788}_{\pm0.0096}$	$0.1157_{\pm0.0076}$	$0.2323_{\pm0.0106}$	$\underline{0.0770}_{\pm0.0099}$	$0.1157_{\pm0.0075}$	$0.2306_{\pm0.0106}$	$\underline{0.0796}_{\pm0.0091}$	$0.1158_{\pm0.0076}$	$0.2325_{\pm0.0106}$	$\underline{0.1000}_{\pm0.0388}$	$0.1157_{\pm0.0075}$	$0.2405_{\pm0.0166}$
GEst	$0.1872_{\pm0.0672}$	$0.2369_{\pm0.0607}$	$0.1422_{\pm0.0562}$	$0.1955_{\pm0.0611}$	$0.2391_{\pm0.0617}$	$0.1302_{\pm0.0524}$	$0.2307_{\pm0.0493}$	$0.2603_{\pm0.0586}$	$0.1877_{\pm0.0495}$	$0.2388_{\pm0.0431}$	$0.2623_{\pm0.0592}$	$0.1790_{\pm0.0440}$
ND+z	$0.2375_{\pm0.0450}$	$0.0316_{\pm0.0104}$	$0.0790_{\pm0.0226}$	$0.2380_{\pm0.0458}$	$0.0323_{\pm0.0122}$	$0.0768_{\pm0.0254}$	$0.2377_{\pm0.0448}$	$\underline{0.0321}_{\pm0.0101}$	$0.0792_{\pm0.0226}$	$0.2477_{\pm0.0460}$	$\underline{0.0379}_{\pm0.0099}$	$0.1068_{\pm0.0172}$
NetEst	$0.1059_{\pm0.0609}$	$\underline{0.0284}_{\pm0.0297}$	$\underline{0.0387}_{\pm0.0288}$	$0.0987_{\pm0.0663}$	$\underline{0.0257}_{\pm0.0276}$	$\underline{0.0356}_{\pm0.0268}$	$0.1366_{\pm0.0481}$	$0.0631_{\pm0.0205}$	$0.0994_{\pm0.0214}$	$0.1680_{\pm0.0620}$	$0.0920_{\pm0.0316}$	$0.1507_{\pm0.0647}$
TNet	$0.1045_{\pm0.0610}$	$0.0502_{\pm0.0559}$	$0.0473_{\pm0.0229}$	$0.1045_{\pm0.0610}$	$0.0502_{\pm0.0559}$	$0.0473_{\pm0.0229}$	$0.1045_{\pm0.0610}$	$0.0502_{\pm0.0559}$	$0.0473_{\pm0.0229}$	$0.1045_{\pm0.0610}$	$0.0502_{\pm0.0559}$	$\underline{0.0473}_{\pm0.0229}$
RRNet	$0.0884_{\pm0.0495}$	$0.0445_{\pm0.0158}$	$0.0768_{\pm0.0239}$	$0.0892_{\pm0.0505}$	$0.0447_{\pm0.0160}$	$0.0782_{\pm0.0253}$	$0.0915_{\pm0.0462}$	$0.0452_{\pm0.0153}$	$0.0865_{\pm0.0260}$	$0.0917_{\pm0.0491}$	$0.0453_{\pm0.0159}$	$0.0887_{\pm0.0282}$
Ours	$\mathbf{0.0661}_{\pm0.0485}$	$\mathbf{0.0232}_{\pm0.0164}$	$\mathbf{0.0442}_{\pm0.0258}$	$\mathbf{0.0661}_{\pm0.0485}$	$\mathbf{0.0232}_{\pm0.0164}$	$\mathbf{0.0442}_{\pm0.0258}$	$\mathbf{0.0661}_{\pm0.0485}$	$\mathbf{0.0232}_{\pm0.0164}$	$\mathbf{0.0442}_{\pm0.0258}$	$\mathbf{0.0661}_{\pm0.0485}$	$\mathbf{0.0232}_{\pm0.0164}$	$\mathbf{0.0442}_{\pm0.0258}$
SPNet's metric	ATE	/	/	ATE	/	/	ITE	/	/	ITE	/	/
SPNet	0.0220±0.0077	/	/	$0.0222_{\pm0.0109}$	/	/	$0.0422_{\pm0.0089}$	/	/	$0.0967_{\pm0.0689}$	/	/

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	$0.2538_{\pm0.1127}$	$0.1657_{\pm0.0563}$	$0.3866_{\pm0.0711}$	$0.2619_{\pm0.1054}$	$0.1701_{\pm0.0594}$	$0.4044_{\pm0.1334}$	$0.3455_{\pm0.0654}$	$0.2122_{\pm0.0558}$	$0.4605_{\pm0.0720}$	$0.5590_{\pm0.2643}$	$0.2207_{\pm0.0510}$	$0.6349_{\pm0.3280}$
CFR+z	$0.1580_{\pm0.0189}$	$0.2071_{\pm0.0237}$	$0.4067_{\pm0.0407}$	$0.1559_{\pm0.0203}$	$0.2076_{\pm0.0245}$	$0.4061_{\pm0.0449}$	$0.1825_{\pm0.0129}$	$0.2092_{\pm0.0233}$	$0.4316_{\pm0.0351}$	$0.2058_{\pm0.0432}$	$0.2098_{\pm0.0242}$	$0.4422_{\pm0.0456}$
GEst	$0.2734_{\pm0.1240}$	$0.4257_{\pm0.0973}$	$0.2916_{\pm0.1119}$	$0.2722_{\pm0.1308}$	$0.4277_{\pm0.1012}$	$0.2873_{\pm0.1220}$	$0.3334_{\pm0.1082}$	$0.4592_{\pm0.0934}$	$0.3546_{\pm0.0947}$	$0.3832_{\pm0.1474}$	$0.4612_{\pm0.0972}$	$0.3958_{\pm0.1486}$
ND+z	$0.4124_{\pm0.0702}$	$0.0451_{\pm0.0201}$	$0.1330_{\pm0.0205}$	$0.4111_{\pm0.0737}$	$0.0486_{\pm0.0206}$	$0.1326_{\pm0.0261}$	$0.4226_{\pm0.0673}$	$\underline{0.0562}_{\pm0.0146}$	$0.1941_{\pm0.0246}$	$0.4330_{\pm0.0662}$	$0.0666_{\pm0.0137}$	$0.2211_{\pm0.0321}$
NetEst	$0.1643_{\pm0.1337}$	$0.0450_{\pm0.0180}$	$0.0594_{\pm0.0262}$	$0.1857_{\pm0.1168}$	$\underline{0.0405}_{\pm0.0252}$	$\mathbf{0.0343}_{\pm0.0179}$	$0.2199_{\pm0.1039}$	$0.0667_{\pm0.0171}$	$0.1731_{\pm0.0368}$	$1.5595_{\pm2.5329}$	$1.1347_{\pm1.9028}$	$1.0924_{\pm1.7278}$
TNet	$\underline{0.1216}_{\pm0.0864}$	$0.0537_{\pm0.0524}$	$\underline{0.0429}_{\pm0.0301}$	$\underline{0.1257}_{\pm0.0727}$	$0.0537_{\pm0.0511}$	$\underline{0.0481}_{\pm0.0269}$	$\underline{0.1731}_{\pm0.0450}$	$0.0655_{\pm0.0465}$	$\underline{0.1458}_{\pm0.0175}$	$\underline{0.1915}_{\pm0.0542}$	$0.0650_{\pm0.0458}$	$\underline{0.1740}_{\pm0.0621}$
RRNet	$0.1628_{\pm0.1183}$	$\underline{0.0476}_{\pm0.0416}$	$0.0919_{\pm0.0581}$	$0.1636_{\pm0.1162}$	$0.0474_{\pm0.0424}$	$0.0961_{\pm0.0640}$	$0.1967_{\pm0.0979}$	$0.0591_{\pm0.0364}$	$0.1719_{\pm0.0485}$	$0.1974_{\pm0.0960}$	$\underline{0.0595}_{\pm0.0365}$	$0.1764_{\pm0.0505}$
Ours	$\mathbf{0.0625}_{\pm0.0597}$	$\mathbf{0.0195}_{\pm0.0162}$	$\underline{0.0579}_{\pm0.0255}$	$\mathbf{0.0604}_{\pm0.0610}$	$\mathbf{0.0195}_{\pm0.0130}$	$0.0598_{\pm0.0250}$	$\mathbf{0.1175}_{\pm0.0380}$	$\mathbf{0.0373}_{\pm0.0164}$	$\mathbf{0.1545}_{\pm0.0141}$	$\mathbf{0.1172}_{\pm0.0392}$	$\mathbf{0.0365}_{\pm0.0074}$	$\mathbf{0.1563}_{\pm0.0130}$
SPNet's metric	ATE	/	/	ATE	/	/	ITE	/	/	ITE	/	/
SPNet	$0.0393_{\pm0.0129}$	/	/	$0.0455_{\pm0.0268}$	/	/	$0.1127_{\pm0.0159}$	/	/	$0.2171_{\pm0.1414}$	/	/

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

Methods	$\varepsilon_{average}$						$\varepsilon_{individual}$					
	Within Sample			Out-of Sample			Within Sample			Out-of Sample		
	AME	ASE	ATE	AME	ASE	ATE	IME	ISE	ITE	IME	ISE	ITE
TARNET+z	$0.0783_{\pm0.0418}$	$0.0874_{\pm0.0213}$	$0.2025_{\pm0.0396}$	$0.0976_{\pm0.0506}$	$0.0724_{\pm0.0184}$	$0.1356_{\pm0.0587}$	$0.1362_{\pm0.0254}$	$0.1103_{\pm0.0194}$	$0.2358_{\pm0.0383}$	$1.0869_{\pm1.2258}$	$0.1011_{\pm0.0185}$	$1.0889_{\pm1.2270}$
CFR+z	$0.0579_{\pm0.0247}$	$0.0785_{\pm0.0070}$	$0.1651_{\pm0.0121}$	$0.0507_{\pm0.0192}$	$0.0783_{\pm0.0070}$	$0.1581_{\pm0.0097}$	$0.0599_{\pm0.0240}$	$0.0786_{\pm0.0070}$	$0.1654_{\pm0.0120}$	$0.3465_{\pm0.4615}$	$0.0786_{\pm0.0069}$	$0.4102_{\pm0.4278}$
GEst	$0.1551_{\pm0.0130}$	$0.2475_{\pm0.0476}$	$0.0805_{\pm0.0325}$	$0.1511_{\pm0.0137}$	$0.2494_{\pm0.0470}$	$0.0805_{\pm0.0278}$	$0.1779_{\pm0.0122}$	$0.2656_{\pm0.0378}$	$0.1208_{\pm0.0160}$	$0.2867_{\pm0.2172}$	$0.2677_{\pm0.0372}$	$0.2471_{\pm0.2352}$
ND+z	$0.1416_{\pm0.0240}$	$0.0204_{\pm0.0093}$	$0.0478_{\pm0.0216}$	$0.1435_{\pm0.0364}$	$0.0226_{\pm0.0101}$	$0.0485_{\pm0.0236}$	$0.1427_{\pm0.0246}$	$0.0221_{\pm0.0090}$	$0.0501_{\pm0.0178}$	$0.3849_{\pm0.2395}$	$0.0348_{\pm0.0078}$	$0.3453_{\pm0.2772}$
NetEst	$0.0515_{\pm0.0538}$	$0.0355_{\pm0.0317}$	$0.0715_{\pm0.0381}$	$0.0470_{\pm0.0500}$	$0.0338_{\pm0.0330}$	$0.0529_{\pm0.0395}$	$0.0844_{\pm0.0406}$	$0.0566_{\pm0.0253}$	$0.1043_{\pm0.0312}$	$0.2934_{\pm0.3001}$	$0.2809_{\pm0.3387}$	$0.3068_{\pm0.1860}$
TNet	$0.0319_{\pm0.0249}$	$0.0274_{\pm0.0309}$	$0.0735_{\pm0.0240}$	$0.0299_{\pm0.0231}$	$0.0277_{\pm0.0313}$	$0.0715_{\pm0.0214}$	$0.0347_{\pm0.0282}$	$0.0276_{\pm0.0313}$	$0.0752_{\pm0.0263}$	$0.0561_{\pm0.0648}$	$0.0286_{\pm0.0331}$	$0.0918_{\pm0.0555}$
RRNet	$\underline{0.0296}_{\pm0.0123}$	$\underline{0.0251}_{\pm0.0172}$	$\mathbf{0.0199}_{\pm0.0179}$	$0.0296_{\pm0.0123}$	$\underline{0.0251}_{\pm0.0172}$	$\mathbf{0.0199}_{\pm0.0179}$	$\underline{0.0296}_{\pm0.0123}$	$\underline{0.0251}_{\pm0.0172}$	$\mathbf{0.0199}_{\pm0.0179}$	$\underline{0.0296}_{\pm0.0123}$	$\underline{0.0251}_{\pm0.0172}$	$\mathbf{0.0199}_{\pm0.0179}$
Ours	$\mathbf{0.0238}_{\pm0.0096}$	$\mathbf{0.0092}_{\pm0.0080}$	$\underline{0.0312}_{\pm0.0191}$	$\mathbf{0.0235}_{\pm0.0096}$	$\mathbf{0.0091}_{\pm0.0081}$	$\underline{0.0314}_{\pm0.0190}$	$\mathbf{0.0241}_{\pm0.0094}$	$\mathbf{0.0094}_{\pm0.0080}$	$\underline{0.0315}_{\pm0.0193}$	$\mathbf{0.0249}_{\pm0.0100}$	$\mathbf{0.0108}_{\pm0.0070}$	$\underline{0.0329}_{\pm0.0195}$
SPNet's metric	ATE	/	/	ATE	/	/	ITE	/	/	ITE	/	/
SPNet	$0.0303_{\pm0.0112}$	/	/	$0.0228_{\pm0.0159}$	/	/	$0.0522_{\pm0.0111}$	/	/	$0.2040_{\pm0.3012}$	/	/

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

Methods	$\varepsilon_{average}$						$\varepsilon_{individual}$					
	Within Sample			Out-of Sample			Within Sample			Out-of Sample		
	AME	ASE	ATE	AME	ASE	ATE	IME	ISE	ITE	IME	ISE	ITE
TARNET+z	$0.1315_{\pm0.0740}$	$0.1673_{\pm0.0423}$	$0.3590_{\pm0.0785}$	$0.1554_{\pm0.1110}$	$0.1319_{\pm0.0307}$	$0.2728_{\pm0.1321}$	$0.2320_{\pm0.0432}$	$0.2042_{\pm0.0479}$	$0.4254_{\pm0.0802}$	$1.5274_{\pm1.6256}$	$0.1760_{\pm0.0351}$	$1.5957_{\pm1.5779}$
CFR+z	$0.1131_{\pm0.0476}$	$0.1437_{\pm0.0081}$	$0.2960_{\pm0.0182}$	$0.0998_{\pm0.0458}$	$0.1412_{\pm0.0085}$	$0.2789_{\pm0.0309}$	$0.1445_{\pm0.0407}$	$0.1463_{\pm0.0083}$	$0.3242_{\pm0.0224}$	$0.5946_{\pm0.7379}$	$0.1448_{\pm0.0087}$	$0.7104_{\pm0.6761}$
GEst	$0.3283_{\pm0.0426}$	$0.4717_{\pm0.1336}$	$0.1074_{\pm0.0255}$	$0.3356_{\pm0.0270}$	$0.4723_{\pm0.1312}$	$0.0969_{\pm0.0099}$	$0.3697_{\pm0.0386}$	$0.5123_{\pm0.1231}$	$0.2178_{\pm0.0214}$	$0.7124_{\pm0.6463}$	$0.5144_{\pm0.1202}$	$0.5914_{\pm0.7073}$
ND+z	$0.2420_{\pm0.0330}$	$0.0293_{\pm0.0113}$	$0.0852_{\pm0.0365}$	$0.2433_{\pm0.0539}$	$0.0318_{\pm0.0134}$	$0.0785_{\pm0.0422}$	$0.2571_{\pm0.0348}$	$0.0430_{\pm0.0040}$	$0.1607_{\pm0.0188}$	$0.5156_{\pm0.2180}$	$0.0669_{\pm0.0059}$	$0.4720_{\pm0.2580}$
NetEst	$0.0530_{\pm0.0423}$	$0.0452_{\pm0.0351}$	$0.0723_{\pm0.0319}$	$0.0466_{\pm0.0322}$	$0.0565_{\pm0.0454}$	$0.0818_{\pm0.0379}$	$0.1145_{\pm0.0278}$	$0.0667_{\pm0.0267}$	$0.1660_{\pm0.0163}$	$0.6855_{\pm0.2607}$	$0.5353_{\pm0.2507}$	$0.5625_{\pm0.1367}$
TNet	$\underline{0.0411}_{\pm0.0238}$	$\mathbf{0.0206}_{\pm0.0073}$	$\underline{0.0282}_{\pm0.0297}$	$\underline{0.0417}_{\pm0.0237}$	$\mathbf{0.0196}_{\pm0.0698}$	$0.0268_{\pm0.0314}$	$\underline{0.0936}_{\pm0.0170}$	$\mathbf{0.0338}_{\pm0.0065}$	$\underline{0.1360}_{\pm0.0210}$	$\underline{0.0950}_{\pm0.0157}$	$\mathbf{0.0361}_{\pm0.0074}$	$\underline{0.1415}_{\pm0.0223}$
RRNET	$0.0441_{\pm0.0196}$	$\underline{0.0280}_{\pm0.0153}$	$0.0367_{\pm0.0243}$	$0.0446_{\pm0.0183}$	$0.0292_{\pm0.0165}$	$0.0329_{\pm0.0255}$	$0.0940_{\pm0.0166}$	$0.0401_{\pm0.0105}$	$0.1373_{\pm0.0188}$	$0.0952_{\pm0.0153}$	$0.0436_{\pm0.0100}$	$0.1419_{\pm0.0202}$
Ours	$\mathbf{0.0377}_{\pm0.0207}$	$\mathbf{0.0206}_{\pm0.0157}$	$\mathbf{0.0228}_{\pm0.0058}$	$\mathbf{0.0384}_{\pm0.0225}$	$\underline{0.0226}_{\pm0.0177}$	$\mathbf{0.0197}_{\pm0.0088}$	$\mathbf{0.0922}_{\pm0.0115}$	$\underline{0.0353}_{\pm0.0121}$	$\mathbf{0.1326}_{\pm0.0161}$	$\mathbf{0.0941}_{\pm0.0100}$	$\underline{0.0390}_{\pm0.0135}$	$\mathbf{0.1379}_{\pm0.0164}$
SPNet's metric	ATE	/	/	ATE	/	/	ITE	/	/	ITE	/	/
SPNet	$0.0523_{\pm0.0148}$	/	/	$0.1837_{\pm0.3056}$	/	/	$0.1210_{\pm0.0198}$	/	/	$0.5914_{\pm0.9313}$	/	/