# ‹Simulation Scenario 구현 결과 기록›

- 1월 4일 Version

‹What TO DO›

: $\delta_0 \in \{-2, 0, 1\}$, $\delta_B, \delta_C \in \{(0.01, 0.01), (0.2, 0.2), (0.6, 0.6)\}$ 에 대해 가능한 모든 조합 고려해 분산 추정량의 Coverage probability, SD Ratio 확인해보기

‹Result›

1) Exposure 변수를 생성하는 분포에 따른 Exposure prevalence, PS 범위 확인
(Positivity assumption 만족하는지 확인)

| A ~ inv.logit(delta0 + deltaB*B + deltaC*C) | Exposure prevalence range | PS range |
|---|---|---|
| -2 + 0.01B + 0.01C | (0.09, 0.152) | (0.114, 0.125) |
| -2 + 0.6B + 0.6C | (0.139, 0.211) | (0.007, 0.807) |
| -2 + 0.2B + 0.2C | (0.099, 0.162) | (0.0495, 0.298) |
| 0 + 0.01B + 0.01C | (0.44, 0.56) | (0.488, 0.514) |
| 0 + 0.6B + 0.6C | (0.52, 0.62) | (0.054, 0.968) |
| 0 + 0.2B + 0.2C | (0.47, 0.58) | (0.278, 0.758) |
| 1 + 0.01B + 0.01C | (0.7, 0.78) | (0.724, 0.742) |
| 1 + 0.6B + 0.6C | (0.72, 0.8) | (0.134, 0.988) |
| 1 + 0.2B + 0.2C | (0.7, 0.8) | (0.511, 0.895) |

: 각 Exposure 변수 생성하는 분포에 따른 Exposure ratio range 확인해본 결과, 최솟값이 모두 0.05보다 크므로 Positivity assumption에 문제가 없는 것으로 판단.

2) Coverage probability, SD Ratio 확인 결과

2)-①. $(\delta_B, \delta_C) = (0.01, 0.01)$

↳ $\delta_0$ = -2

```
print(ATE_1_performance_2_0.01)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.002379192 0.009928812              0.941          0.9906055                          NA                    NA
# IPW         -0.002150330 0.010115352              0.867          0.6172538                       0.982              1.489921
# DR          -0.002304139 0.009961594              0.938          0.9841385                       0.980              1.223564
print(ATT_1_performance_2_0.01)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.002379192 0.009928812              0.941          0.9906055                          NA                    NA
# IPW         -0.002438935 0.009934539              0.870          0.6283862                       0.995              2.001384
# DR          -0.002399891 0.009940280              0.377          0.0638348                       1.000              3.812503
```

↳ $\delta_0$ = 0

```
print(ATE_1_performance_0_0.01)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.002241823 0.003760756              0.965          1.0014697                          NA                    NA
# IPW         -0.002248391 0.003761677              0.986          1.5195091                       0.986              1.522118
# DR          -0.002244212 0.003761608              0.965          0.9974757                       0.972              1.051887

print(ATT_1_performance_0_0.01)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.002241823 0.003760756              0.965          1.0014697                          NA                    NA
# IPW         -0.002328212 0.003802594              0.988          1.5137374                       0.997              2.037757
# DR          -0.002253352 0.003789663              0.678          0.2550663                       0.975              1.174636
```

↳ $\delta_0$ = 1

```
print(ATE_1_performance_1_0.01)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg 0.0004502813 0.005469130              0.935          0.9994199                          NA                    NA
# IPW         0.0002465322 0.005456610              0.947          1.1838910                       0.976              1.519467
# DR          0.0003177392 0.005460426              0.936          0.9955787                       0.939              1.010190
print(ATT_1_performance_1_0.01)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg 0.0004502813 0.005469130              0.935          0.9994199                          NA                    NA
# IPW         0.0001459426 0.005467401              0.948          1.1773203                       0.991              2.037184
# DR          0.0002460947 0.005464088              0.667          0.2475306                       0.939              1.052139
```

---

2)-②. $(\delta_B, \delta_C) = (0.6, 0.6)$

↳ $\delta_0$ = -2

```
print(ATE_1_performance_2_0.6)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.001359273 0.007306984              0.953          0.9910826                          NA                    NA
# IPW         -0.001065766 0.011507225              0.840          0.5380857                       0.968              1.365758
# DR          -0.003097177 0.008945412              0.949          0.9952240                       0.981              1.268540
print(ATT_1_performance_2_0.6)

#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.0013592730 0.007306984              0.953         0.99108256                          NA                    NA
# IPW         -0.0009557775 0.007682229              0.920         0.74769924                       0.992              1.946291
# DR          -0.0005144325 0.007538381              0.450         0.09304479                       1.000              2.782268
```

↳ $\delta_0$ = 0

```
print(ATE_1_performance_0_0.6)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.002941931 0.004282521              0.962          0.9971873                          NA                    NA
# IPW         -0.003451570 0.004709817              0.974          1.2522184                       0.983              1.577980
# DR          -0.003431347 0.004399258              0.957          0.9953517                       0.961              1.054439
print(ATT_1_performance_0_0.6)

#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.002941931 0.004282521              0.962          0.9971873                          NA                    NA
# IPW         -0.005151964 0.006159374              0.936          0.9573452                       0.991              1.773160
# DR          -0.004043887 0.004997942              0.656          0.2137094                       0.976              1.169281
```

↳ $\delta_0$ = 1

```
print(ATE_1_performance_1_0.6)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg  0.0003874388 0.006238101              0.945          0.9899499                          NA                    NA
# IPW         -0.0010898597 0.008635468              0.898          0.7380445                       0.973              1.427612
# DR          -0.0011992856 0.007116551              0.935          0.9898167                       0.936              1.001990
print(ATT_1_performance_1_0.6)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg  0.0003874388 0.006238101              0.945          0.9899499                          NA                    NA
# IPW         -0.0017570411 0.010623404              0.850          0.5898777                       0.982              1.641531
# DR          -0.0015704926 0.007993020              0.570          0.1654181                       0.978              1.712062
```

2)-③. $(\delta_B, \delta_C) = (0.2, 0.2)$

↳ $\delta_0$ = -2

```
print(ATE_1_performance_2_0.2)
#                     Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.001817516 0.008770811              0.955          0.9927099                          NA                   NA
# IPW         -0.001943531 0.009628179              0.886          0.6381045                       0.987             1.482649
# DR          -0.002539970 0.009200259              0.953          0.9875051                       0.982             1.239156
print(ATT_1_performance_2_0.2)
#                     Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.001817516 0.008770811              0.955          0.99270988                         NA                   NA
# IPW         -0.001722056 0.008771304              0.905          0.68148855                      0.995             2.016187
# DR          -0.001581589 0.008754451              0.385          0.07198237                      1.000             3.357375
```

↳ $\delta_0$ = 0

```
print(ATE_1_performance_0_0.2)
#                     Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.002385700 0.003875722              0.955          1.0013542                          NA                   NA
# IPW         -0.002457571 0.003881849              0.989          1.4949810                       0.991             1.534238
# DR          -0.002527949 0.003873439              0.955          0.9976173                       0.968             1.053159
print(ATT_1_performance_0_0.2)
#                     Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.002385700 0.003875722              0.955          1.0013542                          NA                   NA
# IPW         -0.003028923 0.004037370              0.987          1.4418739                       0.996             2.008142
# DR          -0.002589178 0.003943840              0.689          0.2570541                       0.971             1.145508
```

↳ $\delta_0$ = 1

```
print(ATE_1_performance_1_0.2)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg 0.002063519 0.005596075              0.941          0.9986546                          NA                   NA
# IPW         0.001374973 0.005771056              0.951          1.0969043                       0.974             1.512286
# DR          0.001334201 0.005653815              0.942          0.9928079                       0.944             1.006816
print(ATT_1_performance_1_0.2)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg 0.0020635187 0.005596075              0.941          0.9986546                          NA                   NA
# IPW         0.0011014683 0.005981215              0.946          1.0540567                       0.991             1.978902
# DR          0.0009793262 0.005744209              0.653          0.2331804                       0.954             1.098095
```

: DR Sandwich robust variance estimator의 Coverage가 0.95가 되는 parameter 조합이 (1, 0.2, 0.2)임을 확인.

---

〈추가 확인사항〉

: $(\delta_B, \delta_C)$가 (0.15, 0.15), (0.1, 0.1)일 때 DR Sandwich robust variance estimator의 Coverage가 어떻게 되는지 파악.

1) $(\delta_B, \delta_C) = (0.15, 0.15)$

↳ $\delta_0$ = 1

```
print(ATE_1_performance_1_0.15)
#                     Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg 0.0013880355 0.005629874              0.939          1.0001338                          NA                   NA
# IPW         0.0010016317 0.005696205              0.948          1.1268023                       0.979             1.516891
# DR          0.0008961764 0.005641388              0.940          0.9947404                       0.940             1.008672
print(ATT_1_performance_1_0.15)
#                     Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg 0.0013880355 0.005629874              0.939          1.0001338                          NA                   NA
# IPW         0.0008427491 0.005811606              0.949          1.0984808                       0.991             2.005155
# DR          0.0006495854 0.005687560              0.664          0.2387266                       0.954             1.080070
```

↳ $\delta_0$ = -2

```
print(ATE_1_performance_2_0.15)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.001417042 0.009156878              0.952          0.9900948                          NA                    NA
# IPW         -0.001115622 0.009661244              0.885          0.6358976                       0.981              1.482102
# DR          -0.001773683 0.009424915              0.947          0.9841285                       0.979              1.233120
print(ATT_1_performance_2_0.15)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.001417042 0.009156878              0.952          0.99009475                          NA                    NA
# IPW         -0.001424640 0.009174354              0.894          0.66546779                       0.993              2.006792
# DR          -0.001282738 0.009153650              0.375          0.06951088                       1.000              3.465330
```

2) $(\delta_B, \delta_C) = (0.1, 0.1)$

↳ $\delta_0$ = -2

```
print(ATE_1_performance_2_0.1)
#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.001677387 0.009088494              0.951          0.9881315                          NA                    NA
# IPW         -0.001361512 0.009426090              0.886          0.6326320                       0.983              1.486378
# DR          -0.001842740 0.009259559              0.953          0.9825853                       0.983              1.226561
print(ATT_1_performance_2_0.1)

#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg -0.001677387 0.009088494              0.951          0.98813147                          NA                    NA
# IPW         -0.001717224 0.009096289              0.893          0.65131283                       0.993              2.002483
# DR          -0.001611515 0.009085696              0.384          0.06727376                       1.000              3.552003
```

↳ $\delta_0$ = 1

```
print(ATE_1_performance_1_0.1)

#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg 0.0008694784 0.005514316              0.935          0.9997228                          NA                    NA
# IPW         0.0005978085 0.005514707              0.952          1.1512652                       0.975              1.518563
# DR          0.0005677368 0.005507375              0.940          0.9951671                       0.946              1.009306
print(ATT_1_performance_1_0.1)

#                    Bias        rMSE Naive_var_coverage Naive_var_SD_Ratio Sandwich_robust_var_coverage Sandwich_var_SD_Ratio
# Outcome_reg 0.0008694784 0.005514316              0.935          0.9997228                          NA                    NA
# IPW         0.0004861319 0.005559121              0.954          1.1347822                       0.991              2.023850
# DR          0.0004101940 0.005525991              0.665          0.2429480                       0.955              1.066706
```