IPW models

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Load packages and function script...

```
library(lme4)
library(plyr)
library(dplyr)
library(igraph)
library(numDeriv)
library(gtools)
rm(list = ls())

source("https://github.com/uri-ncipher/Nearest-Neighbor-estimators/blob/main/functions.R?raw=TRUE")
```

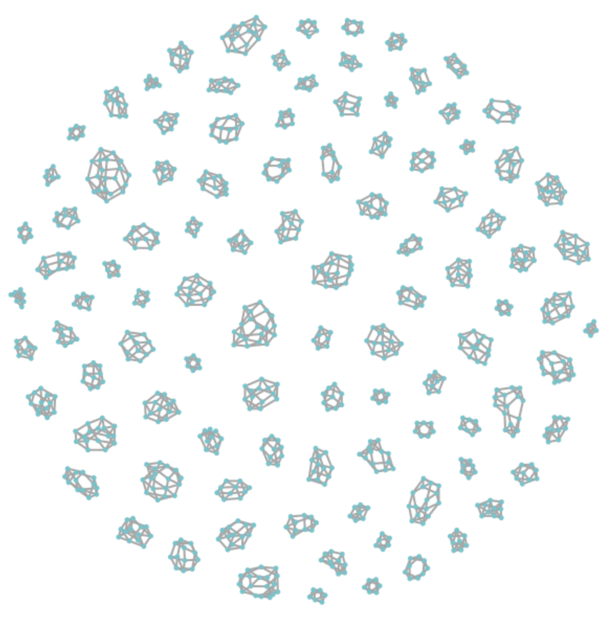
Data Preparation

Read in the synthetic nodes and edges file for creating the simulated network.

```
nodes=read.csv("https://github.com/uri-ncipher/Nearest-Neighbor-estimators/blob/main/nodes.csv?raw=TRUE")
edges=read.csv("https://github.com/uri-ncipher/Nearest-Neighbor-estimators/blob/main/edges.csv?raw=TRUE")
net0=graph_from_data_frame(d=edges, vertices = nodes, directed=F)
```

Network visuliation

```
plot(net0, vertex.size=1, vertex.label=NA, vertex.color="cadetblue3", vertex.frame.color="cadetblue3")
```



Make the data for modeling

```
n=length(V(net0))
m=components(net0)$no

data=data.frame(id=1:n, na=unlist(lapply(1:n, num_neighbors, net=net0)),
                component=components(net0)$membership)

#assign treatment, outcome, and baseline covariates to data
data$treatment=nodes$treatment
data$outcome=nodes$outcome
data$var1=nodes$var1
data$var2=nodes$var2
data$na_a= unlist(lapply(1:n, trt_neighbors, net=net0))
data$notna_a=data$na-data$na_a

base_covariate=c("var1", "var2")
#averaging baseline covariates
data$avg_var1=unlist(lapply(1:n, avg_neighbors, net=net0, variable="var1"))
data$avg_var2=unlist(lapply(1:n, avg_neighbors, net=net0, variable="var2"))

avg_covariate=c("avg_var1", "avg_var2")
```

Modeling

Using IPW1 to evaluate the average potential outcome and causal effects under allocation strategies α. The model will output the point estimation and the estimated variance of average potention outcomes $\widehat{Y}(1,\alpha)$, $\widehat{Y}(0,\alpha)$, $\widehat{Y}(\alpha)$.

```
alpha=c(0.25, 0.5, 0.75)
IPW_1_model(data, base_covariate, alpha)
```

```
## [[1]]
##            a=1         a=0       margin alpha           type
## 1 0.1852175678 0.188372738 0.1875839458  0.25 point estimate
## 2 0.1451336794 0.276759930 0.2109468049  0.50 point estimate
## 3 0.1352103897 0.261785879 0.1668542621  0.75 point estimate
## 4 0.0014465618 0.000919702 0.0005100593  0.25       variance
## 5 0.0003415270 0.001480020 0.0004108478  0.50       variance
## 6 0.0004228426 0.001566447 0.0003414386  0.75       variance
##
## [[2]]
##       estimation alpha0 alpha1     type
## 1  -0.0031551706   0.25   0.25   Direct
## 2  -0.1316262511   0.50   0.50   Direct
## 3  -0.1265754895   0.75   0.75   Direct
## 4   0.0028872409   0.25   0.25   Var DE
## 5   0.0019997039   0.50   0.50   Var DE
## 6   0.0019589605   0.75   0.75   Var DE
## 7  -0.0883871920   0.25   0.50 Indirect
## 8  -0.0734131408   0.25   0.75 Indirect
## 9   0.0149740512   0.50   0.75 Indirect
## 10  0.0004993204   0.25   0.50   Var IE
## 11  0.0018240734   0.25   0.75   Var IE
## 12  0.0012634087   0.50   0.75   Var IE
## 13 -0.0915423626   0.25   0.50    Total
## 14 -0.0765683114   0.25   0.75    Total
## 15 -0.1166521998   0.50   0.75    Total
## 16  0.0033180932   0.25   0.50   Var IE
## 17  0.0024878018   0.25   0.75   Var IE
## 18  0.0017330800   0.50   0.75   Var IE
## 19 -0.0262624477   0.25   0.50  Overall
## 20 -0.0551034003   0.25   0.75  Overall
## 21 -0.0288409526   0.50   0.75  Overall
## 22  0.0001937051   0.25   0.50   Var IE
## 23  0.0006692608   0.25   0.75   Var IE
## 24  0.0003768236   0.50   0.75   Var IE
```

IPW 2

Using IPW2 to evaluate the average potential outcome and causal effects under allocation strategies α. The model will output the point estimation and the estimated variance of average potention outcomes $\widehat{Y}(1,\alpha)$, $\widehat{Y}(0,\alpha)$, $\widehat{Y}(\alpha)$.

```
formula_1=paste("cbind(na_a, notna_a)", "~", "treatment", "+",
                paste(base_covariate, collapse = "+"), "+",
                paste(avg_covariate, collapse = "+"))
formula_2=paste("treatment", "~", paste(base_covariate, collapse = "+"))
M1=glm(formula_1, family = binomial(link = "logit"), data=data)
M2=glm(formula_2, family = binomial(link = "logit"), data=data)

IPW_2_model(data, M1, M2, alpha)
```

```
## [[1]]
##            a=1          a=0       margin alpha           type
## 1 0.1796249651 0.1454643863 0.1540045310  0.25 point estimate
## 2 0.1597258863 0.2266322694 0.1931790778  0.50 point estimate
## 3 0.1470394052 0.2526265019 0.1734361794  0.75 point estimate
## 4 0.0011119881 0.0003719574 0.0002913227  0.25       variance
## 5 0.0003355471 0.0004879431 0.0002299846  0.50       variance
## 6 0.0004107754 0.0016837676 0.0003741267  0.75       variance
##
## [[2]]
##       estimation alpha0 alpha1     type
## 1   0.0341605788   0.25   0.25   Direct
## 2  -0.0669063830   0.50   0.50   Direct
## 3  -0.1055870966   0.75   0.75   Direct
## 4   0.0014167592   0.25   0.25   Var DE
## 5   0.0007270418   0.50   0.50   Var DE
## 6   0.0018927829   0.75   0.75   Var DE
## 7  -0.0811678831   0.25   0.50 Indirect
## 8  -0.1071621155   0.25   0.75 Indirect
## 9  -0.0259942325   0.50   0.75 Indirect
## 10  0.0002295839   0.25   0.50   Var IE
## 11  0.0017476652   0.25   0.75   Var IE
## 12  0.0010428090   0.50   0.75   Var IE
## 13 -0.0470073043   0.25   0.50    Total
## 14 -0.0730015368   0.25   0.75    Total
## 15 -0.0929006155   0.50   0.75    Total
## 16  0.0014390786   0.25   0.50   Var IE
## 17  0.0020005766   0.25   0.75   Var IE
## 18  0.0015989317   0.50   0.75   Var IE
## 19 -0.0349567019   0.25   0.50  Overall
## 20 -0.0653733126   0.25   0.75  Overall
## 21 -0.0304166108   0.50   0.75  Overall
## 22  0.0001526009   0.25   0.50   Var IE
## 23  0.0005000172   0.25   0.75   Var IE
## 24  0.0002177706   0.50   0.75   Var IE
```