Aprendizaje de redes bayesianas con R

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```
library(bnlearn)
set.seed(100)
```

Ejercicio 1

Como trabajo obligatorio de esta parte de la asignatura, se debe entrgar un script en R y un documento que haga lo siguiente

1. **Seleccione una red bayesiana con al menos 7 variables. No tiene que ser una red de nueva creación. Puede ser una usada en otras partes de la asignatura o del repositorio de bnlearn**.

```
asia_network <- readRDS("asia.rds")
```

2. **Simular dos conjuntos de datos de distintos tamaños a partir de la red (por ejemplo uno con 200 casos y otro con 5000 casos).**

```
small_dataset <- rbn(asia_network, n = 200)
big_dataset <- rbn(asia_network, n = 5000)
```

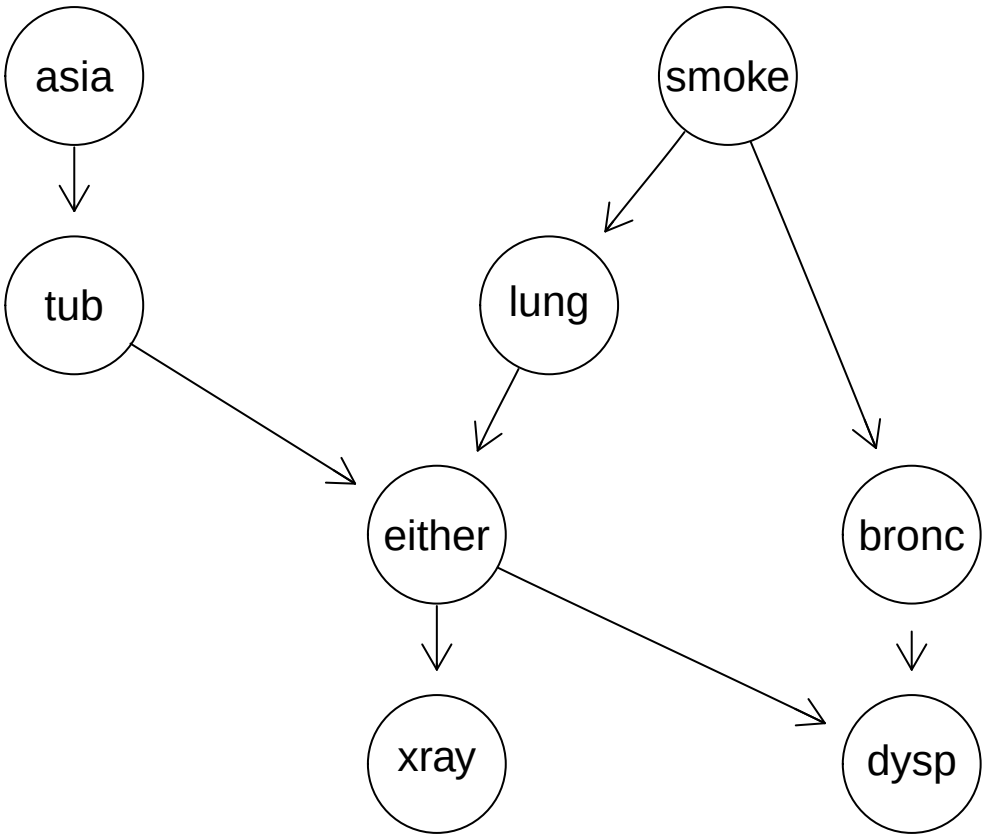
3. **Aprender la estructura con dos métodos distintos, uno basado en test de independencia y otro en scores, y con los dos conjuntos de datos**

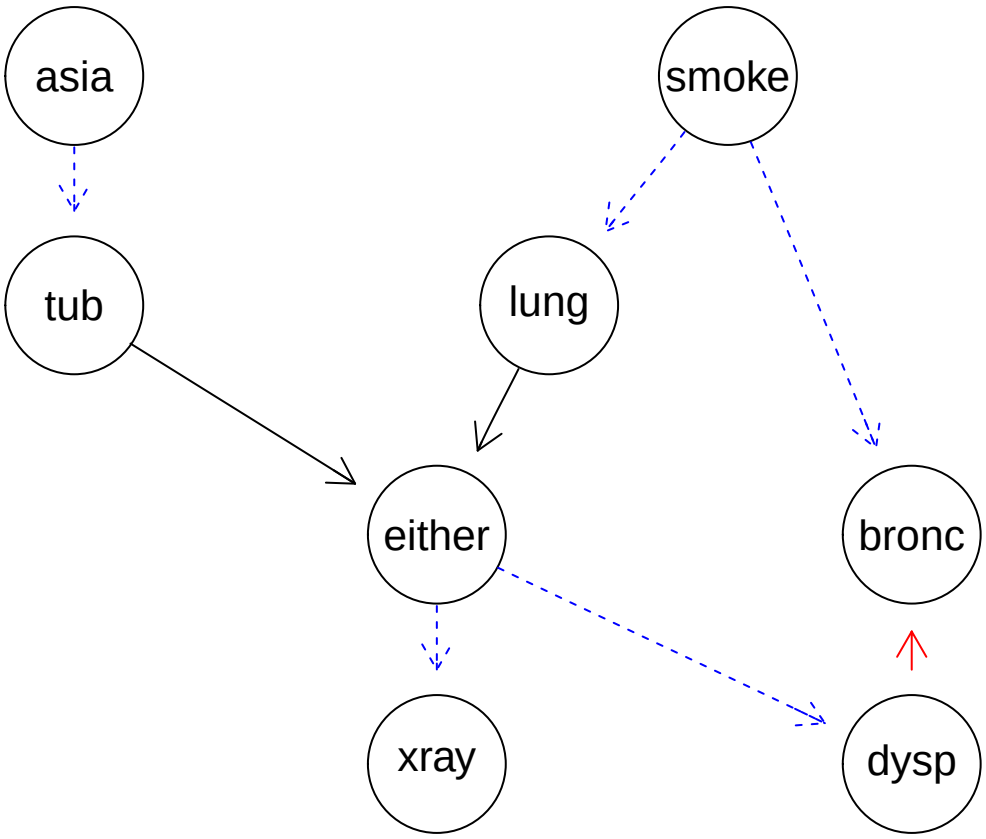
```
gs.small_dataset.dag <- gs(small_dataset)
gs.small_dataset.dag <- cextend(gs.small_dataset.dag)

gs.big_dataset.dag <- gs(big_dataset)
gs.big_dataset.dag <- cextend(gs.big_dataset.dag)

tabu_search.bde.small_dataset.dag <- tabu(small_dataset, score = "bde")
tabu_search.bde.small_dataset.dag <- cextend(tabu_search.bde.small_dataset.dag)

tabu_search.bde.big_dataset.dag <- tabu(big_dataset, score = "bde")
tabu_search.bde.big_dataset.dag <- cextend(tabu_search.bde.big_dataset.dag)
```

4. **Comparar la estructura de las redes obtenidas con las originales. Comentar las diferencias**

```
# Just to convert bn.fit object to bn so we can use graphviz.compare function
asia_network_bn <- model2network(modelstring(asia_network))

graphviz.compare(asia_network_bn, gs.small_dataset.dag)
```

```
## Loading required namespace: Rgraphviz
```


asia
smoke
tub
lung
either
bronc
xray
dysp



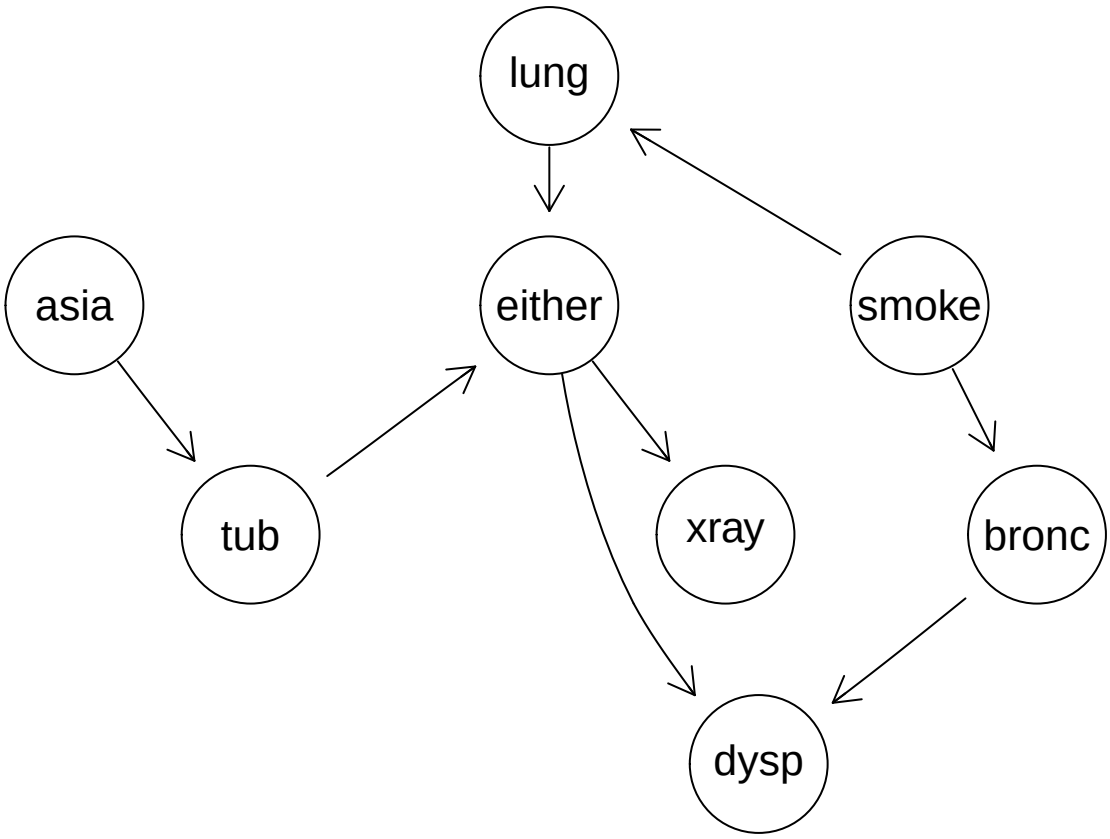

```
hamming(gs.small_dataset.dag, asia_network_bn)
```

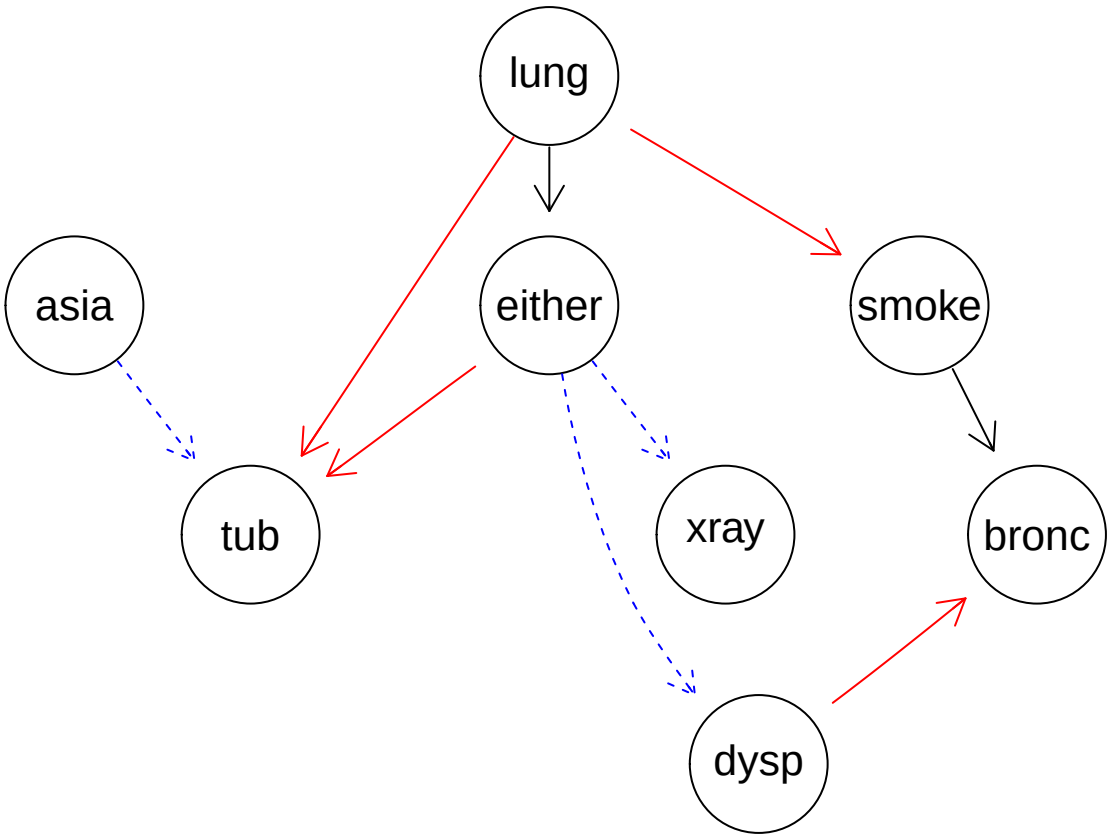
```
## [1] 5
```

```
shd(gs.small_dataset.dag, asia_network_bn)
```

```
## [1] 6
```

```
graphviz.compare(asia_network_bn, gs.big_dataset.dag)
```


lung
asia
either
smoke
tub
xray
bronc
dysp



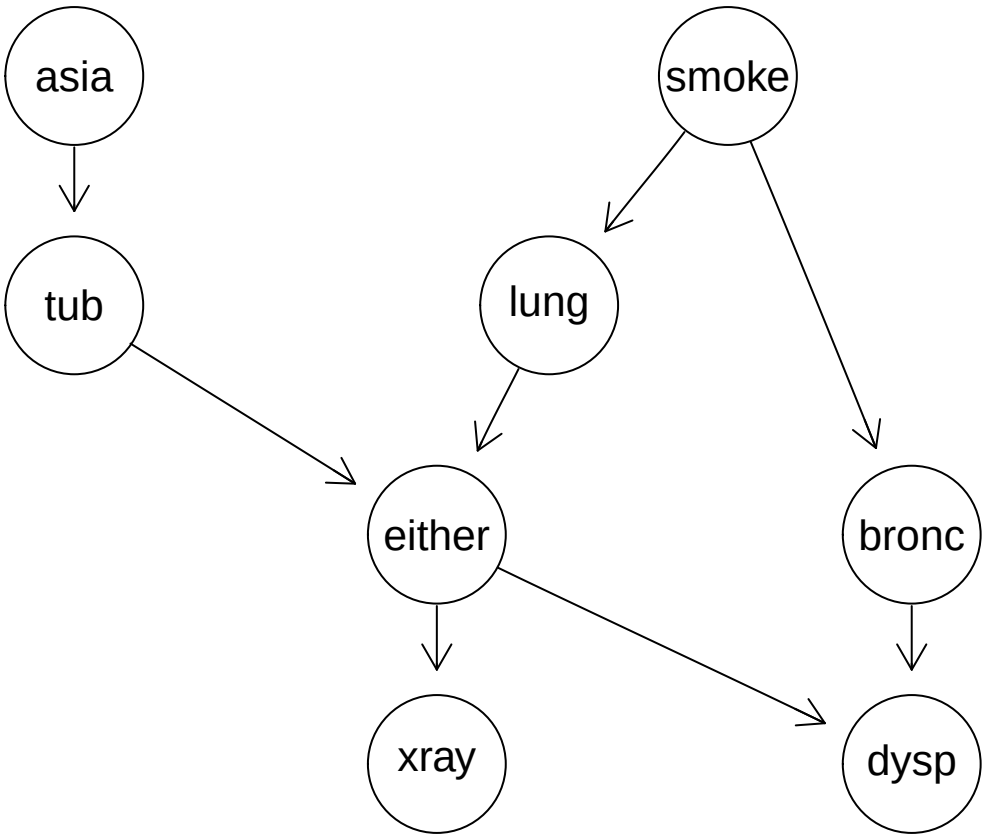

```
hamming(gs.big_dataset.dag, asia_network_bn)
```

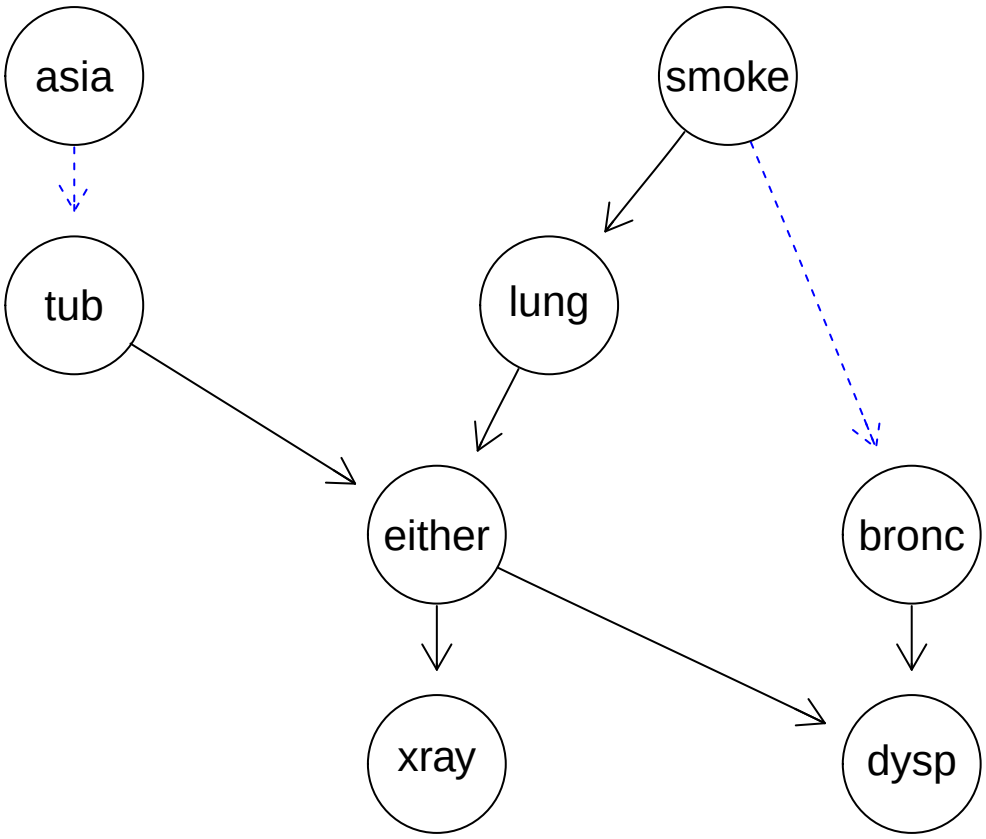
```
## [1] 4
```

```
shd(gs.big_dataset.dag, asia_network_bn)
```

```
## [1] 8
```

```
graphviz.compare(asia_network_bn, tabu_search.bde.small_dataset.dag)
```


asia
smoke
tub
lung
either
bronc
xray
dysp



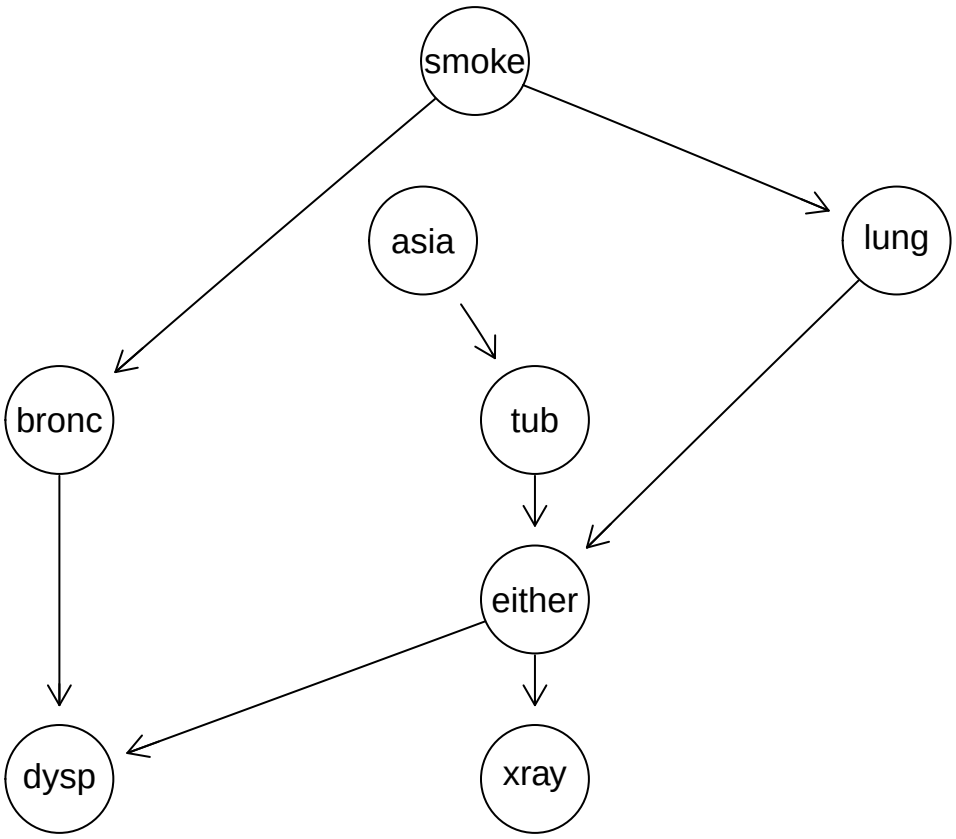

```
hamming(tabu_search.bde.small_dataset.dag, asia_network_bn)
```

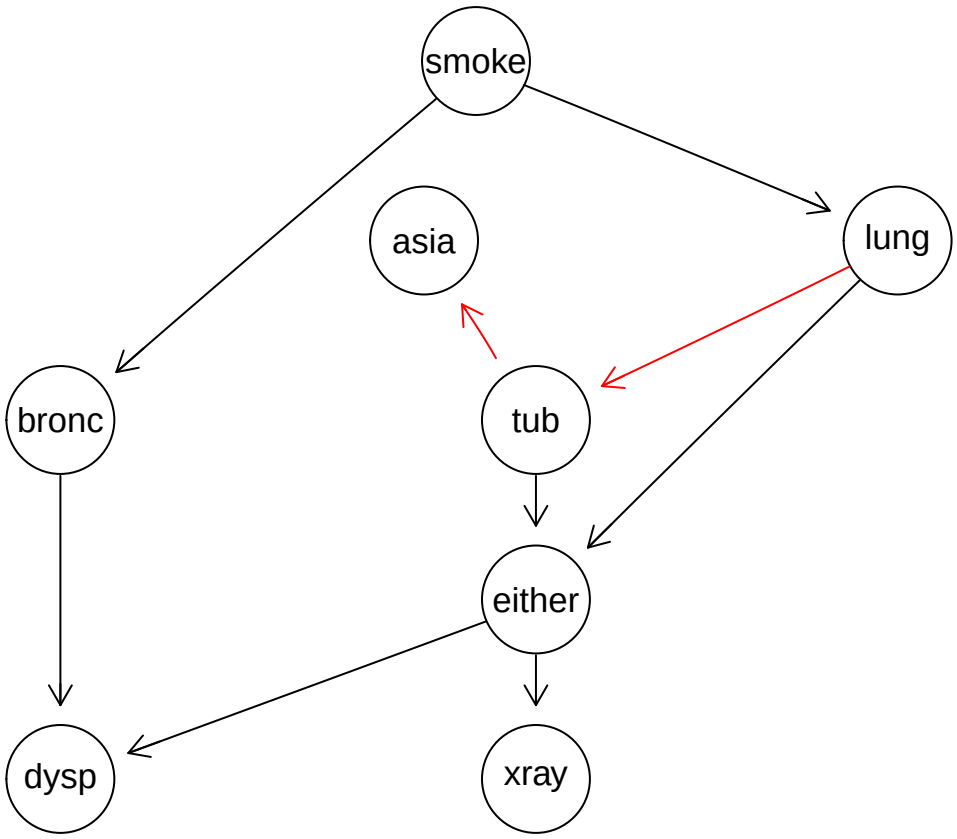
```
## [1] 2
```

```
shd(tabu_search.bde.small_dataset.dag, asia_network_bn)
```

```
## [1] 2
```

```
graphviz.compare(asia_network_bn, tabu_search.bde.big_dataset.dag)
```


smoke
asia
lung
bronc
tub
either
dysp
xray




```
hamming(tabu_search.bde.big_dataset.dag, asia_network_bn)
```

```
## [1] 1
```

```
shd(tabu_search.bde.big_dataset.dag, asia_network_bn)
```

```
## [1] 4
```

5. **Aprender los parámetros de las redes**

```
gs.small_dataset.bayes <- bn.fit(
    gs.small_dataset.dag,
    data = small_dataset,
    method = "bayes",
    iss = 10
)
gs.small_dataset.bayes
```

```
##
##   Bayesian network parameters
##
##   Parameters of node asia (multinomial distribution)
##
## Conditional probability table:
##         yes         no
## 0.03333333 0.96666667
##
##   Parameters of node tub (multinomial distribution)
```

```
##
## Conditional probability table:
##         yes         no
## 0.04761905 0.95238095
##
##   Parameters of node smoke (multinomial distribution)
##
## Conditional probability table:
##        yes        no
## 0.5095238 0.4904762
##
##   Parameters of node lung (multinomial distribution)
##
## Conditional probability table:
##  yes  no
## 0.1 0.9
##
##   Parameters of node bronc (multinomial distribution)
##
## Conditional probability table:
##
##      dysp
## bronc       yes        no
##   yes 0.7783019 0.2163462
##   no  0.2216981 0.7836538
##
##   Parameters of node either (multinomial distribution)
##
## Conditional probability table:
##
## , , lung = yes
##
##       tub
## either         yes          no
##    yes 0.500000000 0.932432432
##    no  0.500000000 0.067567568
##
## , , lung = no
##
##       tub
## either         yes          no
##    yes 0.833333333 0.006887052
##    no  0.166666667 0.993112948
##
##
##   Parameters of node xray (multinomial distribution)
##
## Conditional probability table:
##       yes       no
## 0.152381 0.847619
##
##   Parameters of node dysp (multinomial distribution)
##
## Conditional probability table:
```

```
##        yes        no
## 0.5047619 0.4952381
```

```
gs.big_dataset.bayes <- bn.fit(
    gs.big_dataset.dag,
    data = big_dataset,
    method = "bayes",
    iss = 10
)
gs.big_dataset.bayes
```

```
##
##   Bayesian network parameters
##
##   Parameters of node asia (multinomial distribution)
##
## Conditional probability table:
##         yes         no
## 0.01277445 0.98722555
##
##   Parameters of node tub (multinomial distribution)
##
## Conditional probability table:
##
## , , either = yes
##
##      lung
## tub            yes           no
##   yes 0.0333333333 0.9731182796
##   no  0.9666666667 0.0268817204
##
## , , either = no
##
##      lung
## tub            yes           no
##   yes 0.5000000000 0.0002668944
##   no  0.5000000000 0.9997331056
##
##
##   Parameters of node smoke (multinomial distribution)
##
## Conditional probability table:
##
##      lung
## smoke       yes        no
##   yes 0.8875000 0.4774841
##   no  0.1125000 0.5225159
##
##   Parameters of node lung (multinomial distribution)
##
## Conditional probability table:
##         yes         no
## 0.05588822 0.94411178
##
##   Parameters of node bronc (multinomial distribution)
```

```
##
## Conditional probability table:
##
## , , dysp = yes
##
##      smoke
## bronc        yes         no
##   yes 0.89246356 0.76235992
##   no  0.10753644 0.23764008
##
## , , dysp = no
##
##      smoke
## bronc        yes         no
##   yes 0.27373921 0.08727429
##   no  0.72626079 0.91272571
##
##
##   Parameters of node either (multinomial distribution)
##
## Conditional probability table:
##
##       lung
## either         yes          no
##    yes 0.991071429 0.009830867
##    no  0.008928571 0.990169133
##
##   Parameters of node xray (multinomial distribution)
##
## Conditional probability table:
##        yes        no
## 0.1125749 0.8874251
##
##   Parameters of node dysp (multinomial distribution)
##
## Conditional probability table:
##        yes        no
## 0.4321357 0.5678643
```

```
tabu_search.bde.small_dataset.bayes <- bn.fit(
    tabu_search.bde.small_dataset.dag,
    data = small_dataset,
    method = "bayes",
    iss = 10
)
tabu_search.bde.small_dataset.bayes
```

```
##
##   Bayesian network parameters
##
##   Parameters of node asia (multinomial distribution)
##
## Conditional probability table:
##         yes         no
## 0.03333333 0.96666667
```

```
##
##   Parameters of node tub (multinomial distribution)
##
## Conditional probability table:
##         yes         no
## 0.04761905 0.95238095
##
##   Parameters of node smoke (multinomial distribution)
##
## Conditional probability table:
##        yes        no
## 0.5095238 0.4904762
##
##   Parameters of node lung (multinomial distribution)
##
## Conditional probability table:
##
##      smoke
## lung         yes         no
##   yes 0.15420561 0.04368932
##   no  0.84579439 0.95631068
##
##   Parameters of node bronc (multinomial distribution)
##
## Conditional probability table:
##  yes  no
## 0.5 0.5
##
##   Parameters of node either (multinomial distribution)
##
## Conditional probability table:
##
## , , lung = yes
##
##       tub
## either         yes          no
##    yes 0.500000000 0.932432432
##    no  0.500000000 0.067567568
##
## , , lung = no
##
##       tub
## either         yes          no
##    yes 0.833333333 0.006887052
##    no  0.166666667 0.993112948
##
##
##   Parameters of node xray (multinomial distribution)
##
## Conditional probability table:
##
##      either
## xray         yes         no
##   yes 0.90384615 0.04619565
```

```
##   no  0.09615385 0.95380435
##
##   Parameters of node dysp (multinomial distribution)
##
## Conditional probability table:
##
## , , either = yes
##
##      bronc
## dysp        yes        no
##   yes 0.7068966 0.8913043
##   no  0.2931034 0.1086957
##
## , , either = no
##
##      bronc
## dysp        yes        no
##   yes 0.7983425 0.1417112
##   no  0.2016575 0.8582888
```

```
tabu_search.bde.big_dataset.bayes <- bn.fit(
    tabu_search.bde.big_dataset.dag,
    data = big_dataset,
    method = "bayes",
    iss = 10
)

tabu_search.bde.big_dataset.bayes
```

```
##
##   Bayesian network parameters
##
##   Parameters of node asia (multinomial distribution)
##
## Conditional probability table:
##
##      tub
## asia         yes         no
##   yes 0.13157895 0.01140723
##   no  0.86842105 0.98859277
##
##   Parameters of node tub (multinomial distribution)
##
## Conditional probability table:
##
##      lung
## tub           yes          no
##   yes 0.037500000 0.009830867
##   no  0.962500000 0.990169133
##
##   Parameters of node smoke (multinomial distribution)
##
## Conditional probability table:
##        yes        no
## 0.5003992 0.4996008
```

```
##
##   Parameters of node lung (multinomial distribution)
##
## Conditional probability table:
##
##      smoke
## lung         yes         no
##   yes 0.09912246 0.01258490
##   no  0.90087754 0.98741510
##
##   Parameters of node bronc (multinomial distribution)
##
## Conditional probability table:
##
##      smoke
## bronc       yes        no
##   yes 0.6208616 0.2918498
##   no  0.3791384 0.7081502
##
##   Parameters of node either (multinomial distribution)
##
## Conditional probability table:
##
## , , lung = yes
##
##       tub
## either          yes           no
##    yes 0.8809523810 0.9953617811
##    no  0.1190476190 0.0046382189
##
## , , lung = no
##
##       tub
## either          yes           no
##    yes 0.9731182796 0.0002668944
##    no  0.0268817204 0.9997331056
##
##
##   Parameters of node xray (multinomial distribution)
##
## Conditional probability table:
##
##      either
## xray         yes         no
##   yes 0.97067901 0.05324370
##   no  0.02932099 0.94675630
##
##   Parameters of node dysp (multinomial distribution)
##
## Conditional probability table:
##
## , , either = yes
##
##      bronc
```

```
## dysp         yes         no
##   yes 0.93213296 0.66376307
##   no  0.06786704 0.33623693
##
## , , either = no
##
##      bronc
## dysp         yes         no
##   yes 0.79052931 0.09158752
##   no  0.20947069 0.90841248
```