

HW7 - BN

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Homework

For the homework, you will use the bnlearn library and R to create bayesian network described by the figure below.

Your tasks Submit the list of command you have used to create the network, make sure your CPT tables are correct. Calculate the following probabilities

$P(SR = \text{false} | W = \text{true})$

$P(WG = \text{true} | S = \text{true}; W = \text{true})$

$P(SR = \text{true} | WG = \text{true}; S = \text{false})$

$P(WG = \text{false} | SR = \text{false}; W = \text{true})$

submit a list of the commands you have used to answer the above probabilities calculation along with the results of the commands

Solution

Start by loading the bnlearn library

```
library(bnlearn)
```

```
##  
## Attaching package: 'bnlearn'  
## The following object is masked from 'package:stats':  
##  
##      sigma
```

Create the names of the nodes for the network

```
vname = c("W", "S", "R", "WG", "SR")
```

Attach the nodes to a graph

```
e = empty.graph(vname)
```

Create the connection(relation) between the nodes. Then, attach the connection to the graph

```
arc.set = matrix(c("W", "W", "S", "R", "R", "S", "R", "WG", "WG", "SR"),  
ncol = 2, dimnames = list (NULL, c("from", "to")))  
arcs(e) = arc.set
```

Create the conditional probability tables for each node

```

cptW = matrix(c(0.6,0.4), ncol = 2, dimnames = list(NULL, c("true","false")))

cptWR = c(0.8,0.2,0.1,0.9)
dim(cptWR) = c(2,2)
dimnames(cptWR) = list("R" = c("true","false"), "W" = c("true","false"))

cptWS = c(0.2,0.8,0.75,0.25)
dim(cptWS) = c(2,2)
dimnames(cptWS) = list("S" = c("true","false"), "W" = c("true","false"))

cptWG = c(0.8,0.2,0.1,0.95,0.05,0.9,0.1)
dim(cptWG) = c(2,2,2)
dimnames(cptWG) = list("WG" = c("true","false"), "R" = c("true","false"), "S" = c("true","false"))

cptRSR = c(0.7,0.3,0.1)
dim(cptRSR) = c(2,2)
dimnames(cptRSR) = list("SR" = c("true","false"), "R" = c("true","false"))

```

Attach the CPTs to the graph.

```

dfit = custom.fit(e, dist = list(W = cptW, R = cptWR, S = cptWS, WG = cptWG, SR= cptRSR))
dfit

```

```

##
##   Bayesian network parameters
##
##   Parameters of node W (multinomial distribution)
##
## Conditional probability table:
##
## true false
##  0.6    0.4
##
##   Parameters of node S (multinomial distribution)
##
##Conditional probability table:
##
##           W
## S         true false
## true  0.20  0.75
## false 0.80  0.25
##
##   Parameters of node R (multinomial distribution)
##
##Conditional probability table:
##
##           W
## R         true false
## true   0.8   0.1
## false  0.2   0.9
##
##   Parameters of node WG (multinomial distribution)
##
##Conditional probability table:
##

```

```
## , , R = true
##
##      S
## WG      true false
## true  0.80  0.95
## false 0.20  0.05
##
## , , R = false
##
##      S
## WG      true false
## true  0.00  0.90
## false 1.00  0.10
##
##
## Parameters of node SR (multinomial distribution)
##
## Conditional probability table:
##
##      R
## SR      true false
## true   0.7   0.0
## false  0.3   1.0
```

Now we are ready to query the network. The R code below are calculating the following probabilities:

$P(\text{SR} = \text{false} | \text{W} = \text{true})$

$P(\text{WG} = \text{true} | \text{S} = \text{true}; \text{W} = \text{true})$

$P(\text{SR} = \text{true} | \text{WG} = \text{true}; \text{S} = \text{false})$

$P(\text{WG} = \text{false} | \text{SR} = \text{false}; \text{W} = \text{true})$

```
cpquery(dfrit,event=(SR == "false"), evidence=(W == "true"))
```

```
## [1] 0.4522207
```

```
cpquery(dfrit,event=(WG == "true"), evidence=(S == "true") & (W=="true"))
```

```
## [1] 0.6461794
```

```
cpquery(dfrit,event=(SR == "true"), evidence=(WG == "true") & (S=="false"))
```

```
## [1] 0.4757211
```

```
cpquery(dfrit,event=(WG == "false"), evidence=(SR == "false") & (W=="true"))
```

```
## [1] 0.1609977
```