

Homework 1: January 10

Due: 01/17/20

1. Install package `bnlearn` in R. All documentation about `bnlearn` can be found at <https://www.bnlearn.com/documentation/>.
2. Install package `Rgraphviz`. If your R version is ≥ 3.5 then you can install using:

```
install.packages("BiocManager")  
BiocManager::install("Rgraphviz")
```

For R version < 3.5 :

```
source("http://bioconductor.org/biocLite.R")  
biocLite("Rgraphviz")
```
3. We will try to learn a Bayesian network on `marks` data set which contains examination marks of 88 students on five different topics, from Mardia (1979). Please print the outputs of the following code and answer the question.
 - Load the data using

```
>data(marks)
```
 - Learn a graph structure using the *hill-climbing* method by comparing BIC scores via the following code:

```
>graph_name = hc(marks, score= "bic-g")
```
 - Check the `bn` object that we just obtained by running

```
>graph_name
```
 - Check all the paths in the graph using

```
>arcs(graph_name)
```
 - Visualize the graph using the `graphviz` package.

```
>graphviz.plot(graph_name)
```
 - Check the d-separation between X and Y conditioned on Z using

```
>dsep(graph_name,"X","Y","Z")
```

List three sets of $\{X, Y, Z\}$ that X and Y are separated given Z .
 - Compute the continuous BIC score of the graph using the `score` function.

```
>bnlearn::score(graph_name,marks, type="bic-g")
```
 - Compute the parameters of the linear Gaussian using `bn.fit`.

```
>fit = bn.fit(graph_name, marks)
```
 - Show the result.

```
>fit
```
 - Check the parameters of a particular variable. Please choose a variable that has at least one parent.

```
>fit$variable_name
```
 - Learn the graph structure via AIC score instead of BIC. Do you get the same values of parameters?

- Make Q-Q plots, residuals vs fits plots and histograms
 `>bn.fit.qqplot(fit)`
 `>bn.fit.xyplot(fit)`
 `>bn.fit.histogram(fit)`