

Package ‘dbnlearn’

October 13, 2022

Type Package

Title Dynamic Bayesian Network Structure Learning, Parameter Learning and Forecasting

Version 0.1.0

Depends R (>= 3.4)

Description

It allows to learn the structure of univariate time series, learning parameters and forecasting. Implements a model of Dynamic Bayesian Networks with temporal windows, with collections of linear regressors for Gaussian nodes, based on the introductory texts of Korb and Nicholson (2010) <[doi:10.1201/b10391](https://doi.org/10.1201/b10391)> and Nagarajan, Scutari and Lèbre (2013) <[doi:10.1007/978-1-4614-6446-4](https://doi.org/10.1007/978-1-4614-6446-4)>.

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Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

Repository CRAN

Imports bnlearn, bnviewer, ggplot2

NeedsCompilation no

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dbnlearn-package *Dynamic Bayesian Network Structure Learning, Parameter Learning
and Forecasting*

Description

Dynamic Bayesian Network Structure Learning, Parameter Learning and Forecasting. This package implements a model of Gaussian Dynamic Bayesian Networks with temporal windows, based on collections of linear regressors for Gaussian nodes. The package allows learning the structure of univariate time series, learning parameters and forecasting.

Details

Package: dbnlearn-package
Type: Package
Version: 0.1.0
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Author(s)

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References

Koller D, Friedman N (2009). *Probabilistic Graphical Models: Principles and Techniques*. MIT Press.
Korb K, Nicholson AE (2010). *Bayesian Artificial Intelligence*. Chapman & Hall/CRC, 2nd edition.
Pearl J (1988). *Probabilistic Reasoning in Intelligent Systems: Networks of Plausible Inference*. Morgan Kaufmann.
Nagarajan R, Scutari M, Lebre S (2013). *Bayesian Networks in R with Applications in Systems Biology*. Springer.

Examples

```
library(dbnlearn)
library(bnviewer)
library(ggplot2)

#Time Series AirPassengers
```

```
ts <- AirPassengers

#Time Series Preprocessing with time window = 12
X.ts = dbn.preprocessing(ts, window = 12)

#Define 70% Train and 30% Test Data Set
percent = 0.7
n = nrow(X.ts)

trainIndex <- seq_len(length.out = floor(x = percent * n))
X.ts.train <- X.ts[trainIndex,]
X.ts.test <- X.ts[-trainIndex,]

#Dynamic Bayesian Network Structure Learning
ts.learning = dbn.learn(X.ts.train)

#Viewer Dynamic Bayesian Network
viewer(ts.learning,
       edges.smooth = TRUE,
       bayesianNetwork.height = "400px",
       node.colors = list(background = "#f4bafd",
                          border = "#2b7ce9",
                          highlight = list(background = "#97c2fc",
                                           border = "#2b7ce9")),
       bayesianNetwork.layout = "layout_with_sugiyama")

#Dynamic Bayesian Network Fit
ts.fit = dbn.fit(ts.learning, X.ts.train)

#Predict values
prediction = dbn.predict(ts.fit, X.ts.test)

#Plot Real vs Predict
real = X.ts.test[, "X_t"]
prediction = prediction

df.validation = data.frame(list(real = real, prediction = prediction))

ggplot(df.validation, aes(seq(1:nrow(df.validation)))) +
  geom_line(aes(y = real, colour="real")) +
  geom_line(aes(y = prediction, colour="prediction")) +
  scale_color_manual(values = c(
    'real' = 'deepskyblue',
    'prediction' = 'maroon1')) +
  labs(title = "Dynamic Bayesian Network",
       subtitle = "AirPassengers Time Series",
       colour = "Legend",
       x = "Time Index",
       y = "Values") + theme_minimal()
```

`dbn.fit`*Dynamic Bayesian Network Fit*

Description

Dynamic Bayesian Network Fit

Usage`dbn.fit(dbn.learn = NULL, ts = NULL)`**Arguments**

<code>dbn.learn</code>	Dynamic Bayesian Network Learning.
<code>ts</code>	Time Series.

Value

Dynamic Bayesian Network Fit

Author(s)

Robson Fernandes

Examples

```
library(dbnlearn)
library(bnviewer)
library(ggplot2)

#Time Series AirPassengers
ts <- AirPassengers

#Time Series Preprocessing with time window = 12
X.ts = dbn.preprocessing(ts, window = 12)

#Define 70% Train and 30% Test Data Set
percent = 0.7
n = nrow(X.ts)

trainIndex <- seq_len(length.out = floor(x = percent * n))
X.ts.train <- X.ts[trainIndex,]
X.ts.test <- X.ts[-trainIndex,]

#Dynamic Bayesian Network Structure Learning
ts.learning = dbn.learn(X.ts.train)

#Viewer Dynamic Bayesian Network
```

```

viewer(ts.learning,
       edges.smooth = TRUE,
       bayesianNetwork.height = "400px",
       node.colors = list(background = "#f4bafd",
                           border = "#2b7ce9",
                           highlight = list(background = "#97c2fc",
                                             border = "#2b7ce9")),
       bayesianNetwork.layout = "layout_with_sugiyama")

#Dynamic Bayesian Network Fit
ts.fit = dbn.fit(ts.learning, X.ts.train)

#Predict values
prediction = dbn.predict(ts.fit, X.ts.test)

#Plot Real vs Predict
real = X.ts.test[, "X_t"]
prediction = prediction

df.validation = data.frame(list(real = real, prediction = prediction))

ggplot(df.validation, aes(seq(1:nrow(df.validation)))) +
  geom_line(aes(y = real, colour="real")) +
  geom_line(aes(y = prediction, colour="prediction")) +
  scale_color_manual(values = c(
    'real' = 'deepskyblue',
    'prediction' = 'maroon1')) +
  labs(title = "Dynamic Bayesian Network",
       subtitle = "AirPassengers Time Series",
       colour = "Legend",
       x = "Time Index",
       y = "Values") + theme_minimal()

```

 dbn.learn

Dynamic Bayesian Network Structure Learning

Description

Dynamic Bayesian Network Structure Learning

Usage

```
dbn.learn(ts = NULL)
```

Arguments

ts Time Series.

Value

Dynamic Bayesian Network Structure Learning

Author(s)

Robson Fernandes

Examples

```
library(dbnlearn)
library(bnviewer)
library(ggplot2)

#Time Series AirPassengers
ts <- AirPassengers

#Time Series Preprocessing with time window = 12
X.ts = dbn.preprocessing(ts, window = 12)

#Define 70\% Train and 30\% Test Data Set
percent = 0.7
n = nrow(X.ts)

trainIndex <- seq_len(length.out = floor(x = percent * n))
X.ts.train <- X.ts[trainIndex,]
X.ts.test <- X.ts[-trainIndex,]

#Dynamic Bayesian Network Structure Learning
ts.learning = dbn.learn(X.ts.train)

#Viewer Dynamic Bayesian Network
viewer(ts.learning,
       edges.smooth = TRUE,
       bayesianNetwork.height = "400px",
       node.colors = list(background = "#f4bafd",
                          border = "#2b7ce9",
                          highlight = list(background = "#97c2fc",
                                           border = "#2b7ce9")),
       bayesianNetwork.layout = "layout_with_sugiyama")

#Dynamic Bayesian Network Fit
ts.fit = dbn.fit(ts.learning, X.ts.train)

#Predict values
prediction = dbn.predict(ts.fit, X.ts.test)

#Plot Real vs Predict
real = X.ts.test[, "X_t"]
```

```
prediction = prediction

df.validation = data.frame(list(real = real, prediction = prediction))

ggplot(df.validation, aes(seq(1:nrow(df.validation)))) +
  geom_line(aes(y = real, colour="real")) +
  geom_line(aes(y = prediction, colour="prediction")) +
  scale_color_manual(values = c(
    'real' = 'deepskyblue',
    'prediction' = 'maroon1')) +
  labs(title = "Dynamic Bayesian Network",
        subtitle = "AirPassengers Time Series",
        colour = "Legend",
        x = "Time Index",
        y = "Values") + theme_minimal()
```

dbn.predict

Dynamic Bayesian Network Predict

Description

Dynamic Bayesian Network Predict

Usage

```
dbn.predict(dbn.fit = NULL, ts = NULL)
```

Arguments

dbn.fit	Dynamic Bayesian Network Fit
ts	Time Series.

Value

Dynamic Bayesian Network Predict

Author(s)

Robson Fernandes

Examples

```
library(dbnlearn)
library(bnviewer)
library(ggplot2)

#Time Series AirPassengers
```

```

ts <- AirPassengers

#Time Series Preprocessing with time window = 12
X.ts = dbn.preprocessing(ts, window = 12)

#Define 70\% Train and 30\% Test Data Set
percent = 0.7
n = nrow(X.ts)

trainIndex <- seq_len(length.out = floor(x = percent * n))
X.ts.train <- X.ts[trainIndex,]
X.ts.test <- X.ts[-trainIndex,]

#Dynamic Bayesian Network Structure Learning
ts.learning = dbn.learn(X.ts.train)

#Viewer Dynamic Bayesian Network
viewer(ts.learning,
       edges.smooth = TRUE,
       bayesianNetwork.height = "400px",
       node.colors = list(background = "#f4bafd",
                           border = "#2b7ce9",
                           highlight = list(background = "#97c2fc",
                                             border = "#2b7ce9")),
       bayesianNetwork.layout = "layout_with_sugiyama")

#Dynamic Bayesian Network Fit
ts.fit = dbn.fit(ts.learning, X.ts.train)

#Predict values
prediction = dbn.predict(ts.fit, X.ts.test)

#Plot Real vs Predict
real = X.ts.test[, "X_t"]
prediction = prediction

df.validation = data.frame(list(real = real, prediction = prediction))

ggplot(df.validation, aes(seq(1:nrow(df.validation)))) +
  geom_line(aes(y = real, colour="real")) +
  geom_line(aes(y = prediction, colour="prediction")) +
  scale_color_manual(values = c(
    'real' = 'deepskyblue',
    'prediction' = 'maroon1')) +
  labs(title = "Dynamic Bayesian Network",
       subtitle = "AirPassengers Time Series",
       colour = "Legend",
       x = "Time Index",
       y = "Values") + theme_minimal()

```

dbn.preprocessing *Time Series Preprocessing with time window.*

Description

Time Series Preprocessing with time window.

Usage

```
dbn.preprocessing(ts = NULL, window = 12)
```

Arguments

ts	Time Series.
window	Number of steps in the time window.

Value

Time Series Preprocessing

Author(s)

Robson Fernandes

Examples

```
library(dbnlearn)
library(bnviewer)
library(ggplot2)

#Time Series AirPassengers
ts <- AirPassengers

#Time Series Preprocessing with time window = 12
X.ts = dbn.preprocessing(ts, window = 12)

#Define 70% Train and 30% Test Data Set
percent = 0.7
n = nrow(X.ts)

trainIndex <- seq_len(length.out = floor(x = percent * n))
X.ts.train <- X.ts[trainIndex,]
X.ts.test <- X.ts[-trainIndex,]

#Dynamic Bayesian Network Structure Learning
ts.learning = dbn.learn(X.ts.train)

#Viewer Dynamic Bayesian Network
```

```
viewer(ts.learning,
       edges.smooth = TRUE,
       bayesianNetwork.height = "400px",
       node.colors = list(background = "#f4bafd",
                          border = "#2b7ce9",
                          highlight = list(background = "#97c2fc",
                                           border = "#2b7ce9")),
       bayesianNetwork.layout = "layout_with_sugiyama")

#Dynamic Bayesian Network Fit
ts.fit = dbn.fit(ts.learning, X.ts.train)

#Predict values
prediction = dbn.predict(ts.fit, X.ts.test)

#Plot Real vs Predict
real = X.ts.test[, "X_t"]
prediction = prediction

df.validation = data.frame(list(real = real, prediction = prediction))

ggplot(df.validation, aes(seq(1:nrow(df.validation)))) +
  geom_line(aes(y = real, colour="real")) +
  geom_line(aes(y = prediction, colour="prediction")) +
  scale_color_manual(values = c(
    'real' = 'deepskyblue',
    'prediction' = 'maroon1')) +
  labs(title = "Dynamic Bayesian Network",
       subtitle = "AirPassengers Time Series",
       colour = "Legend",
       x = "Time Index",
       y = "Values") + theme_minimal()
```

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