Crash Introduction to markovchain R package

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19th April 2015

Intro

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- The package is intended to provide S4 classes to perform probabilistic and statistical analysis of Discrete Time Markov Chains (DTMC). See (Brémaud 1999) for a theoretical review of the mathematics underlying the DTMC models.
- The vignette will show: how to load the package and create a DTMC, how to manage a DTMC, how to perform basic probabilistic analysis, how to fit a DTMC.

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- It requires a recent version of R (>=3.0). Since version 0.2 parts of code have been moved to Rcpp (Eddelbuettel 2013).
- The package won a slot in Google Summer of Code 2015 for optimizing internals and expanding functionalities.

First moves into the markovchain package

Loading the package

- The package is loaded using

```
library(markovchain) #load the package
```

Creating a DTMC

- DTMC can be easily create following standard S4 classes syntax. The show method displays it.

```
tmA <- matrix(c(0,0.5,0.5,.5,0,.5,.5,.5,0),nrow = 3,byrow =
dtmcA <- new("markovchain",transitionMatrix=tmA, states=c("
dtmcA
```

```
## MarkovChain A
##  A  3 - dimensional discrete Markov Chain with followin
##  a b c
##  The transition matrix   (by rows)  is defined as follo
##     a   b   c
## a 0.0 0.5 0.5
## b 0.5 0.0 0.5
## c 0.5 0.5 0.0
```

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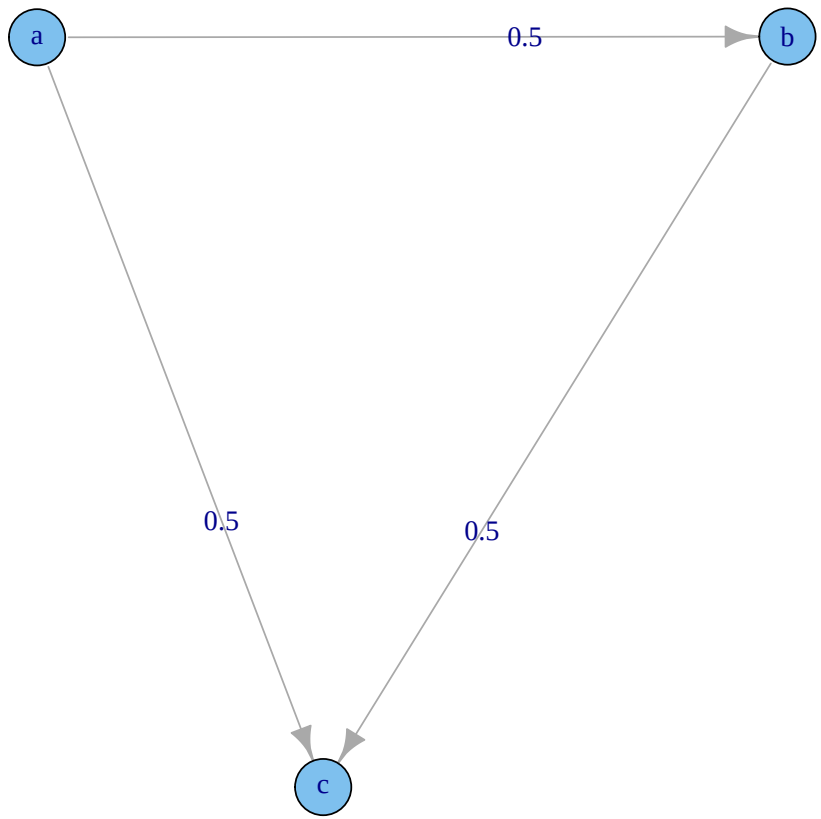
```

- Otherwise, it can also be created directly coercing a matrix

- It is also possible to display a DTMC, using (Csardi and Nepusz 2006) capabilities

```
plot(dtmcA)
```



Probabilistic analysis

The basic

- It is possible to access transition probabilities and to perform basic operations.

```
dtmcA[2,3] #using [ method
```

```
## [1] 0.5
```

```
transitionProbability(dtmcA, "b","c") #using specific S4 m
```

```
## [1] 0.5
```

```
conditionalDistribution(dtmcA,"b")
```

```
##   a   b   c
## 0.5 0.0 0.5
```

The basic

- It is possible to access transition probabilities and to perform basic operations.
- Similarly, it is possible to access the conditional distribution of states, $Pr\left(X_{t+1}|X_t = s\right)$

```
dtmcA[2,3] #using [ method
```

```
## [1] 0.5
```

```
transitionProbability(dtmcA, "b","c") #using specific S4 m
```

```
## [1] 0.5
```

```
conditionalDistribution(dtmcA,"b")
```

```
##   a   b   c
## 0.5 0.0 0.5
```

- It is possible to simulate states distribution after n-steps

```
##              a     b       c
## [1,] 0.3125 0.375 0.3125
```

- As well as steady states distribution

```
##                a         b         c
## [1,] 0.3333333 0.3333333 0.3333333
```

```
summary(mcMathematica)
```

```
## Mathematica  Markov chain that is composed by:
## Closed classes:
## a b c d
## Transient classes:
## NONE
## The Markov chain is irreducible
## The absorbing states are: NONE
```

- As well as steady states distribution

```
##                a         b         c
## [1,] 0.3333333 0.3333333 0.3333333
```

- The summary method shows the proprieties of the DTCM

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Bibliography I

Brémaud, Pierre. 1999. "Discrete-Time Markov Models." In *Markov Chains*, 53–93. Springer.

Csardi, Gabor, and Tamas Nepusz. 2006. "The Igraph Software Package for Complex Network Research." *InterJournal* Complex Systems: 1695. `http://igraph.sf.net`.

Eddelbuettel, Dirk. 2013. *Seamless R and C++ Integration with Rcpp*. New York: Springer-Verlag.

Spedicato, Giorgio Alfredo. 2015. *Markovchain: An R Package to Easily Handle Discrete Markov Chains*.