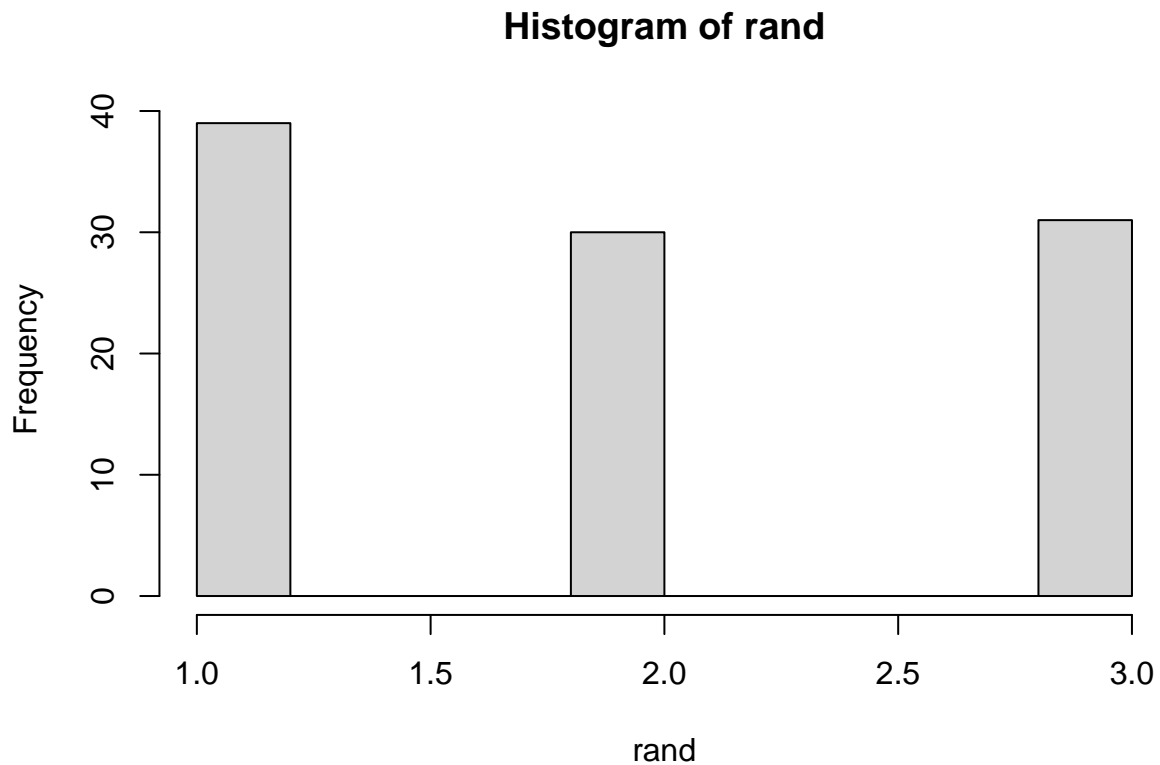


Look into markov chains

```
rand <- sample(1:3, 100, replace=TRUE)
hist(rand)
```



```
norm <- as.integer(rnorm(100,mean=2, sd=1))
unif <- as.integer(runif(100, min=1, max=4))
```

```
library(markovchain)
```

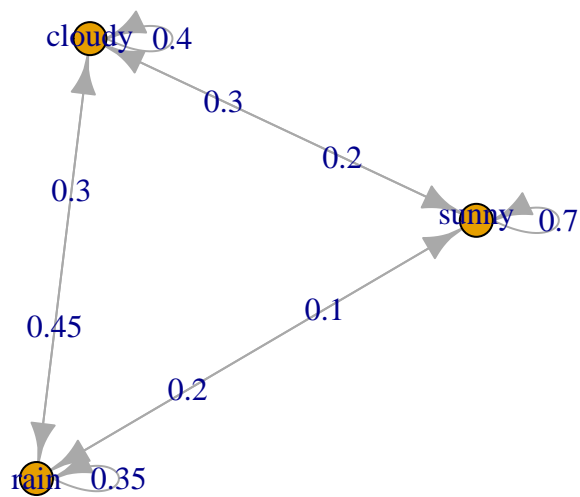
```
## Warning: package 'markovchain' was built under R version 4.0.5
```

```
## Package: markovchain
## Version: 0.8.6
## Date: 2021-05-17
## BugReport: https://github.com/spedygiorgio/markovchain/issues
```

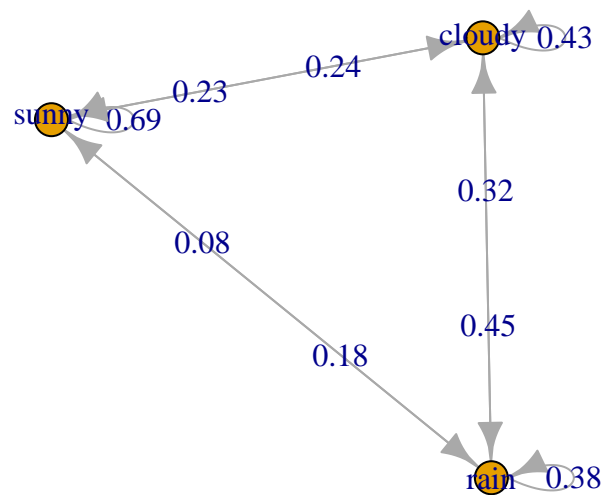
```
mcWeather <- new("markovchain", states=c("sunny","cloudy","rain"), transitionMatrix = matrix(data=c(0.7,
weatherOfDays <- rmarkovchain(n=365, object=mcWeather, t0="sunny")

tmp <- markovchainFit(data=weatherOfDays, method="mle", name = "Weather MLE")

plot(mcWeather)
```



```
plot(tmp$estimate)
```



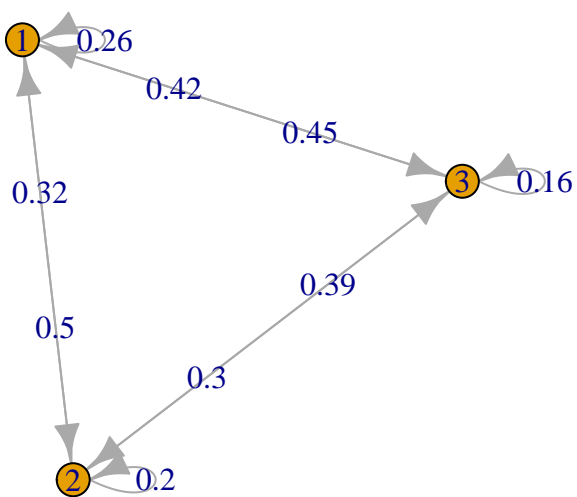
```
mcWeather
```

```
## Weather
## A 3 - dimensional discrete Markov Chain defined by the following states:
## sunny, cloudy, rain
## The transition matrix (by rows) is defined as follows:
##      sunny cloudy rain
## sunny  0.7   0.20 0.10
## cloudy  0.3   0.40 0.30
## rain    0.2   0.45 0.35
```

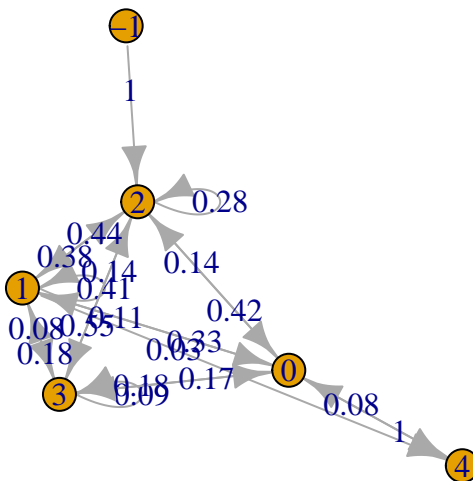
```
tmp$estimate
```

```
## Weather MLE
## A 3 - dimensional discrete Markov Chain defined by the following states:
## cloudy, rain, sunny
## The transition matrix (by rows) is defined as follows:
##      cloudy      rain      sunny
## cloudy 0.4330709 0.32283465 0.2440945
## rain   0.4470588 0.37647059 0.1764706
## sunny  0.2302632 0.07894737 0.6907895
```

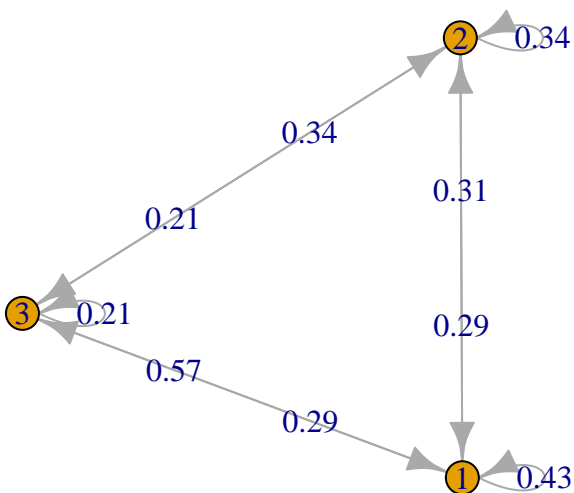
```
test <- markovchainFit(data=rand, method="mle", name="Bird jumping")
plot(test$estimate)
```



```
test2 <- markovchainFit(data=norm, method="mle", name="normal birds")  
plot(test2$estimate)
```



```
test3 <- markovchainFit(data=unif, method="mle", name="uniform birds")
plot(test3$estimate)
```



```

six_nine_two_eight <- read.csv("6928.csv")

six_nine_two_eight["DateTime"] <- as.POSIXct(six_nine_two_eight$access, origin="1970-01-01", tz="GMT")

six_nine_two_eight_uniq <- subset(six_nine_two_eight, subzone!="test")

unique(six_nine_two_eight_uniq$subzone)

## [1] "Bottom" "Top"      "middle"

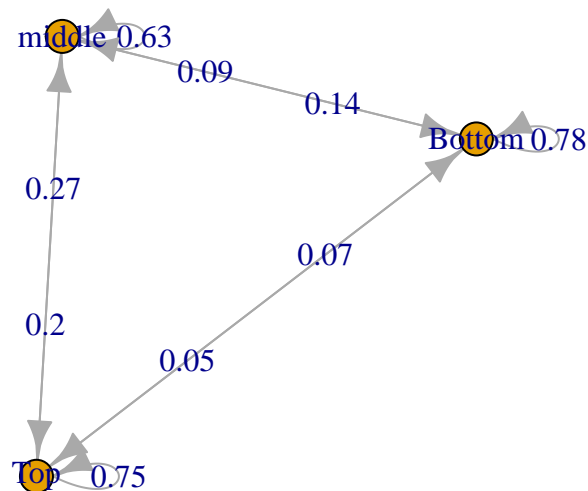
test <- markovchainFit(data=six_nine_two_eight_uniq$subzone, method="mle", name="Tag number 6928 overall
test

## $estimate
## Tag number 6928 overall
## A 3 - dimensional discrete Markov Chain defined by the following states:
## Bottom, Top, middle
## The transition matrix (by rows) is defined as follows:
##           Bottom      Top    middle
## Bottom 0.78189120 0.07316308 0.1449457
## Top     0.05452792 0.74725039 0.1982217
## middle 0.09046580 0.27460177 0.6349324
##
##
## $standardError

```

```
##           Bottom      Top      middle
## Bottom 0.007004383 0.002142608 0.003015778
## Top    0.001395402 0.005165627 0.002660514
## middle 0.002049698 0.003571079 0.005430146
##
## $confidenceLevel
## [1] 0.95
##
## $lowerEndpointMatrix
##           Bottom      Top      middle
## Bottom 0.76816286 0.06896364 0.1390349
## Top    0.05179299 0.73712595 0.1930072
## middle 0.08644846 0.26760259 0.6242895
##
## $upperEndpointMatrix
##           Bottom      Top      middle
## Bottom 0.79561954 0.07736251 0.1508565
## Top    0.05726286 0.75737484 0.2034362
## middle 0.09448313 0.28160096 0.6455753
##
## $logLikelihood
## [1] -48632.26
```

```
plot(test$estimate)
```



```

#input a sample name
#returns a vector labeled with sample name, and bottom, middle, top and total transitions

calc_trans<- function(samp_name,samp_obj){
  bottom_trans <-0
  mid_trans<-0
  top_trans<-0
  trans<-0
  count <- 0

  for (i in 2:length(samp_obj$subzone)) {
    previous_state <- as.character(samp_obj$subzone[i-1])
    current_state <- as.character(samp_obj$subzone[i])

    #print(paste(previous_state,":",current_state))

    if (previous_state == current_state) {
      count <- count+1
    }
    else{
      if(current_state == "bottom" || current_state == "Bottom"){
        bottom_trans <- bottom_trans+1
        trans<- trans+1
      }
      if (current_state=="middle" || current_state == "Middle") {
        mid_trans <- mid_trans+1
        trans <- trans+1
      }
      if(current_state == "top" || current_state=="Top"){
        top_trans <- top_trans+1
        trans <- trans+1
      }
    }
  }
  result <- c(samp_name,bottom_trans,mid_trans,top_trans,trans)
  return(result)
}

calc_trans_period<- function(samp_name, daily_indexed, raw_table,freq){
  result <- data.frame()

  for (i in 2:(length(daily_indexed))){
    curr_day <- raw_table[paste0(index(daily_indexed)[i-1],"/",index(daily_indexed)[i])]
    curr_day_trans <- calc_trans(paste0(samp_name,".",freq,".",i),curr_day)
    result <- rbind(result,curr_day_trans)
  }
  colnames(result) <- c("sample","bottom","mid","top","total")
  return(result)
}

```



```
library(xts)
```

```
## Warning: package 'xts' was built under R version 4.0.5
```

```
## Loading required package: zoo
```

```
## Warning: package 'zoo' was built under R version 4.0.5
```

```
##
```

```
## Attaching package: 'zoo'
```

```
## The following object is masked from 'package:markovchain':
```

```
##
```

```
## is.regular
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
## as.Date, as.Date.numeric
```

```
six_eight_nine_four <- read.csv("6894.csv")
```

```
six_eight_nine_four["DateTime"] <- as.POSIXct(six_eight_nine_four$access, origin="1970-01-01", tz="GMT")
```

```
unique(six_eight_nine_four$subzone)
```

```
## [1] "middle" "top" "bottom" "M" "B" "T" ""
```

```
six_eight_nine_four$subzone[six_eight_nine_four$subzone == "M"] <- "middle"
```

```
six_eight_nine_four$subzone[six_eight_nine_four$subzone == "B"] <- "bottom"
```

```
six_eight_nine_four$subzone[six_eight_nine_four$subzone == "T"] <- "top"
```

```
unique(six_eight_nine_four$subzone)
```

```
## [1] "middle" "top" "bottom" ""
```

```
sum(is.na(six_eight_nine_four$DateTime))
```

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

```
six_eight_nine_four <- six_eight_nine_four[!is.na(six_eight_nine_four$DateTime),]
```

```
sum(is.na(six_eight_nine_four$DateTime))
```

```
## [1] 0
```

```
xts_6894 <- xts(six_eight_nine_four, order.by = six_eight_nine_four$DateTime)
```

```
summary(xts_6894)
```

```
##      Index                tagnumber      tagstatus
## Min.   :2020-11-16 20:39:26 Length:65520      Length:65520
## 1st Qu.:2020-12-24 20:25:30 Class :character Class :character
## Median :2021-01-12 09:50:41 Mode  :character Mode  :character
## Mean   :2021-01-20 11:55:11
## 3rd Qu.:2021-02-06 00:31:18
## Max.   :2021-05-07 18:32:54
## detectstat      subzone      alarmtype      access
## Length:65520      Length:65520      Length:65520      Length:65520
## Class :character  Class :character  Class :character  Class :character
## Mode  :character  Mode  :character  Mode  :character  Mode  :character
##
##
##
##      unixDTms      Access.Timestamp      tagname      OldTag
## Length:65520      Length:65520      Length:65520      Length:65520
## Class :character  Class :character  Class :character  Class :character
## Mode  :character  Mode  :character  Mode  :character  Mode  :character
##
##
##
##      CageID      DateTime
## Length:65520      Length:65520
## Class :character  Class :character
## Mode  :character  Mode  :character
##
##
##
```

```
daily_6894 <- to.daily(xts_6894$subzone, OHLC=F,)
weekly_6894 <- to.weekly(xts_6894$subzone, OHLC=F)
monthly_6894 <- to.monthly(xts_6894$subzone, OHLC=F)
index(monthly_6894) <- as.POSIXct(index(monthly_6894))

length(daily_6894)
```

```
## [1] 164
```

```
six_eight_nine_four_daily <- calc_trans_period("6894",daily_6894,xts_6894,"d")
six_eight_nine_four_weekly <- calc_trans_period("6894",weekly_6894,xts_6894,"w")
six_eight_nine_four_monthly <- calc_trans_period("6894",monthly_6894,xts_6894,"m")

write.csv(six_eight_nine_four_daily,"6894_daily.csv",row.names = F)
write.csv(six_eight_nine_four_weekly,"6894_weekly.csv",row.names=F)
write.csv(six_eight_nine_four_monthly,"6894_monthly.csv",row.names=F)
```

```
#65530
six_nine_two_eight <- read.csv("6928.csv")

six_nine_two_eight["DateTime"] <- as.POSIXct(six_nine_two_eight$access, origin="1970-01-01", tz="GMT")
```

```
unique(six_nine_two_eight$subzone)
```

```
## [1] "Bottom" "Top"      "middle" "test"
```

```
six_nine_two_eight$subzone[six_nine_two_eight$subzone == "Bottom"] <- "bottom"
six_nine_two_eight$subzone[six_nine_two_eight$subzone == "middle"] <- "middle"
six_nine_two_eight$subzone[six_nine_two_eight$subzone == "Top"] <- "top"
six_nine_two_eight <- subset(six_nine_two_eight, subzone!="test")
#65475
unique(six_nine_two_eight$subzone)
```

```
## [1] "bottom" "top"      "middle"
```

```
sum(is.na(six_nine_two_eight$DateTime))
```

```
## [1] 0
```

```
sum(is.na(six_nine_two_eight$subzone))
```

```
## [1] 0
```

```
xts_6928 <- xts(six_nine_two_eight, order.by = six_nine_two_eight$DateTime)
```

```
summary(xts_6928)
```

```
##      Index                tagnumber      tagstatus
## Min.   :2021-02-01 18:40:53 Length:65475      Length:65475
## 1st Qu.:2021-02-26 14:46:37 Class :character Class :character
## Median :2021-03-21 01:16:23 Mode  :character Mode  :character
## Mean   :2021-03-21 13:46:33
## 3rd Qu.:2021-04-13 19:13:03
## Max.   :2021-05-07 18:39:43
## detectstat      subzone      alarmtype      access
## Length:65475    Length:65475    Length:65475    Length:65475
## Class :character Class :character Class :character Class :character
## Mode  :character Mode  :character Mode  :character Mode  :character
##
##
##      unixDTms      accessdate      tagname      CageID
## Length:65475      Length:65475    Length:65475    Length:65475
## Class :character  Class :character  Class :character  Class :character
## Mode  :character  Mode  :character  Mode  :character  Mode  :character
##
##
##      DateTime
## Length:65475
## Class :character
```

```
## Mode :character
##
##
##
```

```
daily_6928 <- to.daily(xts_6928$subzone, OHLC=F,)
weekly_6928 <- to.weekly(xts_6928$subzone, OHLC=F)
monthly_6928 <- to.monthly(xts_6928$subzone, OHLC=F)
index(monthly_6928) <-as.POSIXct(index(monthly_6928))

length(daily_6928)
```

```
## [1] 96
```

```
six_nine_two_eight_daily <- calc_trans_period("6928",daily_6928,xts_6928,"d")

six_nine_two_eight_weekly <- calc_trans_period("6928",weekly_6928,xts_6928,"w")

six_nine_two_eight_monthly <- calc_trans_period("6928",monthly_6928,xts_6928,"m")

write.csv(six_nine_two_eight_daily,"6928_daily.csv",row.names = F)
write.csv(six_nine_two_eight_weekly,"6928_weekly.csv",row.names=F)
write.csv(six_nine_two_eight_monthly,"6928_monthly.csv",row.names=F)
```

```
#65524
```

```
six_nine_eight_eight <- read.csv("6988.csv")

six_nine_eight_eight["DateTime"] <- as.POSIXct(six_nine_eight_eight$access, origin="1970-01-01", tz="GMT")

unique(six_nine_eight_eight$subzone)
```

```
## [1] "Bottom" "Middle" "Top"
```

```
six_nine_eight_eight$subzone[six_nine_eight_eight$subzone == "Bottom"] <- "bottom"
six_nine_eight_eight$subzone[six_nine_eight_eight$subzone == "Middle"] <- "middle"
six_nine_eight_eight$subzone[six_nine_eight_eight$subzone == "Top"] <- "top"
```

```
#65475
```

```
unique(six_nine_eight_eight$subzone)
```

```
## [1] "bottom" "middle" "top"
```

```
sum(is.na(six_nine_eight_eight$DateTime))
```

```
## [1] 0
```

```
sum(is.na(six_nine_eight_eight$subzone))
```

```
## [1] 0
```

```
xts_6988 <- xts(six_nine_eight_eight,order.by = six_nine_eight_eight$DateTime)

summary(xts_6988)
```

```
##      Index                Tagnumber      tagstatus
##  Min.   :2021-02-01 16:49:18  Length:65524      Length:65524
## 1st Qu.:2021-02-25 19:52:19  Class :character  Class :character
## Median :2021-03-17 04:27:45  Mode  :character  Mode  :character
## Mean   :2021-03-18 15:33:24
## 3rd Qu.:2021-04-08 23:56:48
## Max.   :2021-05-07 16:45:29
## detectstat      subzone      alarmtype      access
## Length:65524    Length:65524    Length:65524    Length:65524
## Class :character Class :character Class :character Class :character
## Mode  :character Mode  :character Mode  :character Mode  :character
##
##
##
##      unixDTms      accessdate      tagname      Cage_ID
## Length:65524      Length:65524    Length:65524    Length:65524
## Class :character  Class :character  Class :character  Class :character
## Mode  :character  Mode  :character  Mode  :character  Mode  :character
##
##
##
##      DateTime
## Length:65524
## Class :character
## Mode  :character
##
##
##
```

```
daily_6988 <- to.daily(xts_6988$subzone, OHLC=F,)
weekly_6988 <- to.weekly(xts_6988$subzone, OHLC=F)
monthly_6988 <- to.monthly(xts_6988$subzone, OHLC=F)
index(monthly_6988) <-as.POSIXct(index(monthly_6988))
```

```
length(daily_6988)
```

```
## [1] 96
```

```
six_nine_eight_eight_daily <- calc_trans_period("6988",daily_6988,xts_6988,"d")
six_nine_eight_eight_weekly <- calc_trans_period("6988",weekly_6988,xts_6988,"w")
six_nine_eight_eight_monthly <- calc_trans_period("6988",monthly_6988,xts_6988,"m")

write.csv(six_nine_eight_eight_daily,"6988_daily.csv",row.names = F)
write.csv(six_nine_eight_eight_weekly,"6988_weekly.csv",row.names=F)
write.csv(six_nine_eight_eight_monthly,"6988_monthly.csv",row.names=F)
```

```

#65495
nine_zero_one_three <- read.csv("9013.csv")

nine_zero_one_three["DateTime"] <- as.POSIXct(nine_zero_one_three$access, origin="1970-01-01", tz="GMT")

unique(nine_zero_one_three$subzone)

## [1] "Middle" "Top"      "Bottom"

nine_zero_one_three$subzone[nine_zero_one_three$subzone == "Bottom"] <- "bottom"
nine_zero_one_three$subzone[nine_zero_one_three$subzone == "Middle"] <- "middle"
nine_zero_one_three$subzone[nine_zero_one_three$subzone == "Top"] <- "top"

#65495
unique(nine_zero_one_three$subzone)

## [1] "middle" "top"      "bottom"

sum(is.na(nine_zero_one_three$DateTime))

## [1] 0

sum(is.na(nine_zero_one_three$subzone))

## [1] 0

xts_9013 <- xts(nine_zero_one_three, order.by = nine_zero_one_three$DateTime)

summary(xts_9013)

##           Index              Tagnumber      tagstatus
## Min.      :2021-03-09 17:37:22  Length:65495    Length:65495
## 1st Qu.:2021-03-24 14:51:28    Class :character Class :character
## Median :2021-04-08 14:30:49    Mode  :character Mode  :character
## Mean     :2021-04-08 17:27:41
## 3rd Qu.:2021-04-23 23:57:58
## Max.     :2021-05-07 18:31:54
## detectstat      subzone          alarmtype          access
## Length:65495    Length:65495    Length:65495    Length:65495
## Class :character Class :character Class :character Class :character
## Mode  :character Mode  :character Mode  :character Mode  :character
##
##
##           unixDTms      accessdate      CageID      LegBand
## Length:65495    Length:65495    Length:65495    Length:65495
## Class :character Class :character Class :character Class :character
## Mode  :character Mode  :character Mode  :character Mode  :character
##
##

```

```
##
##   DateTime
## Length:65495
## Class :character
## Mode  :character
##
##
##
```

```
daily_9013 <- to.daily(xts_9013$subzone, OHLC=F,)
weekly_9013 <- to.weekly(xts_9013$subzone, OHLC=F)
monthly_9013 <- to.monthly(xts_9013$subzone, OHLC=F)
index(monthly_9013) <-as.POSIXct(index(monthly_9013))

length(daily_9013)
```

```
## [1] 60
```

```
nine_zero_one_three_daily <- calc_trans_period("9013",daily_9013,xts_9013,"d")
nine_zero_one_three_weekly <- calc_trans_period("9013",weekly_9013,xts_9013,"w")
nine_zero_one_three_monthly <- calc_trans_period("9013",monthly_9013,xts_9013,"m")

write.csv(nine_zero_one_three_daily,"9013_daily.csv",row.names = F)
write.csv(nine_zero_one_three_weekly,"9013_weekly.csv",row.names=F)
write.csv(nine_zero_one_three_monthly,"9013_monthly.csv",row.names=F)
```