Introduction to the mondate Package

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Contents

Base R provides two broad date/time classes,`POSIXt` and `Date`. Objects of these classes mark a day with the instant of time that begins the day. This conforms with internationally recognized standards[1]. In contrast, `mondate` objects represent a day as at the instant of time that ends the day. This "close of business" perspective is useful for modeling accounting as-of dates, and easily extends to "month close" and "year close." The other major purpose of the `mondate` package is to measure elapsed time in units of "months", and therefore also "years", in a way that improves on base R's approach, particularly in end-of-month situations.

The four major benefits of the mondate package are:

1. Date Aging
2. Date Formatting
3. Date Sequencing
4. Date Cutting

1. Date Aging

The "age" of an event plays many important roles in business use cases. By default, `Date` objects are measured in units of "days" and `POSIXt` objects in units of "seconds". But sometimes it is more convenient to measure elapsed time in units of "months" or "years". This is where `mondate` comes in.

[1] Refer to http://www.iso.org/iso/home/standards/iso8601.htm or https://en.wikipedia.org/wiki/ISO_8601

Example 1 If my "birth event" took place on February 29, 1996 then my age on February 28, 2006 was 10:

```
require(mondate)
```

```
## Loading required package: mondate
##
## Attaching package: 'mondate'
##
## The following object is masked from 'package:base':
##
##     as.difftime
```

```
YearsBetween("1996-02-29", "2006-02-28")
```

```
## [1] 10
## attr(,"timeunits")
## [1] "years"
```

or in the US

```
YearsBetween("2/29/1996", "2/28/2006")
```

```
## [1] 10
## attr(,"timeunits")
## [1] "years"
```

and

```
MonthsBetween("2/29/1996", "2/28/2006")
```

```
## [1] 120
## attr(,"timeunits")
## [1] "months"
```

which also results when subtracting two `mondate`s

```
m1 <- mondate.ymd(1996, 2)
m2 <- mondate.ymd(2006, 2)
m2 - m1
```

```
## Time difference of 120 months
```

Example 2 Suppose ABC Company invoices a customer in late October 2015 and has a policy of recognizing that invoice to have been sent on the 1st of November. This code calculates the ages of that invoice in months as of the ends of 2015 and 2016:

```
invoiceDate = as.Date("2015-11-01")
ages <- mondate.ymd(2015:2016) - invoiceDate
print(ages)
```

```
## Time differences in months
## [1]  2 14
```

Example 3 The last example in this section is actuarial in nature. Suppose ABC Insurance Co. records the date of insured losses using the variable DateOfLoss. Here are 10 random dates of loss after the end of 2010:

```
# generate 10 random dates after 2010
set.seed(1)
z <- rexp(10, .1)
DateOfLoss <- as.Date(mondate.ymd(2010) + z)
print(DateOfLoss)
```

```
##  [1] "2011-08-18" "2011-12-26" "2011-02-13" "2011-02-12" "2011-05-12"
##  [6] "2013-05-30" "2012-01-10" "2011-06-12" "2011-10-18" "2011-02-14"
```

Here are the four quarter-ends in 2013:

```
# Quarter-ends in 2013
QE <- mondate.ymd(2013, 3 * 1:4, displayFormat = "%Y%m")
names(QE) <- QE
print(QE)
```

```
## 201303 201306 201309 201312
## 201303 201306 201309 201312
```

Comments:
The 'displayFormat' argument will be explained in the next section.
"names" were assigned to enable the matrix columns headers below.

Here are the ages of the 10 losses as of each quarter end:

```
# a matrix of ages in units of months
Ages <- round(sapply(QE, `-` , DateOfLoss), 1)
# code ages as "not available" if the evaluation date preceeds
# the Date of Loss (one instance)
Ages[Ages <= 0] <- NA
print(Ages)
```

```
##       201303 201306 201309 201312
##  [1,]   19.5   22.5   25.5   28.5
##  [2,]   15.2   18.2   21.2   24.2
##  [3,]   25.6   28.6   31.6   34.6
##  [4,]   25.6   28.6   31.6   34.6
##  [5,]   22.6   25.6   28.6   31.6
##  [6,]     NA    1.1    4.1    7.1
##  [7,]   14.7   17.7   20.7   23.7
##  [8,]   21.6   24.6   27.6   30.6
##  [9,]   17.5   20.5   23.5   26.5
## [10,]   25.5   28.5   31.5   34.5
```

The actuarial "accident year" concept can be created as follows:

```
# Accident year age
AccidentYear <- year(DateOfLoss)
aybegin <- sort(unique(as.Date(mondate.ymd(AccidentYear, 1, 1))))
print(sapply(QE, `-`, aybegin))
```

```
##      201303 201306 201309 201312
## [1,]     27     30     33     36
## [2,]     15     18     21     24
## [3,]      3      6      9     12
```

See the "Date Cutting" section below for another way to do the last calculation.

Date Arithmetic

`mondate`s can act arithmetically in (almost always) the same way their underlying `numeric` can act.[2] In particular, use subtraction to measure the magnitude of the interval between two dates in units of months.

For example, the following two calculations yield the same result:

```
mondate("2015-12-31") - mondate("2014-12-31")
```

```
## Time difference of 12 months
```

```
mondate("2015-12-31") - as.Date("2015-01-01")
```

```
## Time difference of 12 months
```

Why are the results identical even though the subtrahends would appear to be a day apart? The answer is that the two objects, `as.Date("2015-01-01")` and `mondate("2014-12-31")` *represent the same instant in time*, i.e., the moment that separates events occuring in 2014 from events occurring in 2015. And that moment is exactly one year away from the following year-end moment, `mondate("2015-12-31")`, that separates calendar year 2015 from calendar year 2016.

This points out a new feature in mondate v1.0: ***`Dates` can be subracted directly from `mondates`.***

2. Date Formatting

`mondate` enables dates to be read and displayed in more than one format. The default formats currently recognized are

- US format: "%m/%d/%Y" or "%m-%d-%Y"
- EU format: "%Y-%m-%d" or "%Y/%m/%d"

in that order, depending on your value of `Sys.getlocale("LC_TIME")`. The order can be changed and new formats added using `base::options` for display ("writing") and `set.mondate.displayFormats` for "reading".

[2] The underlying `numeric` measures the number of months since the close of business 1999-12-31 (".mondate.origin").

"writing": dynamic format display

Example 4 This vignette is being written in the US, so today's date, November 10, 2015, will be represented using the first format above by default ...

```
mondate(Sys.Date())
```

```
## mondate: timeunits="months"
## [1] 11/10/2015
```

... but that default can be changed to the international standard format[3] "YYYY-MM-DD" using `base::options` and the name "mondate.default.displayFormat" as follows

```
options(mondate.default.displayFormat = "%Y-%m-%d")
mondate(Sys.Date())
```

```
## mondate: timeunits="months"
## [1] 2015-11-10
```

Example 5 French users may choose to use the format "dd/mm/YYYY" as follows:

```
options(mondate.default.displayFormat = "%d/%m/%Y")
mondate(Sys.Date())
```

```
## mondate: timeunits="months"
## [1] 10/11/2015
```

The `options` approach modifies the default display format for **all** mondates in the R session.

To set the display format for **just one** instance of a mondate object, use the `displayFormat` argument during the object's creation.

Example 6 Here we create the first 6 month-ends of 2015 to be displayed in the French format above despite the fact that the default format is first changed to the ISO standard:

```
options(mondate.default.displayFormat = "%Y-%m-%d")
mondate(Sys.Date())
```

```
## mondate: timeunits="months"
## [1] 2015-11-10
```

```
m <- mondate.ymd(2015, 1:6, displayFormat = "%d/%m/%Y")
print(m)
```

```
## [1] 31/01/2015 28/02/2015 31/03/2015 30/04/2015 31/05/2015 30/06/2015
```

More creative formats can be used, as for instance to display just the year and month, as was done in "Example 3" above.

[3] ibid.

"reading": dynamic format detection

As previously mentioned, the `mondate` package is pre-loaded with four formats for detecting dates

1. US format a: "%m/%d/%Y"
2. US format b: "%m-%d-%Y"
3. EU format a: "%Y-%m-%d"
4. EU format b: "%Y/%m/%d"

To inform `mondate` of another format for converting character to date, use `set.mondate.displayFormats`. This function sets the `options` value of "mondate.displayFormats" to the value(s) of your choice.

Example 7 To add the French format "dd/mm/yyyy" to the *head* of the current list of detectable formats – thereby setting that format to priority 1 status – use the following code[4]:

```
set.mondate.displayFormats(c("%d/%m/%Y",
                             get.mondate.displayFormats()),
                           clear = TRUE)
```

Contining, suppose dates in a spreadsheet are saved to a csv file in France and the `read.csv` function results in this data.frame:

```
data <- data.frame(
  cbind(Invoice=c("A", "B", "C"),
        datechar = c("28/11/2015", "29/11/2015", "30/11/2015")))
print(data)
```

```
##   Invoice   datechar
## 1       A 28/11/2015
## 2       B 29/11/2015
## 3       C 30/11/2015
```

Then the character dates can be converted automatically to `Date` objects via `mondate` as follows

```
data$InvoiceDate <- as.Date(mondate(data$datechar))
print(data)
```

```
##   Invoice   datechar InvoiceDate
## 1       A 28/11/2015  2015-11-28
## 2       B 29/11/2015  2015-11-29
## 3       C 30/11/2015  2015-11-30
```

For more information on the codes to use when formatting dates, see the R help page for the `strptime` function. To add addtional defaults according to your value of `Sys.getlocale("LC_TIME")`, contact the author[5]. (All are welcome to visit the package's public repository at https://github.com/chiefmurph/mondate.)

[4] This example is given in ?set.mondate.displayFormats

[5] chiefmurphy at gmail

3. Date Sequencing

Sequences of dates in units of days or weeks is easily accomplished using the base R's `Date` class:

```
seq(as.Date("2015-11-01"), by = "day", length.out = 5)
```

```
## [1] "2015-11-01" "2015-11-02" "2015-11-03" "2015-11-04" "2015-11-05"
```

Month-sequences can similarly be generated with `Date`s, which does work well for most dates. Results can be disappointing, however, for dates near the end of the month. Compare these two sequences starting from the first and last days of January:

```
seq(as.Date("2015-01-01"), by = "month", length.out = 5)
```

```
## [1] "2015-01-01" "2015-02-01" "2015-03-01" "2015-04-01" "2015-05-01"
```

```
seq(as.Date("2015-01-31"), by = "month", length.out = 5)
```

```
## [1] "2015-01-31" "2015-03-03" "2015-03-31" "2015-05-01" "2015-05-31"
```

All dates in the first sequence are the first days of the month, but some dates in the second sequence "leak" into subsequent months. This behavior is well documented in R help[6]:

> Using "month" first advances the month without changing the day: if this results in an invalid day of the month, it is counted forward into the next month

Perhaps the major purpose of the mondate package is to avoid this shortcoming.[7]

Example 8 Sequences of month ends can be accomplished in various "mondate" ways. Here are two:

```
seq(mondate("2015-01-31"), by = "month", length.out = 5)
```

```
## mondate: timeunits="months"
## [1] 2015-01-31 2015-02-28 2015-03-31 2015-04-30 2015-05-31
```

```
mondate.ymd(2015, 1:5)
```

```
## mondate: timeunits="months"
## [1] 01/31/2015 02/28/2015 03/31/2015 04/30/2015 05/31/2015
```

The display format in the first sequence inherits from the format of the character representation of the beginning date. The display format in the second sequence is based on the author's locale (see "Date Formatting" section above). Also note that each of the objects generated above are of class "mondate".

It is often more convenient to generate month sequences from `Date` objects, **and produce `Date` objects**, without having to resort to a `mondate` object in between. For that purpose the `seqmondate` generic function was written.

[6] see `?seq.POSIXt`

[7] "Under the hood" `mondate` represent dates relative to the percent of the month that has transpired by the close of business that day. See references to Damien Laker in the "Thank You" section at the end.

seqmondate

`seqmondate(x)` generates sequences of class(x) for a variety of classes: `Date`, `POSIXt`, and `mondate`. For any other class(x) `seqmondate(x)` will produce a sequence of `mondate`s, if possible. By default, 'by = "month"' is assumed.

Example 9 This example repeats Example 7. The first sequence holds all firsts-of-the-month, the second all month-ends. The class of the resulting object is the same class as the object being operated upon.

```
(d <- seqmondate(as.Date("2015-01-01"), length = 5))
```

```
## [1] "2015-01-01" "2015-02-01" "2015-03-01" "2015-04-01" "2015-05-01"
```

```
(m <- seqmondate(mondate("2015-01-31"), length = 5))
```

```
## mondate: timeunits="months"
## [1] 2015-01-31 2015-02-28 2015-03-31 2015-04-30 2015-05-31
```

```
class(d)
```

```
## [1] "Date"
```

```
class(m)
```

```
## [1] "mondate"
## attr(,"package")
## [1] "mondate"
```

(Homework problem: Why does 'm' display in the "EU" format and not in the default format of the author's locale, US?)

Example 10: Year-ends Here are two ways to generate sequences of year-end dates. The first uses seqmondate as above. The second uses the `mondate.ymd` function which, when only the first argument 'year' is specified, always generates the last day of the year.

```
seqmondate("2010-12-31", by = "year", length = 6)
```

```
## mondate: timeunits="months"
## [1] 2010-12-31 2011-12-31 2012-12-31 2013-12-31 2014-12-31 2015-12-31
```

```
mondate.ymd(2010:2015)
```

```
## mondate: timeunits="months"
## [1] 12/31/2010 12/31/2011 12/31/2012 12/31/2013 12/31/2014 12/31/2015
```

4. Date Cutting

Sidebar on "cut" for numerics
A `cut` of a `numeric` 'x' is a collection of (half-open,half-closed] intervals that "cover" 'x'. By "cover" is meant that every value in 'x' is contained in some interval[8], with the exception that the minimum value of 'x' is excluded – unless the 'include.lowest' argument is explicitly set to `TRUE`. By default, the right endpoint is assumed to be closed, but can be changed by setting `right = FALSE`.

A `cut` in R is represented by a `factor`. The `cut` function elegantly enunciates the `numeric` intervals by clearly identifying the (open,closed] borders in the labels of the factor's levels.

A `cut` of a set of dates 'x' by "months" can be thought of as a collection of contiguous months such that every date in x is contained in some month. This correspondence between a date and its neighboring members in its 'cut' can be an important factor in the statistical analysis of events occurring in similar time periods.

There is a `cut` method for `mondate`s when the 'breaks' argument is

- `numeric` and so determines the borders between intervals, or
- `character` and so identifies that the cover is to be a set of day-, week-, month-, year-, or quarter-intervals.

First we will define some cuts. Then we will see how one might use a `cut`.

Example 11 Because a `mondate` is fundamentally a `numeric`[9], the following two commands – the first on `numeric`, the second on `mondate` – are fundamentally the same. The only difference is how the objects and results display.

```
cut(seq(from = 180.5, to = 185.5, by = .5), breaks = 180:186)
```

```
##  [1] (180,181] (180,181] (181,182] (181,182] (182,183] (182,183] (183,184]
##  [8] (183,184] (184,185] (184,185] (185,186]
## Levels: (180,181] (181,182] (182,183] (183,184] (184,185] (185,186]
```

```
cut(seq(from = mondate(180.5), to = mondate(185.5), by = .5), breaks = 180:186)
```

```
##  [1] (12/31/2014,01/31/2015] (12/31/2014,01/31/2015]
##  [3] (01/31/2015,02/28/2015] (01/31/2015,02/28/2015]
##  [5] (02/28/2015,03/31/2015] (02/28/2015,03/31/2015]
##  [7] (03/31/2015,04/30/2015] (03/31/2015,04/30/2015]
##  [9] (04/30/2015,05/31/2015] (04/30/2015,05/31/2015]
## [11] (05/31/2015,06/30/2015]
## 6 Levels: (12/31/2014,01/31/2015] ... (05/31/2015,06/30/2015]
```

In the month intervals above, if one were to label the interval with one of the endpoints, it seems natural to choose the closed endpoint. That is the 'mondate' convention when 'breaks' is `character`. This bears repeating:

> The 'mondate' convention is to label a *character cut* (breaks = "days", "months", ...) with the **closed endpoint** of the interval. As with `cut.default`, the closed endpoint is determined by the argument `right`: when `TRUE` the right endpoint labels the interval, when `FALSE` the left endpoint labels the interval.

We begin with examples of `mondate` cuts, with `breaks` being `numeric` and `character`.

[8] thus, not an "open cover" in the topological sense
[9] the "mondate class" is defined via `setClass("mondate", contains = "numeric"`, etc.

Example 12 The following two commands generate the same result The first explicitly sets the break points as the month-ends beginning 2014-12-31 and ending six months later. The second implicitly sets the same break points. As with `cut.default`, the labels of the first cut clearly enunciate the (open,closed] monthly intervals. The labels of the second cut only give the closed endpoint.

```
cut(seq(mondate("2015-01-15"), mondate("2015-06-15"), by = .5),
    breaks = mondate.ymd(2014) + 0:6)
```

```
##  [1] (12/31/2014,01/31/2015] (12/31/2014,01/31/2015]
##  [3] (01/31/2015,02/28/2015] (01/31/2015,02/28/2015]
##  [5] (02/28/2015,03/31/2015] (02/28/2015,03/31/2015]
##  [7] (03/31/2015,04/30/2015] (03/31/2015,04/30/2015]
##  [9] (04/30/2015,05/31/2015] (04/30/2015,05/31/2015]
## [11] (05/31/2015,06/30/2015]
## 6 Levels: (12/31/2014,01/31/2015] ... (05/31/2015,06/30/2015]
```

```
cut(seq(mondate("2015-01-15"), mondate("2015-06-15"), by = .5), breaks = "month",
    include.lowest = TRUE)
```

```
##  [1] 2015-01-31 2015-01-31 2015-02-28 2015-02-28 2015-03-31 2015-03-31
##  [7] 2015-04-30 2015-04-30 2015-05-31 2015-05-31 2015-06-30
## 6 Levels: 2015-01-31 2015-02-28 2015-03-31 2015-04-30 ... 2015-06-30
```

In the case that breaks is `character` it is unfortunate to have to set `include.lowest = TRUE`, opposite its default value `FALSE`.[10] Other `cut` arguments as well have default values that may seem counterintuitive for cutting dates.

Perhaps the most troubling default is `right = TRUE` for `Date` objects because it violates the basic principle that `Date` objects begin on, and can be considered synonymous with, the instant beginning the day, i.e., the *left* endpoint.

For those and other reasons, a `cutmondate` method was written to work on `Date`, `mondate`, and other objects with arguments that are more appropriate for their class. Additionally, three new arguments were added to `cut.mondate`, which we will cover in due course.

We now turn our attention to the `cutmondate` methods.

cutmondate

The 'cutmondate' collection of methods are most effective when 'breaks' defines a cover in terms of months or multiple months. When the object being cut is a `Date` or `POSIXt`, the breakpoints are assumed to begin the period, right = FALSE by default, and the levels are labeled by the first date in the period.

Example 13 Here we regenerate the same DateOfLoss dates from Example 3, and cut them into month intervals.

```
set.seed(1)
z <- rexp(10, .1)
monDOL <- mondate.ymd(2010) + z
DateOfLoss <- as.Date(monDOL)
print(DateOfLoss)
```

[10] Excluding the minimum value of 'x' would be somewhat "random" – forgive the colloquialism – given that other values of 'x' are likely to in the same time interval. In the case of `character` breaks, `include.lowest=FALSE` throws an error.

```
##  [1] "2011-08-18" "2011-12-26" "2011-02-13" "2011-02-12" "2011-05-12"
##  [6] "2013-05-30" "2012-01-10" "2011-06-12" "2011-10-18" "2011-02-14"
```

```
cutmondate(DateOfLoss)
```

```
##  [1] 2011-08-01 2011-12-01 2011-02-01 2011-02-01 2011-05-01 2013-05-01
##  [7] 2012-01-01 2011-06-01 2011-10-01 2011-02-01
## 28 Levels: 2011-02-01 2011-03-01 2011-04-01 2011-05-01 ... 2013-05-01
```

The "28 Levels" says that it takes 28 contiguous months to cover 'DateOfLoss'. Note that the levels are labeled with the first day of each month because in this case `right=FALSE` by default. Specify `right=TRUE` and the levels are labeled by the last day of the month, which occurs by default in the second, `mondate` case below:

```
cutmondate(DateOfLoss, right = TRUE)
```

```
##  [1] 2011-08-31 2011-12-31 2011-02-28 2011-02-28 2011-05-31 2013-05-31
##  [7] 2012-01-31 2011-06-30 2011-10-31 2011-02-28
## 28 Levels: 2011-02-28 2011-03-31 2011-04-30 2011-05-31 ... 2013-05-31
```

```
cutmondate(monDOL)
```

```
##  [1] 08/31/2011 12/31/2011 02/28/2011 02/28/2011 05/31/2011 05/31/2013
##  [7] 01/31/2012 06/30/2011 10/31/2011 02/28/2011
## 28 Levels: 02/28/2011 03/31/2011 04/30/2011 05/31/2011 ... 05/31/2013
```

Before tackling the final examples, it is important to point out three new arguments for `cut.mondate` (and therefore for `cutmondate`) that do not appear in `cut.default` or `cut.Date`:

- startmonth
- startyear
- attr.breaks = FALSE

See the help for `cut.mondate` for details behind these arguments. We will show use of the first and third.

Fiscal Years

The 'startmonth' argument enables *fiscal year cuts*!

Example 14 Suppose ABC's fiscal year is July 1 through June 30. The dates of loss in the previous examples can be cut into fiscal years by setting startmonth = 7.

Here we show three ways to cut DateOfLoss by fiscal year. The choice may depend on whether the company identifies its fiscal year with the beginning day or ending day of the period.

```
cutmondate(DateOfLoss, breaks = "year", startmonth = 7)
```

```
##  [1] 2011-07-01 2011-07-01 2010-07-01 2010-07-01 2010-07-01 2012-07-01
##  [7] 2011-07-01 2010-07-01 2011-07-01 2010-07-01
## Levels: 2010-07-01 2011-07-01 2012-07-01
```

```
cutmondate(DateOfLoss, breaks = "year", startmonth = 7, right = TRUE)
```

```
##  [1] 2012-06-30 2012-06-30 2011-06-30 2011-06-30 2011-06-30 2013-06-30
##  [7] 2012-06-30 2011-06-30 2012-06-30 2011-06-30
## Levels: 2011-06-30 2012-06-30 2013-06-30
```

```
cutmondate(mondate(DateOfLoss), breaks = "year", startmonth = 7)
```

```
##  [1] 06/30/2012 06/30/2012 06/30/2011 06/30/2011 06/30/2011 06/30/2013
##  [7] 06/30/2012 06/30/2011 06/30/2012 06/30/2011
## Levels: 06/30/2011 06/30/2012 06/30/2013
```

Continuing, suppose ABC Company conventually refers to a fiscal year by the first of the two connected calendar years. The dates can be cut and the abbreviated labels automatically generated in the single function call

```
cutmondate(mondate(DateOfLoss, displayFormat = "%Y"),
           breaks = "year", right = FALSE, startmonth = 7)
```

```
##  [1] 2011 2011 2010 2010 2010 2012 2011 2010 2011 2010
## Levels: 2010 2011 2012
```

In the final example we aggregate and plot data by fiscal year.

Example 15 ABC Insurance Co. records loss amounts associated with the dates of loss at regular intervals. Suppose the amounts as of 2016-06-30 are

```
(LossAmount <- round(rnorm(10, 1000, 100), -1))
```

```
##  [1]  890  970  970  960 1030  910 1040  880  980 1040
```

ABC's actuaries want to aggregate loss by "fiscal-accident-year" ages (measured on months) as of June 30, 2016. The C-Suite wants to see loss aggregations by fiscal year. Everyone wants visuals! No problem.

First, cut the loss dates into fiscal years (FY), but this time also use "attr.breaks = TRUE", which makes the break points available for subsequent age calculation.

```
FY <- cutmondate(mondate(DateOfLoss, displayFormat = "%Y"),
           breaks = "year", right = FALSE, startmonth = 7,
           attr.breaks = TRUE)
age <- mondate("2016-12-31") - attr(FY, "breaks")[FY]
(data <- data.frame(DateOfLoss, LossAmount, FY, FYage = age))
```

```
##    DateOfLoss LossAmount   FY     FYage
## 1  2011-08-18        890 2011 66 months
## 2  2011-12-26        970 2011 66 months
## 3  2011-02-13        970 2010 78 months
## 4  2011-02-12        960 2010 78 months
## 5  2011-05-12       1030 2010 78 months
```

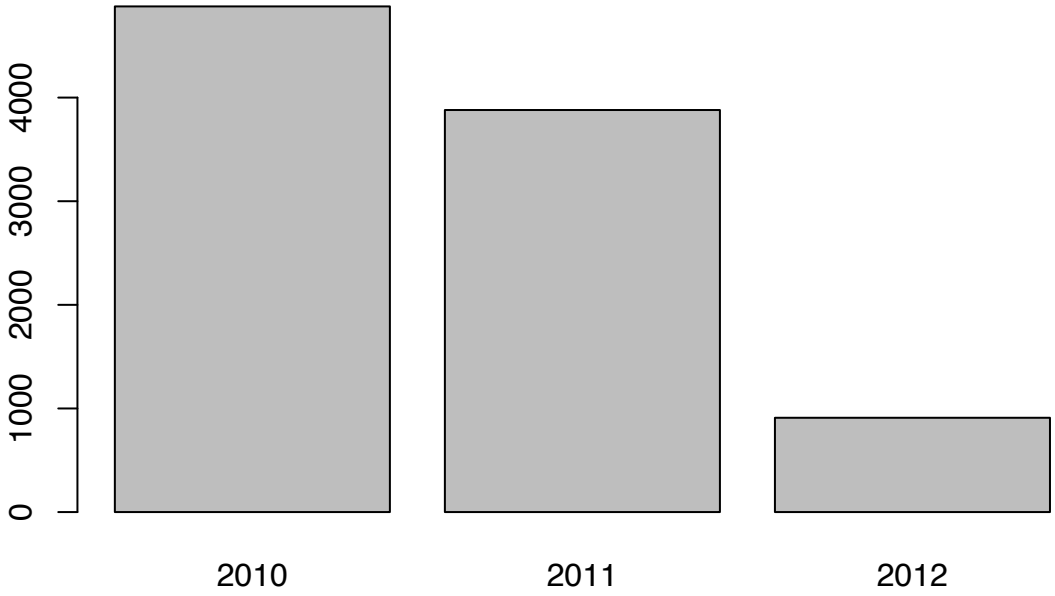
```
## 6  2013-05-30        910 2012 54 months
## 7  2012-01-10       1040 2011 66 months
## 8  2011-06-12        880 2010 78 months
## 9  2011-10-18        980 2011 66 months
## 10 2011-02-14       1040 2010 78 months
```

Then plot the loss totals. The plots below use base R graphics. The first plot is by FY, the second by FY age.

```
(LossByFY <- aggregate(LossAmount ~ FY, data, sum))
```

```
##     FY LossAmount
## 1 2010       4880
## 2 2011       3880
## 3 2012        910
```

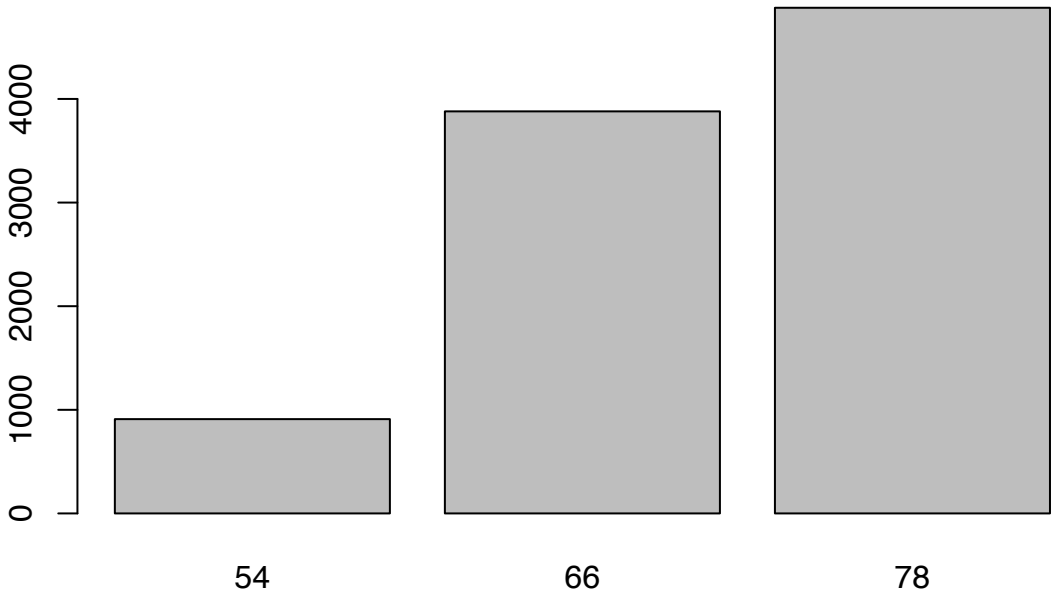
```
barplot(LossByFY$LossAmount, names.arg = LossByFY$FY)
```




```
# and
(LossByFYage <- aggregate(LossAmount ~ FYage, data, sum))
```

```
##       FYage LossAmount
## 1 54 months        910
## 2 66 months       3880
## 3 78 months       4880
```

```
barplot(LossByFYage$LossAmount, names.arg = LossByFYage$FYage)
```



Thank you

Many thanks to the R Development team for their work on `Date` and `POSIXt` objects and methods.

A special thank you goes out to Gabor Grothendieck for his suggestion of, and help with, `cut.mondate`.

Finally, the "mondate perspective" was motivated by Damien Laker in his somewhat obscure 2008 paper *Time Calculations for Annualizing Returns: The Need for Standardization*[11] where he states the obvious :-)

> "Annualization calculations based on whole months never wind up accidentally calculating that a year is anything other than a year long."

Mr. Laker' *Recommended Method* is based on two cases:

1. "For any period that starts and finishes on the last day of a month, the time calculation can be done entirely in months."
2. "In cases where the start date or end date is not the last day of a month, it will be necessary to count a partial month."[12]

The mondate package embraces Mr. Laker's end-of-business, month-centric, a-year-equals-twelve-months perspective.

[11] The Journal of Performance Measurement, Summer 2008
[12] .ibid