Working with dates and times in Stata

Gabriela Ortiz
Applied Econometrician
StataCorp LLC

Ideal dates

October 28, 2021

2021.10.28

10-28-2021

Oct 28 '21

What is your ideal date?

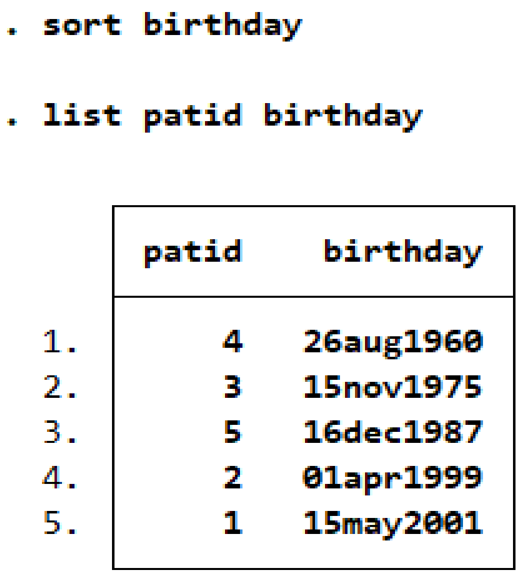
28oct2021

20211028

10/28/2021

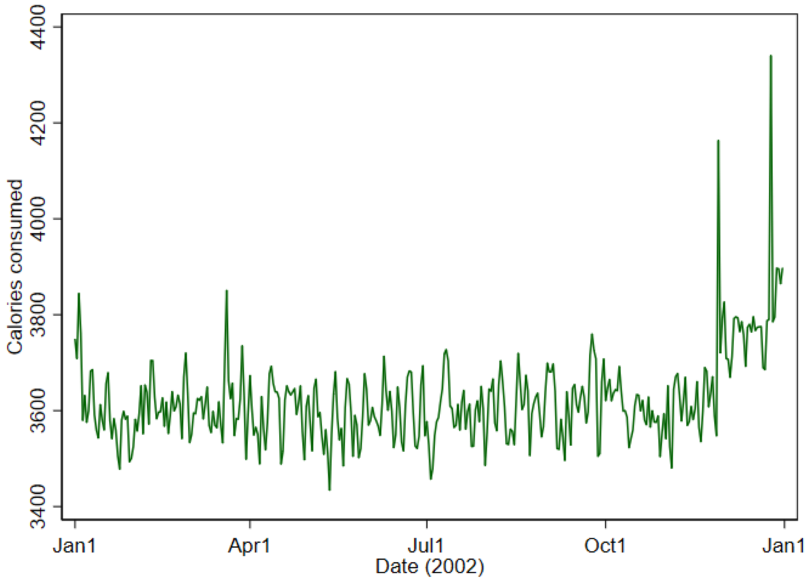
Thu Oct 28 2021

You may be working with dates for a couple different reasons

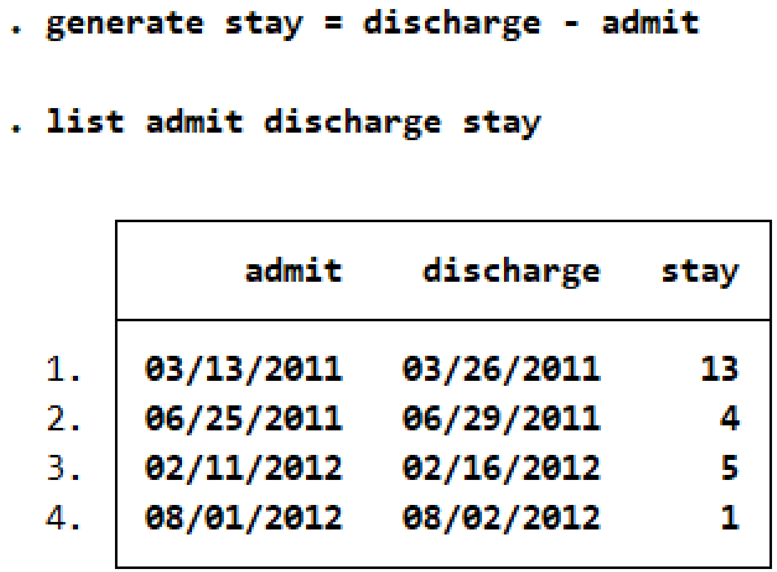


```
. sort birthday

. list patid birthday

     +------------------+
     | patid   birthday |
     |------------------|
  1. |     4  26aug1960 |
  2. |     3  15nov1975 |
  3. |     5  16dec1987 |
  4. |     2  01apr1999 |
  5. |     1  15may2001 |
     +------------------+
```

Sort data chronologically



Perform time-series analysis



```
. generate stay = discharge - admit

. list admit discharge stay

     +-------------------------------+
     |      admit    discharge   stay |
     |-------------------------------|
  1. | 03/13/2011   03/26/2011     13 |
  2. | 06/25/2011   06/29/2011      4 |
  3. | 02/11/2012   02/16/2012      5 |
  4. | 08/01/2012   08/02/2012      1 |
     +-------------------------------+
```

Compute the time between dates

Overview

- How Stata stores dates and times
- Converting dates and times stored as strings to numeric dates and times
- Formatting our dates and times for readability
- Converting among date types
- Using dates and times in expressions
- Building dates and times from components
- Computing durations
- Converting dates and times from other software to Stata dates and times
- Working with business dates

How and why Stata stores dates

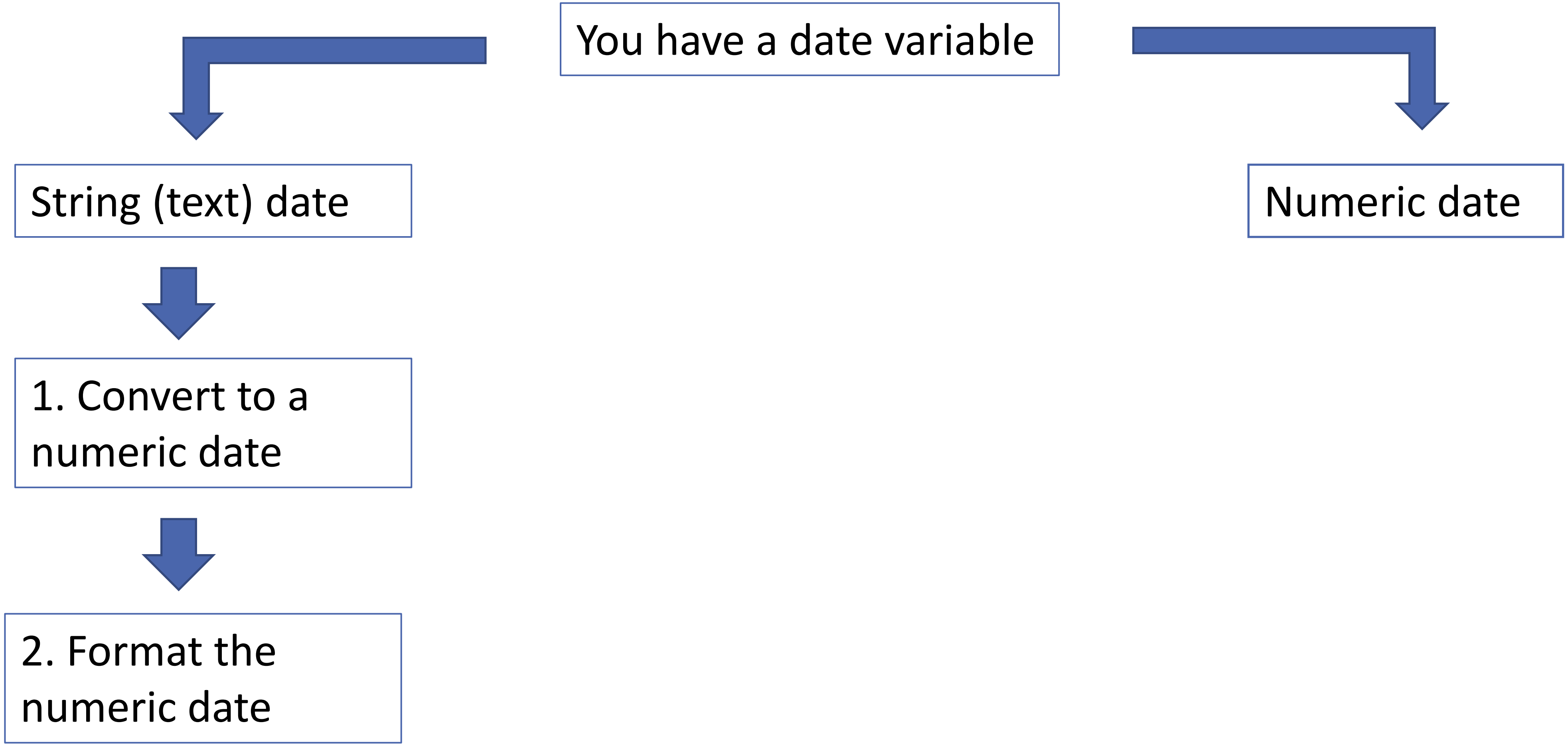
- Stata has dates and datetimes and they are stored differently. We'll begin by focusing on dates.

- Stata stores dates as the number of days elapsed since January 1, 1960
  - This means January 1, 1970, would be stored as 3653 $((365 \times 10) + 3)$

- We use display formats to display 3653 as January 1, 1970

- Numeric dates allow us to:
  - Sort our data chronologically
  - Prepare our data for time-series analysis
  - Compute the time between dates

How dates work in Stata



You have a date variable

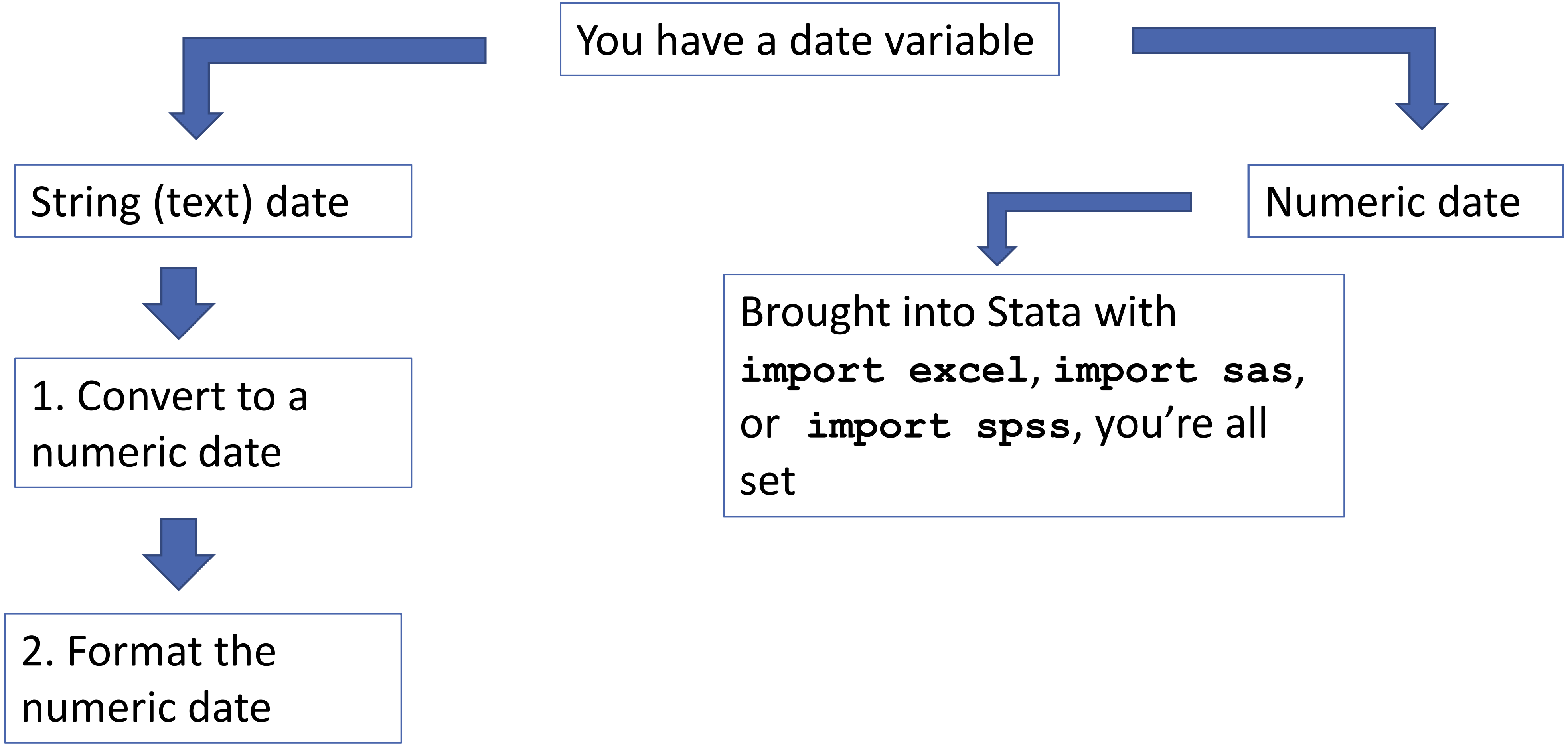
String (text) date

1. Convert to a numeric date

2. Format the numeric date

Numeric date

How dates work in Stata



You have a date variable

String (text) date

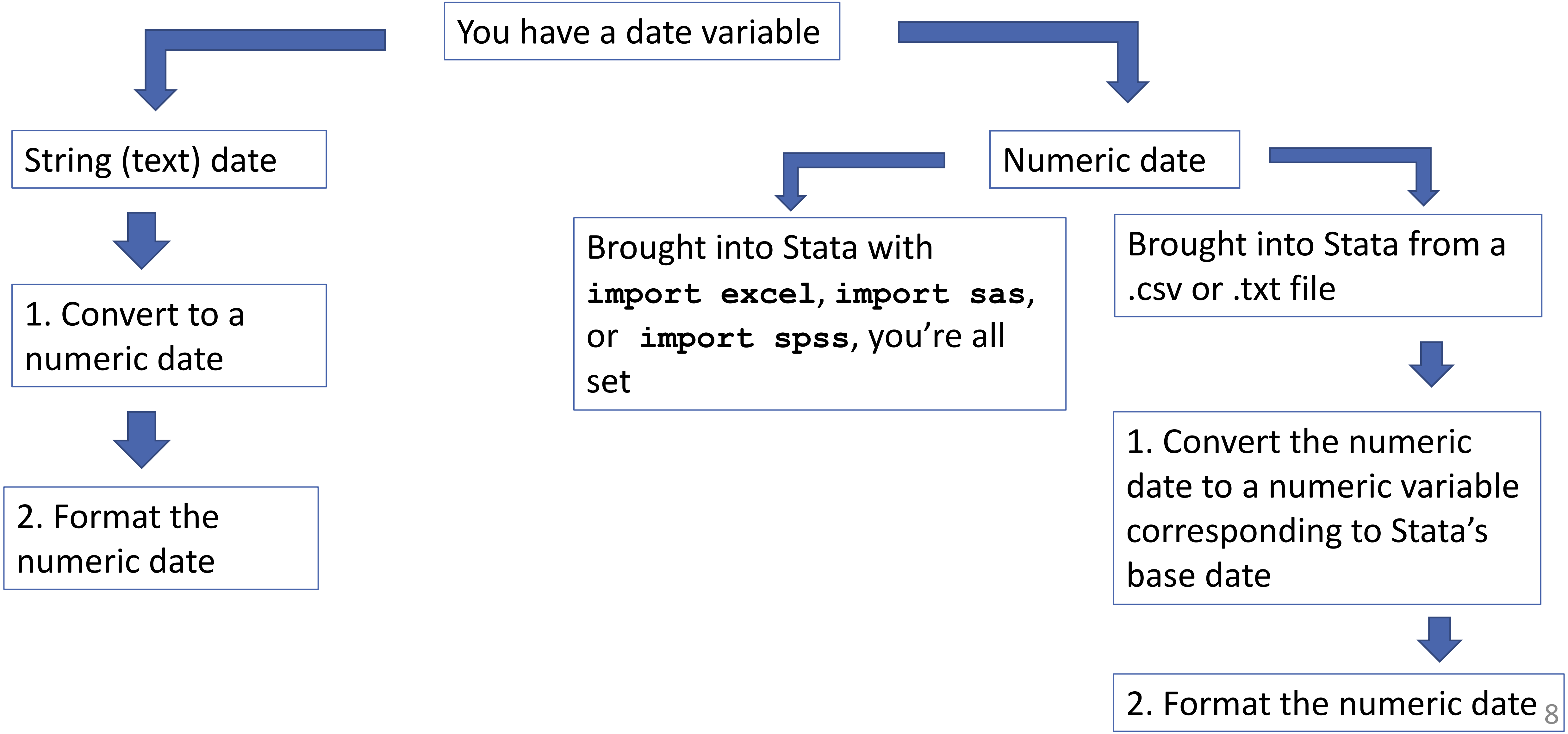
1. Convert to a numeric date

2. Format the numeric date

Numeric date

Brought into Stata with `import excel`, `import sas`, or `import spss`, you're all set

How dates work in Stata



You have a date variable

String (text) date

1. Convert to a numeric date

2. Format the numeric date

Numeric date

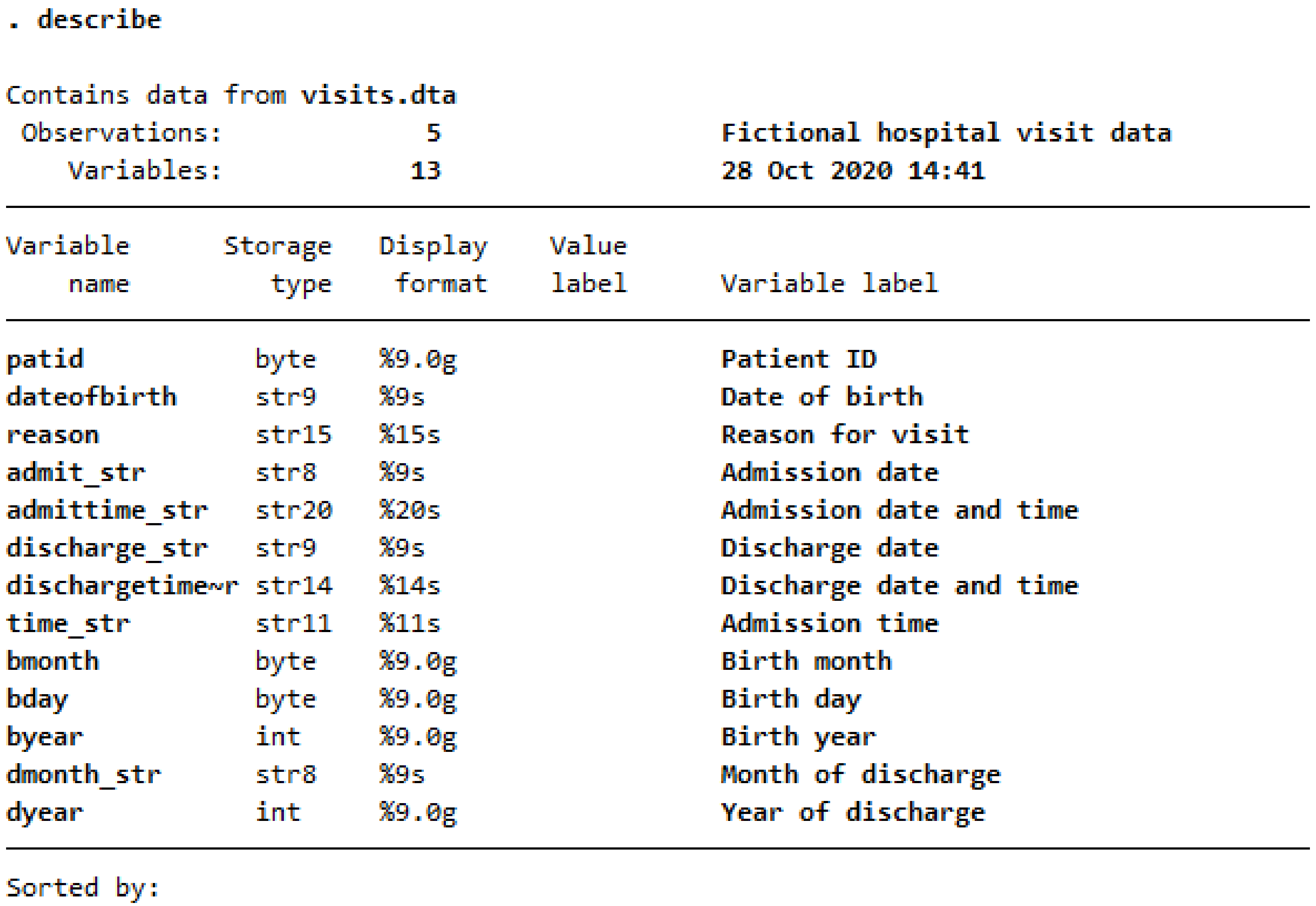
Brought into Stata with **`import excel`**, **`import sas`**, or **`import spss`**, you're all set

Brought into Stata from a .csv or .txt file

1. Convert the numeric date to a numeric variable corresponding to Stata's base date

2. Format the numeric date

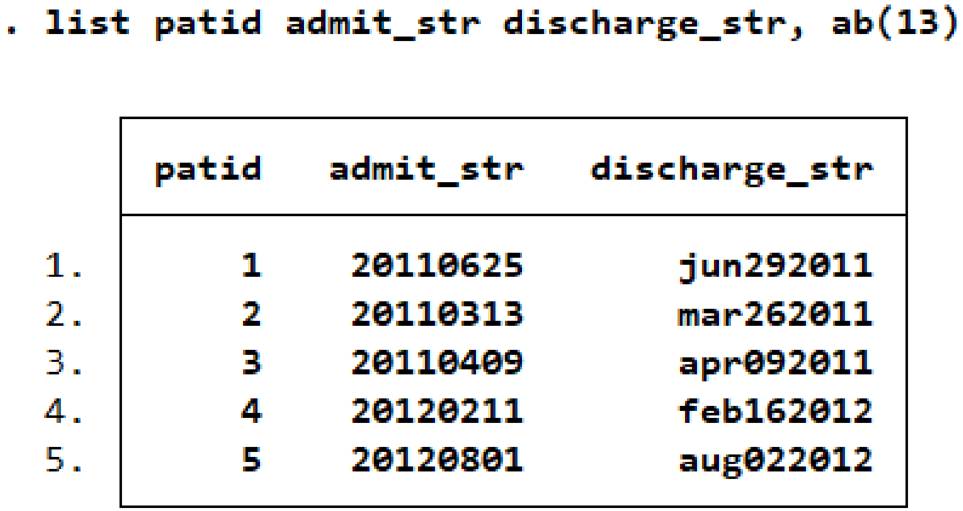
Fictional hospital admissions data



```
. describe

Contains data from visits.dta
 Observations:             5                  Fictional hospital visit data
    Variables:            13                  28 Oct 2020 14:41
-------------------------------------------------------------------------------------
Variable      Storage   Display    Value
    name         type    format    label      Variable label
-------------------------------------------------------------------------------------
patid           byte    %9.0g                 Patient ID
dateofbirth     str9    %9s                   Date of birth
reason          str15   %15s                  Reason for visit
admit_str       str8    %9s                   Admission date
admittime_str   str20   %20s                  Admission date and time
discharge_str   str9    %9s                   Discharge date
dischargetime~r str14   %14s                  Discharge date and time
time_str        str11   %11s                  Admission time
bmonth          byte    %9.0g                 Birth month
bday            byte    %9.0g                 Birth day
byear           int     %9.0g                 Birth year
dmonth_str      str8    %9s                   Month of discharge
dyear           int     %9.0g                 Year of discharge
-------------------------------------------------------------------------------------
Sorted by:
```

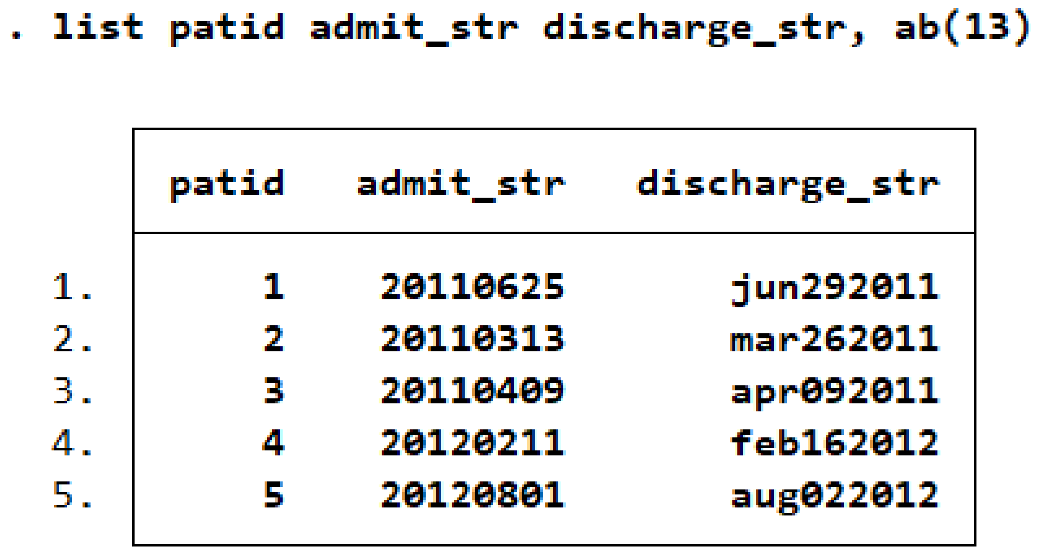
Converting dates and times stored as strings to numeric dates and times

Dates of admission and discharge



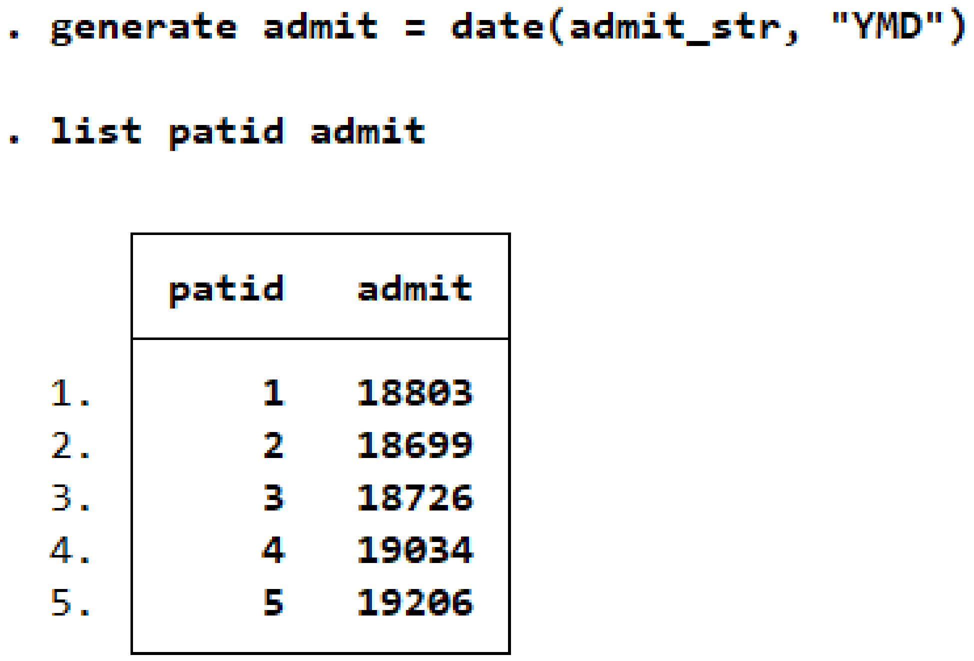
```
. list patid admit_str discharge_str, ab(13)

     +-------------------------------------+
     | patid   admit_str   discharge_str |
     |-------------------------------------|
  1. |     1    20110625       jun292011 |
  2. |     2    20110313       mar262011 |
  3. |     3    20110409       apr092011 |
  4. |     4    20120211       feb162012 |
  5. |     5    20120801       aug022012 |
     +-------------------------------------+
```

Step 1: Convert string date to a numeric date



```
. list patid admit_str discharge_str, ab(13)

     +-----------------------------------+
     | patid   admit_str   discharge_str |
     |-----------------------------------|
  1. |     1    20110625       jun292011 |
  2. |     2    20110313       mar262011 |
  3. |     3    20110409       apr092011 |
  4. |     4    20120211       feb162012 |
  5. |     5    20120801       aug022012 |
     +-----------------------------------+
```

1.



```
. generate admit = date(admit_str, "YMD")

. list patid admit

     +---------------+
     | patid   admit |
     |---------------|
  1. |     1   18803 |
  2. |     2   18699 |
  3. |     3   18726 |
  4. |     4   19034 |
  5. |     5   19206 |
     +---------------+
```

Step 2: Format the numeric date for readability

```
. list patid admit_str discharge_str, ab(13)

     +-----------------------------------------+
     | patid   admit_str   discharge_str       |
     |-----------------------------------------|
  1. |     1    20110625       jun292011       |
  2. |     2    20110313       mar262011       |
  3. |     3    20110409       apr092011       |
  4. |     4    20120211       feb162012       |
  5. |     5    20120801       aug022012       |
     +-----------------------------------------+
```

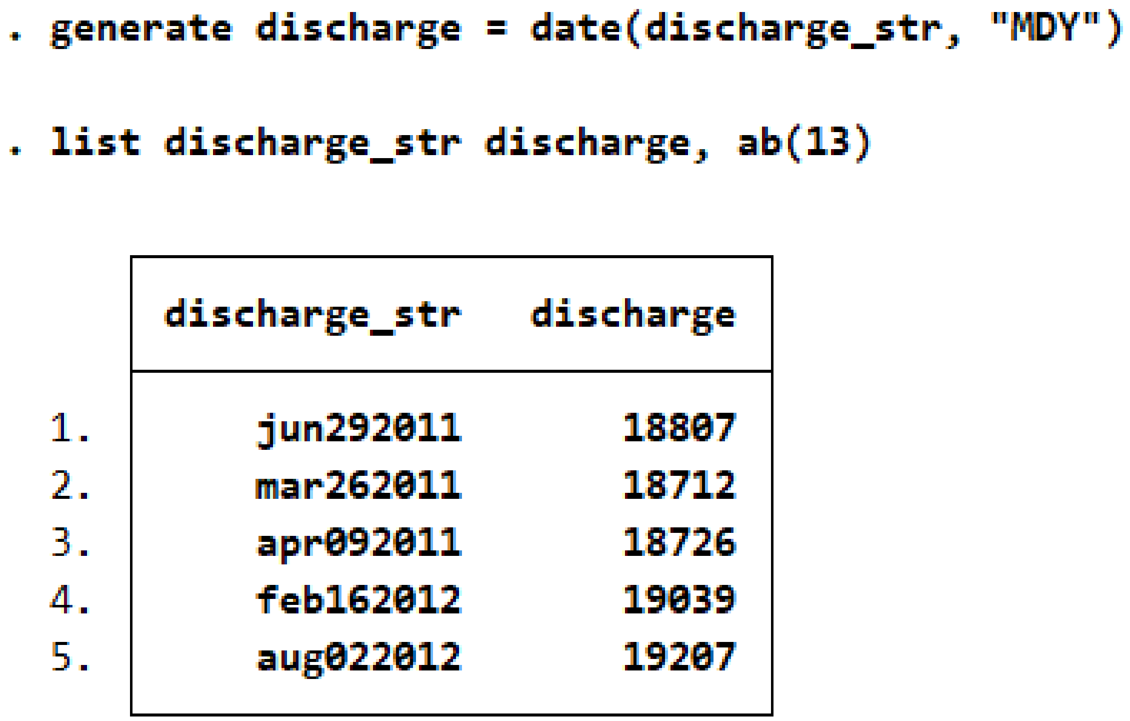
1.

```
. generate admit = date(admit_str, “YMD”)
```

2.

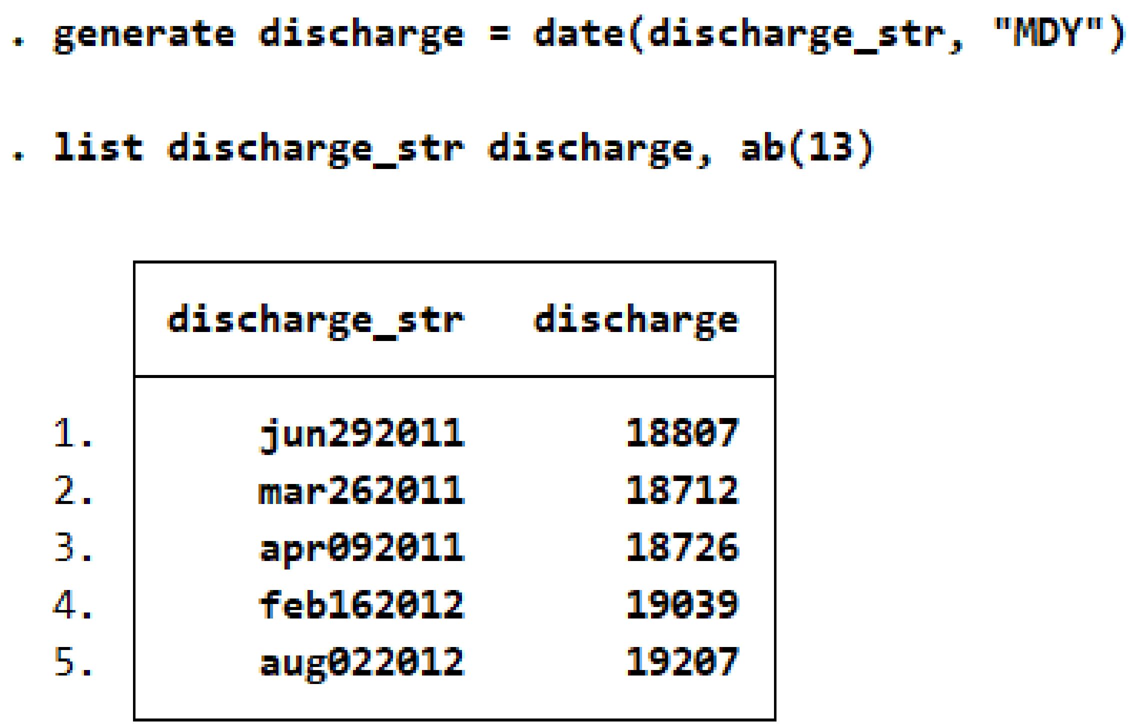
```
. format admit %td

. list patid admit

     +--------------------+
     | patid        admit |
     |--------------------|
  1. |     1    25jun2011 |
  2. |     2    13mar2011 |
  3. |     3    09apr2011 |
  4. |     4    11feb2012 |
  5. |     5    01aug2012 |
     +--------------------+
```

Step 1: Convert string date to a numeric date

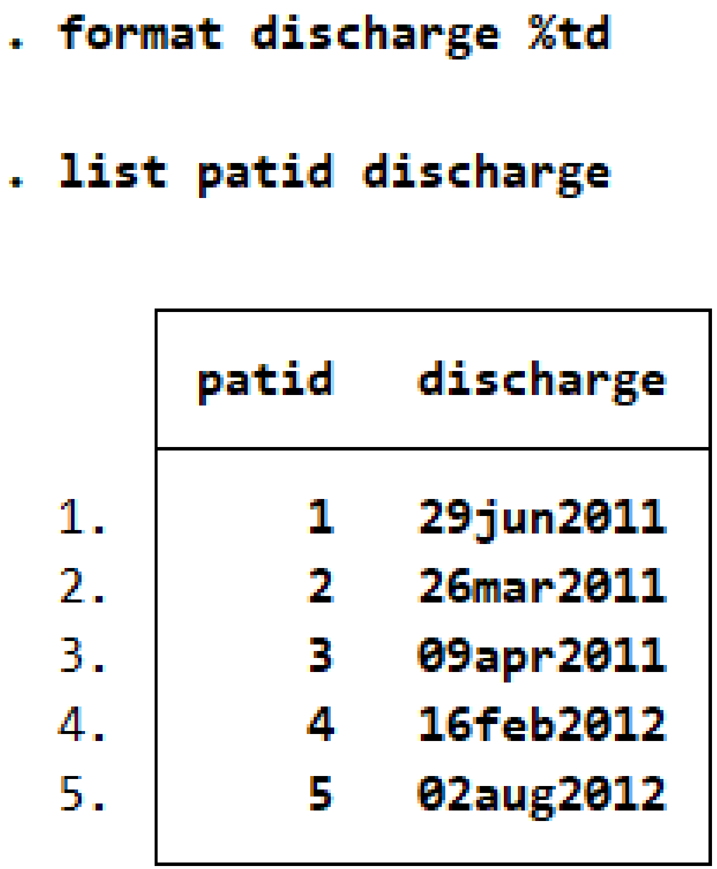


```
. generate discharge = date(discharge_str, "MDY")

. list discharge_str discharge, ab(13)

     +-----------------------------+
     | discharge_str   discharge   |
     |-----------------------------|
  1. |     jun292011       18807   |
  2. |     mar262011       18712   |
  3. |     apr092011       18726   |
  4. |     feb162012       19039   |
  5. |     aug022012       19207   |
     +-----------------------------+
```

Step 2: Format the numeric date for readability

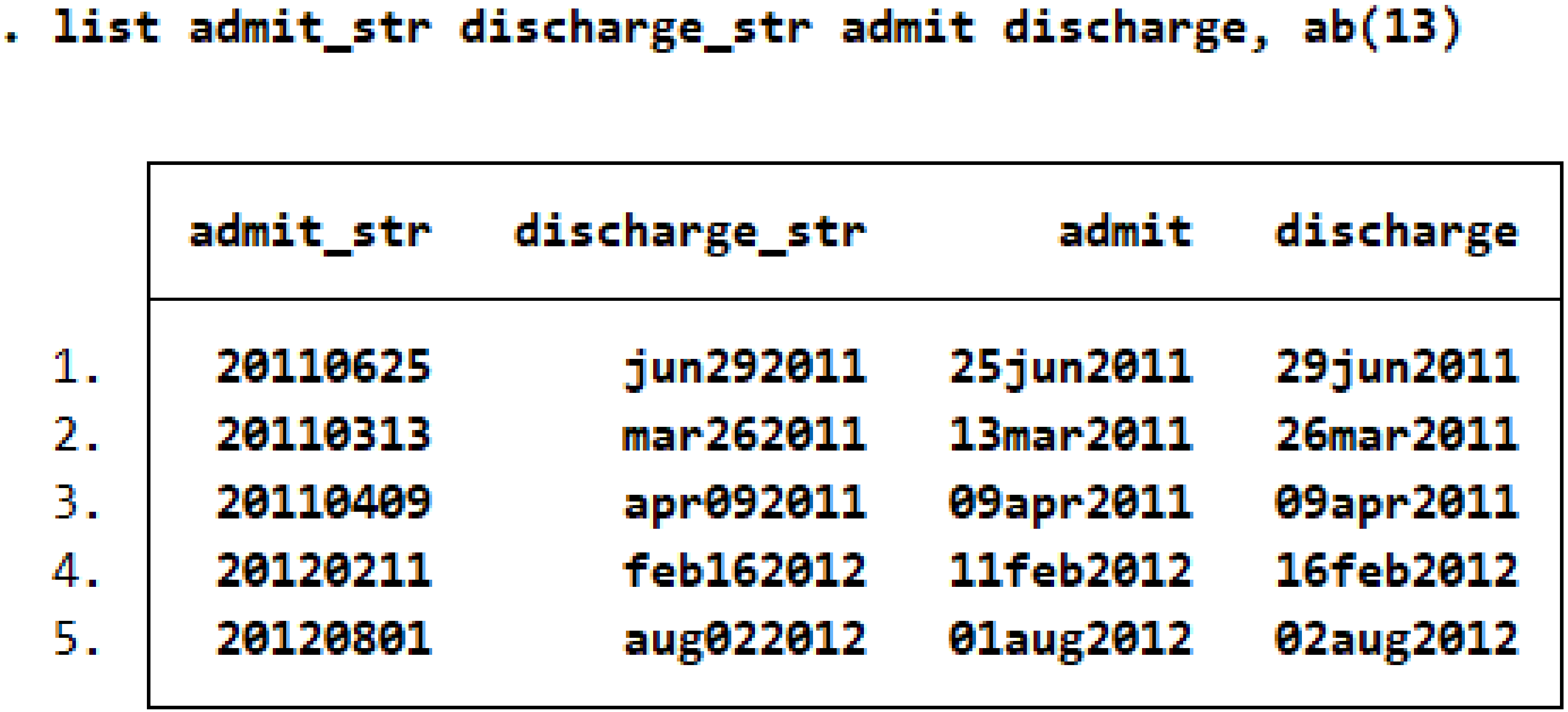


```
. generate discharge = date(discharge_str, "MDY")

. list discharge_str discharge, ab(13)

     +-----------------------------+
     | discharge_str   discharge   |
     |-----------------------------|
  1. |     jun292011       18807   |
  2. |     mar262011       18712   |
  3. |     apr092011       18726   |
  4. |     feb162012       19039   |
  5. |     aug022012       19207   |
     +-----------------------------+
```



```
. format discharge %td

. list patid discharge

     +-------------------+
     | patid   discharge |
     |-------------------|
  1. |     1   29jun2011 |
  2. |     2   26mar2011 |
  3. |     3   09apr2011 |
  4. |     4   16feb2012 |
  5. |     5   02aug2012 |
     +-------------------+
```

The %td display format



```
. list admit_str discharge_str admit discharge, ab(13)

     +-------------------------------------------------------+
     |  admit_str   discharge_str       admit    discharge   |
     |-------------------------------------------------------|
  1. |   20110625       jun292011   25jun2011    29jun2011   |
  2. |   20110313       mar262011   13mar2011    26mar2011   |
  3. |   20110409       apr092011   09apr2011    09apr2011   |
  4. |   20120211       feb162012   11feb2012    16feb2012   |
  5. |   20120801       aug022012   01aug2012    02aug2012   |
     +-------------------------------------------------------+
```

Customized date formats

Format	Date displayed
`%tdnn-dd-yy`	8-1-12
`%tdnn/dd/yy`	8/1/12

Customized date formats

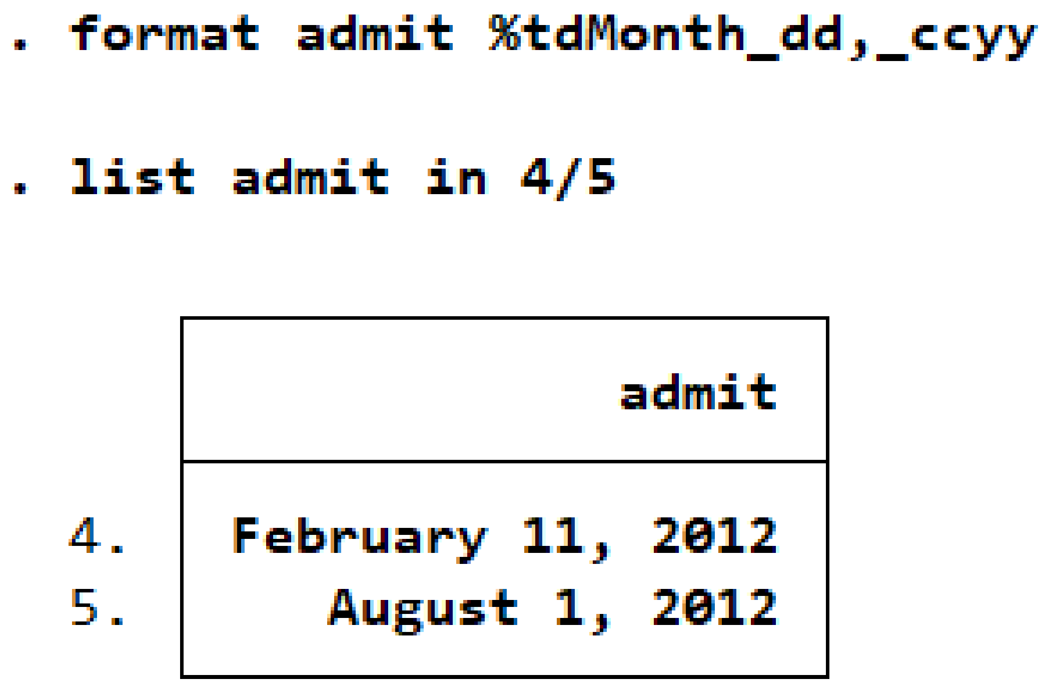
Format	Date displayed
`%tdnn-dd-yy`	8-1-12
`%tdnn/dd/yy`	8/1/12
`%tdNN/DD/YY`	08/01/12
`%tdNN/DD/CCYY`	08/01/2012

Customized date formats

Format	Date displayed
`%tdnn-dd-yy`	8-1-12
`%tdnn/dd/yy`	8/1/12
`%tdNN/DD/YY`	08/01/12
`%tdNN/DD/CCYY`	08/01/2012
`%tdMon_dd_!'yy`	Aug 1 '12
`%tdMonth_dd,_ccyy`	August 1, 2012
`%tdDayname_Mon_dd`	Wednesday Aug 1

See [D] Datetime display formats for more options.

Formatting dates: Spelling out the month

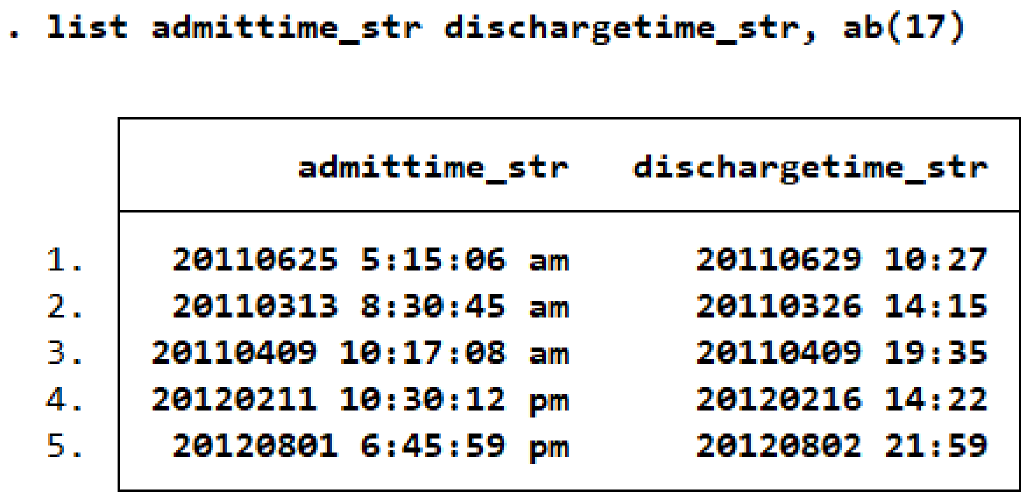


```
. format admit %tdMonth_dd,_ccyy

. list admit in 4/5

     +-------------------+
     |             admit |
     |-------------------|
  4. | February 11, 2012 |
  5. |    August 1, 2012 |
     +-------------------+
```

Date and time variables

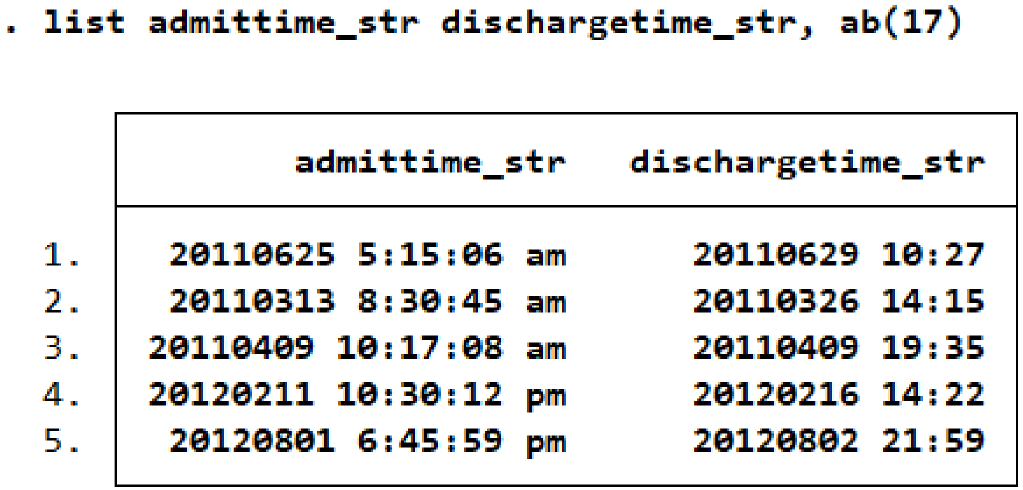
- Stata stores datetimes as the number of milliseconds elapsed since January 1, 1960 00:00:00.000
  - This is assuming there are 86,400 seconds in a day (60 seconds × 60 minutes × 24 hours)
- Once or twice a year, leap seconds are added to atomic clocks so that they're better synchronized with the Earth's rotation
  - We'll see how to adjust for leap seconds

Date and time variables

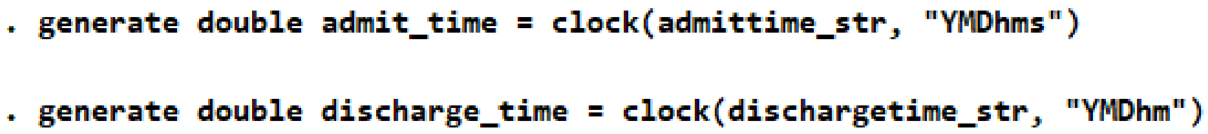


```
. list admittime_str dischargetime_str, ab(17)

     +------------------------------------------+
     |       admittime_str   dischargetime_str  |
     |------------------------------------------|
  1. |  20110625 5:15:06 am      20110629 10:27 |
  2. |  20110313 8:30:45 am      20110326 14:15 |
  3. | 20110409 10:17:08 am      20110409 19:35 |
  4. | 20120211 10:30:12 pm      20120216 14:22 |
  5. |  20120801 6:45:59 pm      20120802 21:59 |
     +------------------------------------------+
```

Converting dates and times stored as strings to numeric datetime variables

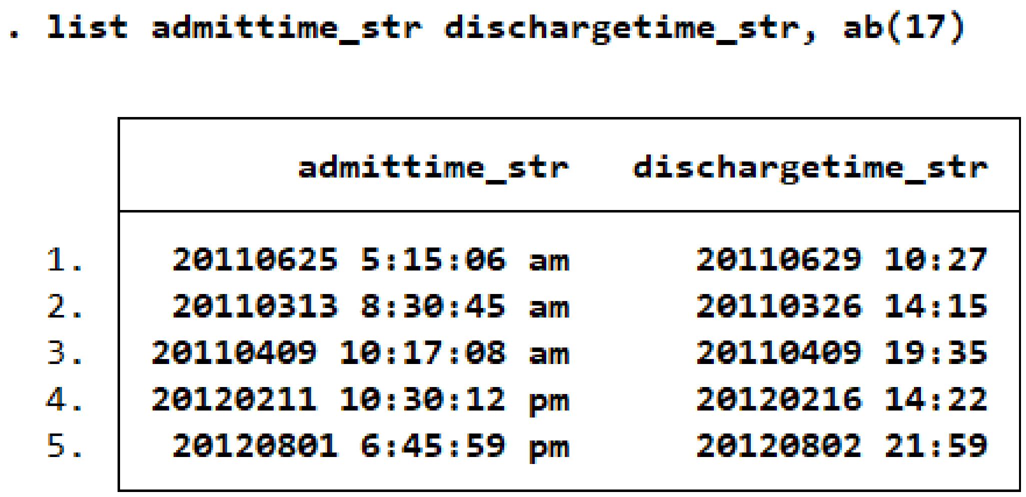


```
. list admittime_str dischargetime_str, ab(17)

     +-------------------------------------------+
     |         admittime_str   dischargetime_str |
     |-------------------------------------------|
  1. |   20110625 5:15:06 am      20110629 10:27 |
  2. |   20110313 8:30:45 am      20110326 14:15 |
  3. |  20110409 10:17:08 am      20110409 19:35 |
  4. |  20120211 10:30:12 pm      20120216 14:22 |
  5. |   20120801 6:45:59 pm      20120802 21:59 |
     +-------------------------------------------+
```

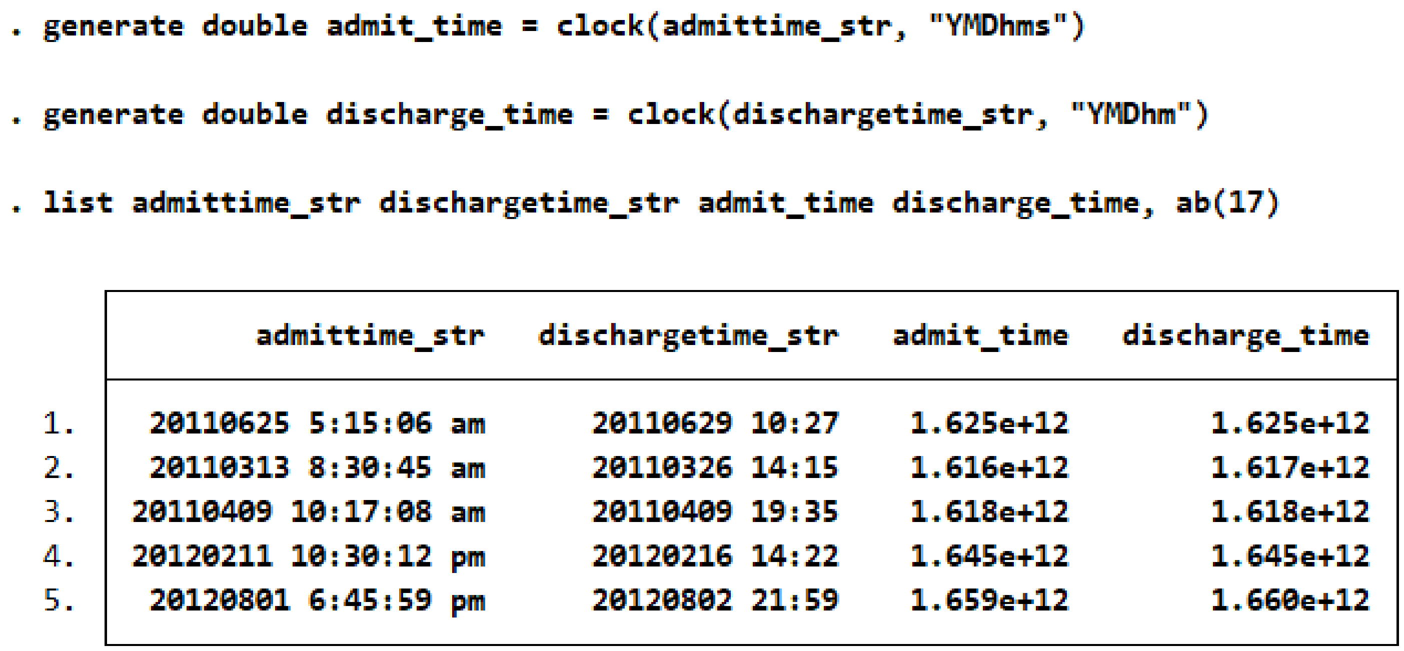


```
. generate double admit_time = clock(admittime_str, "YMDhms")

. generate double discharge_time = clock(dischargetime_str, "YMDhm")
```

Converting dates and times stored as strings to numeric datetime variables

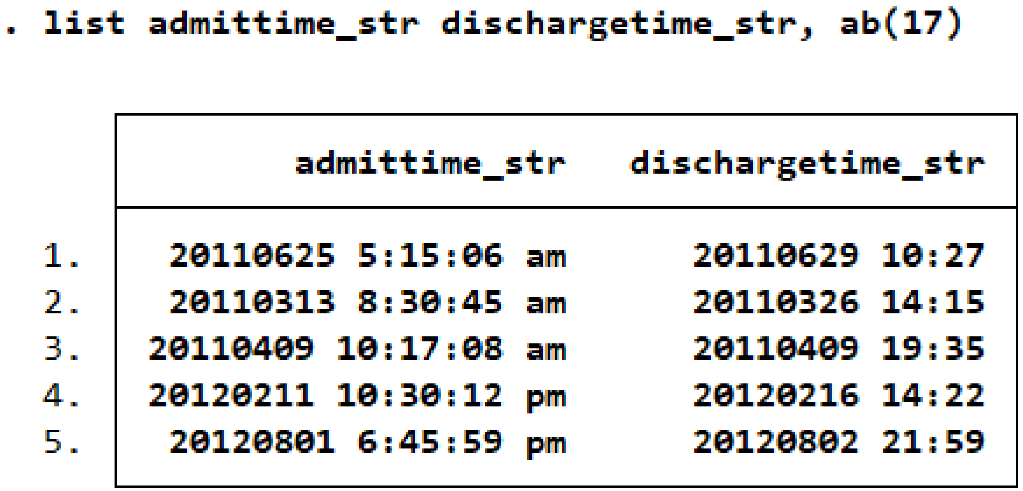


```
. list admittime_str dischargetime_str, ab(17)

     +---------------------------------------+
     |         admittime_str   dischargetime_str |
     |---------------------------------------|
  1. |  20110625 5:15:06 am      20110629 10:27 |
  2. |  20110313 8:30:45 am      20110326 14:15 |
  3. | 20110409 10:17:08 am      20110409 19:35 |
  4. | 20120211 10:30:12 pm      20120216 14:22 |
  5. |  20120801 6:45:59 pm      20120802 21:59 |
     +---------------------------------------+
```

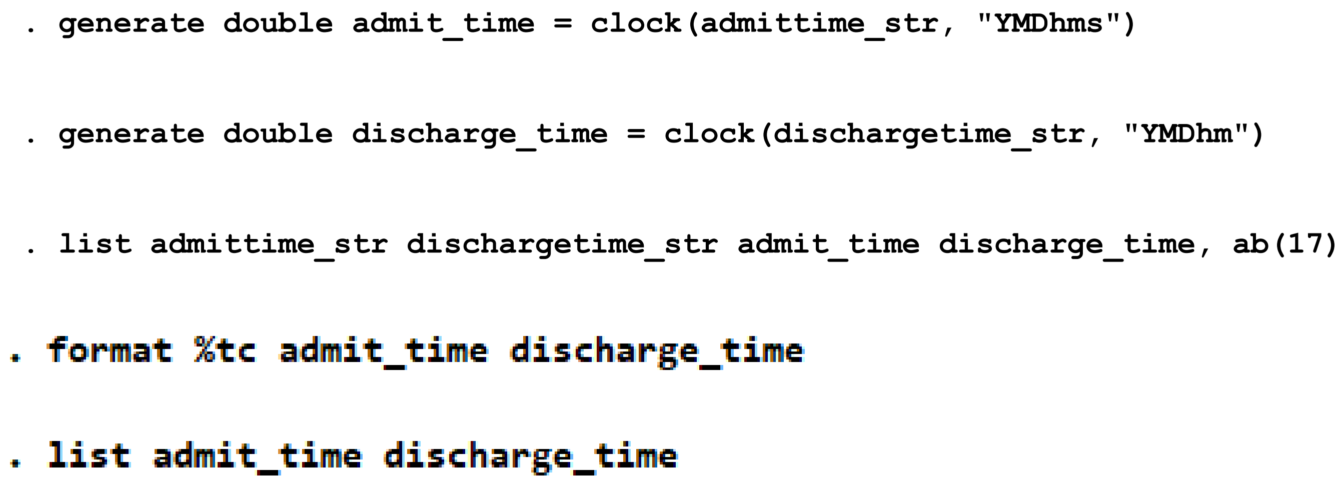


```
. generate double admit_time = clock(admittime_str, "YMDhms")

. generate double discharge_time = clock(dischargetime_str, "YMDhm")

. list admittime_str dischargetime_str admit_time discharge_time, ab(17)

     +--------------------------------------------------------------------+
     |        admittime_str   dischargetime_str   admit_time   discharge_time |
     |--------------------------------------------------------------------|
  1. |  20110625 5:15:06 am      20110629 10:27    1.625e+12        1.625e+12 |
  2. |  20110313 8:30:45 am      20110326 14:15    1.616e+12        1.617e+12 |
  3. | 20110409 10:17:08 am      20110409 19:35    1.618e+12        1.618e+12 |
  4. | 20120211 10:30:12 pm      20120216 14:22    1.645e+12        1.645e+12 |
  5. |  20120801 6:45:59 pm      20120802 21:59    1.659e+12        1.660e+12 |
     +--------------------------------------------------------------------+
```

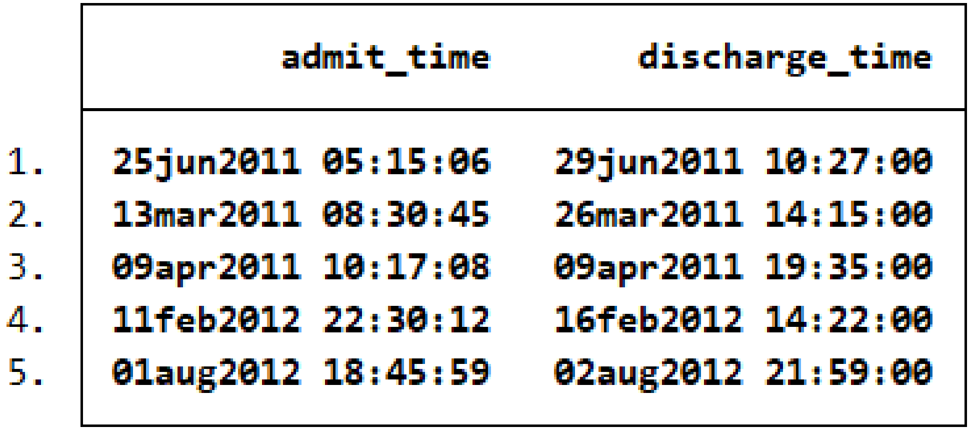
Formatting numeric datetime variables



```
. list admittime_str dischargetime_str, ab(17)

     +------------------------------------------+
     |         admittime_str   dischargetime_str |
     |------------------------------------------|
  1. |   20110625 5:15:06 am      20110629 10:27 |
  2. |   20110313 8:30:45 am      20110326 14:15 |
  3. |  20110409 10:17:08 am      20110409 19:35 |
  4. |  20120211 10:30:12 pm      20120216 14:22 |
  5. |   20120801 6:45:59 pm      20120802 21:59 |
     +------------------------------------------+
```



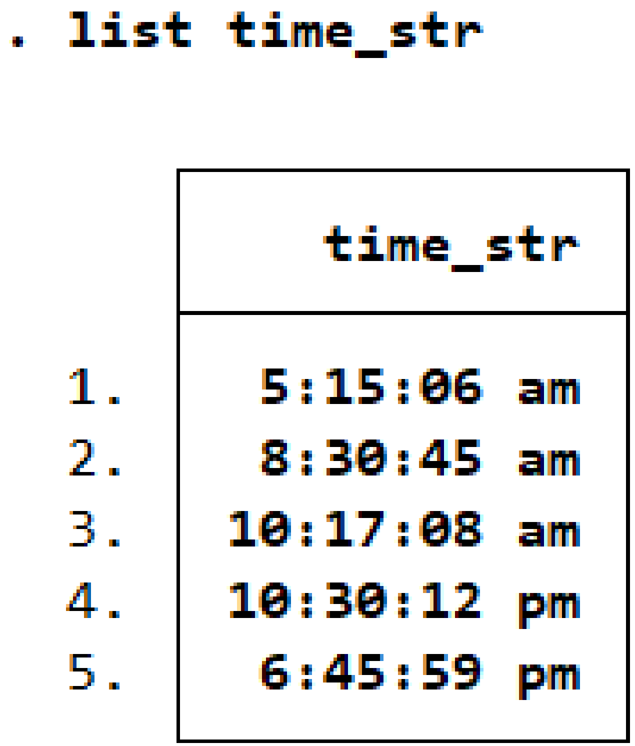
```
. generate double admit_time = clock(admittime_str, "YMDhms")

. generate double discharge_time = clock(dischargetime_str, "YMDhm")

. list admittime_str dischargetime_str admit_time discharge_time, ab(17)

. format %tc admit_time discharge_time

. list admit_time discharge_time
```



```
     +-----------------------------------------+
     |         admit_time       discharge_time |
     |-----------------------------------------|
  1. | 25jun2011 05:15:06   29jun2011 10:27:00 |
  2. | 13mar2011 08:30:45   26mar2011 14:15:00 |
  3. | 09apr2011 10:17:08   09apr2011 19:35:00 |
  4. | 11feb2012 22:30:12   16feb2012 14:22:00 |
  5. | 01aug2012 18:45:59   02aug2012 21:59:00 |
     +-----------------------------------------+
```

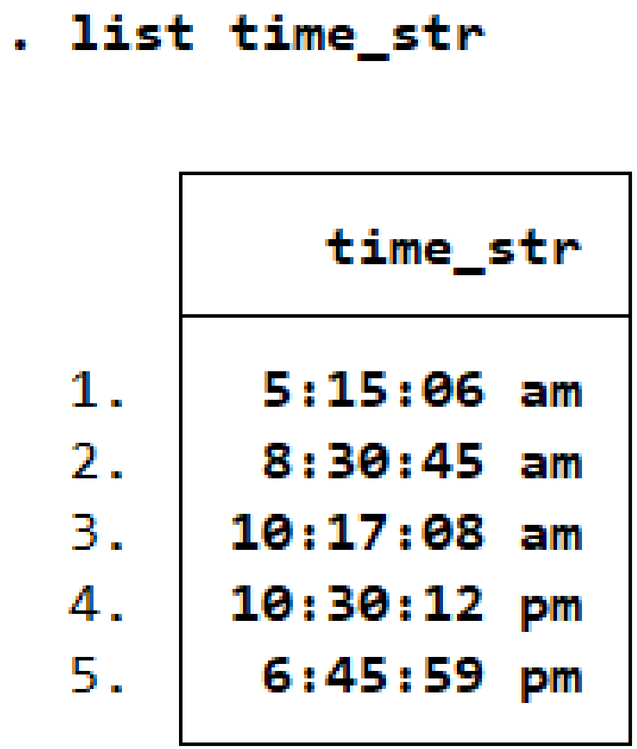
Always use storage type **`double`** when working with datetime variables.

Converting a strictly time variable to a numeric datetime variable

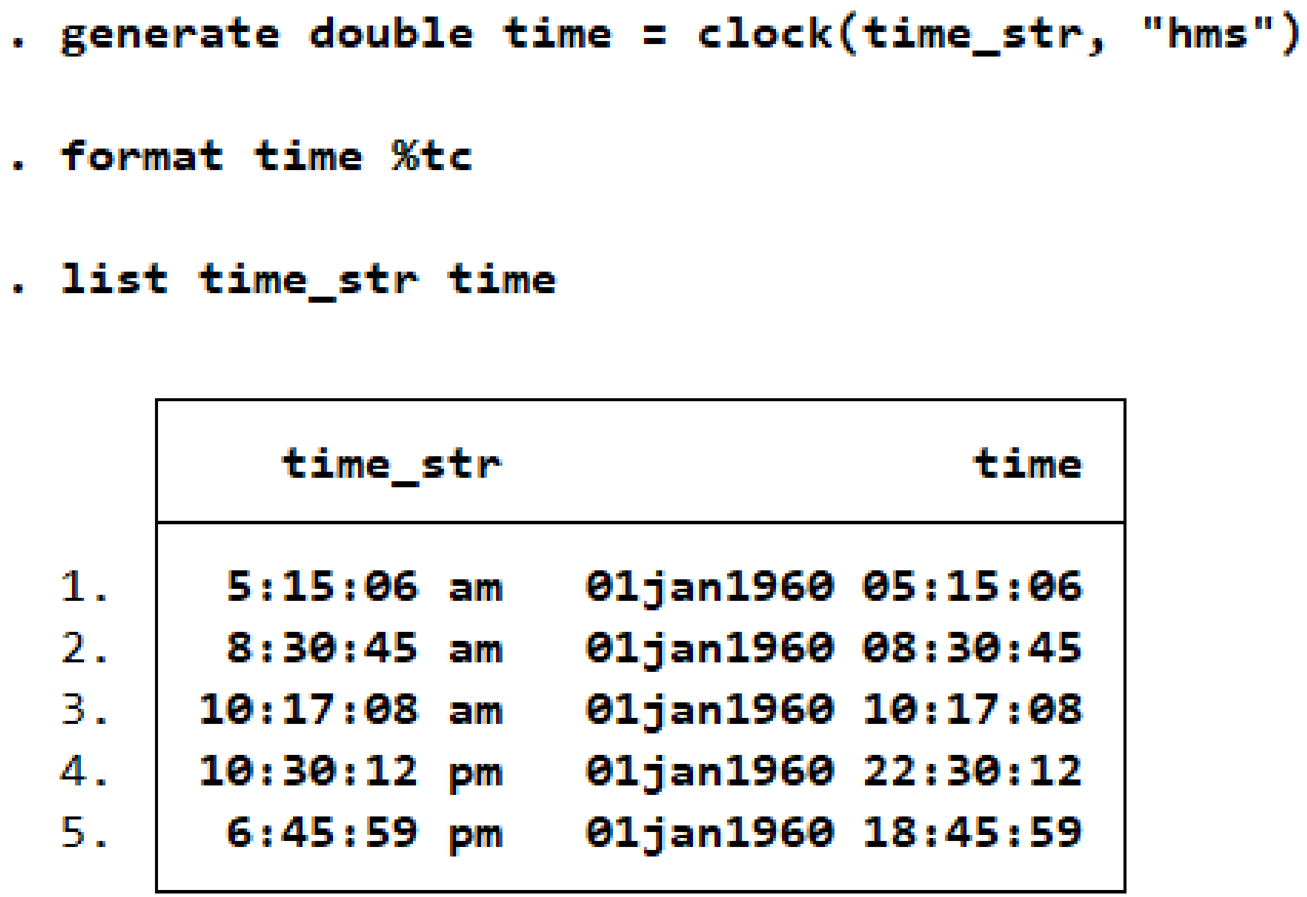


```
. list time_str

     +-------------+
     |    time_str |
     |-------------|
  1. |  5:15:06 am |
  2. |  8:30:45 am |
  3. | 10:17:08 am |
  4. | 10:30:12 pm |
  5. |  6:45:59 pm |
     +-------------+
```

Converting a strictly time variable to a numeric datetime variable



```
. list time_str

     +-------------+
     |    time_str |
     |-------------|
  1. |  5:15:06 am |
  2. |  8:30:45 am |
  3. | 10:17:08 am |
  4. | 10:30:12 pm |
  5. |  6:45:59 pm |
     +-------------+
```



```
. generate double time = clock(time_str, "hms")

. format time %tc

. list time_str time

     +----------------------------------+
     |    time_str                 time |
     |----------------------------------|
  1. |  5:15:06 am   01jan1960 05:15:06 |
  2. |  8:30:45 am   01jan1960 08:30:45 |
  3. | 10:17:08 am   01jan1960 10:17:08 |
  4. | 10:30:12 pm   01jan1960 22:30:12 |
  5. |  6:45:59 pm   01jan1960 18:45:59 |
     +----------------------------------+
```

Customized time formats

Format	Time displayed
`%tcHHMM`	1845
`%tcHH:MM`	18:45

See [D] Datetime display formats for more options.

Customized time formats

Format	Time displayed
`%tcHHMM`	1845
`%tcHH:MM`	18:45
`%tchh:MM`	6:45
`%tcHh:MM`	06:45

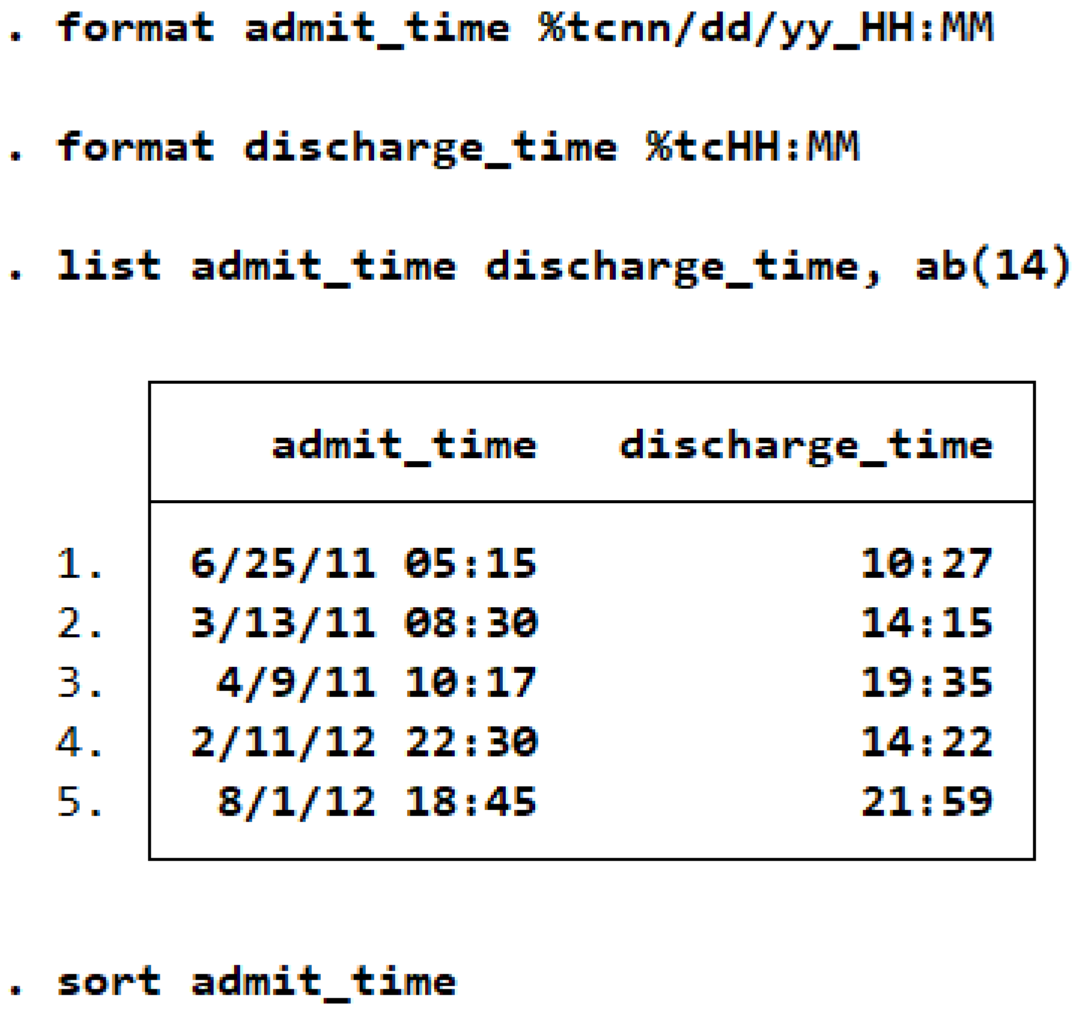
See [D] Datetime display formats for more options.

Customized time formats

Format	Time displayed
`%tcHHMM`	1845
`%tcHH:MM`	18:45
`%tchh:MM`	6:45
`%tcHh:MM`	06:45
`%tcHh:MM_a.m.`	06:45 p.m.
`%tcHh:MM_A.M.`	06:45 P.M.

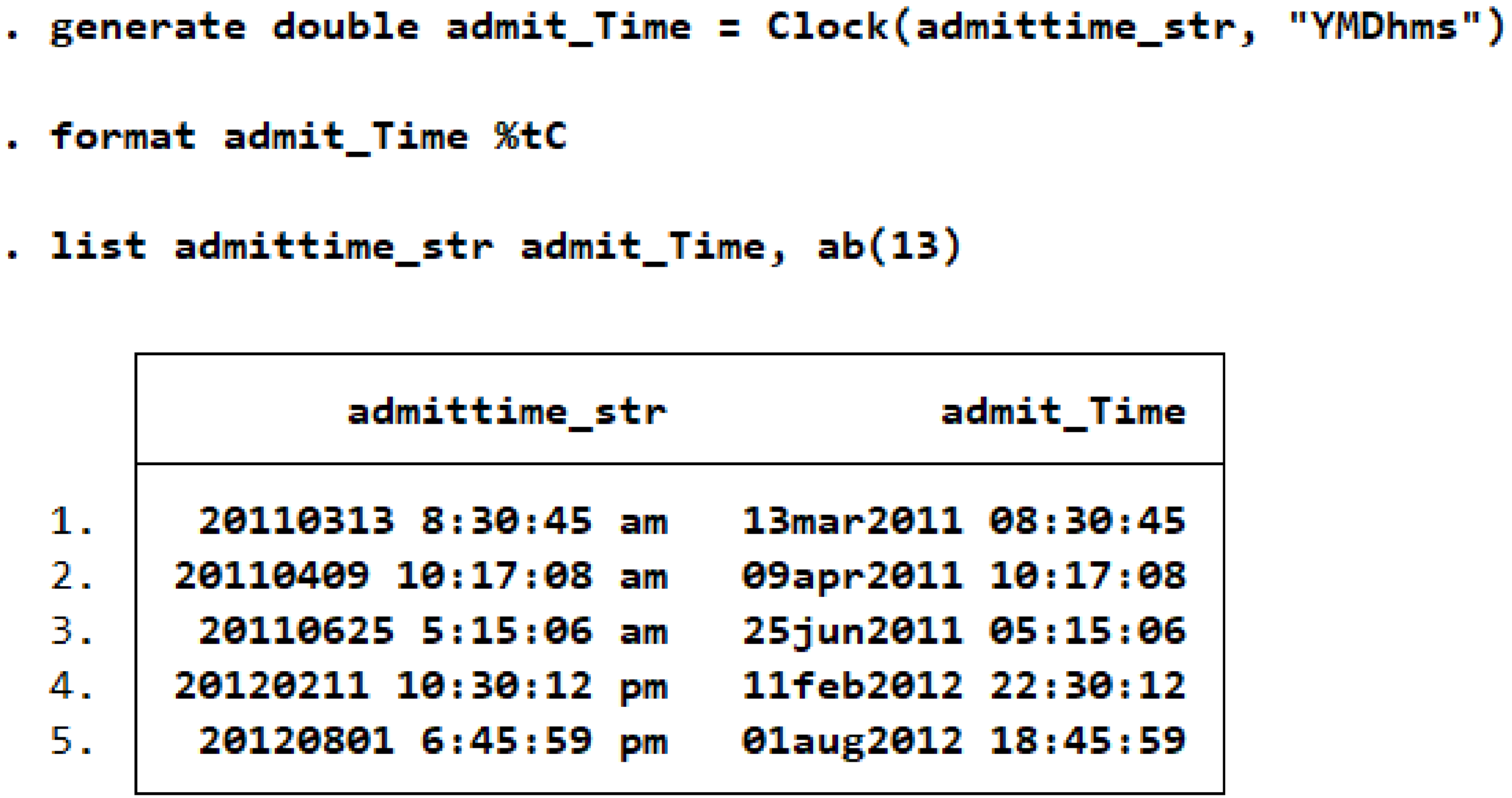
See [D] Datetime display formats for more options.

Customizing the display format for the datetime variables



```
. format admit_time %tcnn/dd/yy_HH:MM

. format discharge_time %tcHH:MM

. list admit_time discharge_time, ab(14)

     +---------------------------------+
     |     admit_time   discharge_time |
     |---------------------------------|
  1. | 6/25/11 05:15            10:27 |
  2. | 3/13/11 08:30            14:15 |
  3. |  4/9/11 10:17            19:35 |
  4. | 2/11/12 22:30            14:22 |
  5. |  8/1/12 18:45            21:59 |
     +---------------------------------+

. sort admit_time
```

Obtaining leap-second adjusted times



```
. generate double admit_Time = Clock(admittime_str, "YMDhms")

. format admit_Time %tC

. list admittime_str admit_Time, ab(13)

     +------------------------------------------+
     |       admittime_str           admit_Time |
     |------------------------------------------|
  1. |  20110313 8:30:45 am   13mar2011 08:30:45 |
  2. | 20110409 10:17:08 am   09apr2011 10:17:08 |
  3. |  20110625 5:15:06 am   25jun2011 05:15:06 |
  4. | 20120211 10:30:12 pm   11feb2012 22:30:12 |
  5. |  20120801 6:45:59 pm   01aug2012 18:45:59 |
     +------------------------------------------+
```

String-to-numeric conversion functions

Date type	String-to-numeric conversion function	Example
Datetime	**`clock(`**`string, “order_of_components”`**`)`**	**`clock(timevar, “YMDhms”)`**
*Datetime (UTC)	**`Clock(`**`string, “order_of_components”`**`)`**	**`Clock(timevar, “YMDhms”)`**
Daily date	**`date(`**`string, “order_of_components”`**`)`**	**`date(datevar, “YMD”)`**
Weekly date	**`weekly(`**`string, “order_of_components”`**`)`**	**`weekly(weekvar, “YW”)`**
Monthly date	**`monthly(`**`string, “order_of_components”`**`)`**	**`monthly(monthvar, “YM”)`**
Quarterly date	**`quarterly(`**`string, “order_of_components”`**`)`**	**`quarterly(qvar, “YQ”)`**

* Adjusted for leap seconds.

Date types and their units

Date type	Unit
Datetime (assuming 86,400 s/day)	Milliseconds since 01jan1960 00:00:00.000
Datetime (UTC)	Milliseconds since 01jan1960 00:00:00.000, adjusted for leap seconds
Daily date	Days since 01jan1960 (01jan1960 = 0)
Weekly date	Weeks since 1960w1
Monthly date	Months since 1960m1
Quarterly date	Quarters since 1960q1

Date and time display formats

Date type	**Display format**	**Date and time displayed**
Datetime	`%tc`	04feb2020 05:15:00
Datetime adjusted for leap seconds	`%tC`	04feb2020 05:15:00
Daily date	`%td`	04feb2020
Weekly date	`%tw`	2020w6
Monthly date	`%tm`	2020m2
Quarterly date	`%tq`	2020q1

Date and time display formats

Date type	**Display format**	**Date and time displayed**	**Customized display format**
Datetime	`%tc`	04feb2020 05:15:00	`%tc[`*`details`*`]`
Datetime adjusted for leap seconds	`%tC`	04feb2020 05:15:00	`%tC[`*`details`*`]`
Daily date	`%td`	04feb2020	`%td[`*`details`*`]`
Weekly date	`%tw`	2020w6	`%tw[`*`details`*`]`
Monthly date	`%tm`	2020m2	`%tm[`*`details`*`]`
Quarterly date	`%tq`	2020q1	`%tq[`*`details`*`]`

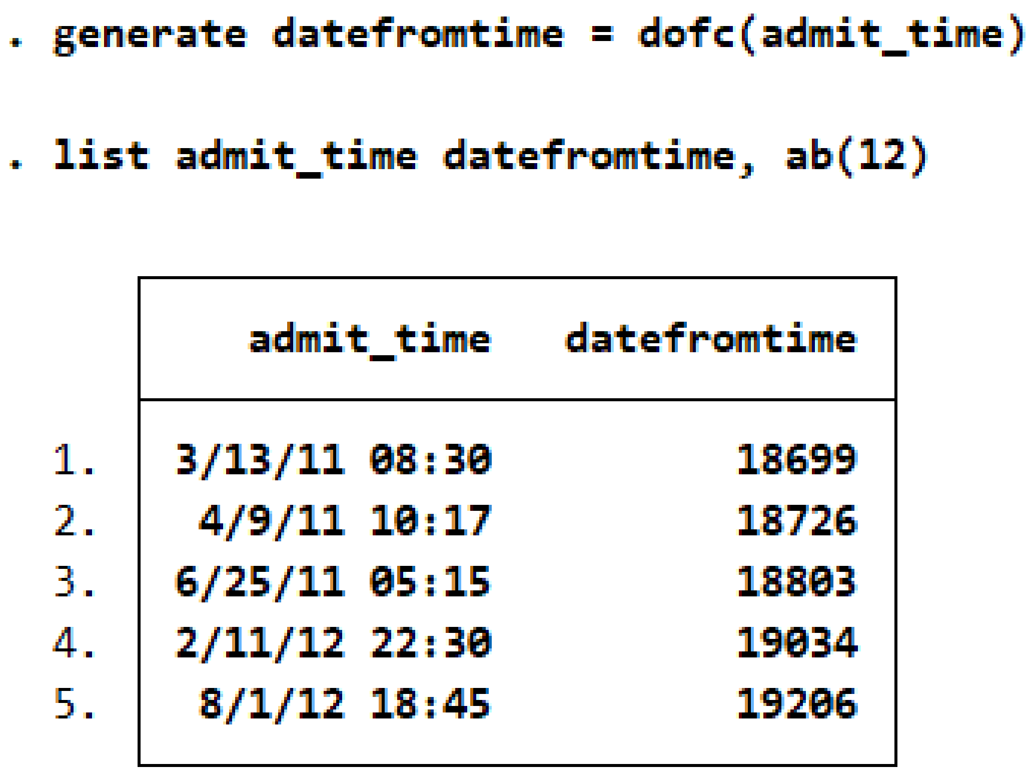
Converting among date types

Converting among date types

- Sometimes the dates we are given are not of the form we need
- We can easily convert a datetime variable to a daily date, a daily date to a monthly date, etc.
  - In these cases, we have more information than we need
- We can also convert, for example, a monthly date to a daily date
  - In this case, we don’t have all the information we need, so Stata uses defaults
- Suppose we only had the date and time variable admit_time, but we are not interested in the time aspect

Converting a datetime variable to a daily date

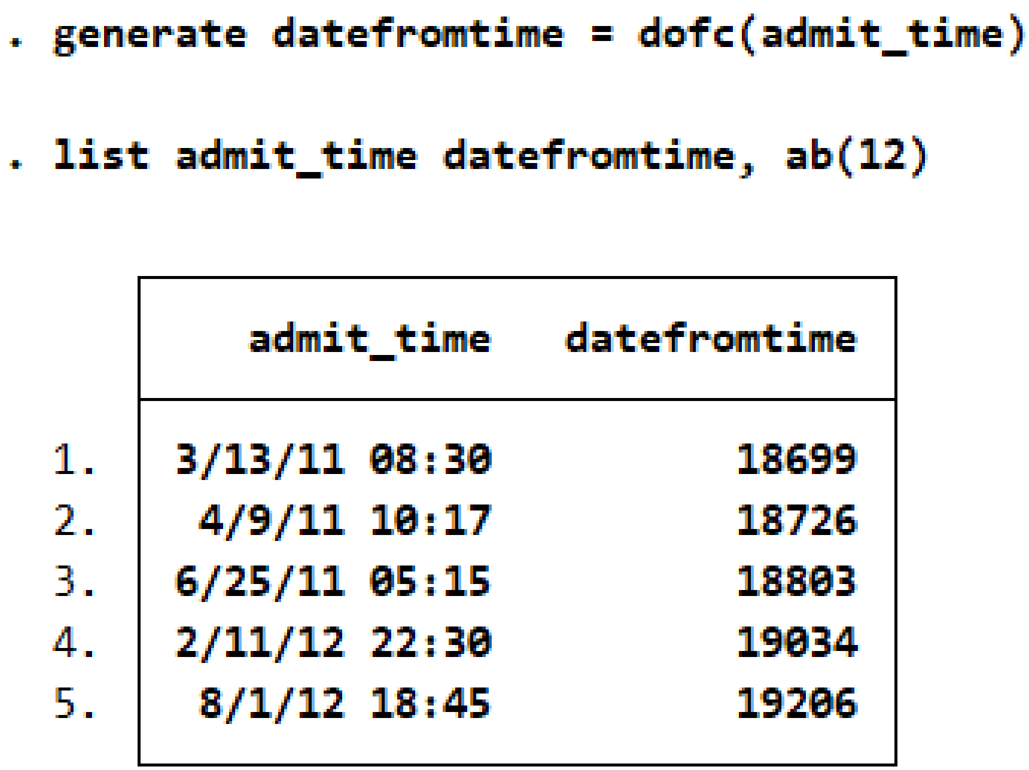
1)



```
. generate datefromtime = dofc(admit_time)

. list admit_time datefromtime, ab(12)

     +-----------------------------+
     |   admit_time   datefromtime |
     |-----------------------------|
  1. | 3/13/11 08:30         18699 |
  2. |  4/9/11 10:17         18726 |
  3. | 6/25/11 05:15         18803 |
  4. | 2/11/12 22:30         19034 |
  5. |  8/1/12 18:45         19206 |
     +-----------------------------+
```

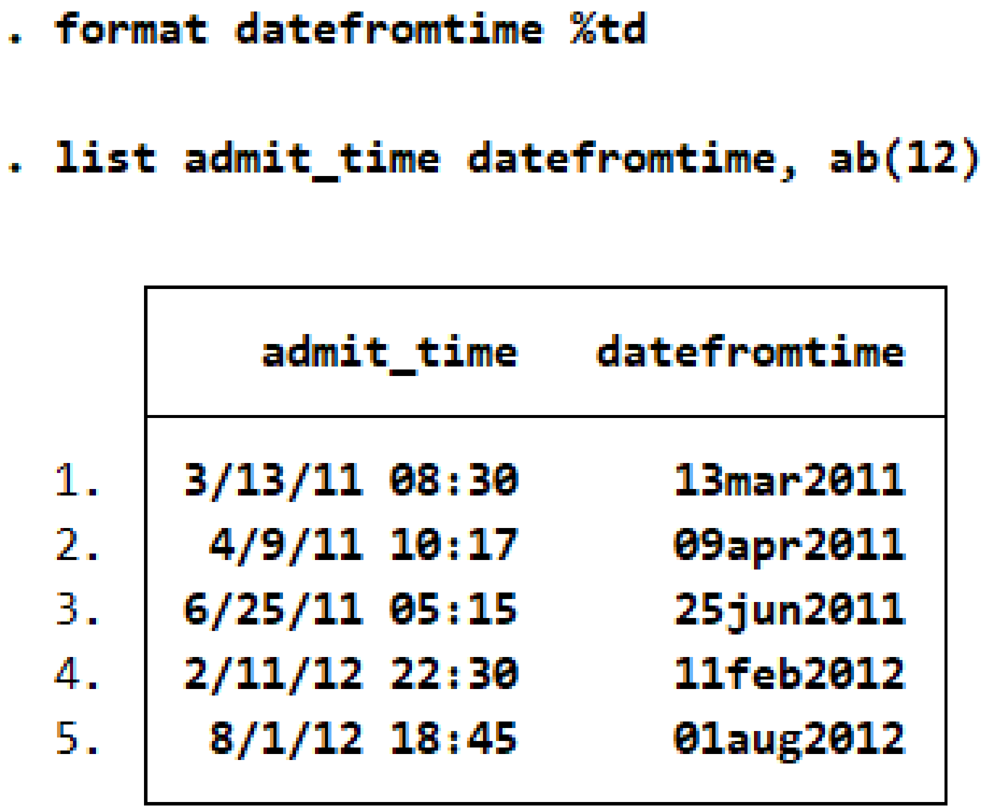
Converting a datetime variable to a daily date

1)



```
. generate datefromtime = dofc(admit_time)

. list admit_time datefromtime, ab(12)

     +-------------------------------+
     |     admit_time   datefromtime |
     |-------------------------------|
  1. | 3/13/11 08:30           18699 |
  2. |  4/9/11 10:17           18726 |
  3. | 6/25/11 05:15           18803 |
  4. | 2/11/12 22:30           19034 |
  5. |  8/1/12 18:45           19206 |
     +-------------------------------+
```

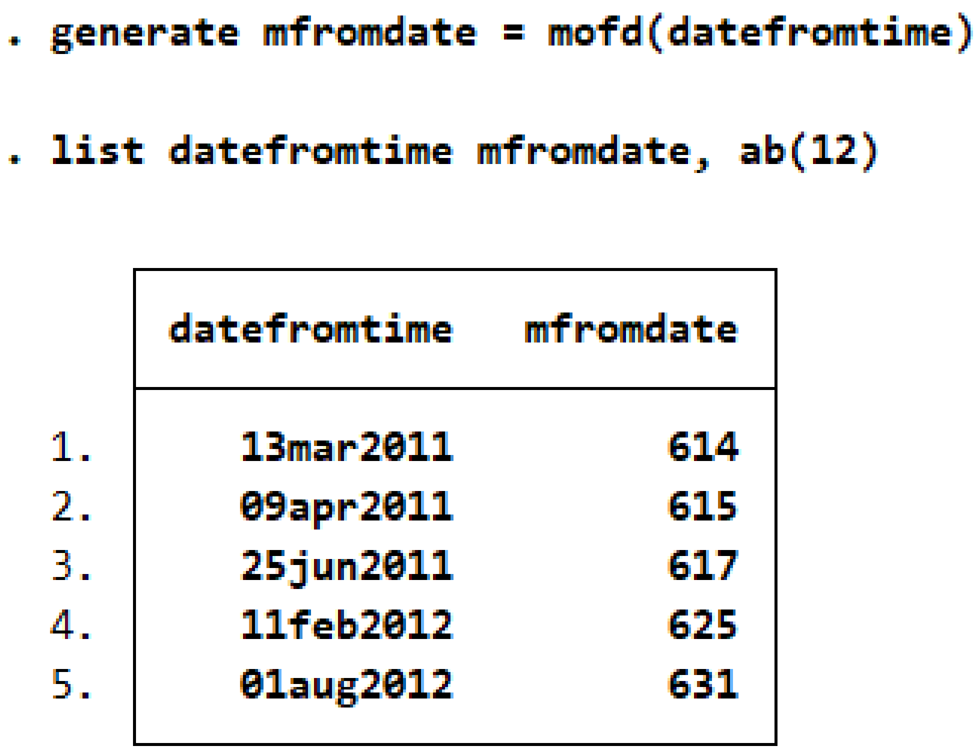
2)



```
. format datefromtime %td

. list admit_time datefromtime, ab(12)

     +-------------------------------+
     |     admit_time   datefromtime |
     |-------------------------------|
  1. | 3/13/11 08:30       13mar2011 |
  2. |  4/9/11 10:17       09apr2011 |
  3. | 6/25/11 05:15       25jun2011 |
  4. | 2/11/12 22:30       11feb2012 |
  5. |  8/1/12 18:45       01aug2012 |
     +-------------------------------+
```

Converting a daily date to a monthly date

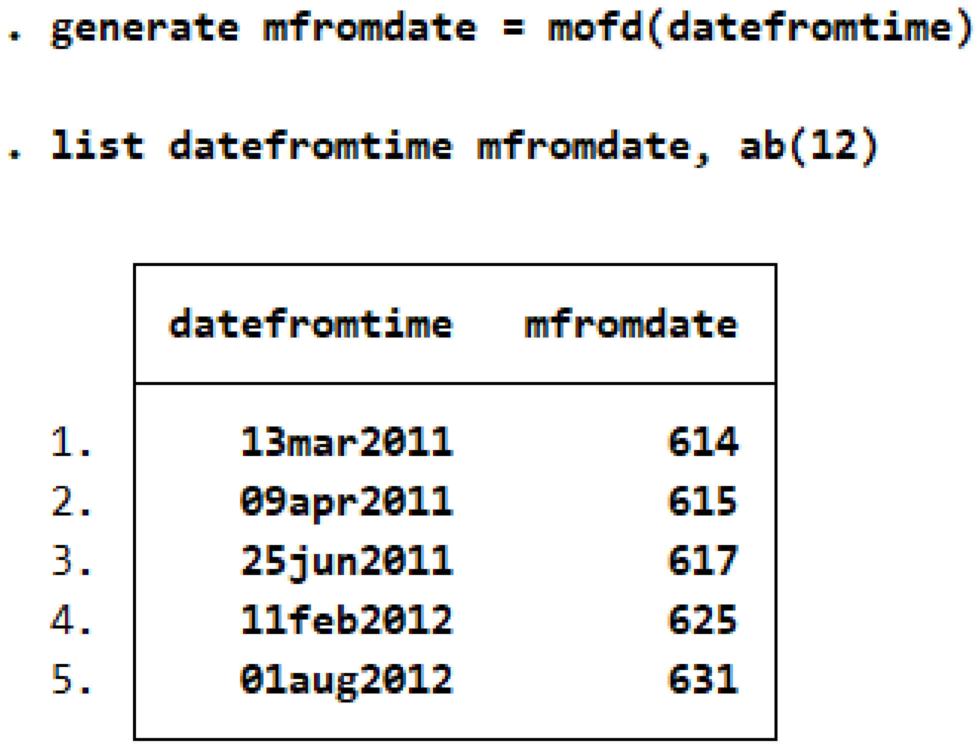
1)



```
. generate mfromdate = mofd(datefromtime)

. list datefromtime mfromdate, ab(12)

     +----------------------------+
     | datefromtime     mfromdate |
     |----------------------------|
  1. |    13mar2011           614 |
  2. |    09apr2011           615 |
  3. |    25jun2011           617 |
  4. |    11feb2012           625 |
  5. |    01aug2012           631 |
     +----------------------------+
```

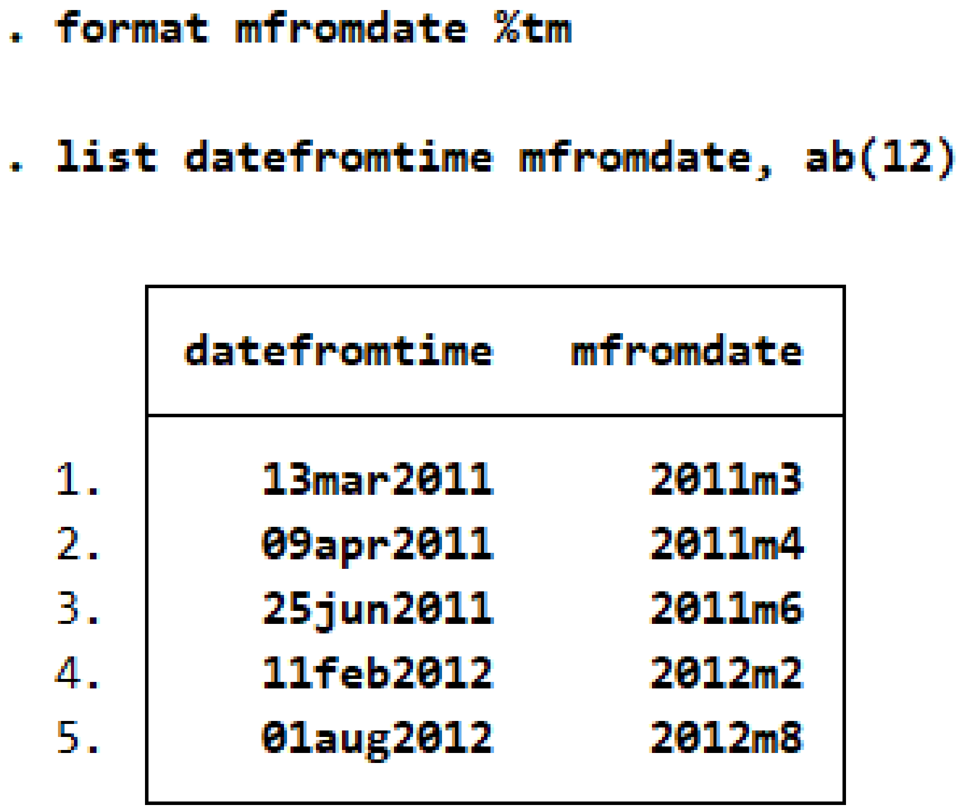
Converting a daily date to a monthly date

1)



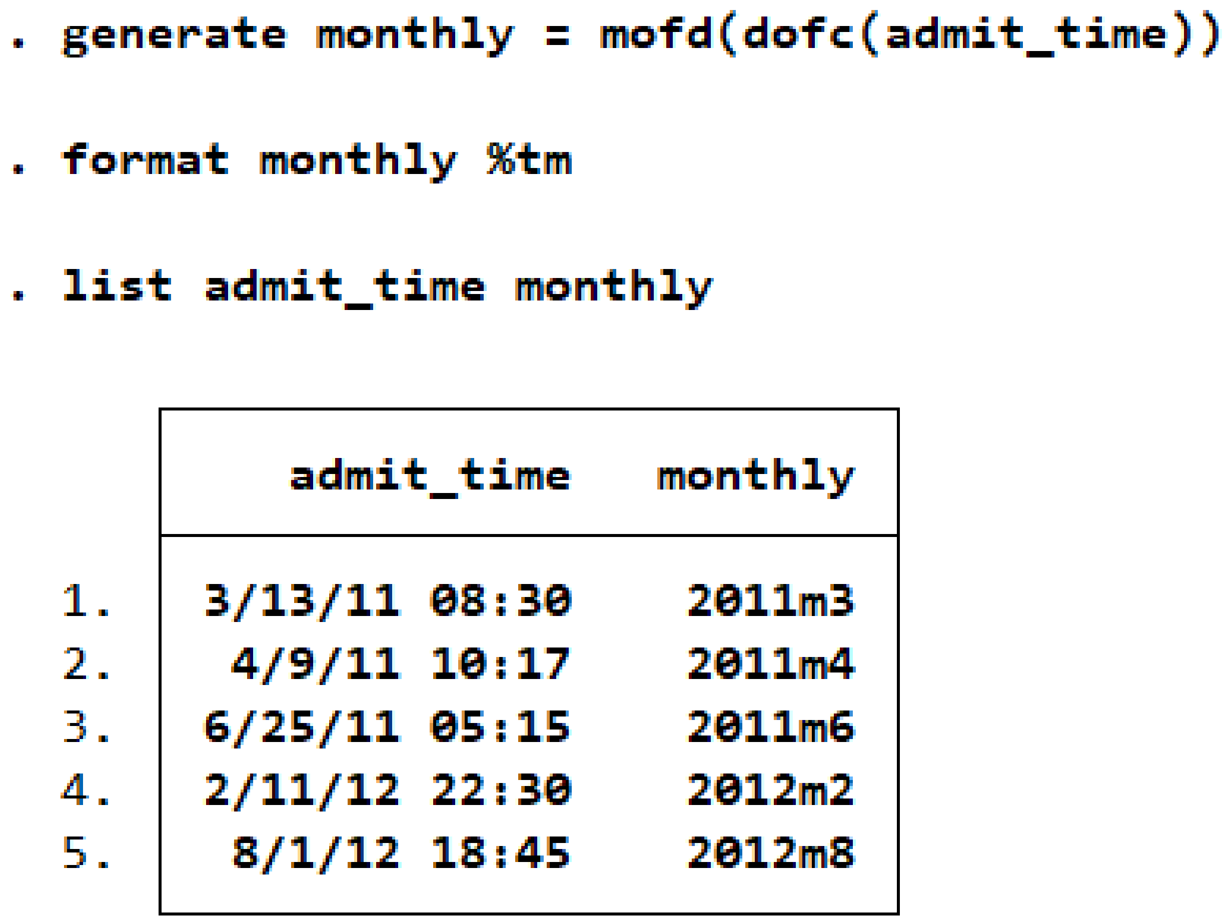
```
. generate mfromdate = mofd(datefromtime)

. list datefromtime mfromdate, ab(12)

     datefromtime   mfromdate

  1.    13mar2011         614
  2.    09apr2011         615
  3.    25jun2011         617
  4.    11feb2012         625
  5.    01aug2012         631
```

2)



```
. format mfromdate %tm

. list datefromtime mfromdate, ab(12)

     datefromtime   mfromdate

  1.    13mar2011      2011m3
  2.    09apr2011      2011m4
  3.    25jun2011      2011m6
  4.    11feb2012      2012m2
  5.    01aug2012      2012m8
```

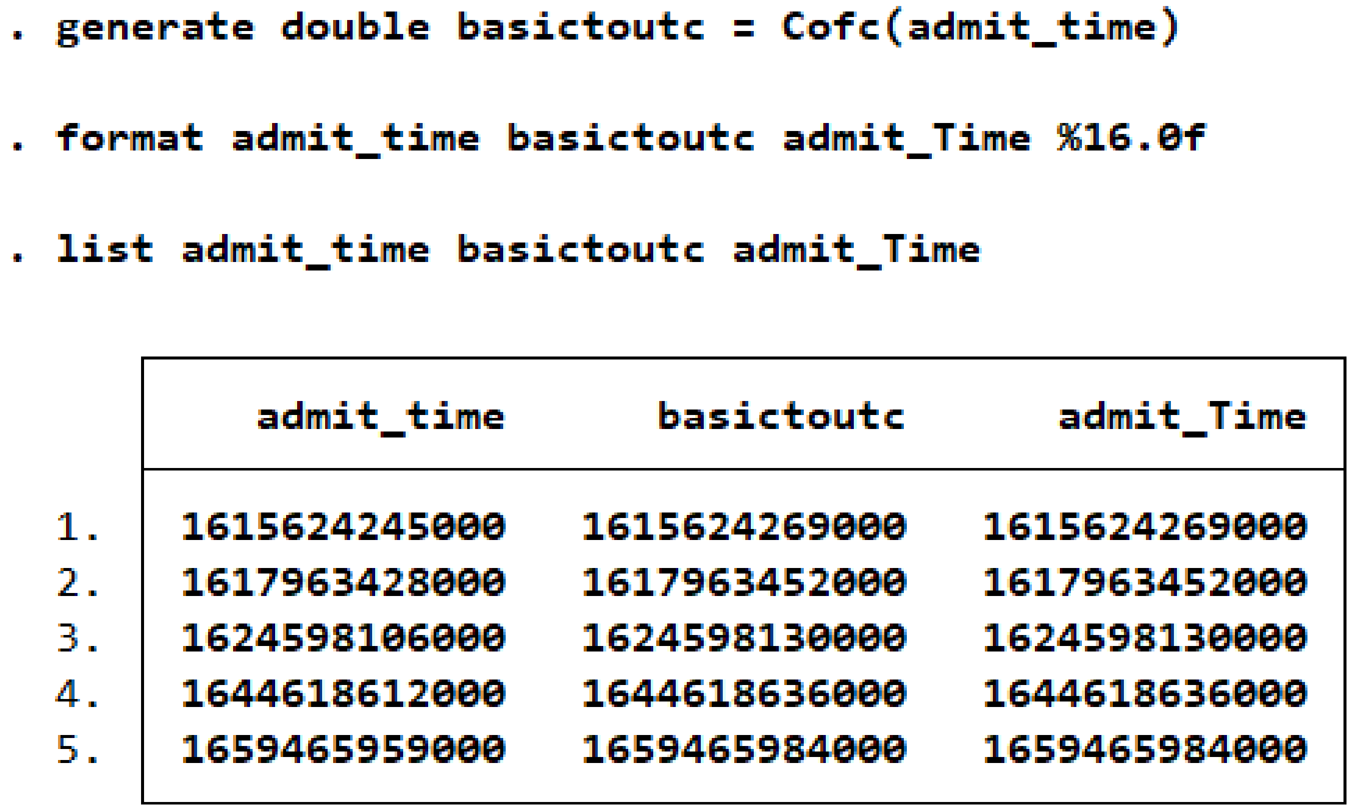
Nesting datetime functions



```
. generate monthly = mofd(dofc(admit_time))

. format monthly %tm

. list admit_time monthly

     +-----------------------------+
     |     admit_time     monthly  |
     |-----------------------------|
  1. | 3/13/11 08:30       2011m3  |
  2. |  4/9/11 10:17       2011m4  |
  3. | 6/25/11 05:15       2011m6  |
  4. | 2/11/12 22:30       2012m2  |
  5. |  8/1/12 18:45       2012m8  |
     +-----------------------------+
```

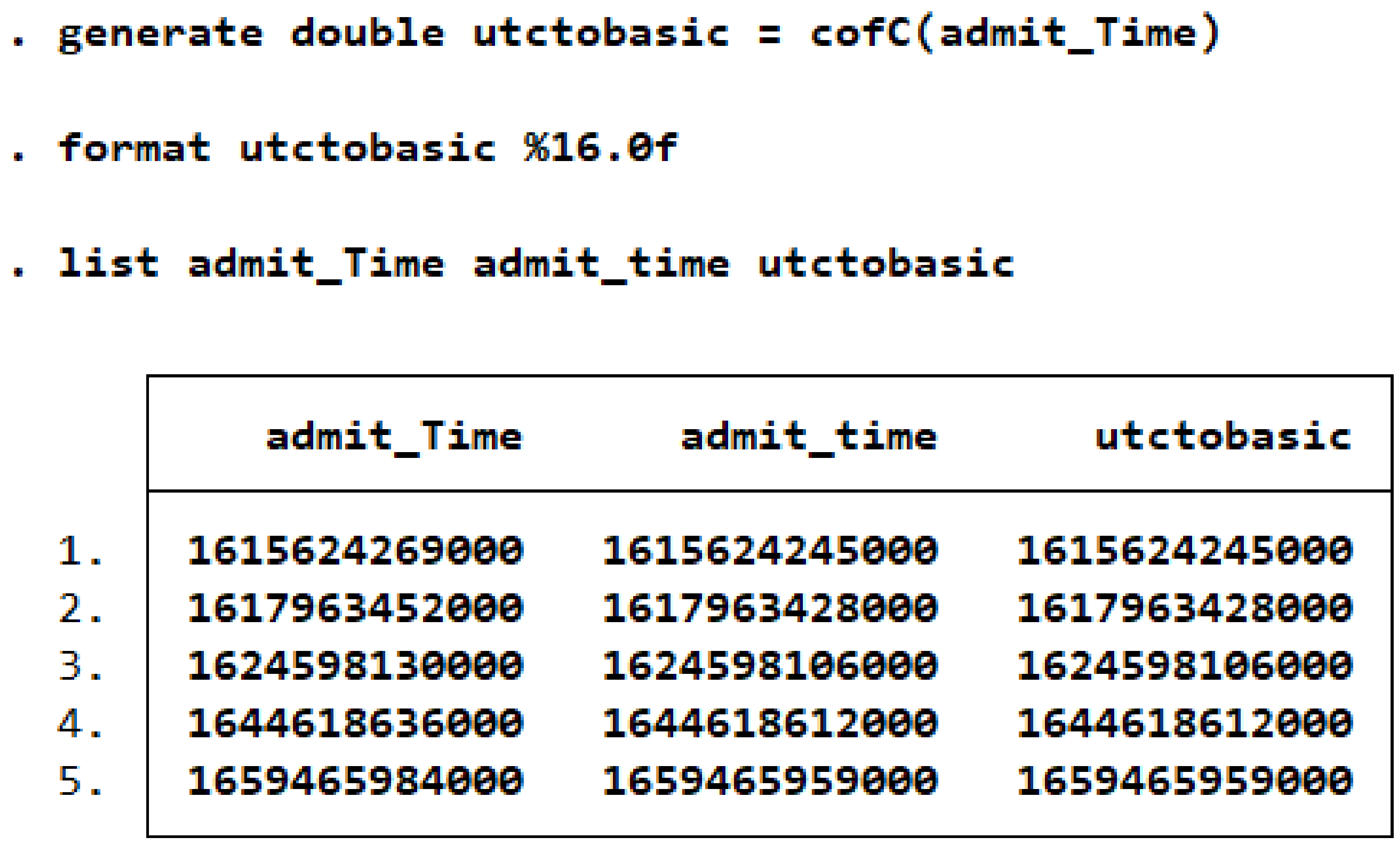
Converting an existing datetime variable to UTC

This time variable should be formatted as `%tC`, but let's look at the underlying values



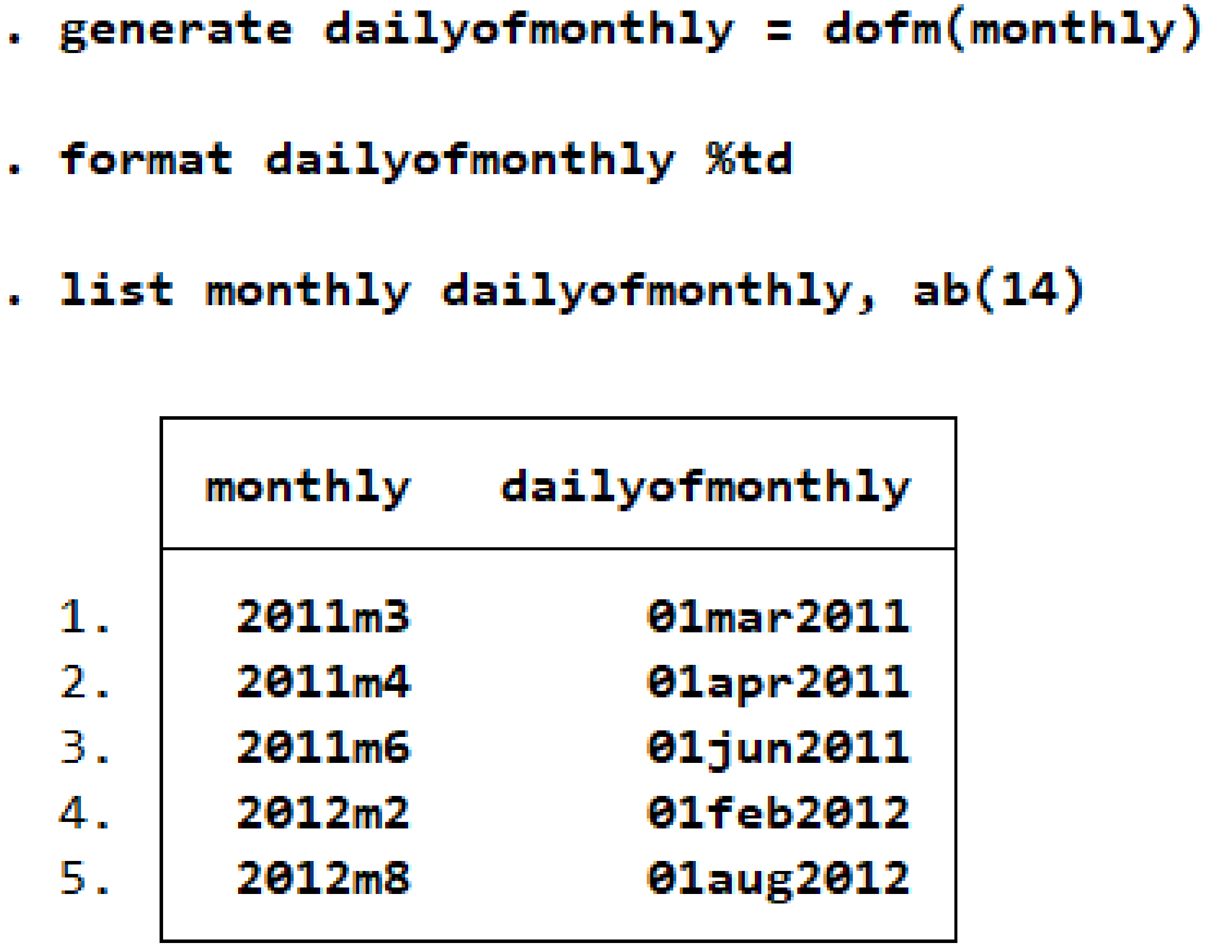
```
. generate double basictoutc = Cofc(admit_time)

. format admit_time basictoutc admit_Time %16.0f

. list admit_time basictoutc admit_Time

     +-----------------------------------------------+
     |    admit_time       basictoutc       admit_Time |
     |-----------------------------------------------|
  1. | 1615624245000    1615624269000    1615624269000 |
  2. | 1617963428000    1617963452000    1617963452000 |
  3. | 1624598106000    1624598130000    1624598130000 |
  4. | 1644618612000    1644618636000    1644618636000 |
  5. | 1659465959000    1659465984000    1659465984000 |
     +-----------------------------------------------+
```

Converting from UTC to non-leap-second adjusted datetimes



```
. generate double utctobasic = cofC(admit_Time)

. format utctobasic %16.0f

. list admit_Time admit_time utctobasic

     +--------------------------------------------+
     |    admit_Time      admit_time    utctobasic |
     |--------------------------------------------|
  1. | 1615624269000   1615624245000 1615624245000 |
  2. | 1617963452000   1617963428000 1617963428000 |
  3. | 1624598130000   1624598106000 1624598106000 |
  4. | 1644618636000   1644618612000 1644618612000 |
  5. | 1659465984000   1659465959000 1659465959000 |
     +--------------------------------------------+
```

Conversions with insufficient information



```
. generate dailyofmonthly = dofm(monthly)

. format dailyofmonthly %td

. list monthly dailyofmonthly, ab(14)

     +--------------------------+
     | monthly   dailyofmonthly |
     |--------------------------|
  1. |  2011m3        01mar2011 |
  2. |  2011m4        01apr2011 |
  3. |  2011m6        01jun2011 |
  4. |  2012m2        01feb2012 |
  5. |  2012m8        01aug2012 |
     +--------------------------+
```

Default values for date components

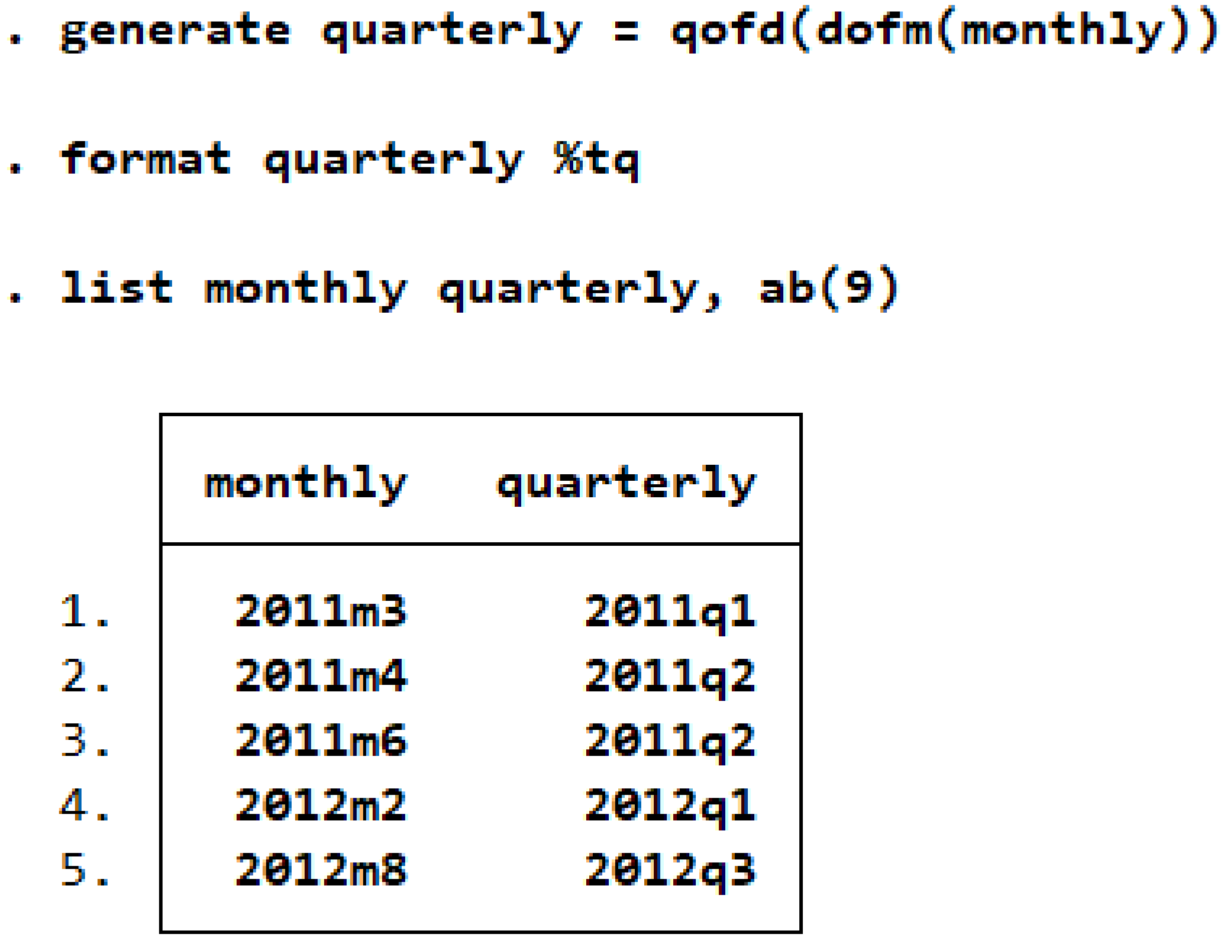
Stata stores datetimes as the number of milliseconds elapsed since January 1, 1960 00:00:00.000.

This falls on the first quarter, and the first week, of 1960.

When converting to a date type for which you don’t have all the components (e.g., quarterly date to monthly date), the missing elements will be set to their default.

Date component	**Default**
Year	1960
Month	1
Day	1
Quarter	1
Week	1
Hour	00
Minute	00
Second	00

Nesting conversion functions



```
. generate quarterly = qofd(dofm(monthly))

. format quarterly %tq

. list monthly quarterly, ab(9)

     +-----------------------+
     |  monthly    quarterly |
     |-----------------------|
  1. |   2011m3       2011q1 |
  2. |   2011m4       2011q2 |
  3. |   2011m6       2011q2 |
  4. |   2012m2       2012q1 |
  5. |   2012m8       2012q3 |
     +-----------------------+
```

Converting across dates and times

		To	
From	**Datetime**	**Datetime (UTC)**	**Daily date**
Datetime		`Cofc()`	`dofc()`
Datetime (UTC)	`cofC()`		`dofC()`
Daily date	`cofd()`	`Cofd()`	

Converting across different types of dates

To

From	Daily date	Weekly date	Monthly date	Quarterly date
Daily date		**`wofd()`**	**`mofd()`**	**`qofd()`**
Weekly date	**`dofw()`**		**`mofd(dofw())`**	**`qofd(dofw())`**
Monthly date	**`dofm()`**	**`wofd(dofm())`**		**`qofd(dofm())`**
Quarterly date	**`dofq()`**	**`wofd(dofq())`**	**`mofd(dofq())`**	

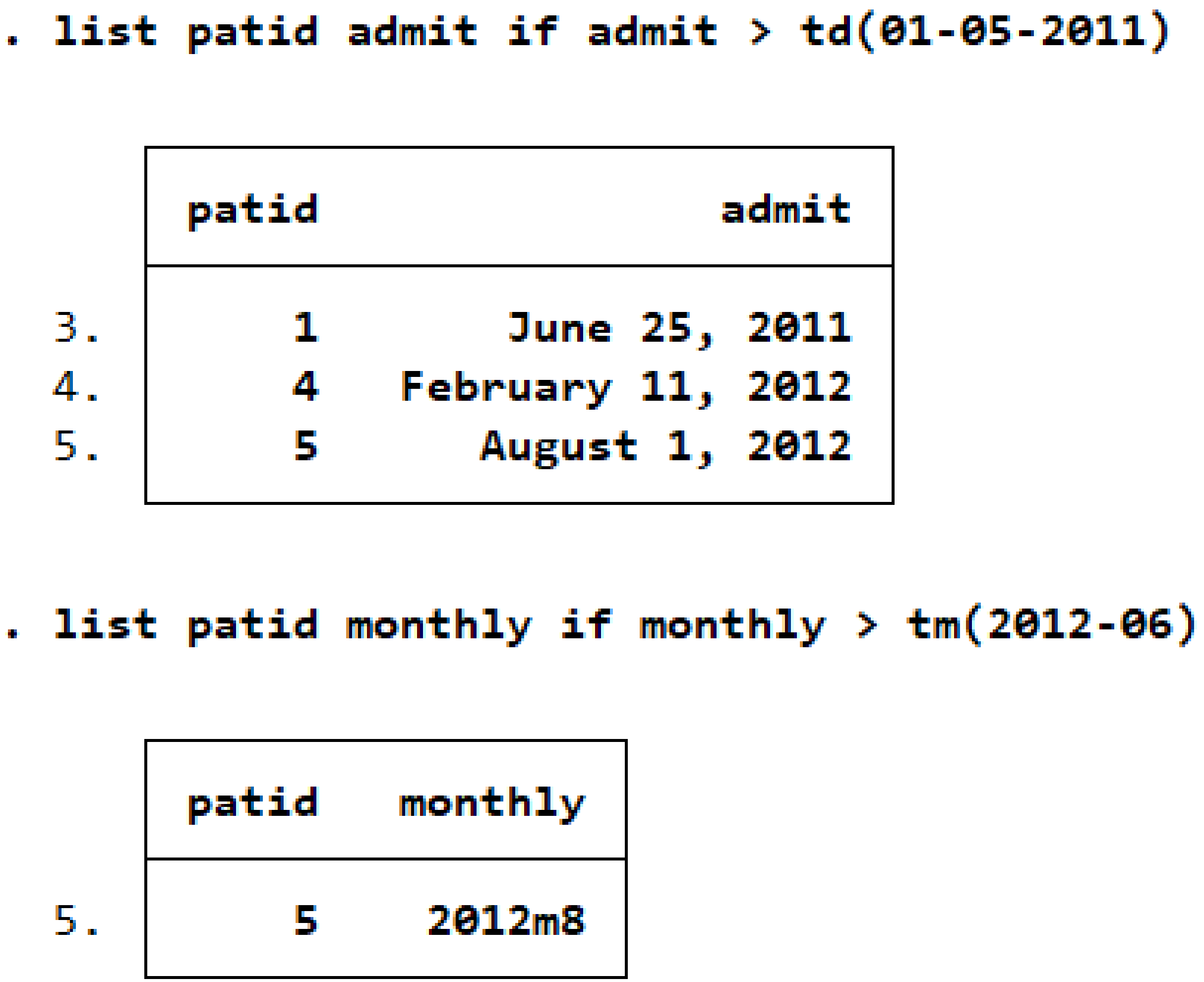
For more conversion functions, see [D] Datetime.

Using dates and times in expressions

Using dates in expressions

- Dates are stored numerically, but formatted to display dates as we know them
- Rather than trying to think of the numeric value for a given date, we can use functions to tell Stata the date we are referring to
- This is useful when examining portions of your data based on dates, and when converting dates from other software, which we'll see shortly

Using dates in expressions

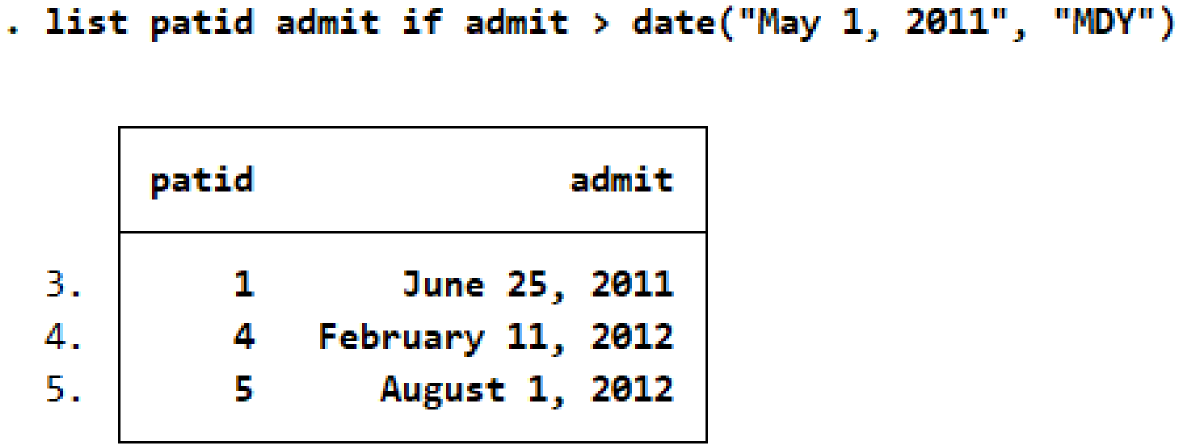


```
. list patid admit if admit > td(01-05-2011)

     +----------------------------+
     | patid                admit |
     |----------------------------|
  3. |     1        June 25, 2011 |
  4. |     4    February 11, 2012 |
  5. |     5       August 1, 2012 |
     +----------------------------+

. list patid monthly if monthly > tm(2012-06)

     +-----------------+
     | patid   monthly |
     |-----------------|
  5. |     5    2012m8 |
     +-----------------+
```

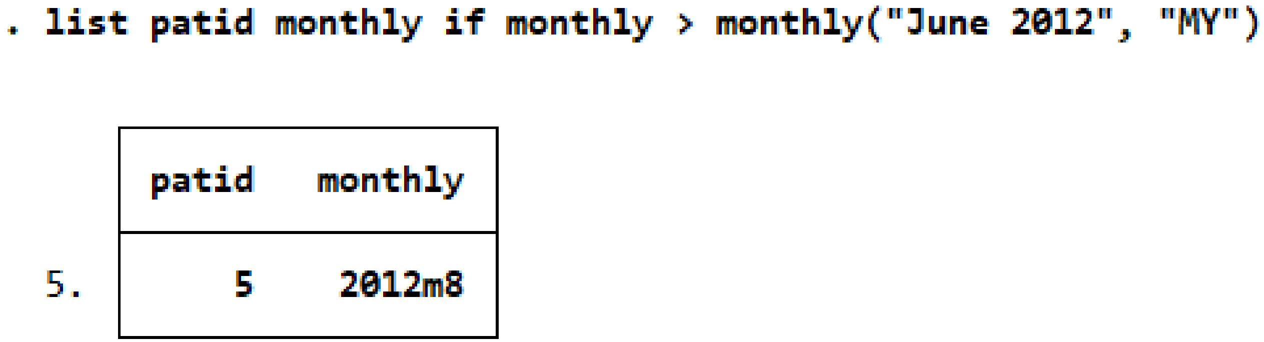
Pseudofunctions for using dates in expressions

Date type	**Pseudofunction**
Datetime	**`tc(`**`[`*`day-month-year`*`]` *`hh`*`:`*`mm`*`[:`*`ss`*`[.`*`sss`*`]]`**`)`**
Datetime (UTC)	**`tC(`**`[`*`day-month-year`*`]` *`hh`*`:`*`mm`*`[:`*`ss`*`[.`*`sss`*`]]`**`)`**
Daily date	**`td(`***`day-month-year`***`)`**
Weekly date	**`tw(`***`year-week`***`)`**
Monthly date	**`tm(`***`year-month`***`)`**
Quarterly date	**`tq(`***`year-quarter`***`)`**

Using string-to-numeric conversion functions in expressions



```
. list patid admit if admit > date("May 1, 2011", "MDY")

     +-----------------------------+
     | patid                 admit |
     |-----------------------------|
  3. |     1         June 25, 2011 |
  4. |     4     February 11, 2012 |
  5. |     5        August 1, 2012 |
     +-----------------------------+
```

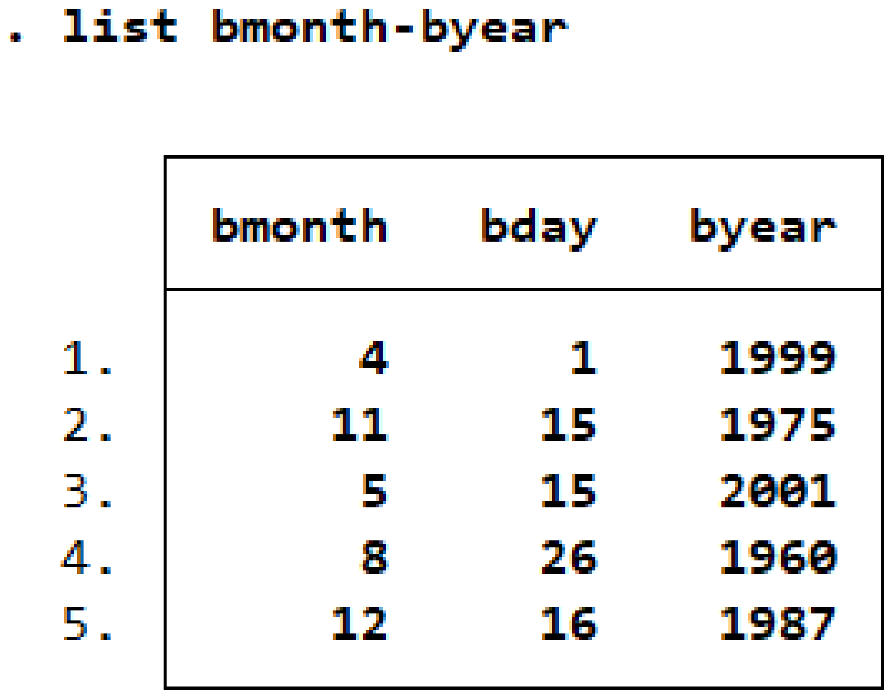


```
. list patid monthly if monthly > monthly("June 2012", "MY")

     +-----------------+
     | patid   monthly |
     |-----------------|
  5. |     5    2012m8 |
     +-----------------+
```

The string-to-numeric conversion functions can also be used in expressions, and they allow you to specify the components in any order you wish.

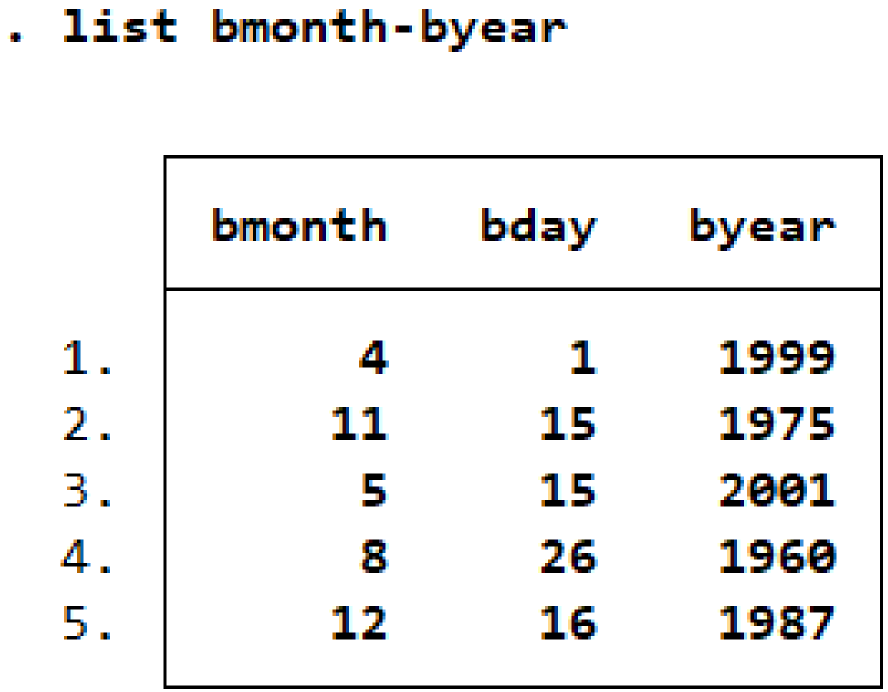
Building dates and times from components

Building a date from numeric components

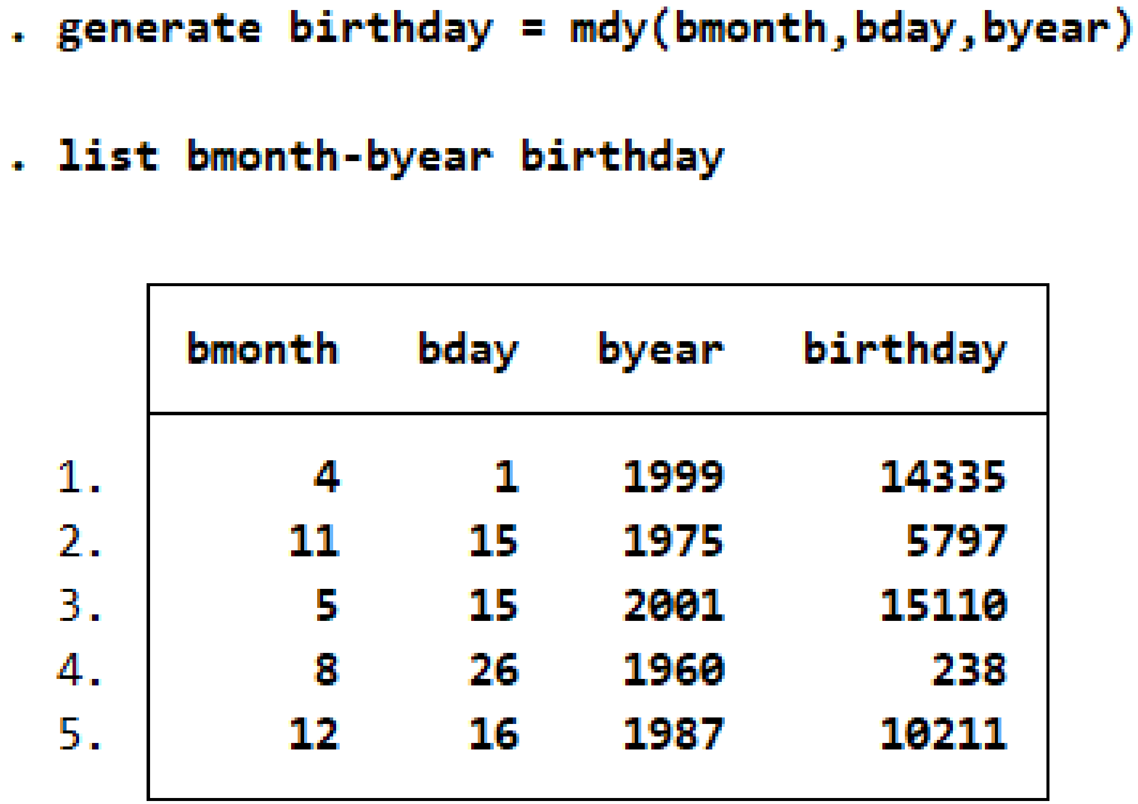


```
. list bmonth-byear

     +------------------------+
     | bmonth   bday   byear  |
     |------------------------|
  1. |      4      1    1999  |
  2. |     11     15    1975  |
  3. |      5     15    2001  |
  4. |      8     26    1960  |
  5. |     12     16    1987  |
     +------------------------+
```

Building a date from numeric components

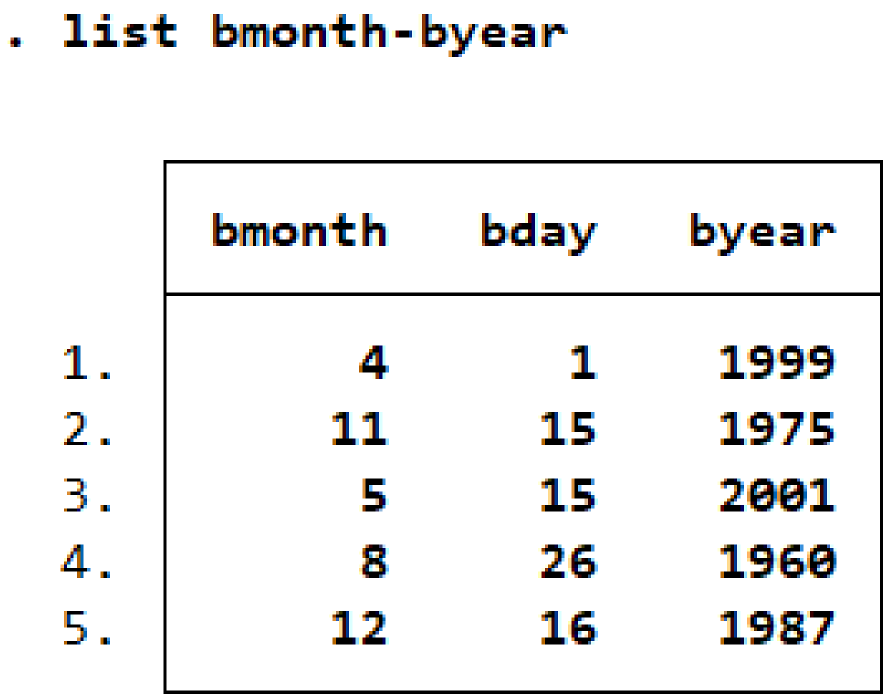


```
. list bmonth-byear

     +------------------------+
     | bmonth   bday   byear  |
     |------------------------|
  1. |      4      1    1999  |
  2. |     11     15    1975  |
  3. |      5     15    2001  |
  4. |      8     26    1960  |
  5. |     12     16    1987  |
     +------------------------+
```



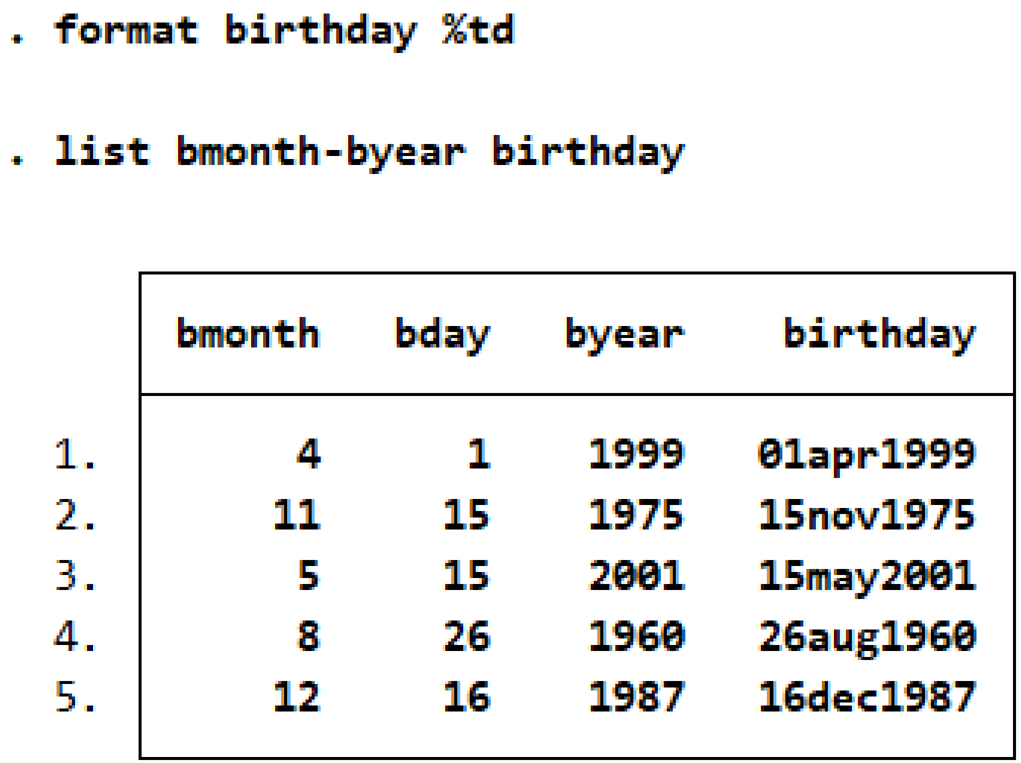
```
. generate birthday = mdy(bmonth,bday,byear)

. list bmonth-byear birthday

     +-------------------------------------+
     | bmonth   bday   byear   birthday    |
     |-------------------------------------|
  1. |      4      1    1999      14335    |
  2. |     11     15    1975       5797    |
  3. |      5     15    2001      15110    |
  4. |      8     26    1960        238    |
  5. |     12     16    1987      10211    |
     +-------------------------------------+
```

Building a date from numeric components



```
. list bmonth-byear

     +-------------------------+
     | bmonth   bday   byear   |
     |-------------------------|
  1. |      4      1    1999   |
  2. |     11     15    1975   |
  3. |      5     15    2001   |
  4. |      8     26    1960   |
  5. |     12     16    1987   |
     +-------------------------+
```

```
. generate birthday = mdy(bmonth,bday,byear)
. list bmonth-byear birthday
```

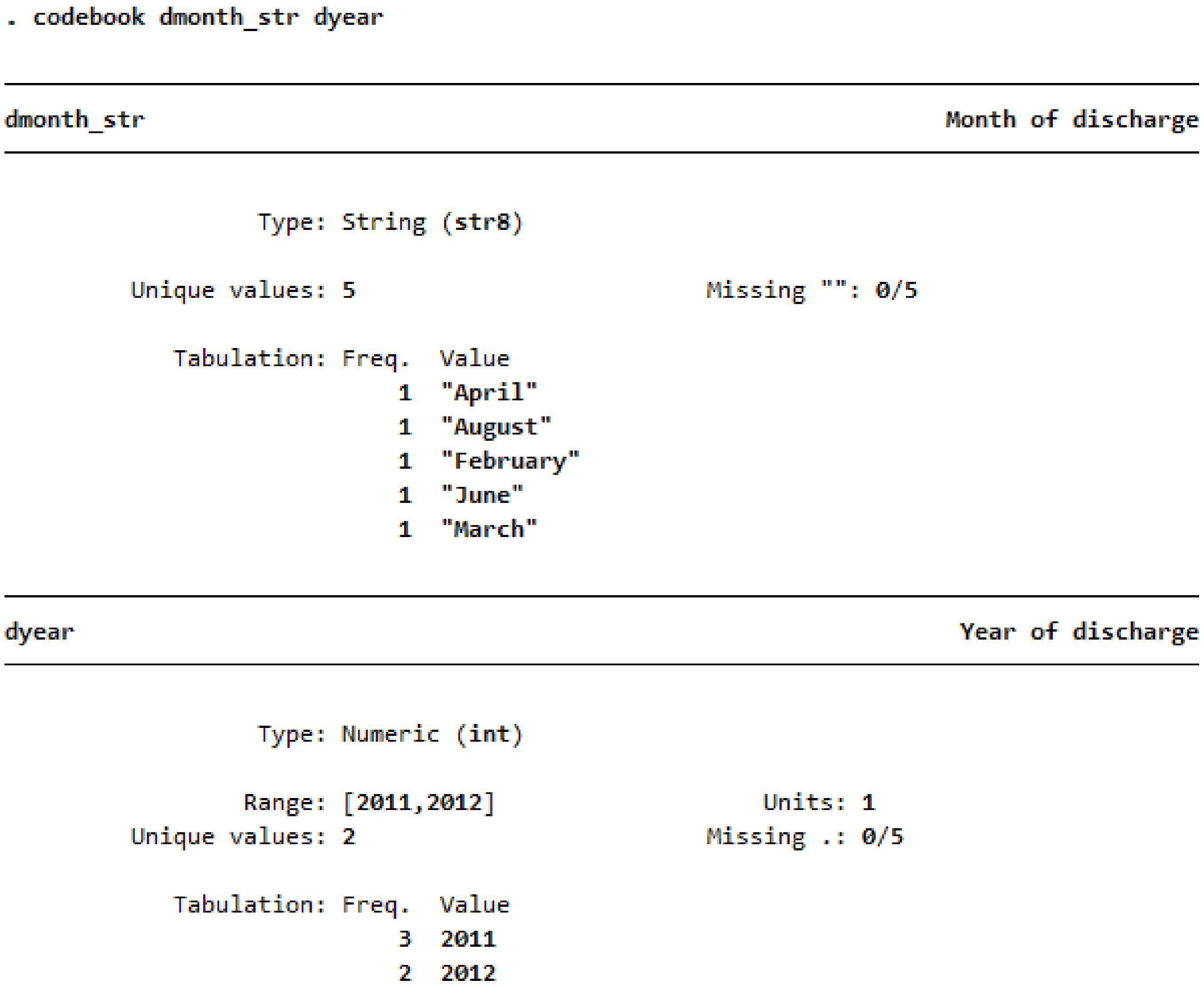


```
. format birthday %td

. list bmonth-byear birthday

     +-----------------------------------------+
     | bmonth   bday   byear     birthday     |
     |-----------------------------------------|
  1. |      4      1    1999    01apr1999    |
  2. |     11     15    1975    15nov1975    |
  3. |      5     15    2001    15may2001    |
  4. |      8     26    1960    26aug1960    |
  5. |     12     16    1987    16dec1987    |
     +-----------------------------------------+
```

Building dates from components

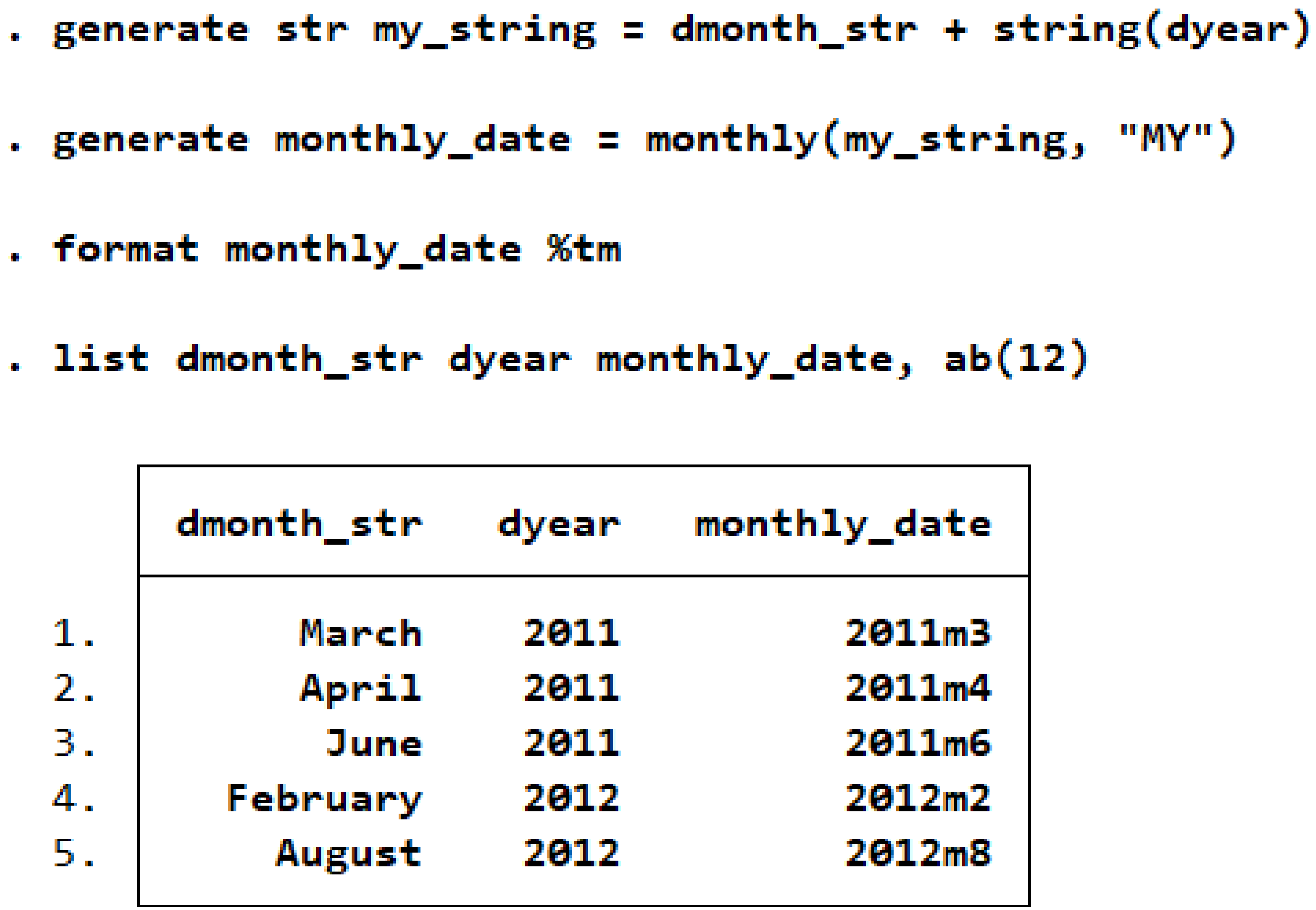
Date type desired	**Function**
Datetime	**mdyhms**(*M*, *D*, *Y*, *h*, *m*, *s*)
	dhms(e_d, *h*, *m*, *s*)
	hms(*h*, *m*, *s*)
Datetime (UTC)	**Cmdyhms**(*M*, *D*, *Y*, *h*, *m*, *s*)
	Cdhms(e_d, *h*, *m*, *s*)
	Chms(*h*, *m*, *s*)
Date	**mdy**(*M*, *D*, *Y*)
Weekly date	**yw**(*Y*, *W*)
Monthly date	**ym**(*Y*, *M*)
Quarterly date	**yq**(*Y*, *Q*)

Building a date from string and numeric components



```
. codebook dmonth_str dyear

-------------------------------------------------------------------------------------
dmonth_str                                                         Month of discharge
-------------------------------------------------------------------------------------


                  Type: String (str8)

         Unique values: 5                         Missing "": 0/5

            Tabulation: Freq.  Value
                            1  "April"
                            1  "August"
                            1  "February"
                            1  "June"
                            1  "March"

-------------------------------------------------------------------------------------
dyear                                                               Year of discharge
-------------------------------------------------------------------------------------


                  Type: Numeric (int)

                 Range: [2011,2012]                   Units: 1
         Unique values: 2                         Missing .: 0/5

            Tabulation: Freq.  Value
                            3  2011
                            2  2012
```

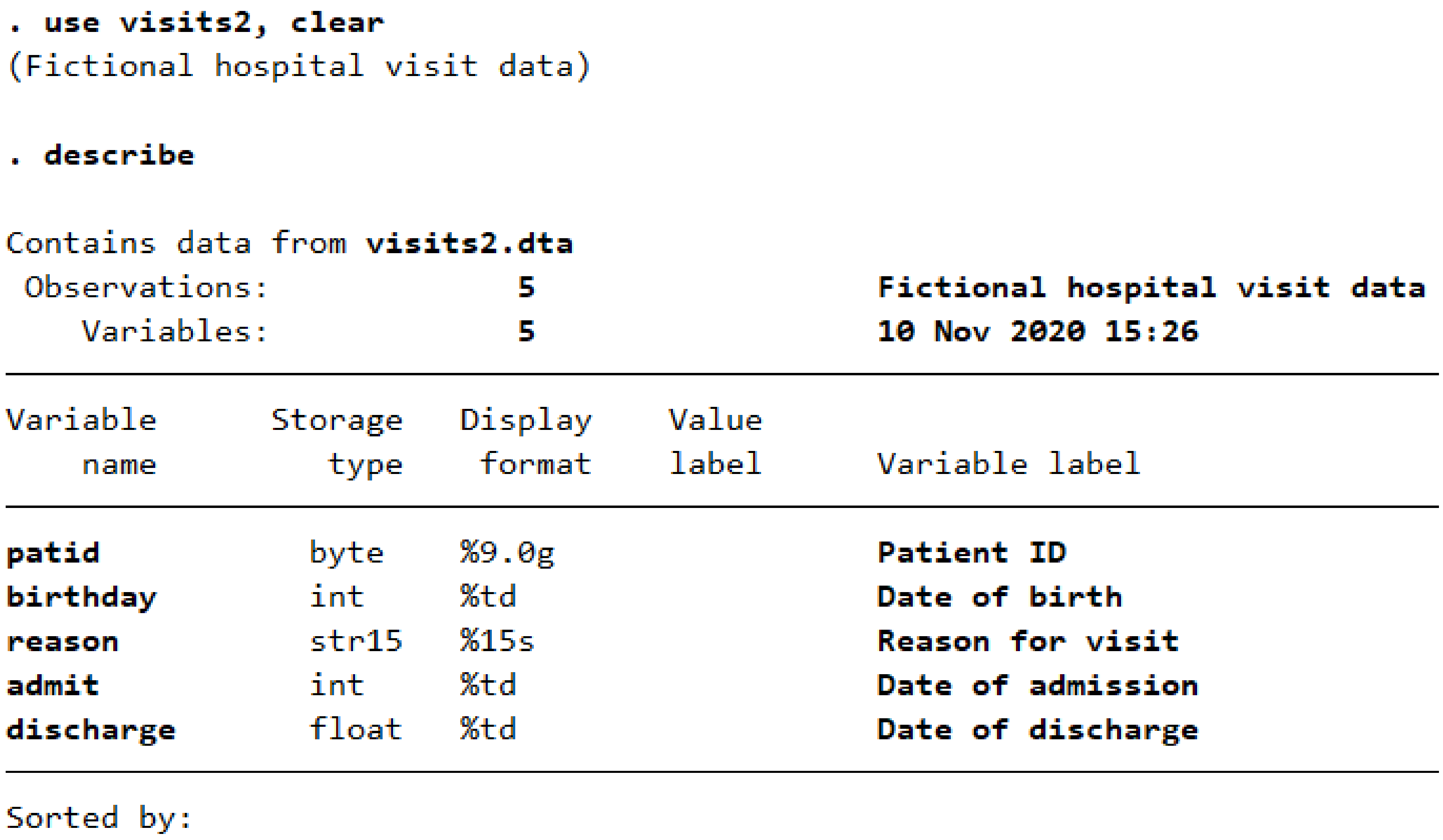
Building a date from string and numeric components



```
. generate str my_string = dmonth_str + string(dyear)

. generate monthly_date = monthly(my_string, "MY")

. format monthly_date %tm

. list dmonth_str dyear monthly_date, ab(12)

     +--------------------------------------+
     | dmonth_str   dyear    monthly_date   |
     |--------------------------------------|
  1. |      March    2011         2011m3   |
  2. |      April    2011         2011m4   |
  3. |       June    2011         2011m6   |
  4. |   February    2012         2012m2   |
  5. |     August    2012         2012m8   |
     +--------------------------------------+
```

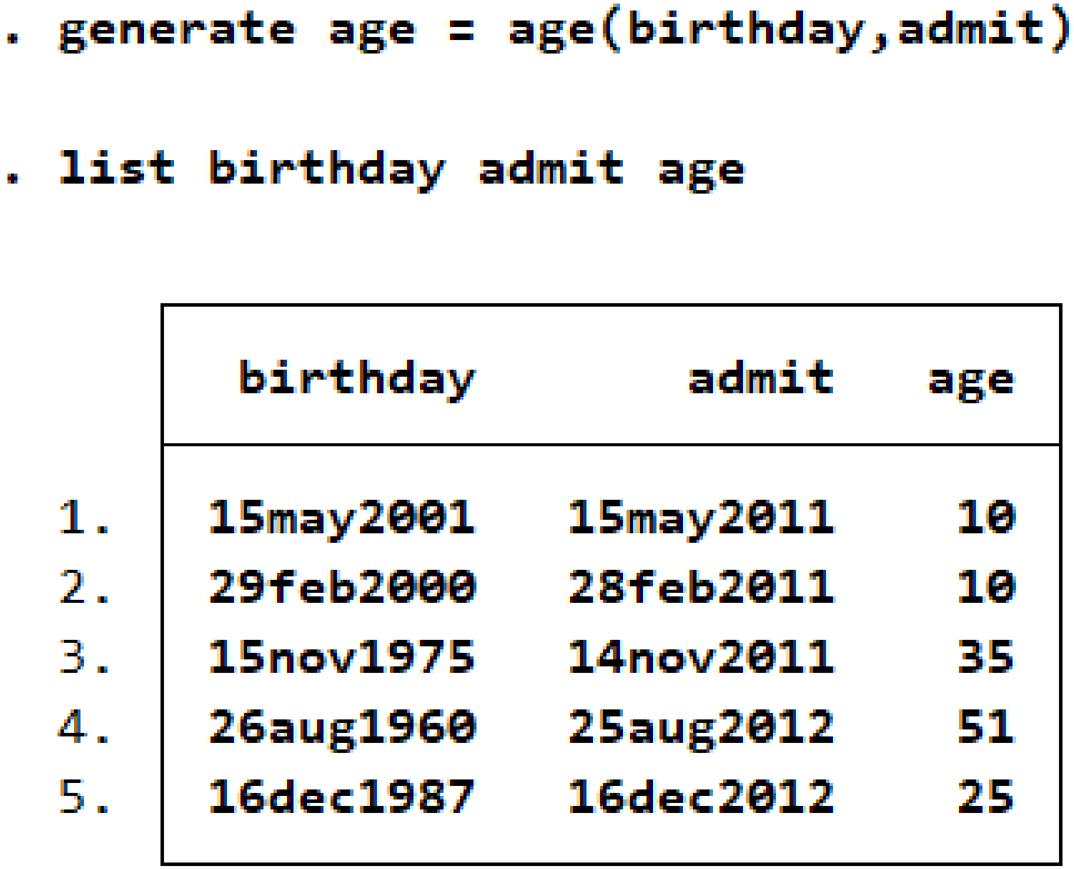
Computing durations

Computing patients’ ages



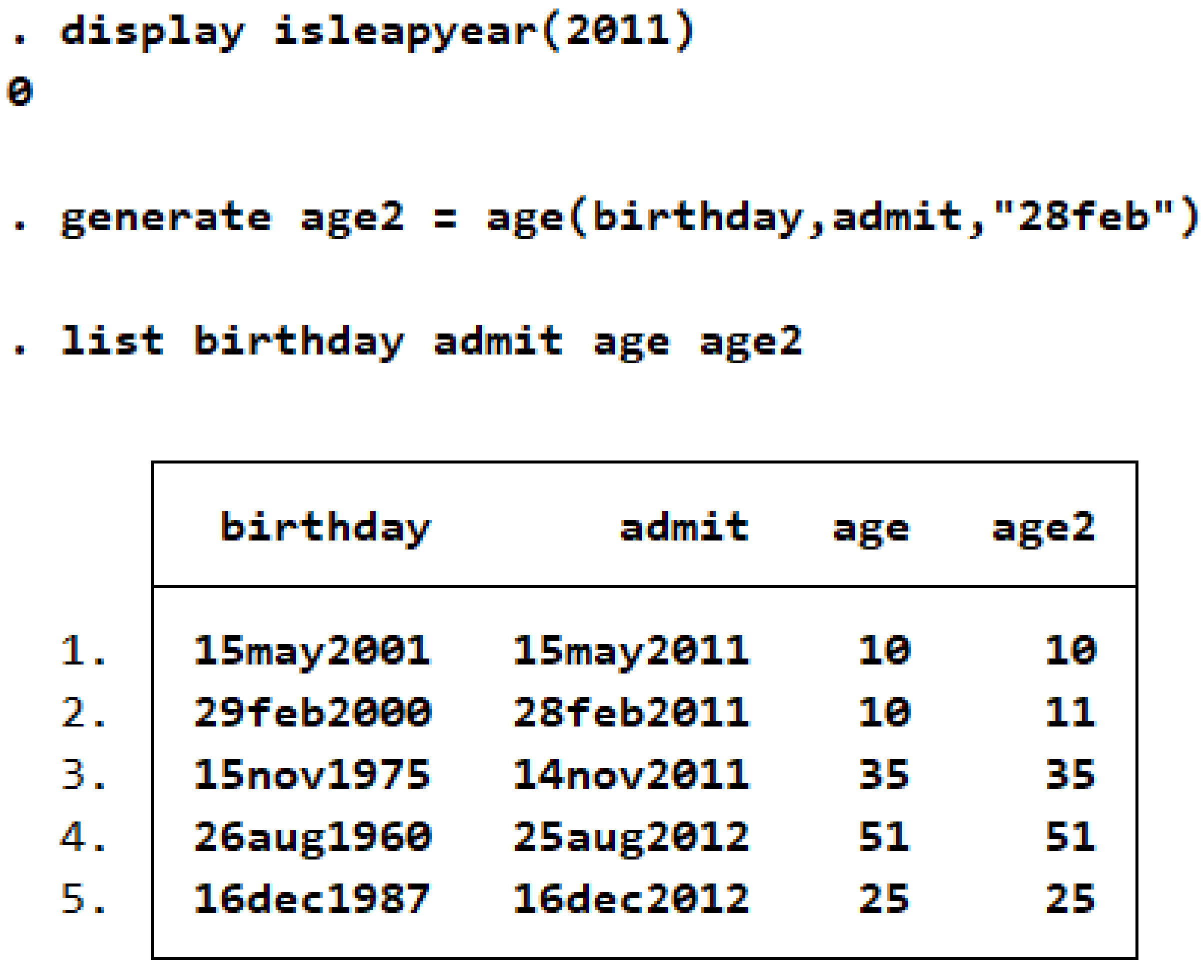
```
. use visits2, clear
(Fictional hospital visit data)

. describe

Contains data from visits2.dta
 Observations:                 5                  Fictional hospital visit data
    Variables:                 5                  10 Nov 2020 15:26
----------------------------------------------------------------------------
Variable      Storage   Display    Value
    name         type    format    label      Variable label
----------------------------------------------------------------------------
patid           byte    %9.0g                 Patient ID
birthday        int     %td                   Date of birth
reason          str15   %15s                  Reason for visit
admit           int     %td                   Date of admission
discharge       float   %td                   Date of discharge
----------------------------------------------------------------------------
Sorted by:
```

Computing age on the day of admission



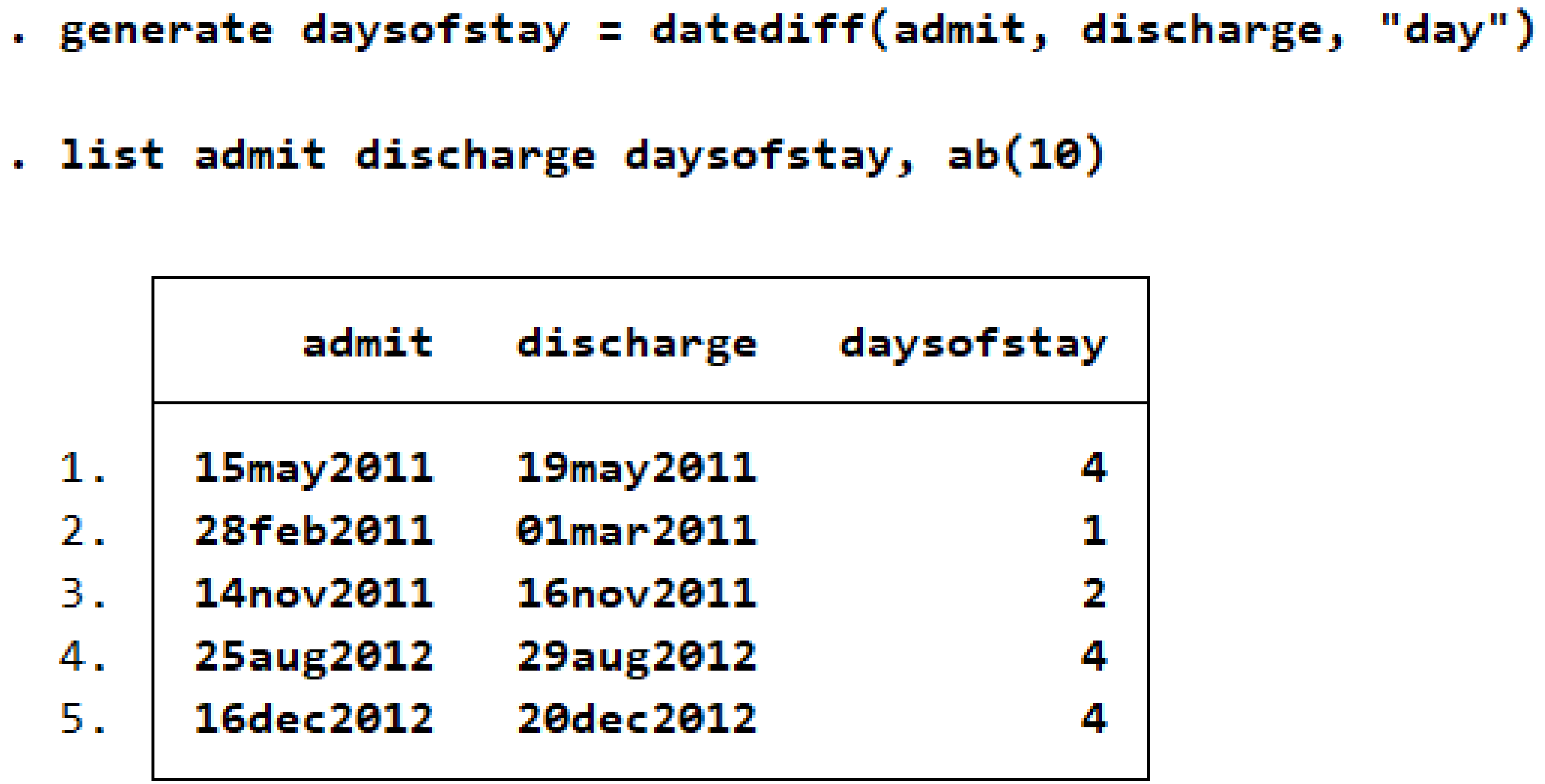
```
. generate age = age(birthday,admit)

. list birthday admit age

     +-----------------------------+
     |  birthday       admit   age |
     |-----------------------------|
  1. | 15may2001   15may2011    10 |
  2. | 29feb2000   28feb2011    10 |
  3. | 15nov1975   14nov2011    35 |
  4. | 26aug1960   25aug2012    51 |
  5. | 16dec1987   16dec2012    25 |
     +-----------------------------+
```

Specifying when nonleap-year birthdays are observed



```
. display isleapyear(2011)
0

. generate age2 = age(birthday,admit,"28feb")

. list birthday admit age age2

     +-----------------------------------------+
     |  birthday        admit   age      age2  |
     |-----------------------------------------|
  1. | 15may2001    15may2011    10        10  |
  2. | 29feb2000    28feb2011    10        11  |
  3. | 15nov1975    14nov2011    35        35  |
  4. | 26aug1960    25aug2012    51        51  |
  5. | 16dec1987    16dec2012    25        25  |
     +-----------------------------------------+
```

Compute the difference between two dates



```
. generate daysofstay = datediff(admit, discharge, "day")

. list admit discharge daysofstay, ab(10)

     +------------------------------------+
     |     admit   discharge   daysofstay |
     |------------------------------------|
  1. | 15may2011   19may2011            4 |
  2. | 28feb2011   01mar2011            1 |
  3. | 14nov2011   16nov2011            2 |
  4. | 25aug2012   29aug2012            4 |
  5. | 16dec2012   20dec2012            4 |
     +------------------------------------+
```

Functions for calculating durations

Description	**Function**
Age	**age(**$e_{d\ DOB}$, e_{d} [, s_{nl}]**)**
Age with fraction	**age_frac(**$e_{d\ DOB}$, e_{d} [, s_{nl}]**)**
Date difference	**datediff(**e_{d1}, e_{d2}, s_{du} [, s_{nl}]**)**
Date difference with fraction	**datediff_frac(**e_{d1}, e_{d2}, s_{du} [, s_{nl}]**)**

* $e_{d\ DOB}$, e_{d}, e_{d1}, and e_{d2} are Stata dates.

* S_{du} is a string specifying date units (`“d”`, `“m”`, or `“y”`).

* S_{nl} is a string specifying nonleap-year birthdays (`“01mar”` or `“28feb”`).

Functions for calculating durations

Description	Function
Age	**age(**$e_{d\ DOB}$, e_d [, s_{nl}]**)**
Age with fraction	**age_frac(**$e_{d\ DOB}$, e_d [, s_{nl}]**)**
Date difference	**datediff(**e_{d1}, e_{d2}, s_{du} [, s_{nl}]**)**
Date difference with fraction	**datediff_frac(**e_{d1}, e_{d2}, s_{du} [, s_{nl}]**)**
Datetime/C difference	**Clockdiff(**e_{tC1}, e_{tC2}, s_{tu}**)**
Datetime/c difference	**clockdiff(**e_{tc1}, e_{tc2}, s_{tu}**)**

* e_{tc1} and e_{tc2} are Stata datetime values (non leap-second adjusted).

* e_{tC1} and e_{tC2} are Stata datetime values (leap-second adjusted).

* S_{tu} is a string specifying time units (“d”, “h”, “m”, “s”, or “ms”).

Functions for calculating durations

Description	Function
Age	**age(**$e_{d\ DOB}$, e_{d} [, s_{nl}]**)**
Age with fraction	**age_frac(**$e_{d\ DOB}$, e_{d} [, s_{nl}]**)**
Date difference	**datediff(**e_{d1}, e_{d2}, s_{du} [, s_{nl}]**)**
Date difference with fraction	**datediff_frac(**e_{d1}, e_{d2}, s_{du} [, s_{nl}]**)**
Datetime/C difference	**Clockdiff(**e_{tC1}, e_{tC2}, s_{tu}**)**
Datetime/c difference	**clockdiff(**e_{tc1}, e_{tc2}, s_{tu}**)**
Datetime/C difference with fraction	**Clockdiff_frac(**e_{tC1}, e_{tC2}, s_{tu}**)**
Datetime/c difference with fraction	**clockdiff_frac(**e_{tc1}, e_{tc2}, s_{tu}**)**

Obtaining dates and date information from other dates

Description	Function
Birthday in year	**birthday(**$e_{d\,DOB}$, Y [, s_{nl}]**)**
Previous birthday	**previousbirthday(**$e_{d\,DOB}$, e_d [, s_{nl}]**)**
Next birthday	**nextbirthday(**$e_{d\,DOB}$, e_d [, s_{nl}]**)**

* e_d and $e_{d\,DOB}$ are Stata dates.

* S_{nl} is a string specifying nonleap-year birthdays (“`01mar`” or “`28feb`”).

* Y is a numeric year.

Obtaining dates and date information from other dates

Description	**Function**
Birthday in year	**birthday(**$e_{d\,DOB}$, Y [, s_{nl}]**)**
Previous birthday	**previousbirthday(**$e_{d\,DOB}$, e_d [, s_{nl}]**)**
Next birthday	**nextbirthday(**$e_{d\,DOB}$, e_d [, s_{nl}]**)**
Days in month	**daysinmonth(**e_d**)**
First day of month	**firstdayofmonth(**e_d**)**
Last day of month	**lastdayofmonth(**e_d**)**

* e_d and $e_{d\,DOB}$ are Stata dates.

* S_{nl} is a string specifying nonleap-year birthdays (“`01mar`” or “`28feb`”).

* Y is a numeric year.

Obtaining dates and date information from other dates

Description	**Function**
Birthday in year	**`birthday(`**$e_{d\,DOB}$, Y [, s_{nl}]**`)`**
Previous birthday	**`previousbirthday(`**$e_{d\,DOB}$, e_d [, s_{nl}]**`)`**
Next birthday	**`nextbirthday(`**$e_{d\,DOB}$, e_d [, s_{nl}]**`)`**
Days in month	**`daysinmonth(`**e_d**`)`**
First day of month	**`firstdayofmonth(`**e_d**`)`**
Last day of month	**`lastdayofmonth(`**e_d**`)`**
Today	**`today()`**
Current date and time	**`now()`**

Obtaining dates and date information from other dates

Description	Function
Leap year indicator	**`isleapyear(`**Y**`)`**
Previous leap year	**`previousleapyear(`**Y**`)`**
Next leap year	**`nextleapyear(`**Y**`)`**
Leap second indicator	**`isleapsecond(`**e_{tC}**`)`**

* Y is a numeric year.

* e_{tC} is a Stata datetime value (leap-second adjusted).

Tell me more about these functions

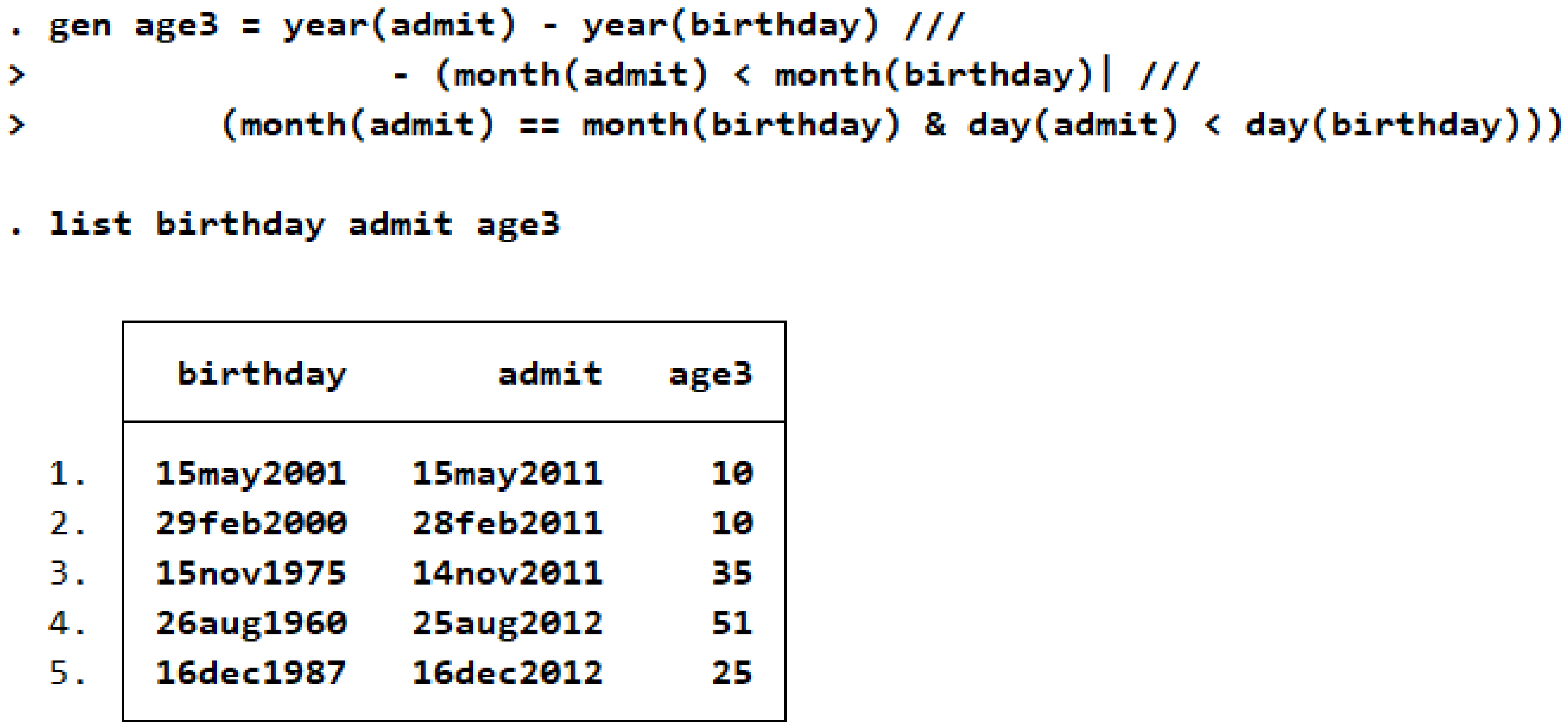
[D] Datetime durations

- Compute age
- Compute the number of days, months, or years between two dates
- Compute the number of days, hours, minutes, seconds, or milliseconds between two datetimes

[D] Datetime relative dates

- Check whether a given year was a leap year
- Determine when the next leap year will be, or determine the most recent one before a given year
- Create dates based on birthdays or anniversaries in a given year
- Determine when the next birthday or anniversary will take place, or determine the most recent one before a given date

Computing age in Stata 15 and previous versions



```
. gen age3 = year(admit) - year(birthday) ///
>                 - (month(admit) < month(birthday)| ///
>         (month(admit) == month(birthday) & day(admit) < day(birthday)))

. list birthday admit age3

     +--------------------------------+
     |  birthday       admit     age3 |
     |--------------------------------|
  1. | 15may2001   15may2011       10 |
  2. | 29feb2000   28feb2011       10 |
  3. | 15nov1975   14nov2011       35 |
  4. | 26aug1960   25aug2012       51 |
  5. | 16dec1987   16dec2012       25 |
     +--------------------------------+
```

Extracting date components from daily dates

Desired component	**Function**	**Example**
Year	**`year(`**e_d**`)`**	2012
Month	**`month(`**e_d**`)`**	12
Day	**`day(`**e_d**`)`**	16
Day of week (0=Sunday)	**`dow(`**e_d**`)`**	0
Julian day of year (1=first day)	**`doy(`**e_d**`)`**	351
* Week within year (1=first week)	**`week(`**e_d**`)`**	51
Quarter within year (1=first quarter)	**`quarter(`**e_d**`)`**	4

* The examples provided are for the date December 16, 2012.

* Week 52 will contain 8 days for non-leap years, and 9 days for leap years.

Extracting time-of-day components from datetime variables

Function

Desired component	Datetime	Datetime (UTC)
Hour of day	**`hh(`**e_{tc}**`)`**	**`hhC(`**e_{tC}**`)`**
Minutes of day	**`mm(`**e_{tc}**`)`**	**`mmC(`**e_{tC}**`)`**
Seconds of day	**`ss(`**e_{tc}**`)`**	**`ssC(`**e_{tC}**`)`**
Year, month, day, hour, minute, second, or millisecond	**`clockpart(`**e_{tc}, s_u**`)`**	**`Clockpart(`**e_{tC}, s_u**`)`**

* e_{tc} is a Stata datetime value (non-leap-second adjusted).

* e_{tC} is a Stata datetime value (leap-second adjusted).

* S_u is a string specifying time units (`“year”, “month”, “day”, “hour”, “minute”, “second”`, or `“millisecond”`).

Converting dates and times from other software to Stata dates and times

Working with dates from other software

- **`import excel`**, **`import sas`**, and **`import spss`** will properly convert numerically encoded dates to Stata dates

Working with dates from other software

- **`import excel`**, **`import sas`**, and **`import spss`** will properly convert numerically encoded dates to Stata dates

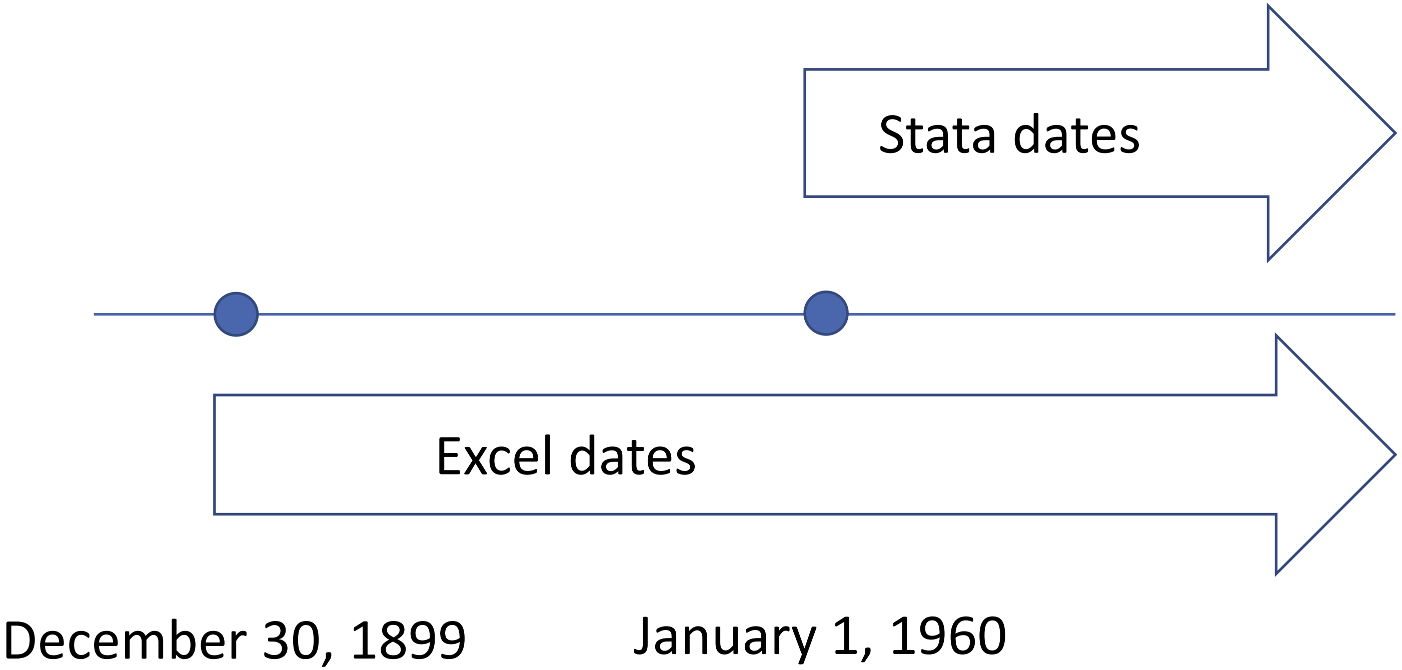
- If you export data from another software to a general format, such as .csv or .txt, and the dates are stored as the underlying numeric values that the other software used, you'll have to convert those to Stata dates.

  - If the other software has a base date earlier than Stata's, you'll have to add the number of days elapsed since that base date

  - If the other software has a base date after Stata's, you'll have to subtract the number of days elapsed since that base date

Working with dates from other software

- For dates on or after 01mar1900, Excel stores dates as days since 30dec1899.



Stata dates

Excel dates

December 30, 1899

January 1, 1960

Note that dates prior to January 1, 1960, are supported in Stata, they are simply negative. However, Excel does not support negative dates.

Converting dates and times from other software

	A. Convert to a Stata date	B. Convert to a Stata datetime
SAS	`sasdate==statadate`	`sastime*1000`
SPSS	`dofc((spsstime*1000) + tc(14oct1582 00:00))`	`(spsstime*1000) + tc(14oct1582 00:00)`
R	`rdate – td(01jan1970)`	`rtime-tC(01jan1970 00:00)` (*UTC)
Excel	`xldate + td(30dec1899)`	`round((xltime+td(30dec1899))*86400)*1000`

To convert datetime values from SAS, SPSS, and Excel to datetimes adjusted for leap seconds (UTC), use the `Cofc(`*B*`)` conversion function, replacing *B* with the contents of column B.

Working with business dates

Business dates

- Suppose we’re working with data from the New York Stock Exchange
- This stock market is closed on weekends
- On a Monday, you want to know the stock price from the last workday (Friday)
- We need to create a calendar so that Stata knows that the previous workday was Friday, and not Sunday
- These types of dates, where some dates are omitted from our calendar, are called business dates

Creating business calendars

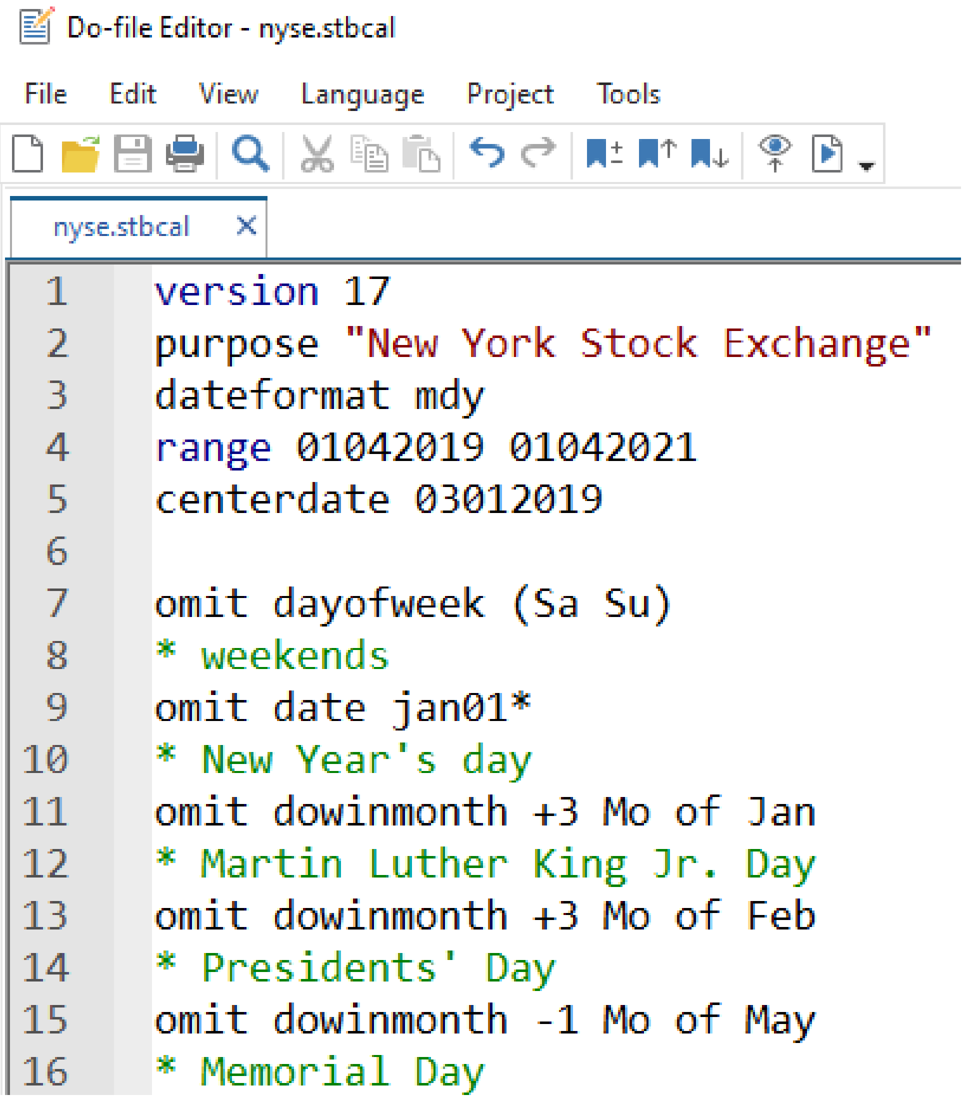
A. Create a calendar from the dataset in memory

- **`bcal create`** *`filename`*`,` **`from(`***`varname`***`)`**
  - See [D] bcal for details

B. Create a calendar manually

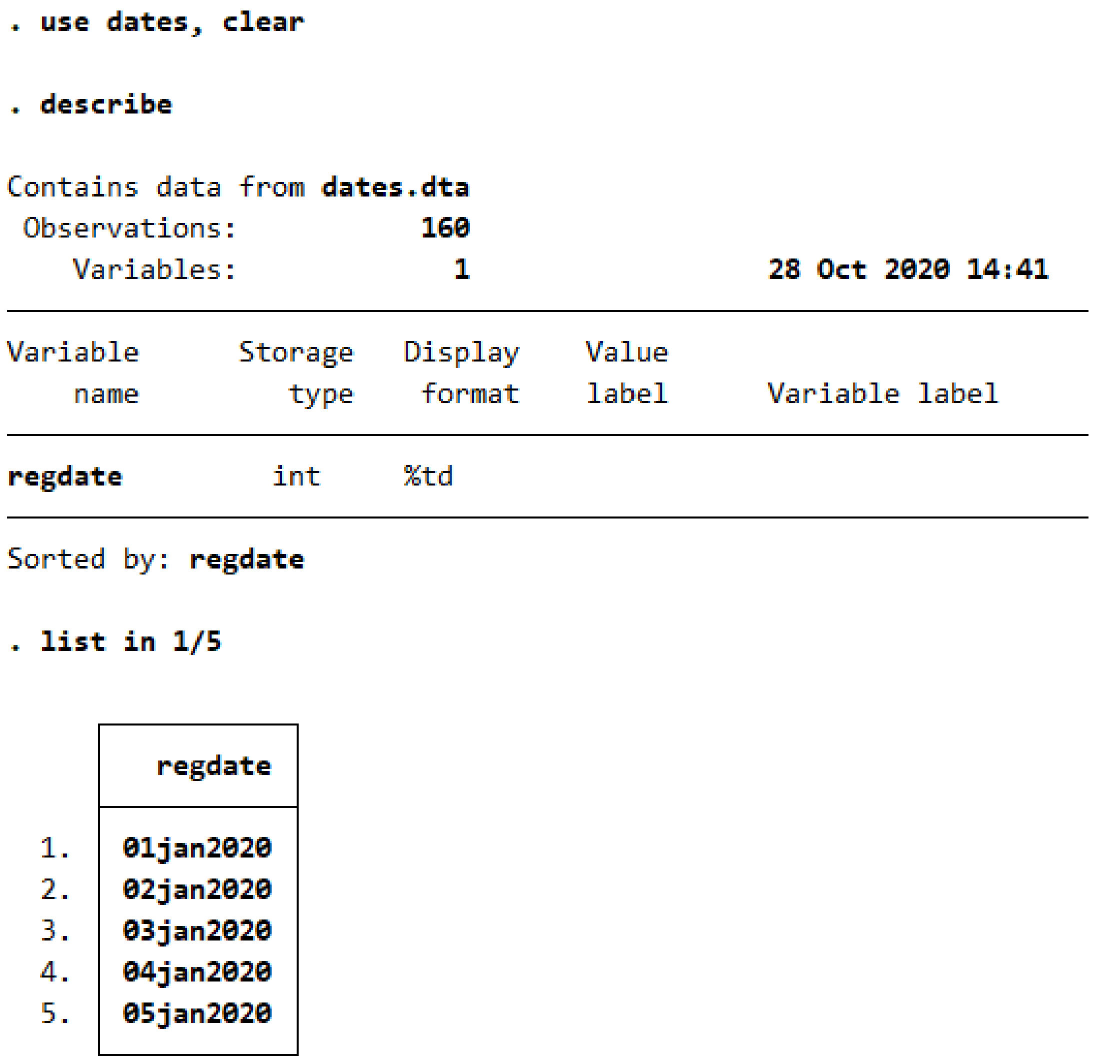
- Tell Stata what dates to omit, the range of dates covered by the calendar, and other details

Creating a business calendar



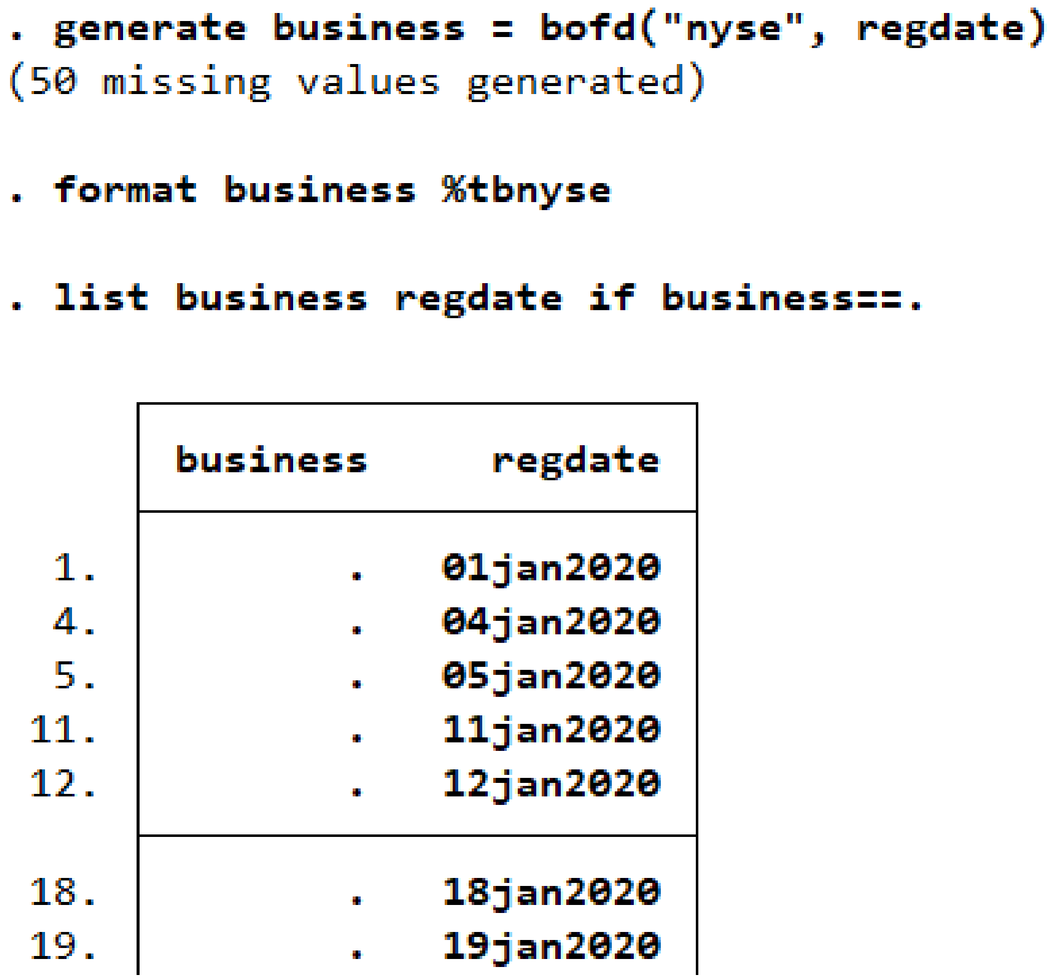
```
version 17
purpose "New York Stock Exchange"
dateformat mdy
range 01042019 01042021
centerdate 03012019

omit dayofweek (Sa Su)
* weekends
omit date jan01*
* New Year's day
omit dowinmonth +3 Mo of Jan
* Martin Luther King Jr. Day
omit dowinmonth +3 Mo of Feb
* Presidents' Day
omit dowinmonth -1 Mo of May
* Memorial Day
```

Fictional data



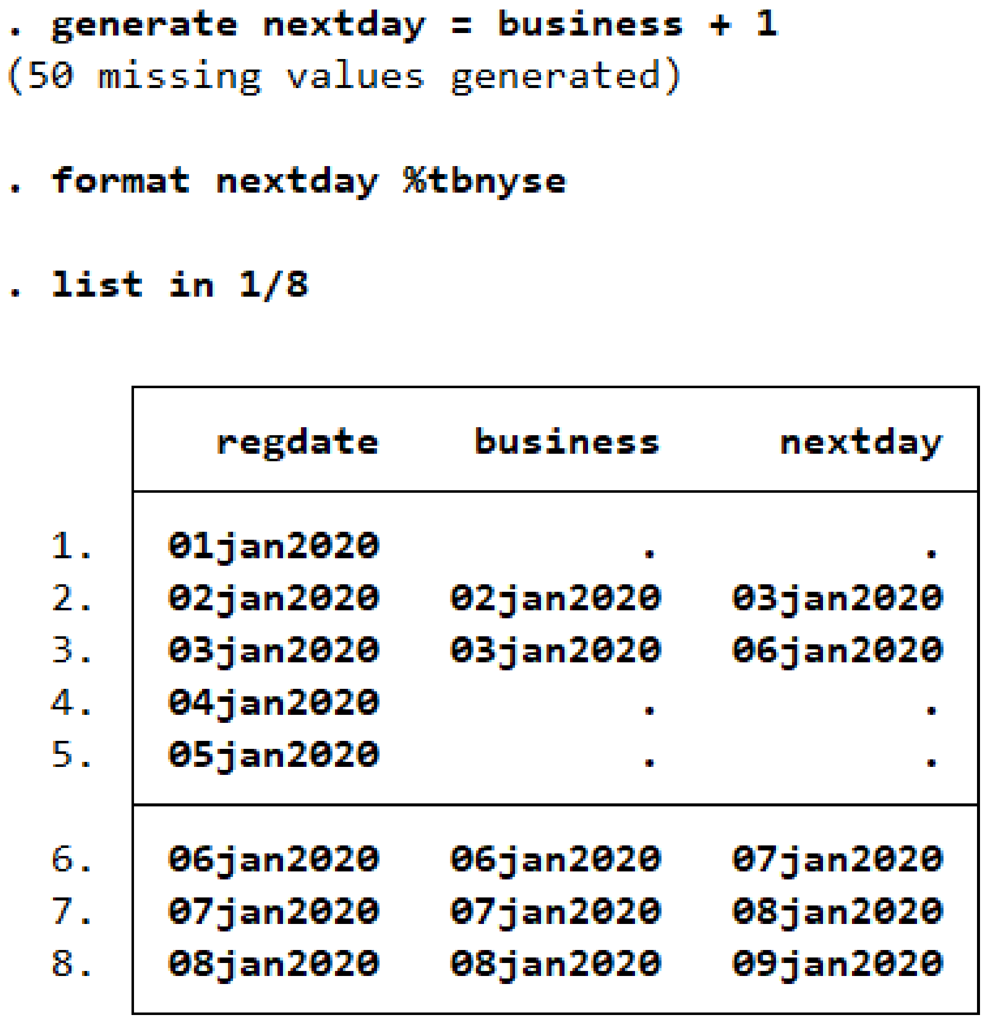
```
. use dates, clear

. describe

Contains data from dates.dta
 Observations:           160
    Variables:             1                  28 Oct 2020 14:41
-----------------------------------------------------------------
Variable      Storage   Display    Value
    name         type    format    label      Variable label
-----------------------------------------------------------------
regdate         int     %td
-----------------------------------------------------------------
Sorted by: regdate

. list in 1/5

     +-----------+
     |   regdate |
     |-----------|
  1. | 01jan2020 |
  2. | 02jan2020 |
  3. | 03jan2020 |
  4. | 04jan2020 |
  5. | 05jan2020 |
     +-----------+
```

Converting daily dates to business dates



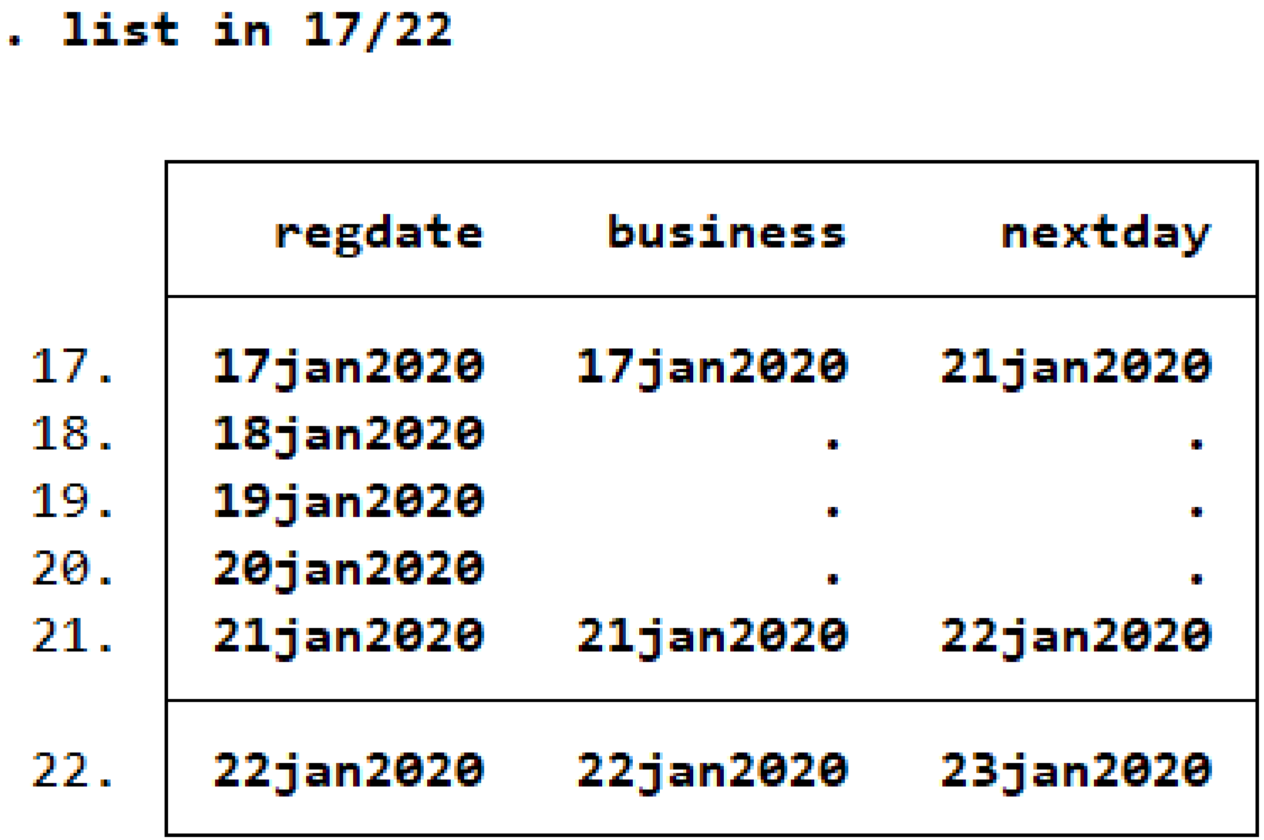
```
. generate business = bofd("nyse", regdate)
(50 missing values generated)

. format business %tbnyse

. list business regdate if business==.

     +----------------------+
     | business     regdate |
     |----------------------|
  1. |        .   01jan2020 |
  4. |        .   04jan2020 |
  5. |        .   05jan2020 |
 11. |        .   11jan2020 |
 12. |        .   12jan2020 |
     |----------------------|
 18. |        .   18jan2020 |
 19. |        .   19jan2020 |
```

Asserting that our omitted dates are truly omitted



```
. generate nextday = business + 1
(50 missing values generated)

. format nextday %tbnyse

. list in 1/8

     +----------------------------------+
     |   regdate    business    nextday |
     |----------------------------------|
  1. | 01jan2020           .          . |
  2. | 02jan2020   02jan2020  03jan2020 |
  3. | 03jan2020   03jan2020  06jan2020 |
  4. | 04jan2020           .          . |
  5. | 05jan2020           .          . |
     |----------------------------------|
  6. | 06jan2020   06jan2020  07jan2020 |
  7. | 07jan2020   07jan2020  08jan2020 |
  8. | 08jan2020   08jan2020  09jan2020 |
     +----------------------------------+
```

Asserting that our omitted dates are truly omitted



```
. list in 17/22

     +----------------------------------+
     |   regdate    business    nextday |
     |----------------------------------|
 17. | 17jan2020   17jan2020  21jan2020 |
 18. | 18jan2020           .          . |
 19. | 19jan2020           .          . |
 20. | 20jan2020           .          . |
 21. | 21jan2020   21jan2020  22jan2020 |
     |----------------------------------|
 22. | 22jan2020   22jan2020  23jan2020 |
     +----------------------------------+
```

But what if

- The actual day of the week that the holiday falls on varies across years
  (e.g., the Christmas holiday may be observed Friday/Monday or Monday/Tuesday depending on what day of the week the 24th falls on)

- The holidays are observed in some years, and not in others
  (e.g., some places no longer observe Columbus day)

Stata can handle these variations; see [D] Datetime business calendars creation for details.

For another introduction to business calendars, see [D] Datetime business calendars.

Final notes

Conclusion

Today we

- converted dates and times stored as strings to numeric date and time variables
- formatted dates and times using simple and customized formats
- converted daily dates to monthly dates, and basic datetimes to UTC
- built dates from multiple components
- computed patients’ ages
- generated business dates after manually creating a business calendar

Resources

- Documentation: Data management reference manual
- Quick guide: Dates and times in Stata
- Stata YouTube video: Creating a numeric date variable from a string variable
- The Stata Blog: A tour of datetime in Stata
- The Stata Blog: Using dates and times from other software
  (Contains advice on whether you should work with basic datetimes or with leap-second adjusted datetimes)
- The Stata Blog: Handling gaps in time series using business calendars
- Stata Technical Support: tech-support@stata.com

Thank you !