tmap 2.0
User's guide

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1 Introduction

The `tmap` package is a suite of Stata programs designed to carry out simple thematic mapping. The first public release of `tmap` (1.2) was described in the latest issue of *The Stata Journal* (Pisati 2004). The purpose of this document is to offer a hands-on introduction to the second public release of `tmap` (2.0) which, thanks to Kit Baum, is available from the SSC archive. For the sake of parsimony, in the following I will assume that the reader is already familiar with the first public release of `tmap`.

Section 2 illustrates the syntax of the new release of `tmap`. To facilitate the existing users of `tmap`, new options are indicated in blue, while revised options are indicated in red.

To exploit `tmap`, the user must be able to access geographical boundary files in the proper format. Section 3 illustrates the format adopted by the new release of `tmap`, shows how to adapt the existing boundary files to the current format, and presents `mif2dta`, a Stata program that converts MapInfo Interchange Format boundary files into Stata boundary files to be used with the new release of `tmap`.

Finally, section 4 illustrates the new features of `tmap` by examples.

2 The tmap package

2.1 Syntax

`tmap` `choropleth` *quantvar* [`if` *exp*] [`in` *range*], `id(`*varname*`)` `map(`*filename*`)`
[`clmethod(quantile|eqint|stdev|custom|unique)` `clnumber(`*#*`)`
`clbreaks(`*numlist*`)` `eirange(`*numlist*`)` `palette(`*colorscheme*`)`
`colors(`*colorstyle_list*`)` `ocolor(`*colorstyle*`)` `osize(`*linewidthstyle*`)`
`bcolor(`*colorstyle*`)` `title(`*tinfo*`)` `subtitle(`*tinfo*`)` `note(`*tinfo*`)`
`caption(`*tinfo*`)` `legpos(`*#*`)` `legcolor(`*colorstyle*`)` `legsize(`*#*`)`
`legformat(`*format*`)` `legtitle(`*tinfo*`)` `legbox(`*roptions*`)` `legcount`
`nolegend` `addplot(`*command*`)`]

tmap propsymbol *quantvar* [if *exp*] [in *range*], xcoord(*varname*) ycoord(*varname*) map(*filename*) [scolor(*colorstyle*) sshape(*symbolstyle*) ssize(*#*) soutline ocolor(*colorstyle*) osize(*linewidthstyle*) fcolor(*colorstyle*) bcolor(*colorstyle*) title(*tinfo*) subtitle(*tinfo*) note(*tinfo*) caption(*tinfo*)]

tmap deviation *quantvar* [if *exp*] [in *range*], xcoord(*varname*) ycoord(*varname*) map(*filename*) [center(mean|median) scolor(*colorstyle*) sshape(*symbolstyle*) ssize(*#*) ocolor(*colorstyle*) osize(*linewidthstyle*) fcolor(*colorstyle*) bcolor(*colorstyle*) title(*tinfo*) subtitle(*tinfo*) note(*tinfo*) caption(*tinfo*)]

tmap dot [if *exp*] [in *range*], xcoord(*varname*) ycoord(*varname*) map(*filename*) [by(*varname*) marker(color|shape|both) scolor(*colorstyle_list*) sshape(*symbolstyle_list*) ssize(*#*) soutline ocolor(*colorstyle*) osize(*linewidthstyle*) fcolor(*colorstyle*) bcolor(*colorstyle*) title(*tinfo*) subtitle(*tinfo*) note(*tinfo*) caption(*tinfo*) legpos(*#*) legcolor(*colorstyle*) legsize(*#*) legtitle(*tinfo*) legbox(*roptions*) legcount nolegend]

tmap label *labvar* [if *exp*] [in *range*], xcoord(*varname*) ycoord(*varname*) map(*filename*) [lcolor(*colorstyle*) lsize(*#*) llength(*#*) ocolor(*colorstyle*) osize(*linewidthstyle*) fcolor(*colorstyle*) bcolor(*colorstyle*) title(*tinfo*) subtitle(*tinfo*) note(*tinfo*) caption(*tinfo*)]

2.2 Common options

map(*filename*) is required. It specifies the name of the file containing the information needed to draw the base map. In tmap choropleth, *filename* must contain the coordinates of the polygons representing the different sub-areas A_i $(i = 1,\ldots,n)$ of the geographical unit of interest R. In all the other cases, *filename* can contain either the coordinates of the polygons representing the different sub-areas A_i, or the coordinates of the polygons representing the whole geographical unit of interest R. *filename* must follow the format described in section 3 below.

ocolor(*colorstyle*) specifies the outline color of the polygons making up the base map (see [G] ***colorstyle***). The default is ocolor(black).

osize(*linewidthstyle*) specifies the outline thickness of the polygons making up the base map (see [G] ***linewidthstyle***). The default is osize(thin).

fcolor(*colorstyle*) (available with all commands but tmap choropleth) specifies the fill color of the polygons making up the base map (see [G] ***colorstyle***). The default is fcolor(white).

`bcolor(`*colorstyle*`)` specifies the background color of the graph (see [G] ***colorstyle***). The default is `bcolor(white)`.

`title(`*tinfo*`)` specifies the overall title of the graph (see [G] ***title_options***).

`subtitle(`*tinfo*`)` specifies the subtitle of the graph (see [G] ***title_options***).

`note(`*tinfo*`)` specifies notes to be displayed with the graph (see [G] ***title_options***).

`caption(`*tinfo*`)` specifies an explanation to accompany the graph (see [G] ***title_options***).

2.3 Options for tmap choropleth

`id(`*varname*`)` is required. It specifies the name of the numeric variable that uniquely identifies the different sub-areas A_i of the geographical unit of interest R. The values taken on by *varname* must correspond to the values taken on by the identifier `_ID` contained in the file specified with option `map(`*filename*`)`.

`clmethod(quantile|eqint|stdev|custom|unique)` specifies the method to be used for determining the class breaks.

`clmethod(quantile)` is the default and requests that the quantiles method be used.

`clmethod(eqint)` requests that the equal intervals method be used.

`clmethod(stdev)` requests that the standard deviates method be used.

`clmethod(custom)` requests that class breaks be specified by the user with option `clbreaks(`*numlist*`)`.

`clmethod(unique)` requests that the variable of interest *quantvar* be treated as a categorical variable taking on a maximum of nine different values.

`clnumber(`*#*`)` specifies the number of classes k in which the variable of interest *quantvar* should be divided. This option accepts only numbers between 2 and 9. The default is `clnumber(4)`.

`clbreaks(`*numlist*`)` is required if option `clmethod(custom)` is specified. It specifies a list of numbers defined as follows: the first element of the list is the minimum value of *quantvar* to be considered; the second to k^{th} elements of the list are the class breaks; the last element of the list is the maximum value of *quantvar* to be considered. For example, suppose that we want to divide the values of *quantvar* into the following four classes: $[10,15]$, $(15,20]$, $(20,25]$, and $(25,50]$; for this we must specify `clbreaks(10 15 20 25 50)`.

`eirange(`*numlist*`)` specifies the range of values (minimum and maximum) to be considered in the calculation of class breaks when option `clmethod(eqint)` is specified. This option overrides the default range $[\min(\mathit{quantvar}), \max(\mathit{quantvar})]$.

`palette(`*colorscheme*`)` specifies the color scheme to be used for representing the different classes in which *quantvar* has been divided. *colorscheme* is one of the following:

Blues	BrBG	Greens	Greys
Paired	PuRd	Purples	RdBu
RdGy	Reds	Set1	Set3
YlOrBr	Custom		

The default is palette(Greys) when clmethod(quantile) or clmethod(eqint) is specified; palette(RdBu) when clmethod(stdev) is specified; and palette(Paired) when clmethod(unique) is specified. If option palette(Custom) is specified, option colors(*colorstyle_list*) must be specified as well.

colors(*colorstyle_list*) specifies a custom list of colors to be used for representing the different classes in which *quantvar* has been divided (see [G] ***colorstyle***). The number of elements of the list must equal *k*, i.e., the desired number of classes.

legpos(*clockpos*) specifies the position of the map legend (see [G] ***clockpos***). The default is legpos(7).

legcolor(*colorstyle*) specifies the color of the main text of the map legend (see [G] ***colorstyle***). The default is legcolor(black).

legsize(*#*) specifies a multiplier that affects the size of the main text of the map legend. For example, to increase the default size of the text by 50%, specify legsize(1.5). The default is legsize(1).

legformat(*format*) specifies the format of the numeric values appearing in the main text of the map legend (see [U] **15.5 Formats: controlling how data are displayed**). The default is legformat(%8.2f).

legtitle(*tinfo*) specifies the title of the map legend (see [G] ***title_options***). By default, no title is used.

legbox(*roptions*) requests that a box be drawn around the map legend and specifies its appearance (see [G] ***legend_option***).

legcount requests that the number of sub-areas A_i belonging to each class k in which *quantvar* has been divided be displayed in the map legend.

nolegend requests that the map legend be suppressed.

addplot(*command*) requests that a propsymbol, deviation, dot or label plot be superimposed onto the current choropleth map. *command* is one of the following:

propsymbol *quantvar* [if *exp*] [in *range*], xcoord(*varname*) ycoord(*varname*) [scolor(*colorstyle*) sshape(*symbolstyle*) ssize(*#*) soutline]

deviation *quantvar* [if *exp*] [in *range*], xcoord(*varname*) ycoord(*varname*) [center(mean | median) scolor(*colorstyle*) sshape(*symbolstyle*) ssize(*#*)]

dot [if *exp*] [in *range*], xcoord(*varname*) ycoord(*varname*) [by(*varname*) marker(color | shape | both) scolor(*colorstyle_list*) sshape(*symbolstyle_list*) ssize(*#*) soutline]

label *labvar* [if *exp*] [in *range*], xcoord(*varname*) ycoord(*varname*) [lcolor(*colorstyle*) lsize(*#*) llength(*#*)]

2.4 Options for tmap propsymbol

xcoord(*varname*) is required. It specifies the name of the variable containing the *x*-coordinate of the centroid of each sub-area A_i. *varname* must be expressed in the same units as the *x*-coordinates of the polygons making up the base map specified with option map(*filename*).

ycoord(*varname*) is required. It specifies the name of the variable containing the *y*-coordinate of the centroid of each sub-area A_i. *varname* must be expressed in the same units as the *y*-coordinates of the polygons making up the base map specified with option map(*filename*).

scolor(*colorstyle*) specifies the color of the symbols (see [G] ***colorstyle***). The default is scolor(black).

sshape(*symbolstyle*) specifies the shape of the symbols (see [G] ***symbolstyle***). The default is sshape(Oh), i.e., a hollow circle.

ssize(*#*) specifies a multiplier that affects the size of the symbols. For example, to increase the size of all the symbols by 50%, specify ssize(1.5). The default is ssize(1).

soutline requests that the symbols be drawn with a black outline.

2.5 Options for tmap deviation

xcoord(*varname*) is required. It specifies the name of the variable containing the *x*-coordinate of the centroid of each sub-area A_i. *varname* must be expressed in the same units as the *x*-coordinates of the polygons making up the base map specified with option map(*filename*).

ycoord(*varname*) is required. It specifies the name of the variable containing the *y*-coordinate of the centroid of each sub-area A_i. *varname* must be expressed in the same units as the *y*-coordinates of the polygons making up the base map specified with option map(*filename*).

center(mean | median) specifies the center of the distribution of *quantvar* to be taken as the reference value. center(mean) is the default requesting that the reference value be the arithmetic mean of *quantvar*. center(median) requests that the reference value be the median of *quantvar*.

scolor(*colorstyle*) specifies the color of the symbols (see [G] ***colorstyle***). The default is scolor(black).

sshape(*symbolstyle*) specifies the shape of the symbols (see [G] ***symbolstyle***). This option accepts only solid symbolstyles expressed in short form, namely O D T S o d t s. The default is sshape(O), i.e., a circle.

ssize(*#*) specifies a multiplier that affects the size of the symbols. For example, to increase the size of all the symbols by 50%, specify ssize(1.5). The default is ssize(1).

2.6 Options for tmap dot

xcoord(*varname*) is required. It specifies the name of the variable containing the *x*-coordinate of the locations at which the events of interest have occurred. *varname* must be expressed in the same units as the *x*-coordinates of the polygons making up the base map specified with option map(*filename*).

ycoord(*varname*) is required. It specifies the name of the variable containing the *y*-coordinate of the locations at which the "events" of interest have occurred. *varname* must be expressed in the same units as the *y*-coordinates of the polygons making up the base map specified with option map(*filename*).

by(*varname*) specifies the name of a categorical variable denoting the type of event that occurred at each location. Although the program does not impose any restriction, it is advisable that *varname* take a maximum of nine different values.

marker(color | shape | both) when by(*varname*) is specified, specifies whether the different types of event should be indicated by symbols having the same shape but different colors, by symbols having the same color but different shapes, or by symbols having both different colors and different shapes. marker(color) is the default and requests that the different types of event be indicated by symbols having the same shape but different colors. marker(shape) requests that the different types of event be indicated by symbols having the same color but different shapes. marker(both) requests that the different types of event be indicated by symbols having both different colors and different shapes.

scolor(*colorstyle_list*) specifies the colors of the symbols (see [G] ***colorstyle***). When by(*varname*) is not specified or is specified along with marker(shape), the default is scolor(black). When by(*varname*) is specified along with marker(color) or marker(both), the default is scolor(black red blue green orange ltblue lime sienna yellow).

sshape(*symbolstyle_list*) specifies the shapes of the symbols (see [G] ***symbolstyle***). When by(*varname*) is not specified or is specified along with marker(color), the default is sshape(o). When by(*varname*) is specified along with marker(shape) or marker(both), the default is sshape(o oh s sh t th d dh x).

`ssize(`*#*`)` specifies a multiplier that affects the size of the symbols. For example, to increase the size of all the symbols by 50%, specify `ssize(1.5)`. The default is `ssize(1)`.

`soutline` requests that the symbols be drawn with a black outline.

`legpos(`*clockpos*`)` specifies the position of the map legend (see [G] ***clockpos***). The default is `legpos(7)`.

`legcolor(`*colorstyle*`)` specifies the color of the main text of the map legend (see [G] ***colorstyle***). The default is `legcolor(black)`.

`legsize(`*#*`)` specifies a multiplier that affects the size of the main text of the map legend. For example, to increase the default size of the text by 50%, specify `legsize(1.5)`. The default is `legsize(1)`.

`legtitle(`*tinfo*`)` specifies the title of the map legend (see [G] ***title_options***). By default, no title is used.

`legbox(`*roptions*`)` requests that a box be drawn around the map legend and specifies its appearance (see [G] ***legend_option***).

`legcount` requests that the number of locations belonging to each possible type of event be displayed in the map legend.

`nolegend` requests that the map legend be suppressed.

2.7 Options for tmap label

`xcoord(`*varname*`)` is required. It specifies the name of the variable containing the *x*-coordinate of the locations at which the labels of interest should be plotted. *varname* must be expressed in the same units as the *x*-coordinates of the polygons making up the base map specified with option `map(`*filename*`)`.

`ycoord(`*varname*`)` is required. It specifies the name of the variable containing the *y*-coordinate of the locations at which the labels of interest should be plotted. *varname* must be expressed in the same units as the *y*-coordinates of the polygons making up the base map specified with option `map(`*filename*`)`.

`lcolor(`*colorstyle*`)` specifies the color of the labels (see [G] ***colorstyle***). The default is `lcolor(black)`.

`lsize(`*#*`)` specifies a multiplier that affects the size of the labels. For example, to increase the size of all the labels by 50%, specify `lsize(1.5)`. The default is `lsize(1)`.

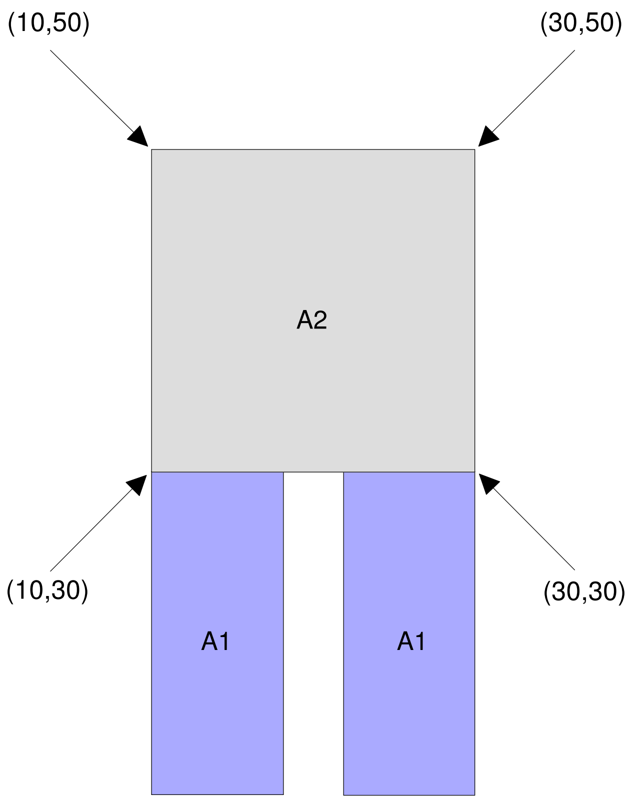
`llength(`*#*`)` specifies the maximum number of characters of the labels to be displayed. The default is `llength(12)`.

3 The tmap boundary file format

3.1 Description

All the programs included in the `tmap` package require that the geographical boundaries of the whole geographical unit of interest *R* or of its sub-areas A_i be stored in an external Stata data file arranged in a proper format. This file – to which I will refer as "Stata boundary file" – must always include the following three variables: `_ID`, which contains the numeric identifier of *R* or of each sub-area A_i; `_X`, which contains the *x*-coordinates of the polygon or polygons that make up *R* or each sub-area A_i; and `_Y`, which contains the *y*-coordinates of the polygon or polygons that make up *R* or each sub-area A_i. The coordinates of each polygon must be arranged so as to correspond to consecutive nodes; moreover, each polygon must be closed, i.e., the last pair of coordinates of each polygon must be equal to the first pair.

To better understand the format of Stata boundary files, let us consider the following geographical unit *R*:



As we can see, *R* is divided into two sub-areas: *A1* and *A2*; moreover, while sub-area *A2* is made up of only one polygon, sub-area *A1* is made up of two different polygons.

How do we translate the above map into a proper Stata boundary file? We simply create a Stata data file arranged as follows:

```
+---------------+
| _ID   _X   _Y |
|---------------|
|   1    .    . |  <- Polygon 1: start
|   1   10   10 |
|   1   10   30 |
|   1   18   30 |
|   1   18   10 |
|   1   10   10 |  <- Polygon 1: end
|   1    .    . |  <- Polygon 2: start
|   1   22   10 |
|   1   22   30 |
|   1   30   30 |
|   1   30   10 |
|   1   22   10 |  <- Polygon 2: end
|   2    .    . |  <- Polygon 3: start
|   2   10   30 |
|   2   10   50 |
|   2   30   50 |
|   2   30   30 |
|   2   10   30 |  <- Polygon 3: end
+---------------+
```

In the first place, we can see that variable `_ID` takes on two values: 1 denotes sub-area *A1*, 2 denotes sub-area *A2*. As noted above, sub-area *A1* is made up of two distinct polygons (identified as Polygon 1 and Polygon 2), while sub-area *A2* is made up of only one polygon (identified as Polygon 3). In the first record of each polygon, both variables `_X` and `_Y` take on a missing value; in the following records, both `_X` and `_Y` take on non-missing values representing the coordinates of the nodes that make up the polygon. Note that each polygon is closed, i.e., the coordinates of the first and last non-missing record of each polygon are identical.

For example, sub-area *A2* takes the shape of a square polygon and, as such, is defined by four nodes, i.e., by four pairs of (x,y) coordinates: (10,30), (10,50), (30,50), and (30,30). In the Stata boundary file, these four coordinate pairs correspond respectively to the second, third, four, and fifth records of Polygon 3; the definition of such polygon is completed by the "opening" record (the first) and the "closing" record (the sixth): the former is defined by the missing coordinate pair (.,.), while the latter is an exact replica of the first node and, therefore, is defined by the coordinate pair (10,30). The presence of the opening record ensures that `tmap` will correctly recognize the beginning of each new polygon, while the presence of the closing record ensures that `tmap` will correctly draw each polygon.

To conclude, it is important to note that a properly formatted Stata boundary file *must* always be sorted by `_ID`.

3.2 How to modify the existing Stata boundary files

In the first public release of `tmap`, Stata boundary files had a slightly – yet, substantially – different format than that described above. In practice, the opening record (i.e., that defined by the missing coordinate pair) was absent. Thus, to adapt the existing Stata boundary files to the current format one must add an opening record to each polygon.

For example, suppose I want to adapt to the new format one of the Stata boundary files included in the distribution of the first public release of `tmap`, namely the file called `Milano-AreaMap.dta`. In this file the city of Milano is divided into 20 sub-areas, each of which is made up of exactly one polygon. To carry out the desired revision, I proceed as follows:

```
. clear
. set obs 20
obs was 0, now 20

. gen _ID=_n
. gen _X=.
(20 missing values generated)

. gen _Y=.
(20 missing values generated)

. gen temp=0
. compress
_ID was float now byte
_X was float now byte
_Y was float now byte
temp was float now byte

. save "temp.dta", replace
file temp.dta saved

. use "Milano-AreaMap.dta", clear
. gen temp=_n
. sort _ID temp
. drop temp
. by _ID: gen temp=_n
. append using "temp.dta"
. sort _ID temp
. drop temp
. save "Milano-AreaMap.dta", replace
file Milano-AreaMap.dta saved
```

The revised Stata boundary file can now be used with the new release of `tmap`.

Admittedly, the above example represents a simple case, and more complex Stata boundary files may require a somewhat different approach. However, the general logic behind the upgrading is straightforward: an opening record must be added to each polygon defined in the Stata boundary file.

3.3 mif2dta

Many geographical boundary files are available in MapInfo Interchange Format. The files written in this format usually go in pairs: the first file has extension `.mif` and contains the coordinates of the polygons making up the geographical areas of interest; the second file has extension `.mid` and contains data on such geographical areas, usually in the form of one record per area.

`mif2dta` is a simple Stata program that converts MapInfo Interchange Format boundary files to Stata boundary files to be used with the new release of `tmap`. Expressly, `mif2dta` converts any given pair of files *rootname*`.mif` and *rootname*`.mid` into a new pair of Stata files: *rootname*`-Coordinates.dta` (the boundary file) and *rootname*`-Database.dta` (the data file). Optionally, `mif2dta` also computes the coordinates of the centroids of the geographical areas of interest, stores them in variables `x_`*stub* and `y_`*stub*, and adds them to file *rootname*`-Database.dta`.

The syntax of `mif2dta` is straightforward:

`mif2dta` *rootname*`, genid(`*newvarname*`)` [`gencentroids(`*stub*`)`]

`genid(`*newvarname*`)` is required. It specifies the name of the new numeric variable that, in file *rootname*`-Database.dta`, will uniquely identify the different geographical areas of interest. The values taken on by *newvarname* will correspond to the values taken on by variable `_ID` in file *rootname*`-Coordinates.dta`.

`gencentroids(`*stub*`)` requests that the coordinates of the centroids of the geographical areas of interest be computed, stored in variables `x_`*stub* and `y_`*stub*, and added to file *rootname*`-Database.dta`.

4 Examples

The following examples will focus on `tmap choropleth`, since it allows to illustrate almost all the new features introduced in release 2.0 of `tmap`. The format of the examples will follow that used by Michael N. Mitchell in his excellent book *A Visual Guide to Stata Graphics* (Mitchell 2004). Finally, all the examples will regard the United States and will be based on a map whose coordinates have been computed using a Gall stereographic projection.

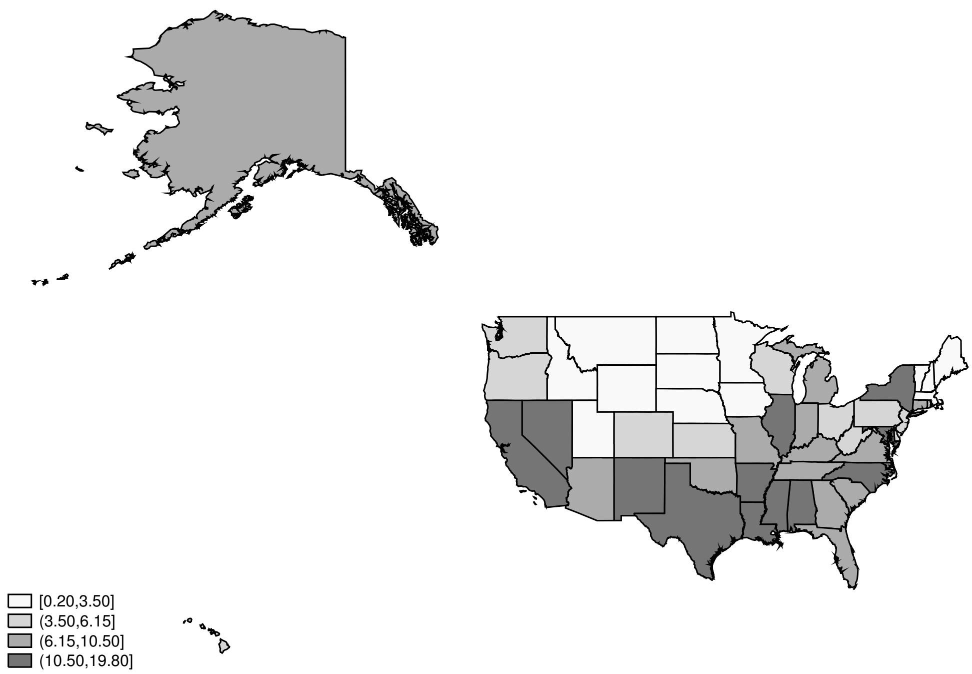
```
use "Us-Database.dta", clear
```

```
describe
```

```
Contains data from D:\Lavori\tmap2\Us-Database.dta
  obs:            51
 vars:            13                          4 Jan 2005 14:59
 size:         3,009 (99.9% of memory free)
-------------------------------------------------------------------------------
              storage  display     value
variable name   type   format      label      variable label
-------------------------------------------------------------------------------
id              byte   %9.0g                  State ID
x_coord         float  %9.0g                  x-coordinate of state centroid
y_coord         float  %9.0g                  y-coordinate of state centroid
```

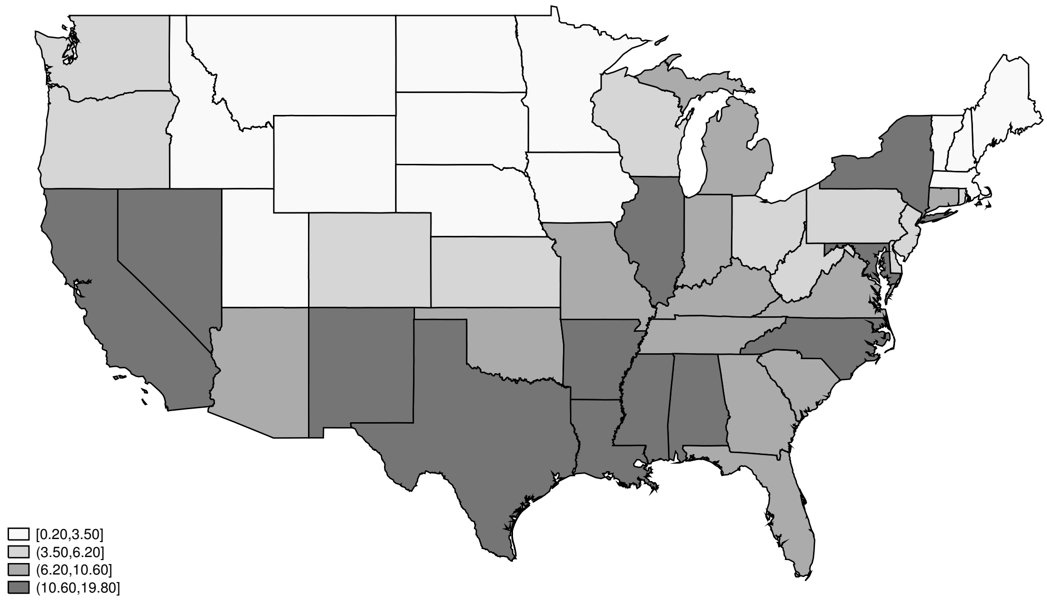
```
name            str20  %20s                        State name
label           str2   %9s                         State abbreviation
fips            byte   %8.0g                       State fips code
region          str7   %9s                         Region
conterminous    byte   %9.0g                       Conterminous state
pop             int    %8.0g                       Population in 1,000s (1994)
murder          float  %9.0g                       Murders per 100,000 population
                                                     (1994)
hsdip           float  %9.0g                       Pct. population with high
                                                     school diploma (1994)
votebushpct     float  %5.1f                       Pct. votes for Bush (2004)
winner          byte   %9.0g       winner          Winner
-------------------------------------------------------------------------------
Sorted by:  id
```

```
tmap choropleth murder, id(id) map(Us-Coordinates.dta)
```



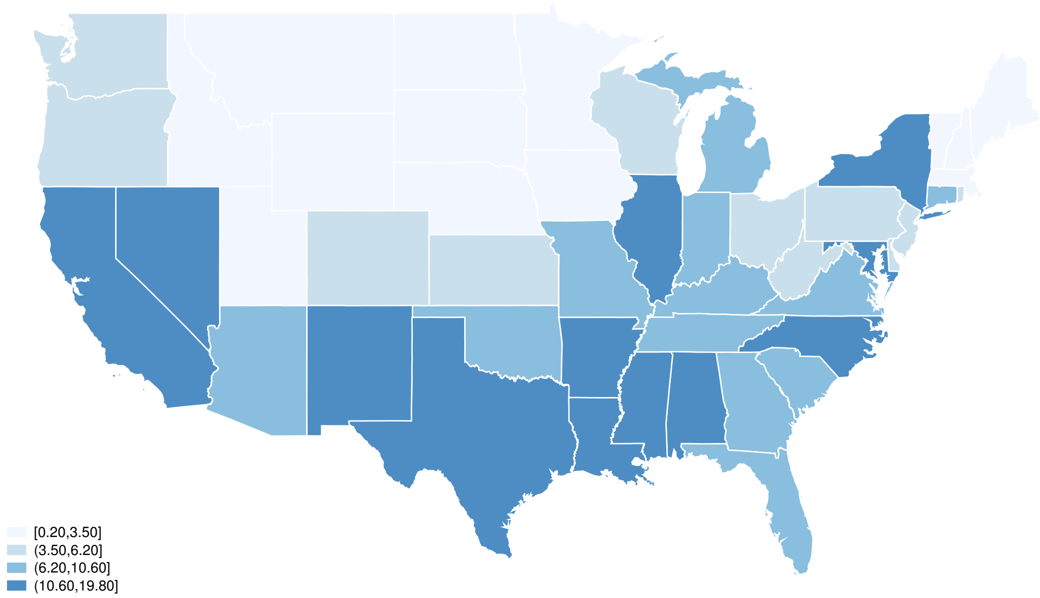
This simple map represents the distribution across the fifty U.S. states of variable `murder` (murders per 100,000 population, 1994). Default values of all options are used.

```
tmap choropleth murder if conterminous, id(id) map(Us-Coordinates.dta)
```



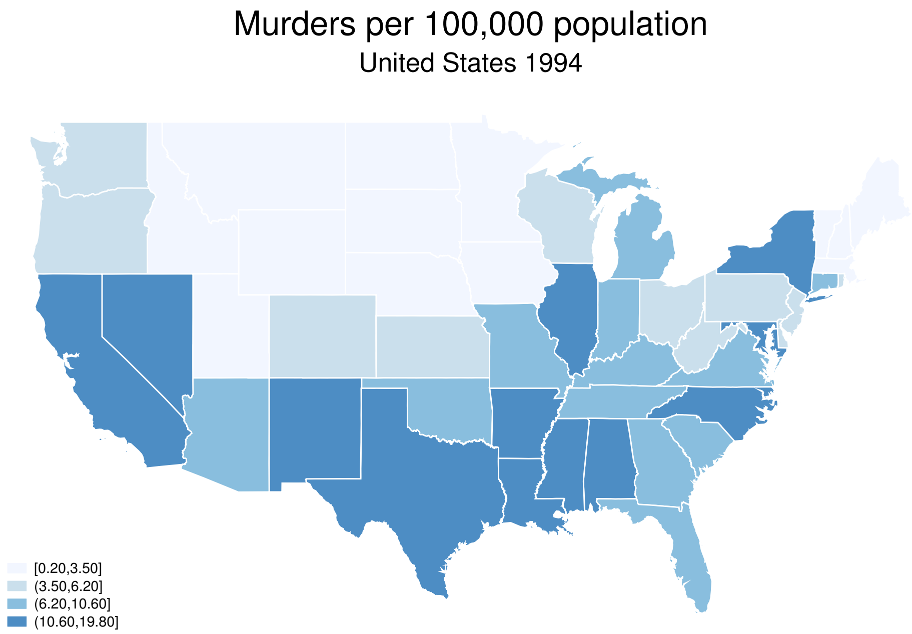
For the sake of simplicity, we decide to restrict our attention to the forty-eight conterminous states; to this purpose, we add to the main command the qualifier `if conterminous`.

```
tmap choropleth murder if conterminous, id(id) map(Us-Coordinates.dta)
     palette(Blues) ocolor(white)
```



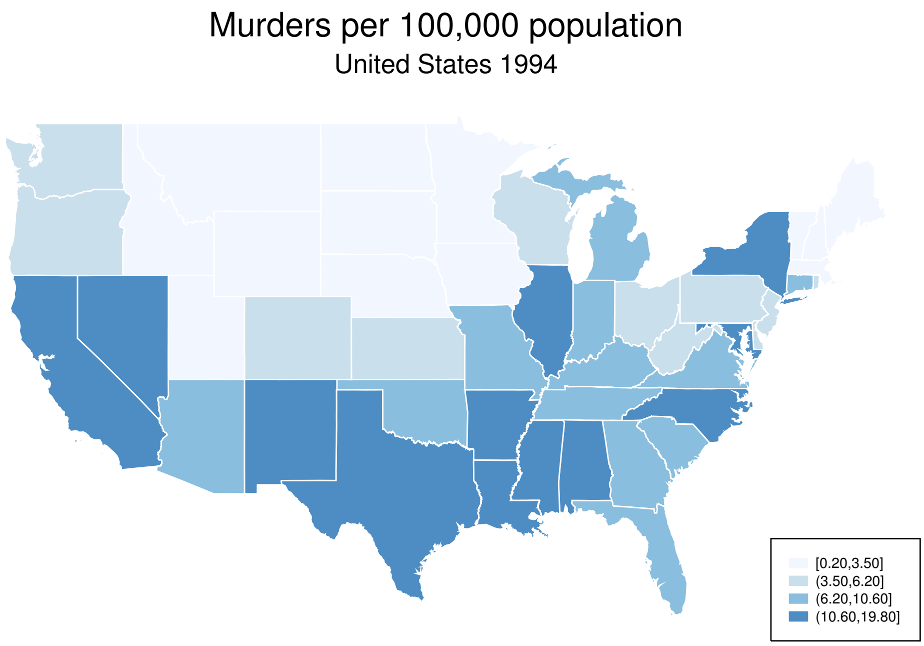
Here, we change the color scheme (shifting from the default Greys to Blues) by specifying `palette(Blues)`. Moreover, we add option `ocolor(white)` to change the color of the polygons' outline from the default black to white.

```
tmap choropleth murder if conterminous, id(id) map(Us-Coordinates.dta)
     palette(Blues) ocolor(white)
     title(`"`"Murders per 100,000 population"'"')
     subtitle("United States 1994")
```



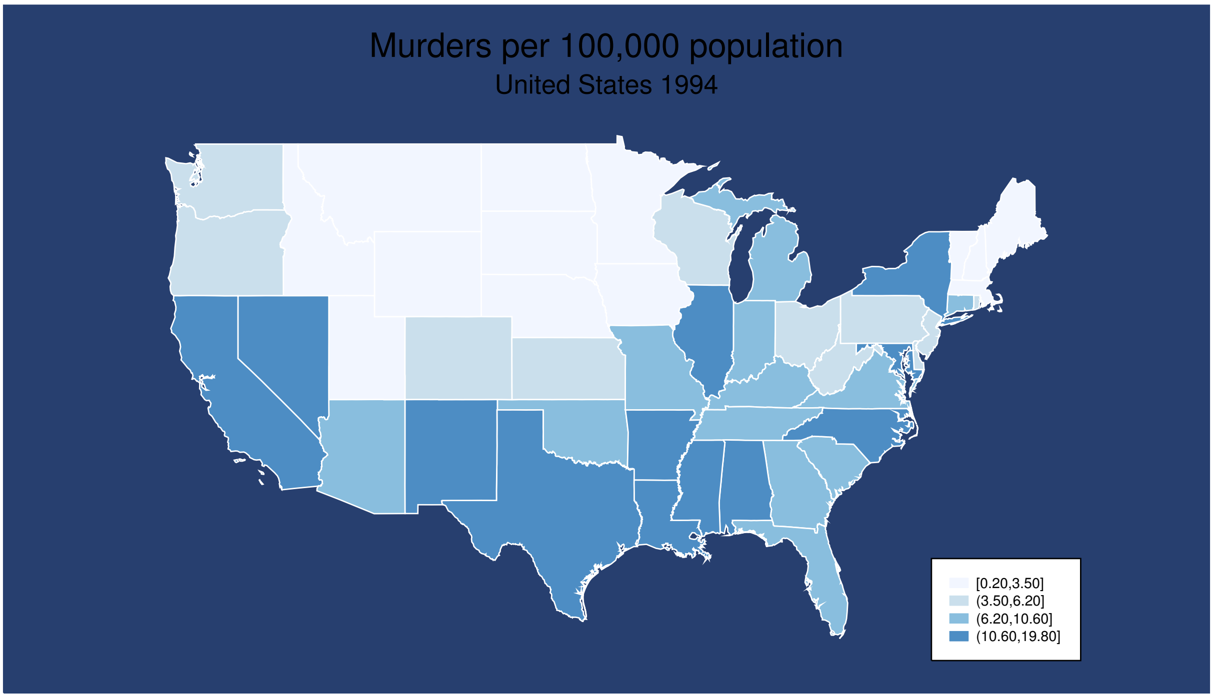
Here, we use options `title()` and `subtitle()` to add a general description of the map. Note that the string of characters representing the title is enclosed in two pairs of compound double quotes; this is necessary whenever the string of interest includes “special” characters (in this case, a comma) or is articulated in two or more lines.

```
tmap choropleth murder if conterminous, id(id) map(Us-Coordinates.dta)
     palette(Blues) ocolor(white)
     title(`"`"Murders per 100,000 population"'"')
     subtitle("United States 1994")
     legbox(lc(black) margin(medsmall)) legpos(5)
```



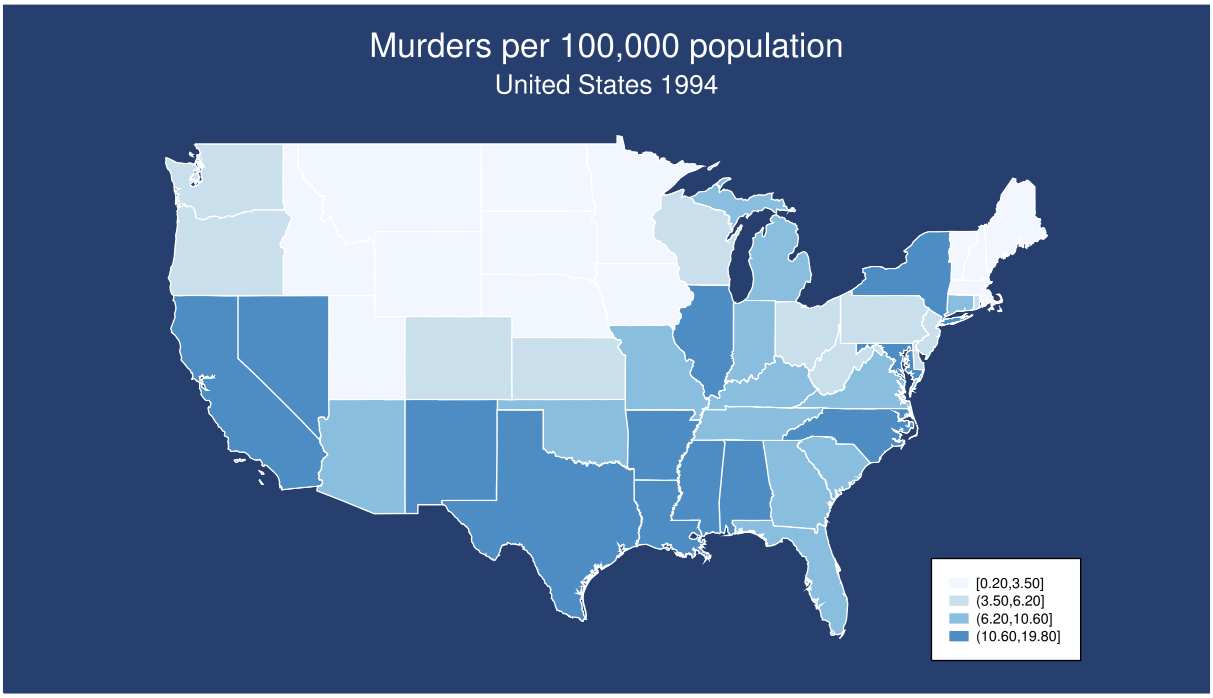
To modify the appearance of the map legend, we use option `legpos(5)` to move the legend to the right, and option `legbox(lc(black) margin(medsmall))` to include it in a box with a black outline and a medium-small margin.

```
tmap choropleth murder if conterminous, id(id) map(Us-Coordinates.dta)
     palette(Blues) ocolor(white)
     title(`"`"Murders per 100,000 population"'"')
     subtitle("United States 1994")
     legbox(lc(black) margin(medsmall)) legpos(5)
     bcolor(navy)
```



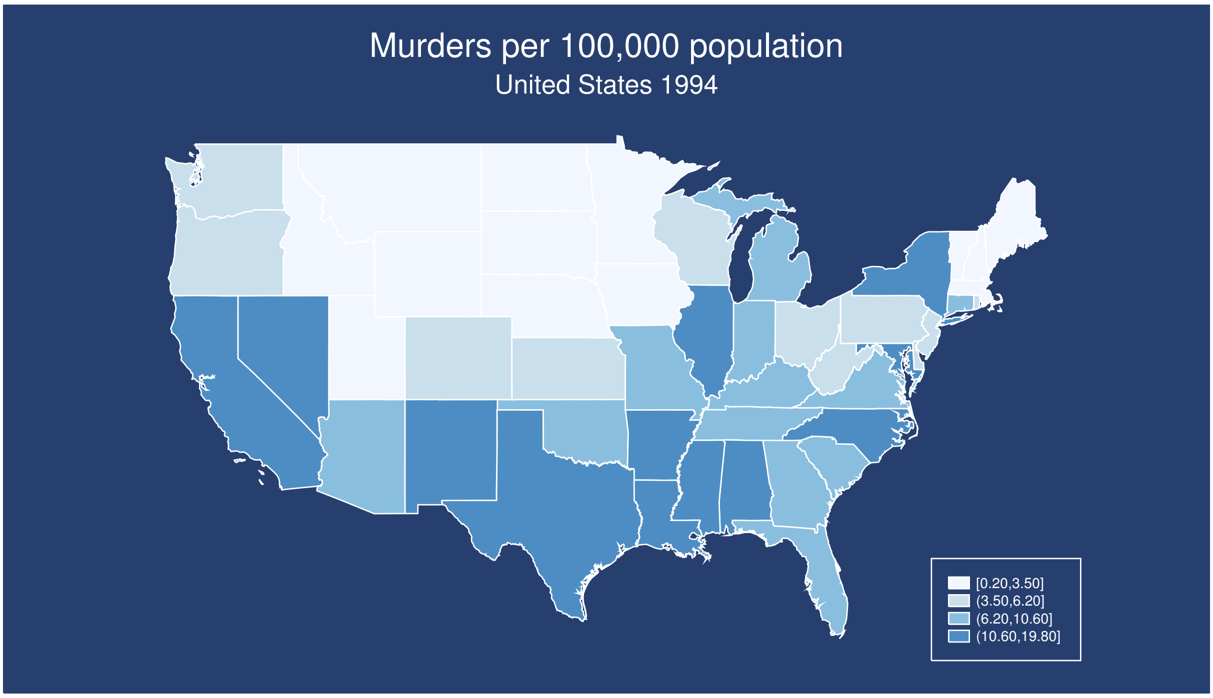
Now, we decide to change the background color of the chart (from the default white to navy blue) by specifying option bcolor(navy).

```
tmap choropleth murder if conterminous, id(id) map(Us-Coordinates.dta)
     palette(Blues) ocolor(white)
     title(`"`"Murders per 100,000 population"'"', color(white))
     subtitle("United States 1994", color(white))
     legbox(lc(black) margin(medsmall)) legpos(5)
     bcolor(navy)
```



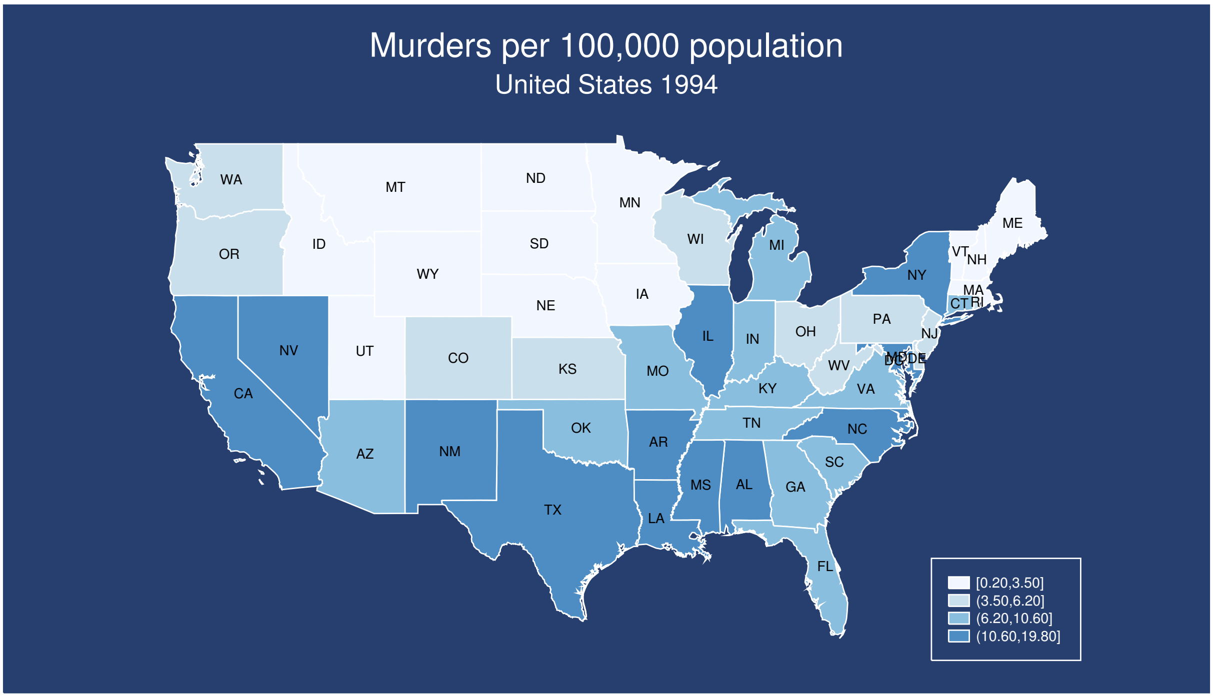
Given the new background color, we choose a more suitable color for the title and the subtitle by specifying suboption `color(white)` within options `title()` and `subtitle()`.

```
tmap choropleth murder if conterminous, id(id) map(Us-Coordinates.dta)
     palette(Blues) ocolor(white)
     title(`"`"Murders per 100,000 population"'"', color(white))
     subtitle("United States 1994", color(white))
     legbox(lc(white) fc(navy) margin(medsmall)) legpos(5) legcol(white)
     bcolor(navy)
```



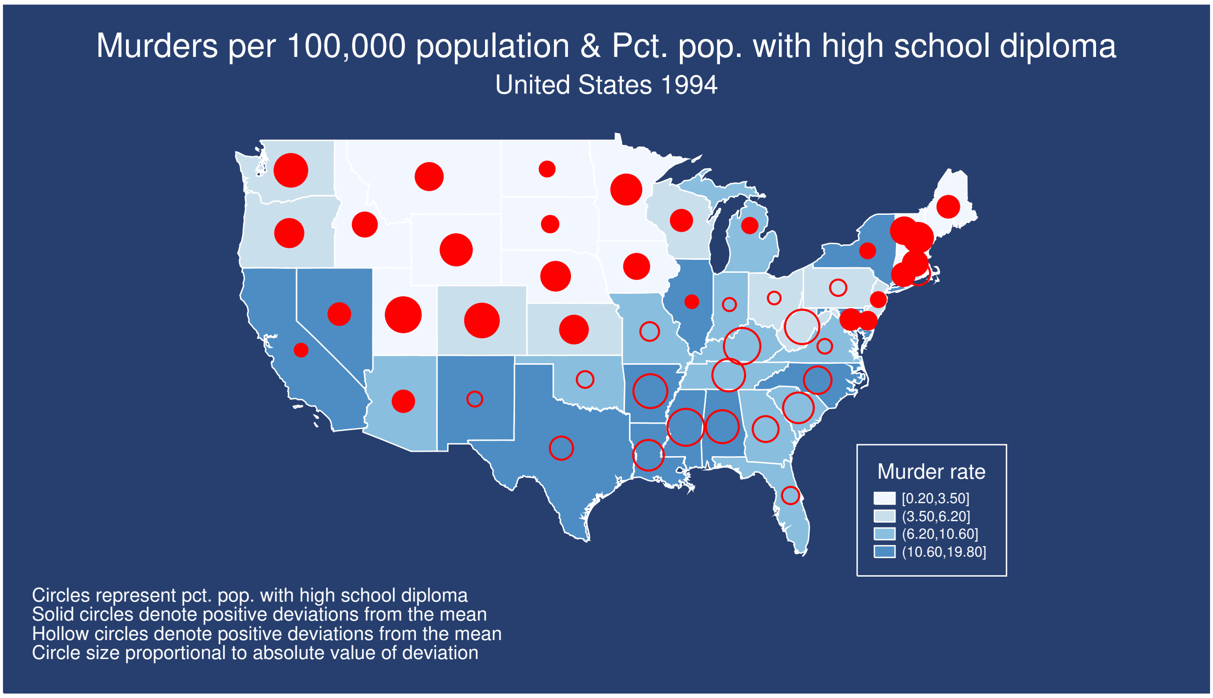
Likewise, we use options `legbox(lc(white) fc(navy) margin(medsmall))` and `legcol(white)` to modify the appearance of the map legend.

```
tmap choropleth murder if conterminous, id(id) map(Us-Coordinates.dta)
     palette(Blues) ocolor(white)
     title(`"`"Murders per 100,000 population"'"', color(white))
     subtitle("United States 1994", color(white))
     legbox(lc(white) fc(navy) margin(medsmall)) legpos(5) legcol(white)
     bcolor(navy)
     addplot(label label if conterminous, x(x) y(y) ls(0.8))
```



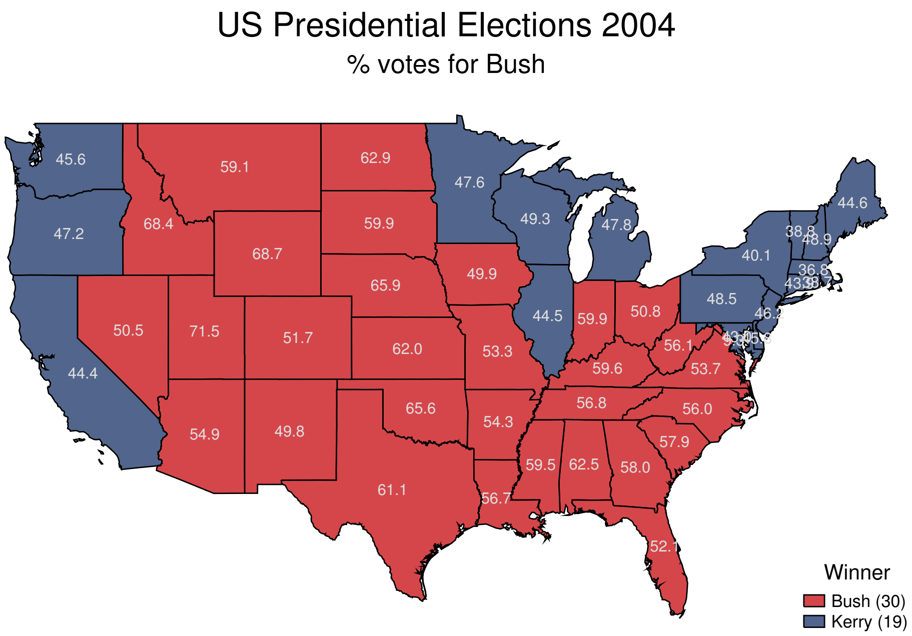
Let us now take a look at the new option addplot(). This option allows the user to superimpose a propysmbol, deviation, dot, or label plot onto the current choropleth map. Here, we use option addplot(label label if conterminous, x(x) y(y) ls(0.8)) to add the short names of the states to the map.

```
tmap choropleth murder if conterminous, id(id) map(Us-Coordinates.dta)
     palette(Blues) ocolor(white)
     title(`"`"Murders per 100,000 population & Pct. pop. with high school
           diploma"'"', color(white) span)
     subtitle("United States 1994", color(white))
     legbox(lc(white) fc(navy) margin(medsmall)) legpos(5) legcol(white)
     legtitle("Murder rate", color(white) size(*0.8))
     bcolor(navy)
     addplot(deviation hsdip if conterminous, x(x) y(y) sc(red) ssi(0.8))
     note(`"`"Circles represent pct. pop. with high school diploma"'"'
          `"`"Solid circles denote positive deviations from the mean"'"'
          `"`"Hollow circles denote positive deviations from the mean"'"'
          `"`"Circle size proportional to absolute value of deviation"'"',
          color(white) span)
```



Let us move to something a little bit more elaborate. In this case we use option `addplot(deviation hsdip if conterminous, x(x) y(y) sc(red) ssi(0.8))` to add to the current choropleth map a deviation plot representing the distribution across states of variable `hsdisp` (percent population with high school diploma). To reflect this addition, we change the chart title, add a title to the map legend, and add a note illustrating the meaning of the symbols.

```
tmap choropleth winner if conterminous, id(id) map(Us-Coordinates.dta)
     clmethod(unique) palette(Custom) colors(`"`"203 24 29"'"' navy)
     title(US Presidential Elections 2004) subtitle(% votes for Bush)
     legpos(5) legsize(1.2) legtitle("Winner", size(*0.8)) legcount
     addplot(label votebushpct if conterminous, x(x) y(y) lc(gs14) ls(0.9))
```



Let us conclude our little tour with a map representing the results of the 2004 U.S. presidential elections. Here, we can note the use of the new option `legcount` to show – in the map legend – the number of states belonging to each class.

5 Acknowledgments

The color schemes used in `tmap choropleth` were designed by Dr. Cynthia A. Brewer, Department of Geography, The Pennsylvania State University, University Park, Pennsylvania, USA. The color schemes are used with Dr. Brewer's permission and are from the ColorBrewer map design tool available at ColorBrewer.org. I wish to thank an anonymous reviewer and Nick Cox for helping improve the first release of the `tmap` package. The second release owes much to ideas and suggestions by Vince Wiggins and Nick Cox. Any remaining errors are mine.

6 References

Mitchell, M. N. 2004. *A Visual Guide to Stata Graphics*. College Station: Stata Press.

Pisati, M. 2004. Simple thematic mapping. *Stata Journal* 4(4): 361-378.