ZevRoss
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Technical Tidbits From Spatial Analysis & Data Science

Beautiful plotting in R: A `ggplot2` cheatsheet

Posted on August 4, 2014 by zev@zevross.com · 9 Comments

Even the most experienced R users need help creating elegant graphics. The `ggplot2` library is a phenomenal tool for creating graphics in R but even after many years of near-daily use we still need to refer to our Cheat Sheet. Up until now, we've kept these key tidbits on a local PDF. But for our own benefit (and hopefully yours) we decided to post the most useful bits of code.

* Last updated February 4, 2015 (new: smooths, margins, label function and correlation tile plot)

You may also be interested in these other `ggplot2`-related posts:

Under the hood of ggplot2 graphics in R
Mapping in R using the ggplot2 package
A new data processing workflow for R: dplyr, magrittr, tidyr and ggplot2

We start with the the quick setup and a default plot followed by a range of adjustments below.

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Quick-setup: The dataset

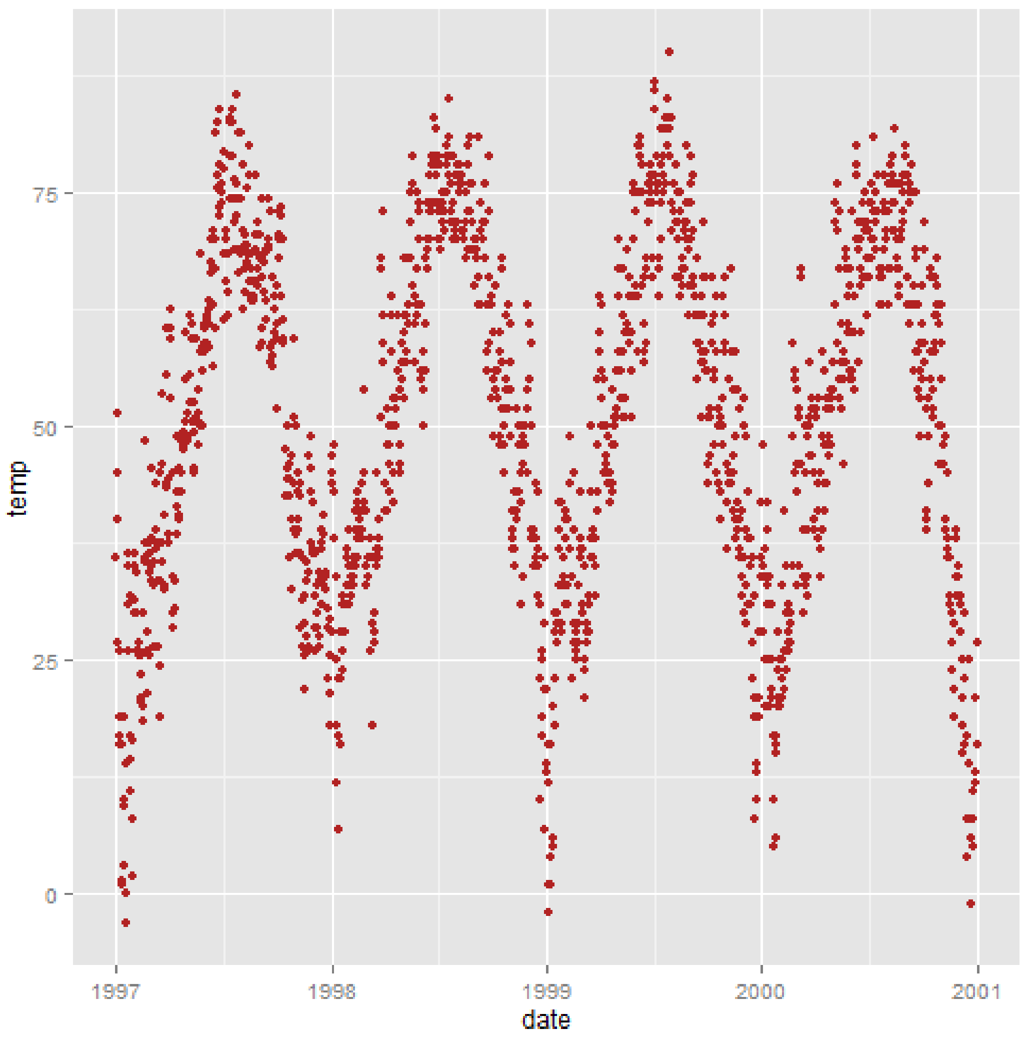
We're using data from the National Morbidity and Mortality Air Pollution Study (NMMAPS). To make the plots manageable we're limiting the data to Chicago and 1997-2000. For more detail on this dataset, consult Roger Peng's book Statistical Methods in Environmental Epidemiology with R.

You can also download the data we're using in this post here.

```
library(ggplot2)
nmmaps<-read.csv("chicago-nmmaps.csv", as.is=T)
nmmaps$date<-as.Date(nmmaps$date)
nmmaps<-nmmaps[nmmaps$date>as.Date("1996-12-31"),]
nmmaps$year<-substring(nmmaps$date,1,4)
head(nmmaps)
##      city       date death temp dewpoint   pm10     o3 time season year
## 3654 chic 1997-01-01   137 36.0    37.50 13.052  5.659 3654 winter 1997
## 3655 chic 1997-01-02   123 45.0    47.25 41.949  5.525 3655 winter 1997
## 3656 chic 1997-01-03   127 40.0    38.00 27.042  6.289 3656 winter 1997
## 3657 chic 1997-01-04   146 51.5    45.50 25.073  7.538 3657 winter 1997
## 3658 chic 1997-01-05   102 27.0    11.25 15.343 20.761 3658 winter 1997
## 3659 chic 1997-01-06   127 17.0     5.75  9.365 14.941 3659 winter 1997
```

A default plot in `ggplot2`

```
g<-ggplot(nmmaps, aes(date, temp))+geom_point(color="firebrick")
g
```



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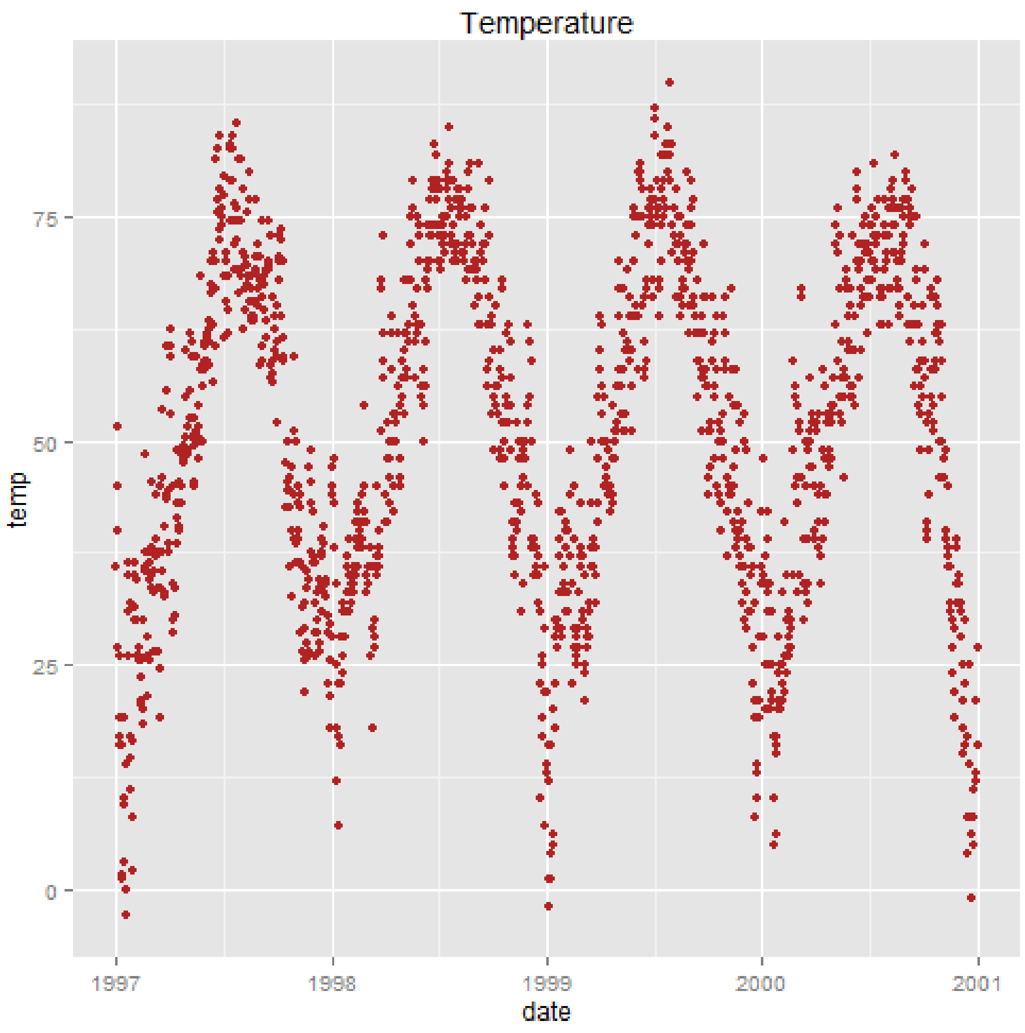
Working with the title

Add a title (`ggtitle()` or `labs()`)

```
g<-g+ggtitle('Temperature')
g
```



Alternatively, you can use `g+labs(title='Temperature')`

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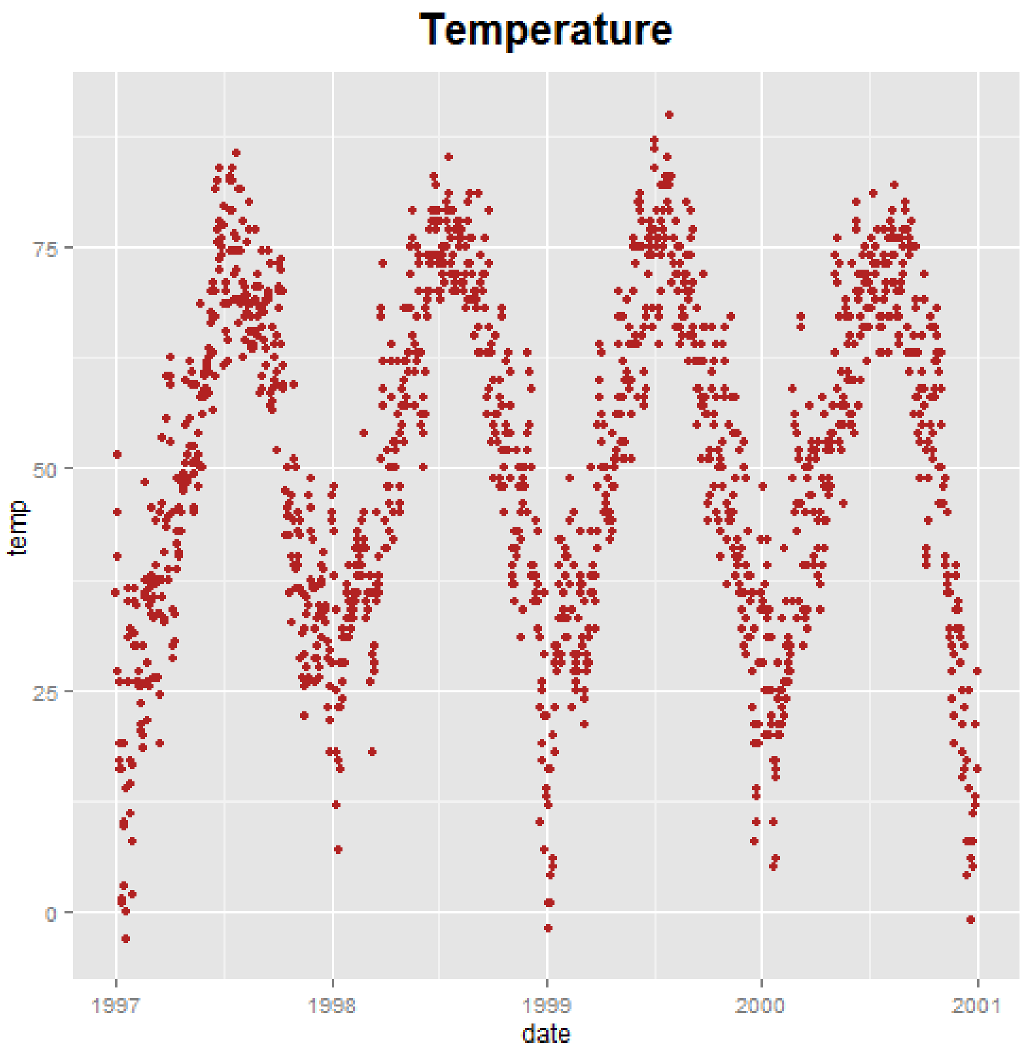
Make title bold and add a little space at the baseline (`face`, `vjust`)

The `vjust` argument controls the vertical justification.

```
g+theme(plot.title = element_text(size=20, face="bold", vjust=2))
```



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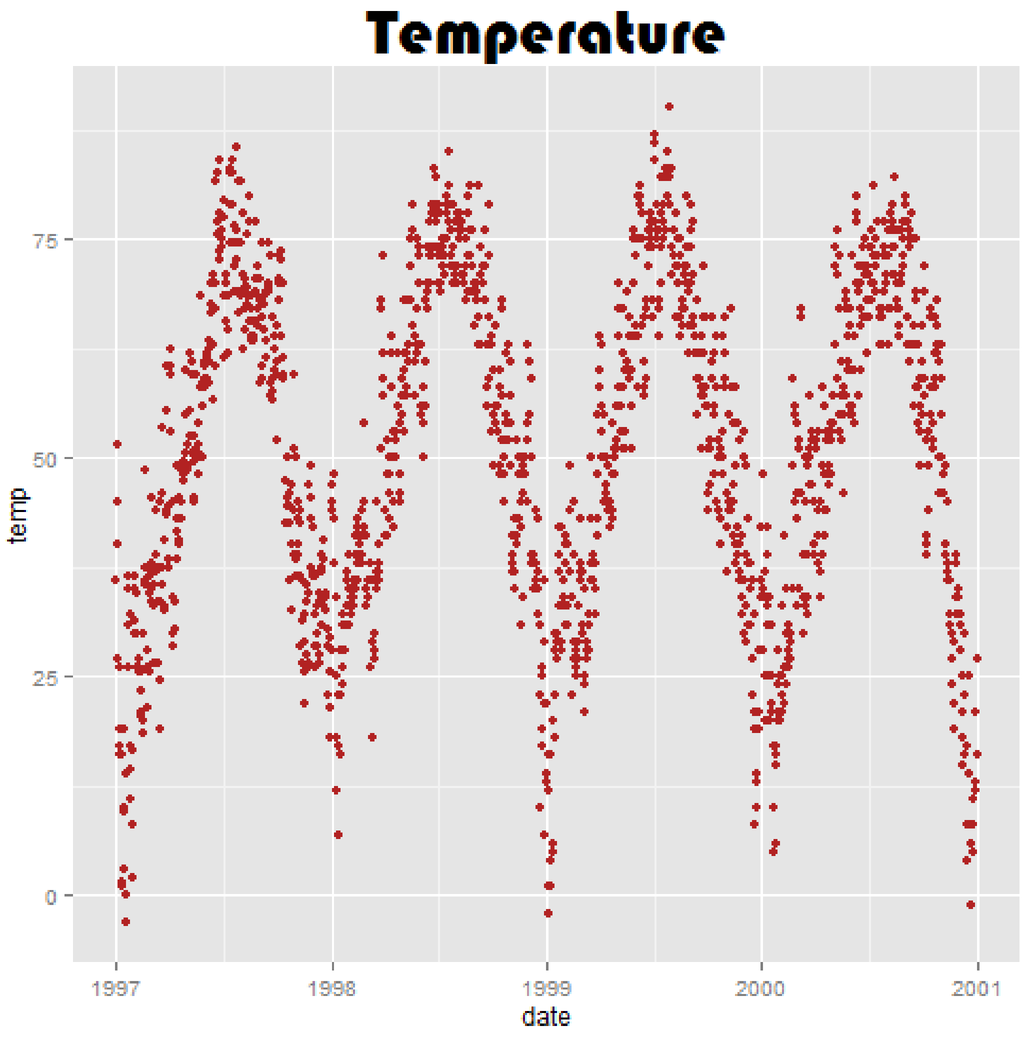
Use a non-traditional font in your title (`family`)

Note that you can also use different fonts. It's not as easy as it seems here, check out this post if you need to use different fonts. This may not work on a Mac (send me a note and let me know).

```
library(extrafont)
g+theme(plot.title = element_text(size=30,lineheight=.8,
  vjust=1,family="Bauhaus 93"))
```



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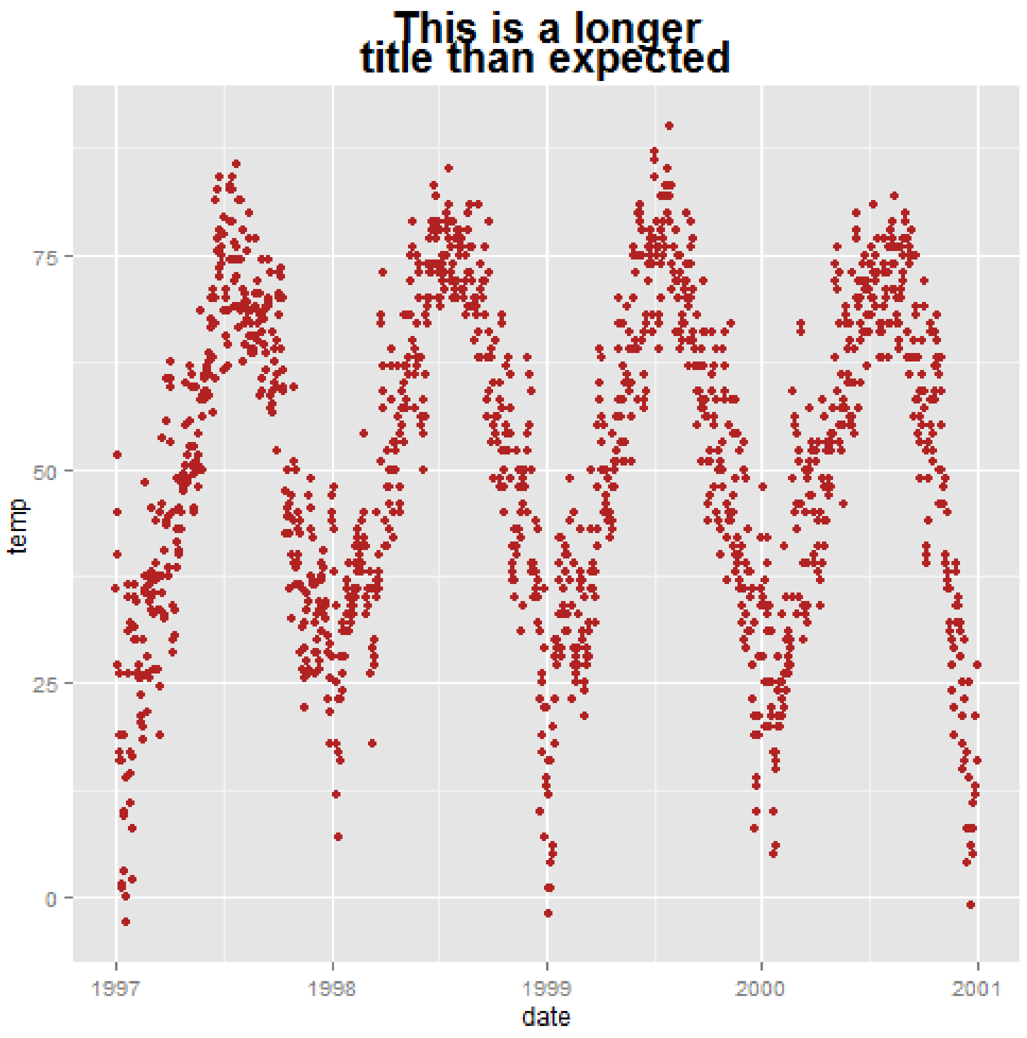
Change spacing in multi-line text (`lineheight`)

You can use the `lineheight` argument to change the spacing between lines. In this example, I've squished the lines together a bit (lineheight < 1).

```
g<-g+ggtitle("This is a longer\ntitle than expected")
g+theme(plot.title = element_text(size=20, face="bold", vjust=1, lineheight=0.6))
```



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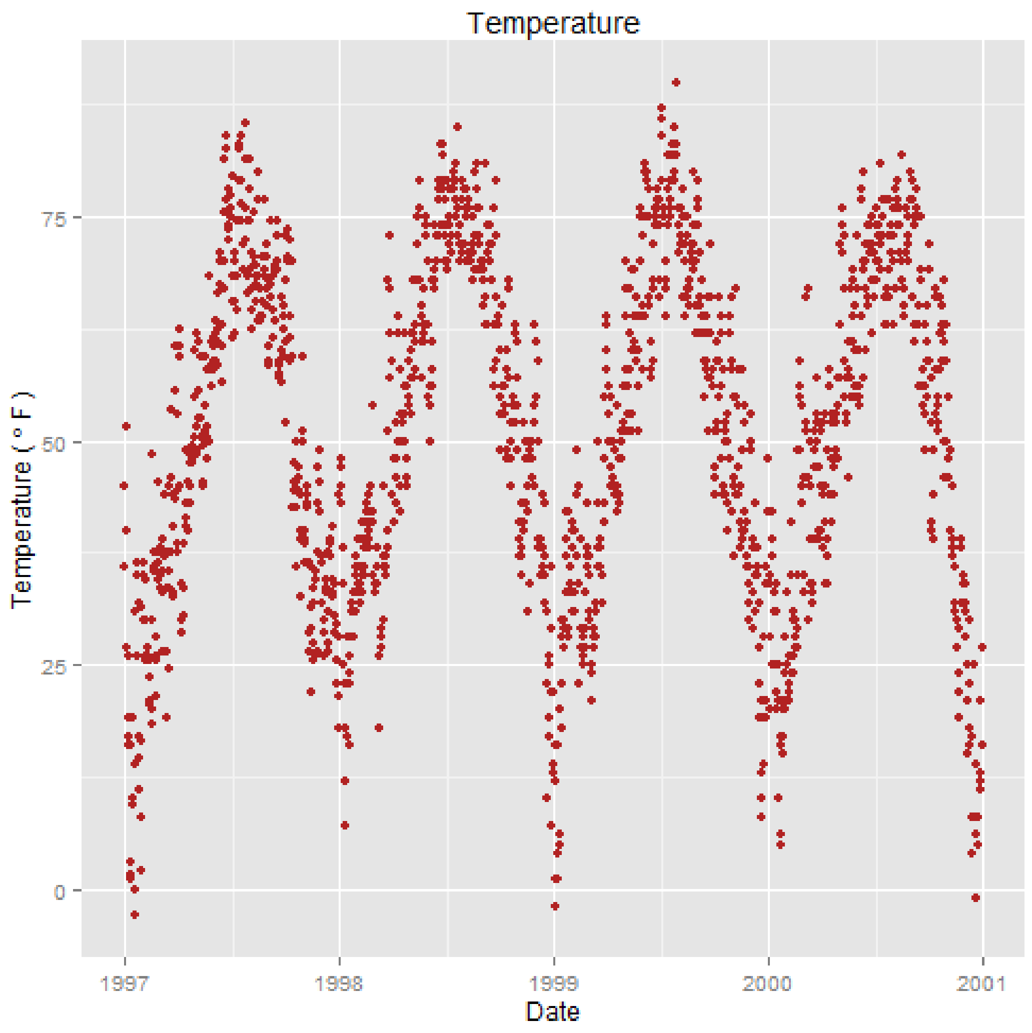
Working with axes

Add x and y axis labels (`labs()`, `xlab()`)

The easiest is:

```
g<-g+labs(x="Date", y=expression(paste("Temperature ( ", degree ~ F, " )")), title="Tempe
g
```



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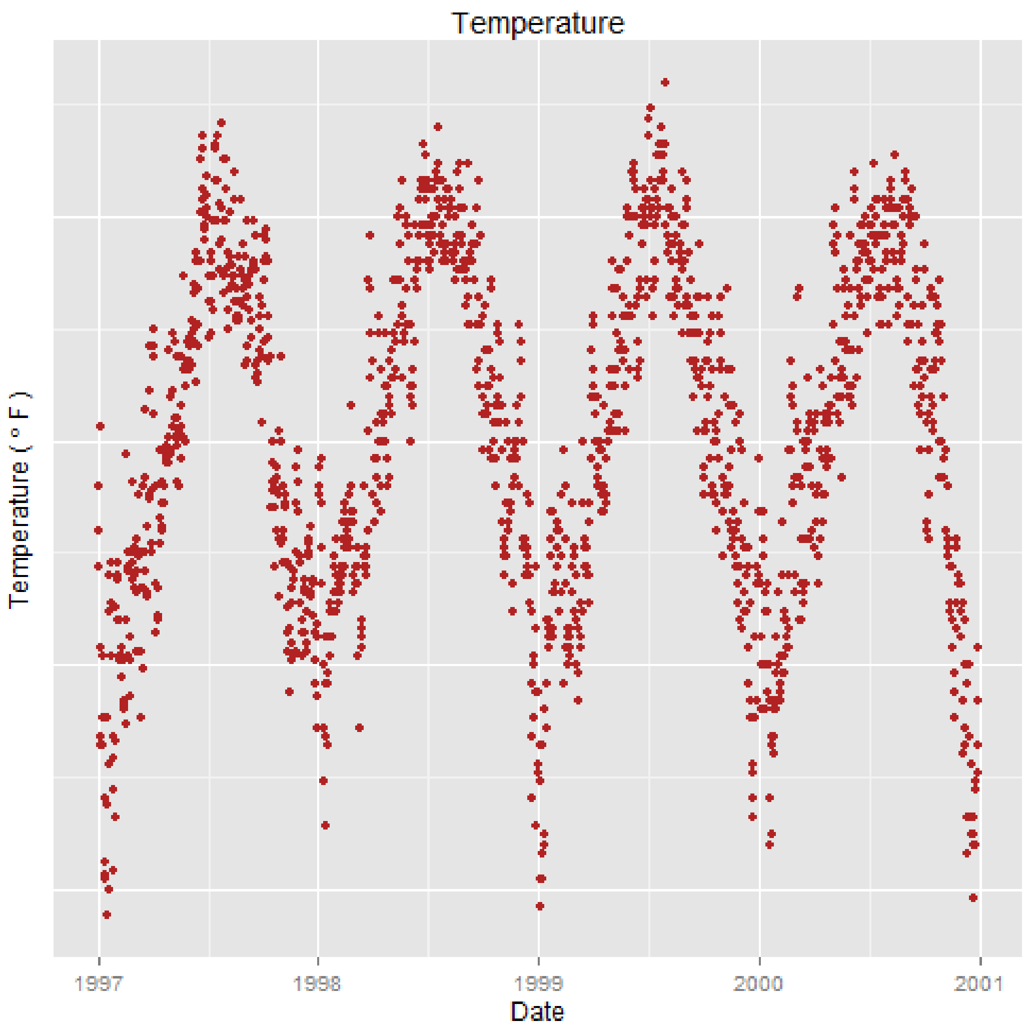
Get rid of axis ticks and tick text (`theme()`, `axis.ticks.y`)

I wouldn't normally do this but demonstration purposes:

```
g + theme(axis.ticks.y = element_blank(),axis.text.y = element_blank())
```



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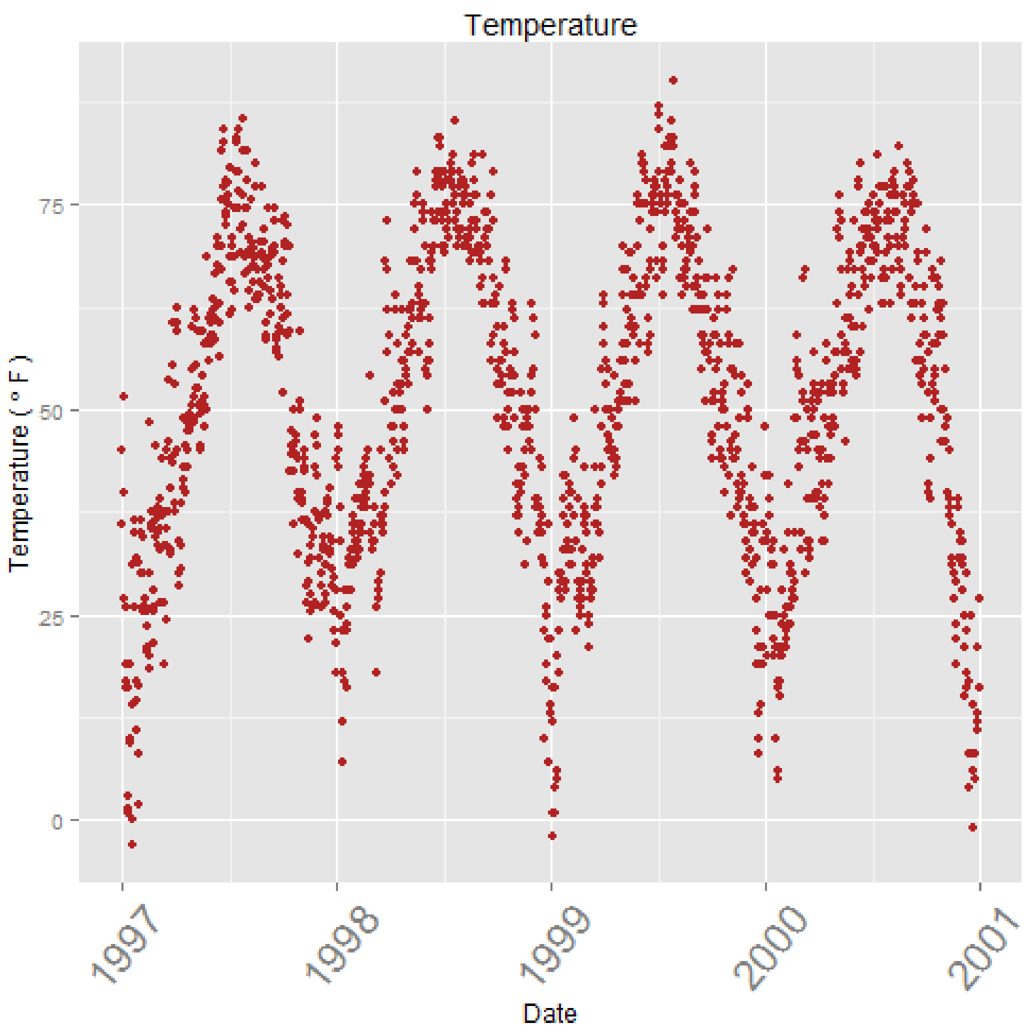
Change size of and rotate tick text (`axis.text.x`)

Go ahead, try to say 'tick text' three times fast.

```
g + theme(axis.text.x=element_text(angle=50, size=20, vjust=0.5))
```



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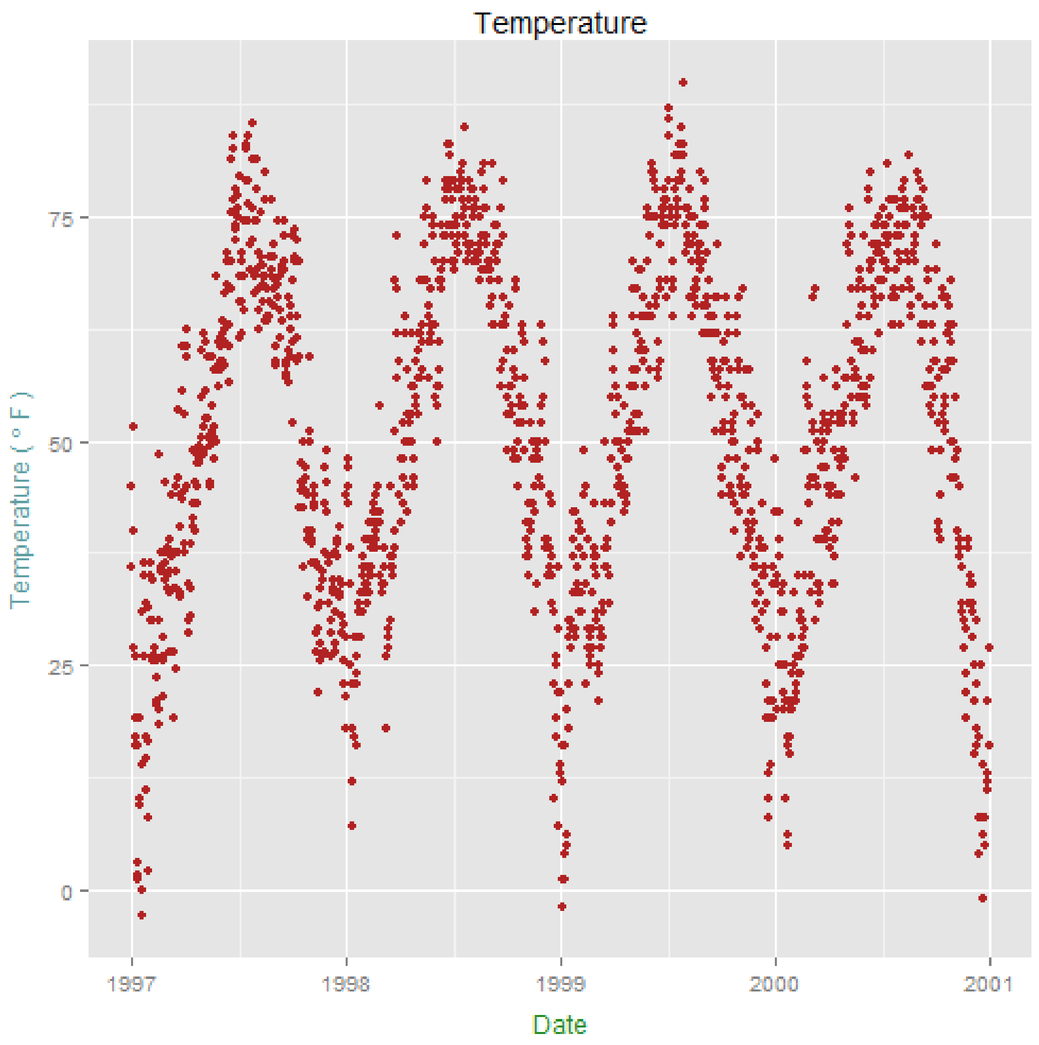
Move the labels away from the plot (and add color) (`theme()`, `axis.title.x`)

I find that the labels are too close to the plot in the default settings so, similar to with the title, I'm using the `vjust` argument.

```
g + theme(
      axis.title.x = element_text(color="forestgreen", vjust=-0.35),
      axis.title.y = element_text(color="cadetblue" , vjust=0.35)
          )
```



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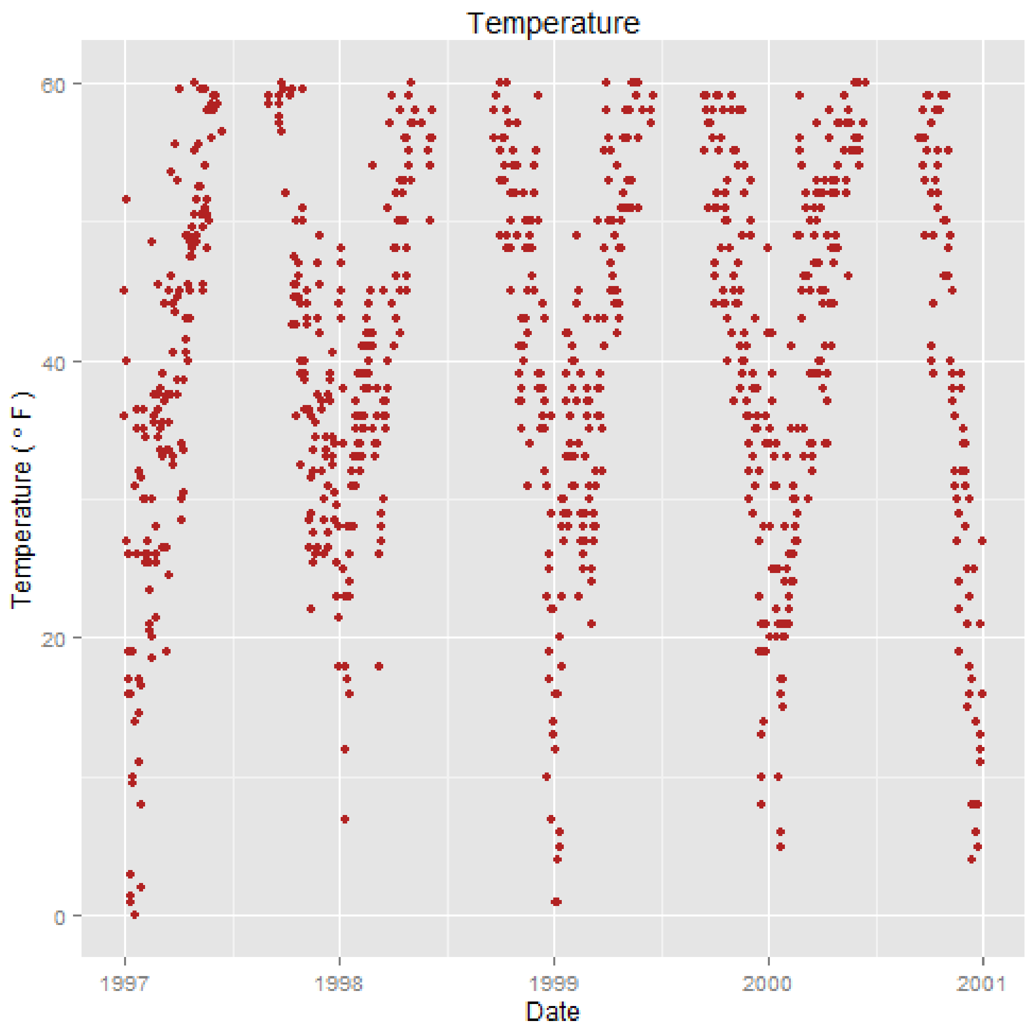
Limit an axis to a range (`ylim()`, `scale_x_continuous()`, `coord_cartesian()`)

Again, this plot is for demonstration purposes:

```
g + ylim(c(0,60))
```



Alternatively: `g+scale_x_continuous(limits=c(0,35))` or `g+coord_cartesian(xlim=c(0,35))`. The former removes all data points outside the range and second adjusts the visible area.

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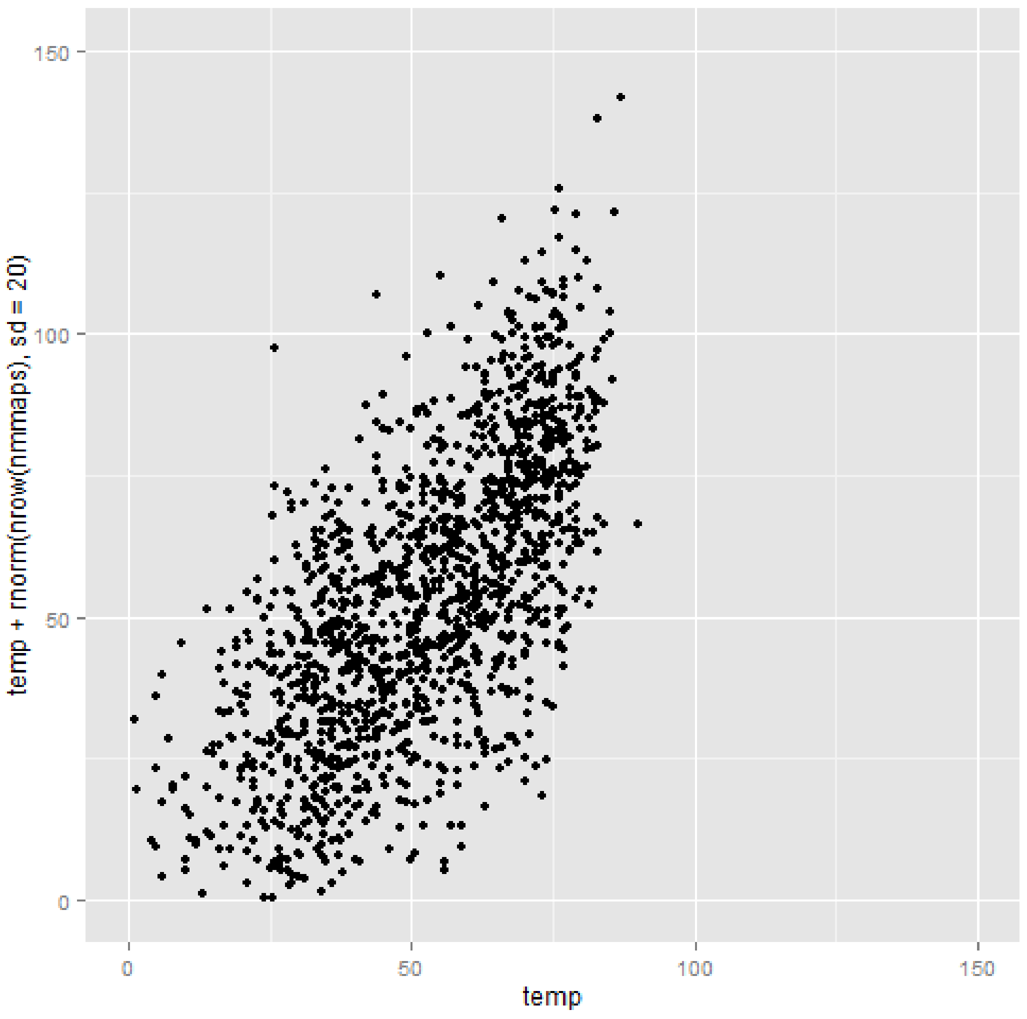
If you want the axes to be the same (`coord_equal()`)

There must be a better way than this. In the example, I'm plotting temperature against temperature with some random noise (for demonstration purposes) and I want both axes to be the same scale/same range.

```
ggplot(nmmaps, aes(temp, temp+rnorm(nrow(nmmaps), sd=20)))+geom_point()+
  xlim(c(0,150))+ylim(c(0,150))+
  coord_equal()
```



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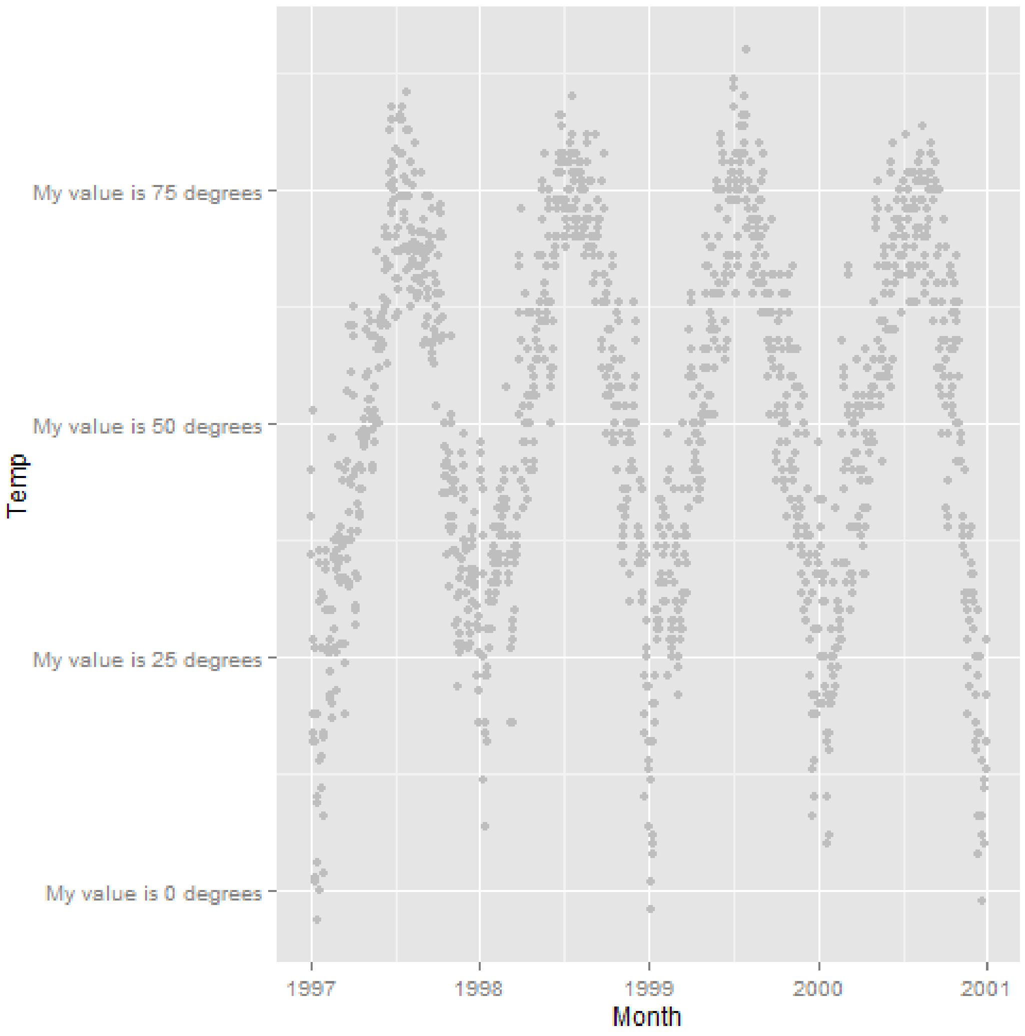
Use a function to alter labels (`label=function(x){}`)

Sometimes it's handy to alter your labels a little, perhaps adding units or percent signs without adding them to your data. You can use a function in this case. Here is an example:

```
ggplot(nmmaps, aes(date, temp))+
  geom_point(color="grey")+
  labs(x="Month", y="Temp")+
  scale_y_continuous(label=function(x){return(paste("My value is", x, "degrees"))})
```



Not pretty here, but this can come in handy.

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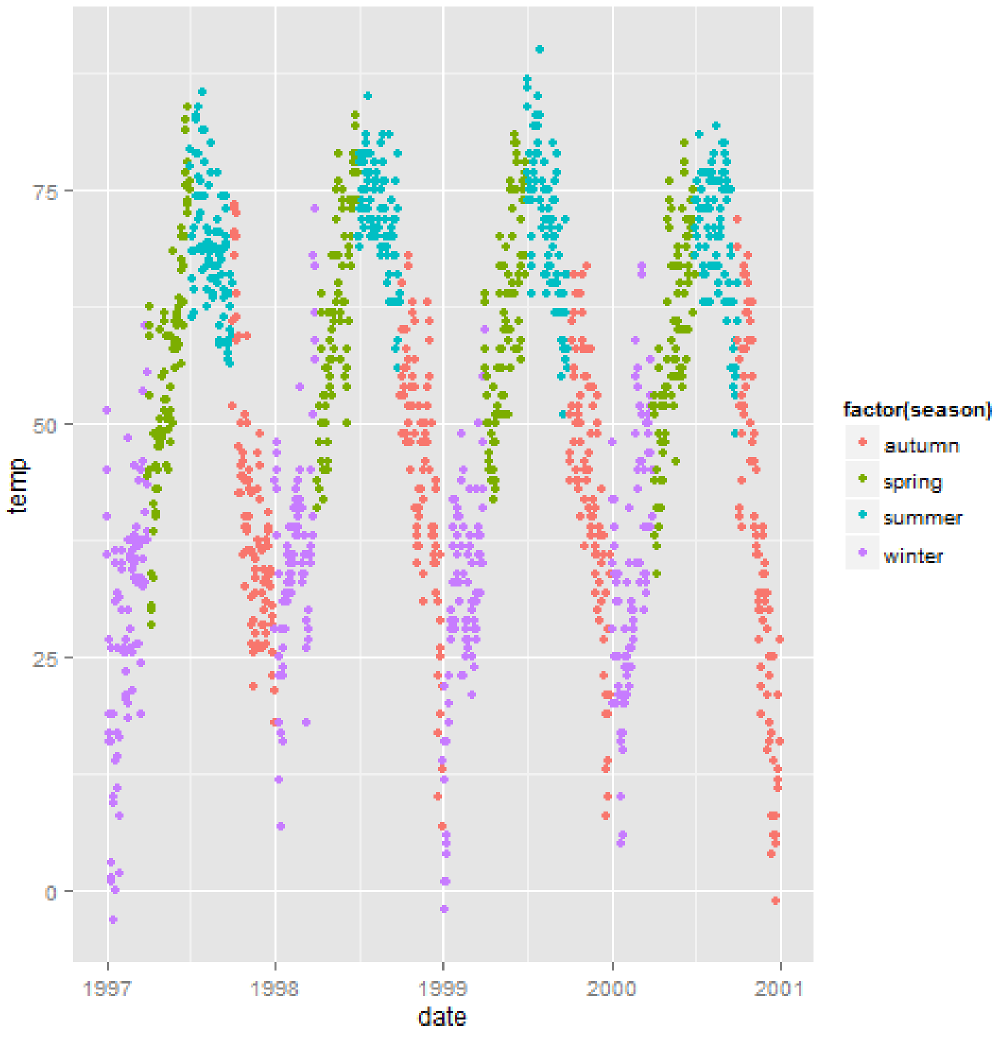
Working with the legend

We will color code the plot based on season. You can see that by default the legend title is what we specified in the `color` argument.

```
g<-ggplot(nmmaps, aes(date, temp, color=factor(season)))+geom_point()
g
```



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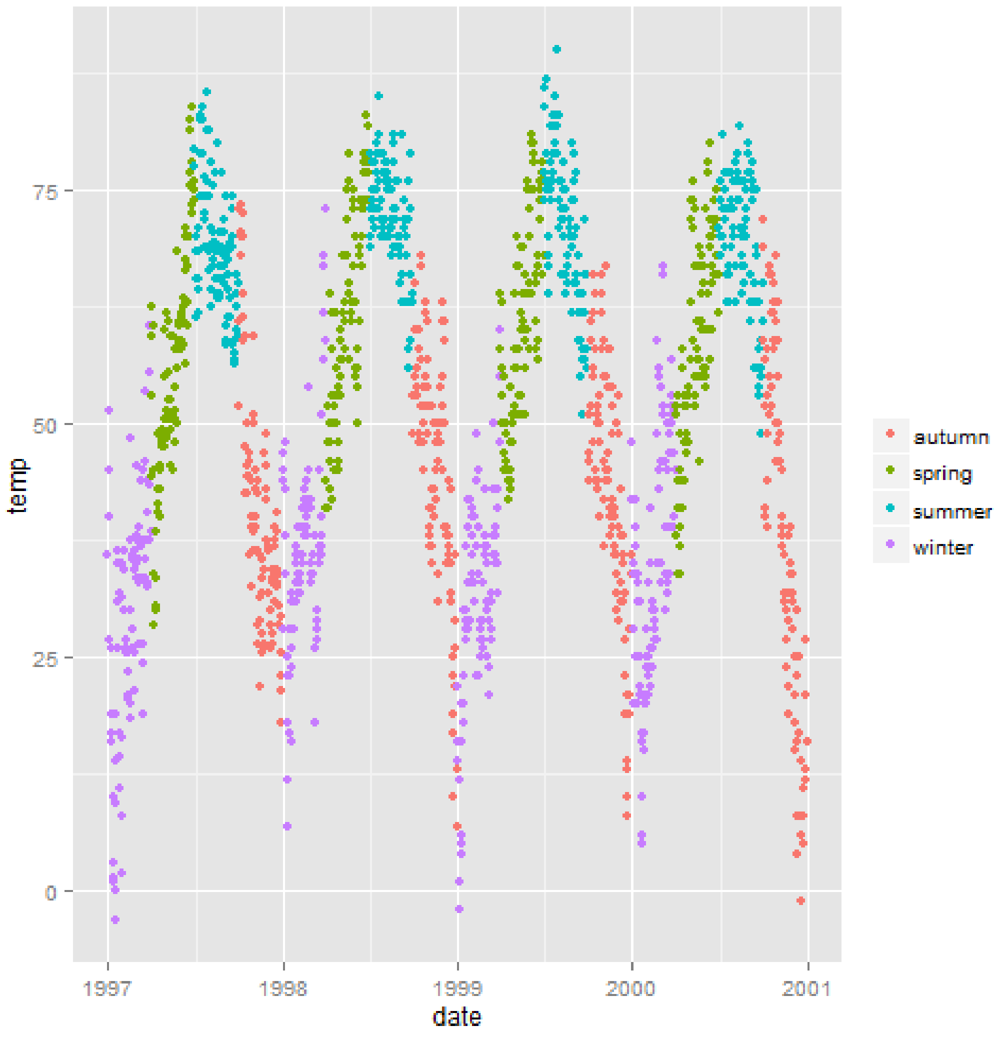
Turn off the legend title (`legend.title`)

```
g+theme(legend.title=element_blank())
```



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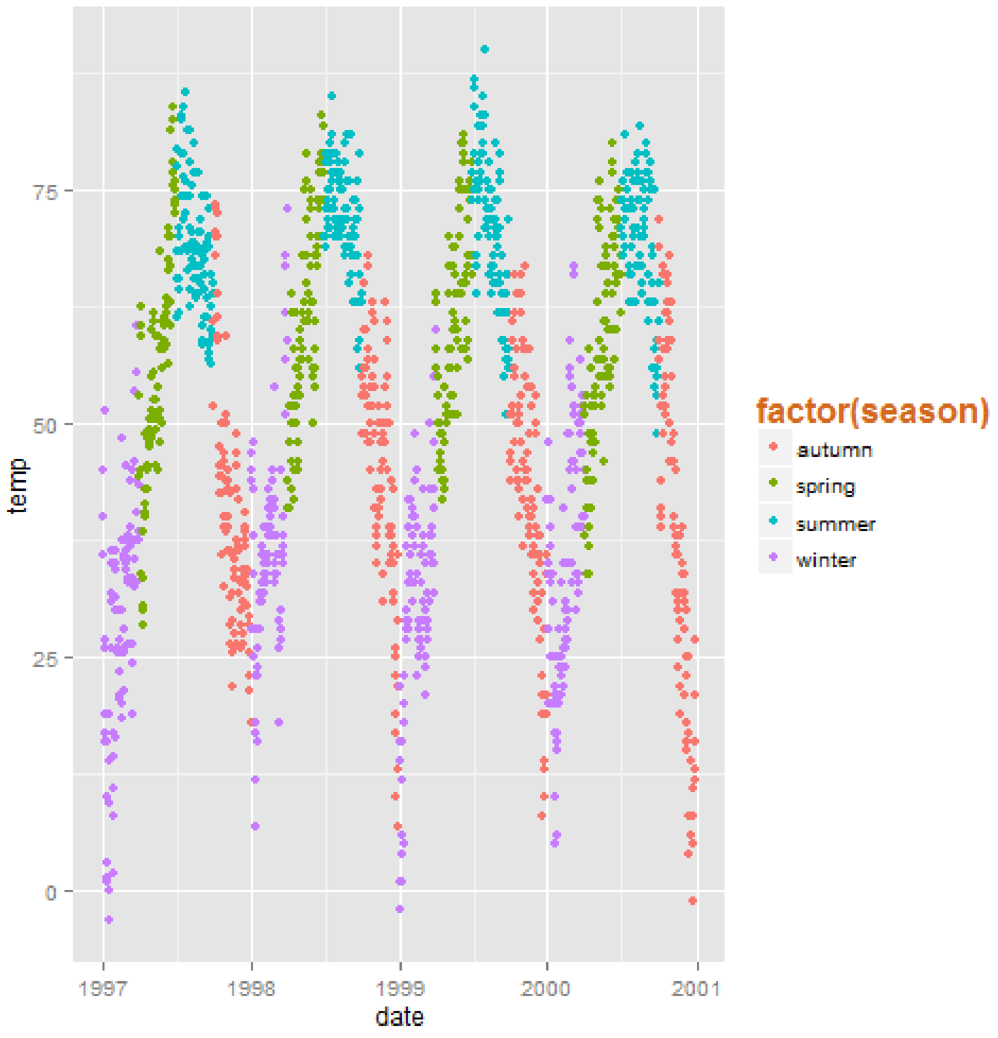
Change the styling of the legend title (`legend.title`)

```
g+theme(legend.title = element_text(colour="chocolate", size=16, face="bold"))
```



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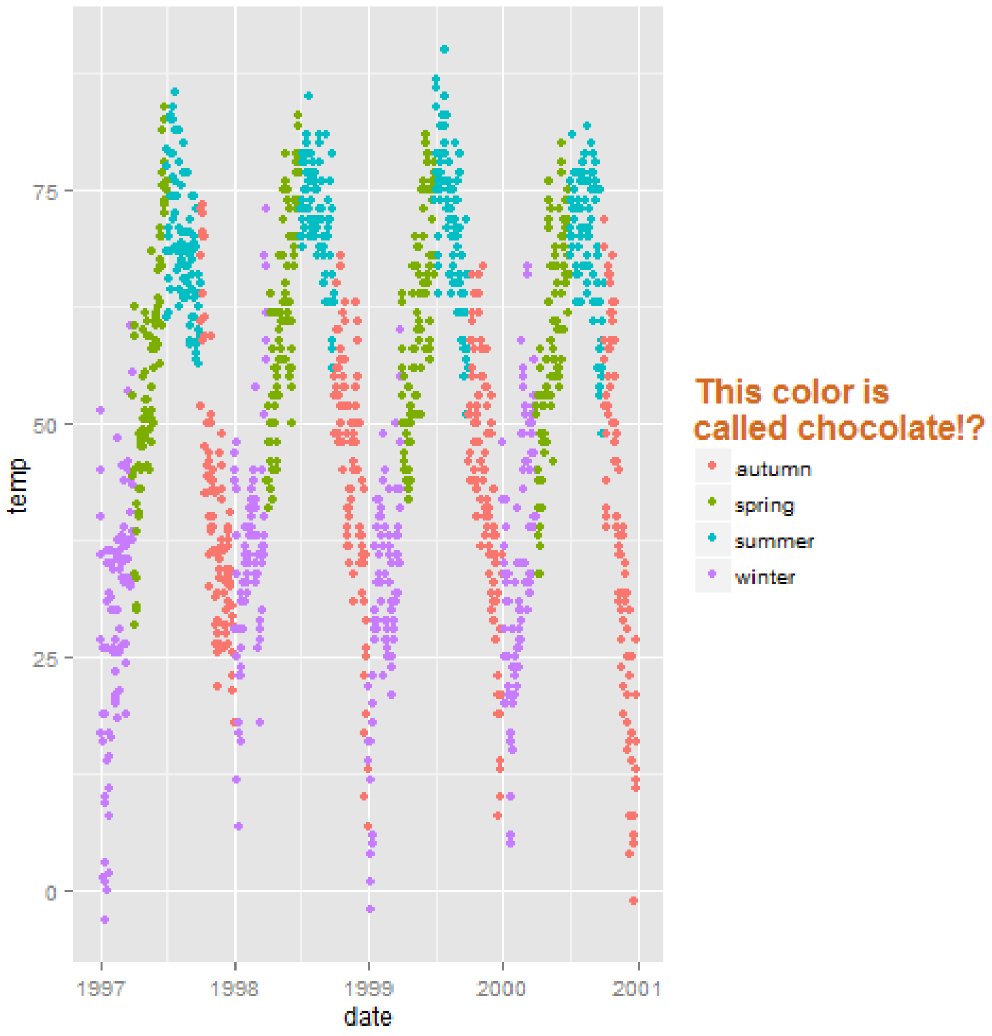
Change the title of the legend (`name`)

To change the title of the legend you would use the `name` argument in your `scale` function. If you don't use a `scale` function you will need to change the data itself so that it has the right format.

```
g+theme(legend.title = element_text(colour="chocolate", size=16, face="bold"))+
  scale_color_discrete(name="This color is\ncalled chocolate!?")
```



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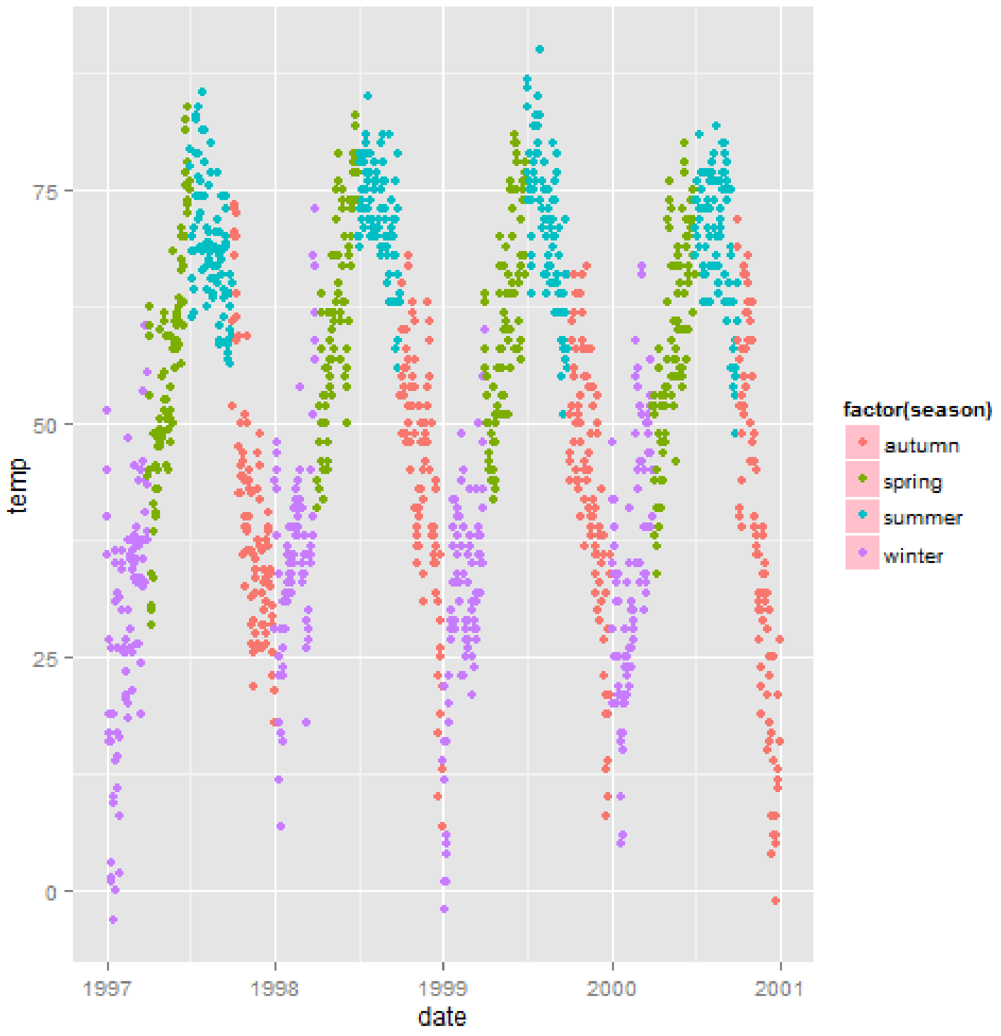
Change the background boxes in the legend (`legend.key`)

I have mixed feelings about those boxes. If you want to get rid of them entirely use `fill=NA`.

```
g+theme(legend.key=element_rect(fill='pink'))
```



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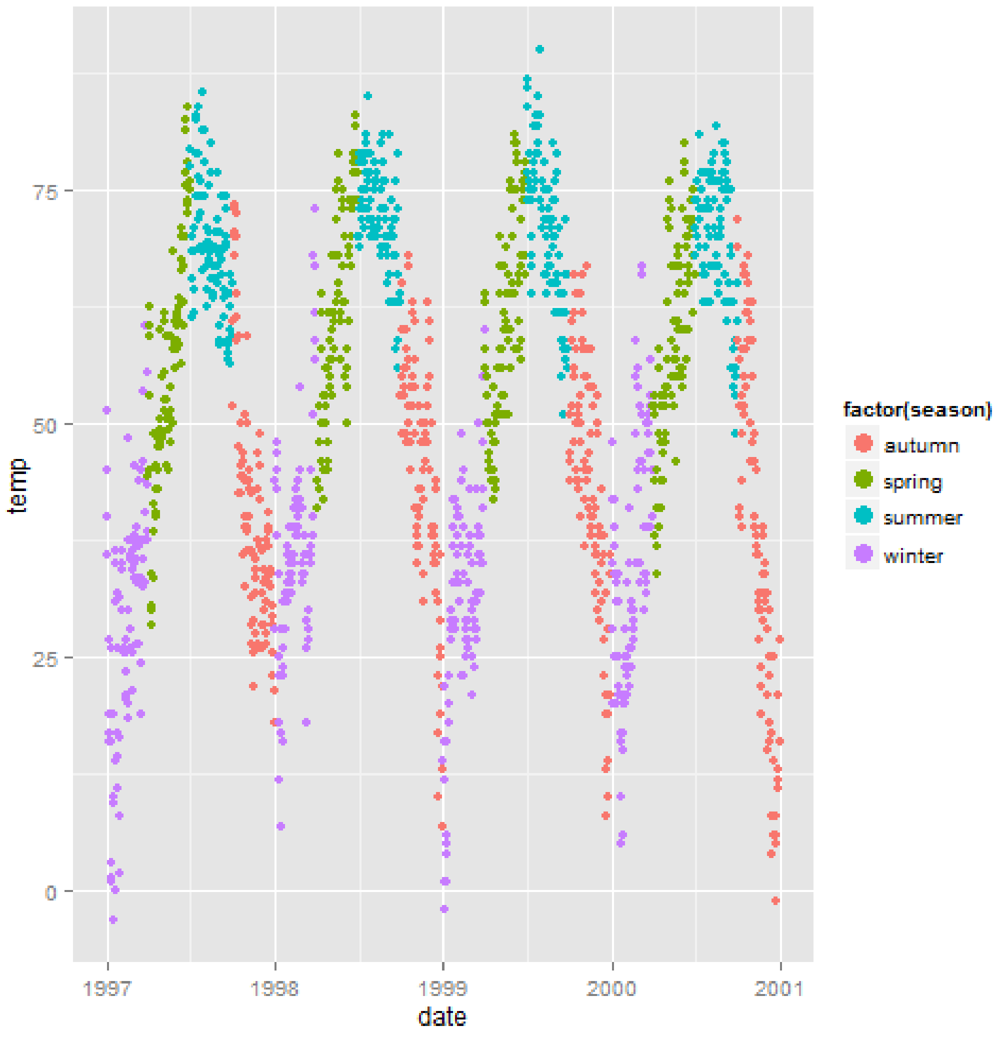
Change the size of the symbols in the legend only (`guides()`, `guide_legend`)

Points in the legend get a little lost, especially without the boxes. To override the default try:

```
g+guides(colour = guide_legend(override.aes = list(size=4)))
```



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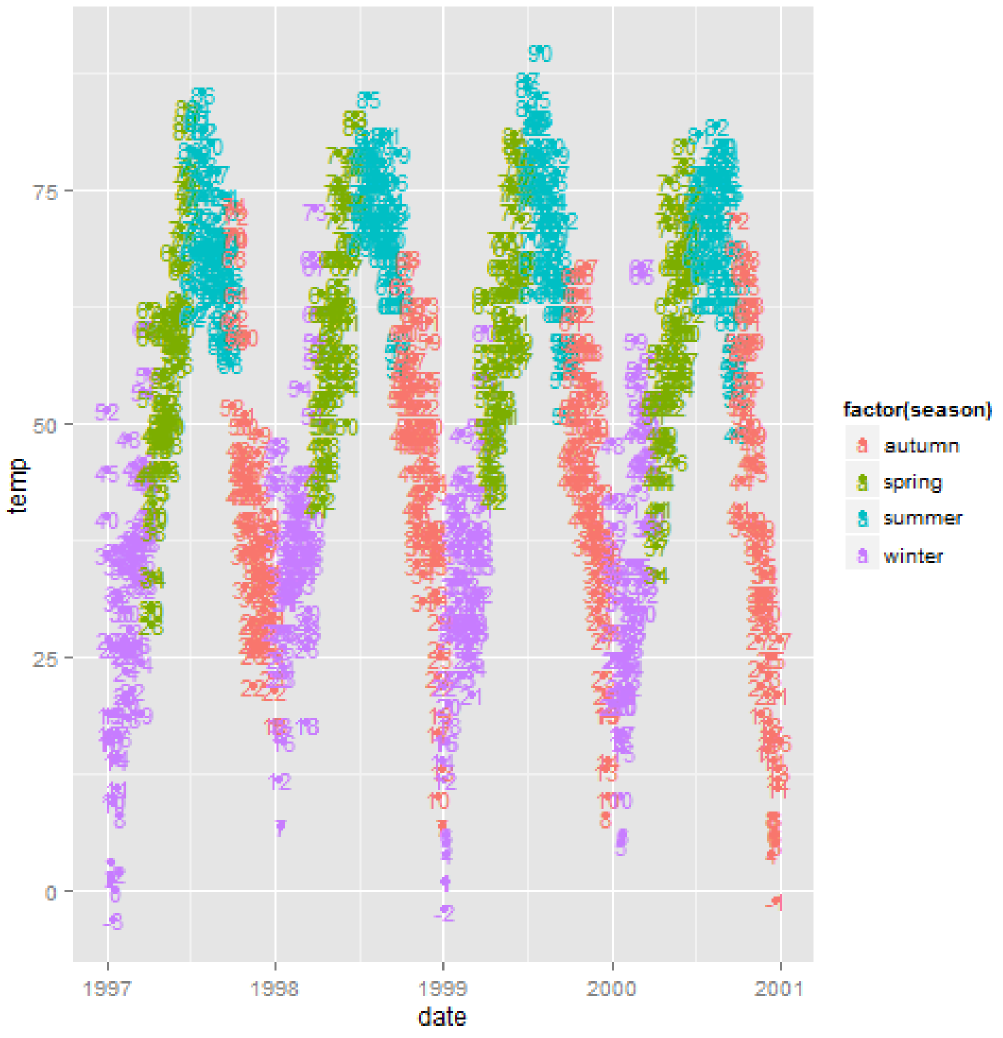
Leave a layer off the legend (`show_guide`)

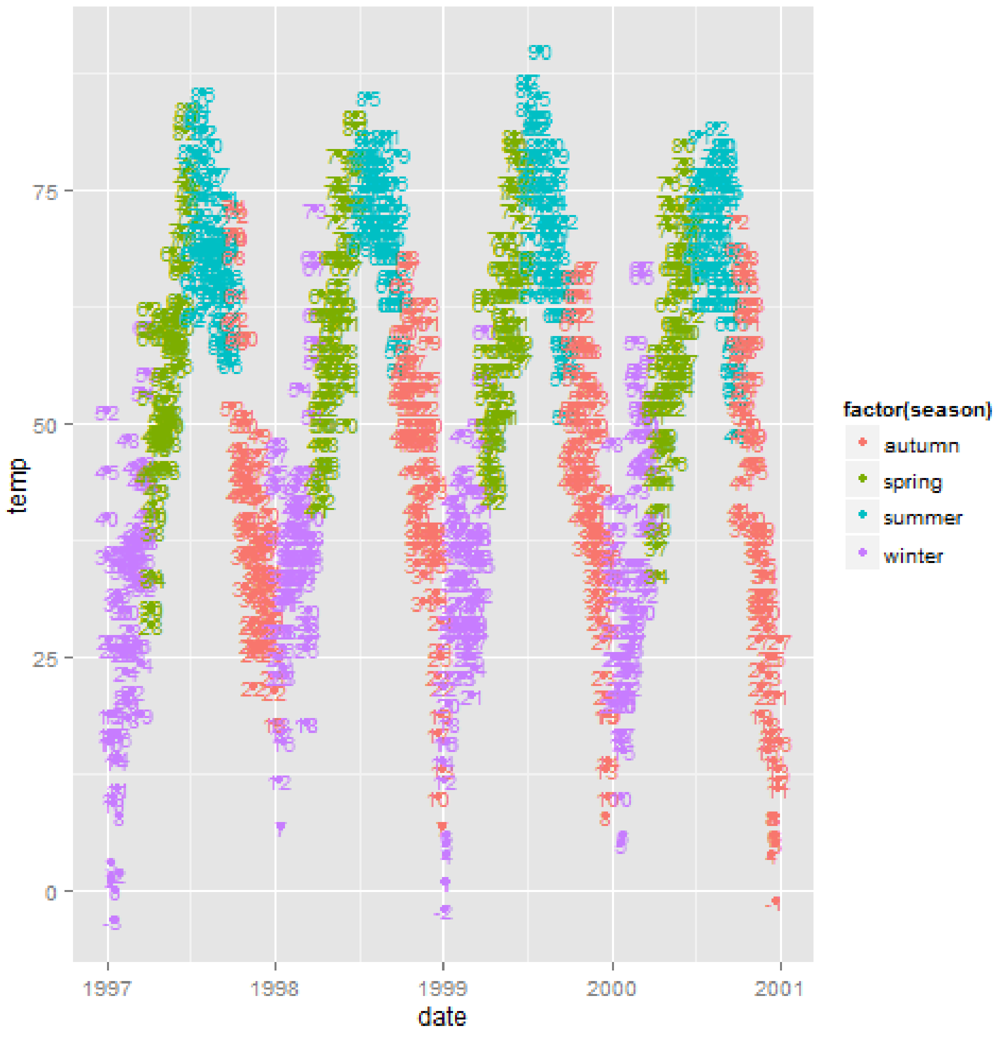
Let's say you have a point layer and you add label text to it. By default, both the points and the label text end up in the legend like this (again, who would make a plot like this? It's for demonstration purposes):

```
g+geom_text(data=nmmaps, aes(date, temp, label=round(temp)), size=4)
```



You can use `show_guide=FALSE` to turn a layer off in the legend. Useful!

```
g+geom_text(data=nmmaps, aes(date, temp, label=round(temp), size=4), show_guide=FALSE)
```



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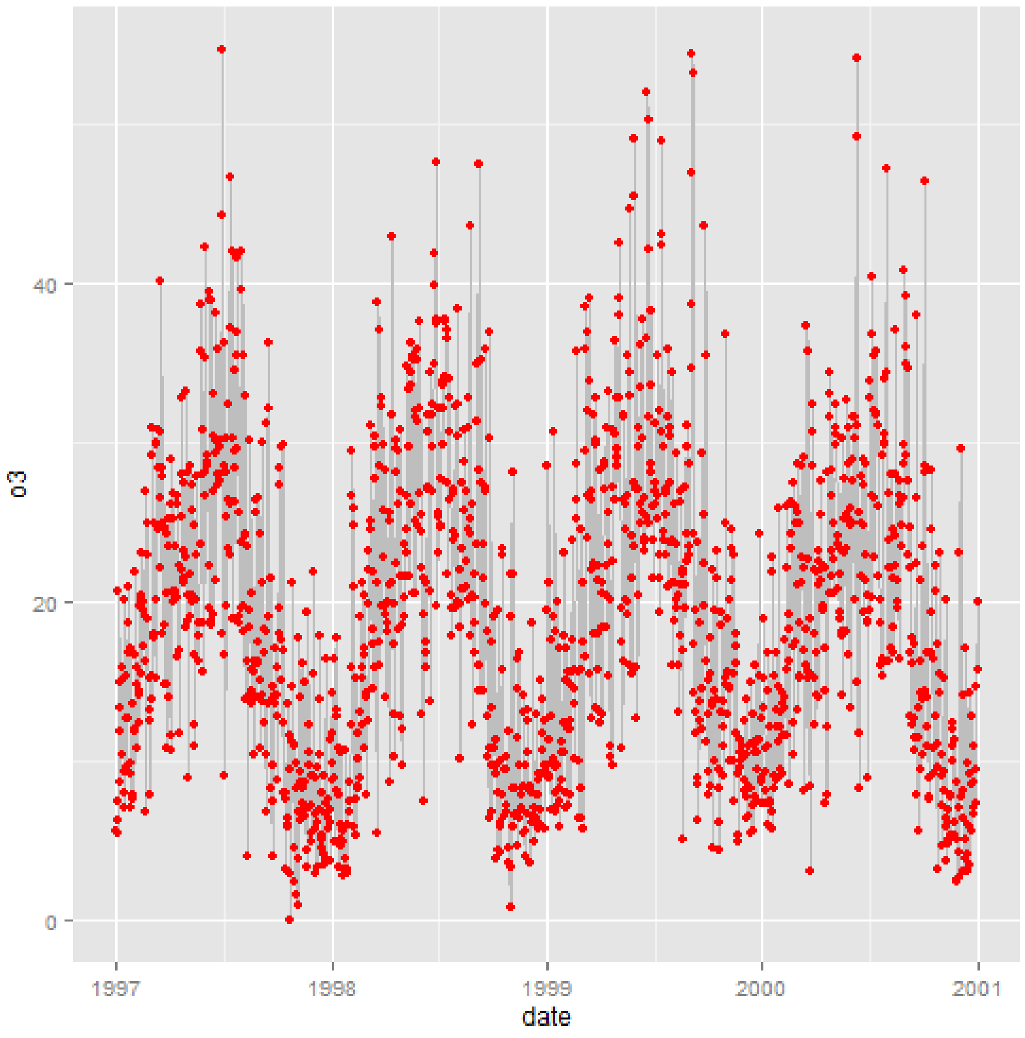
Manually adding legend items (`guides()`, `override.aes`)

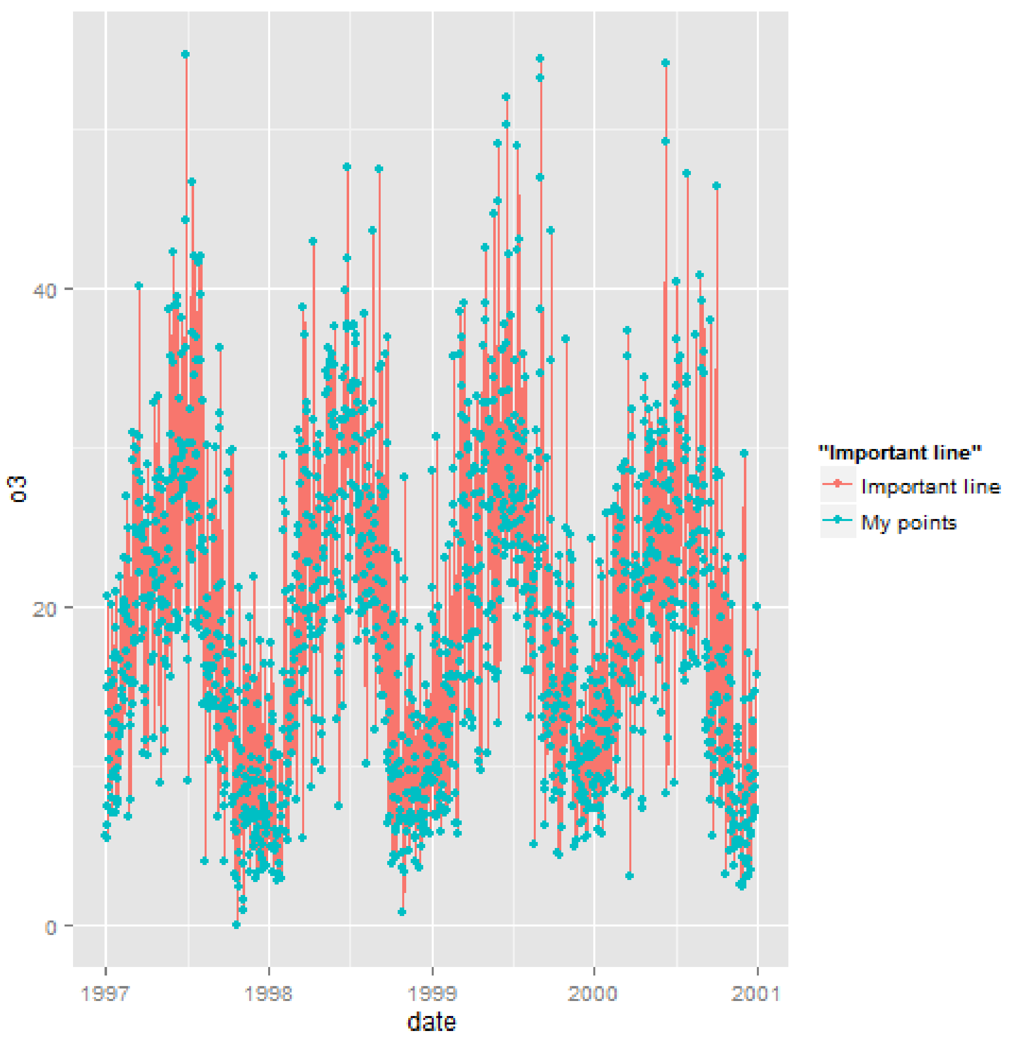
ggplot2 will not add a legend automatically unless you map aethetics (color, size etc) to a variable. There are times, though, that I want to have a legend so that it's clear what you're plotting. Here is the default:

```
# here there is no legend automatically
ggplot(nmmaps, aes(x=date, y=o3))+geom_line(color="grey")+geom_point(color="red")
```



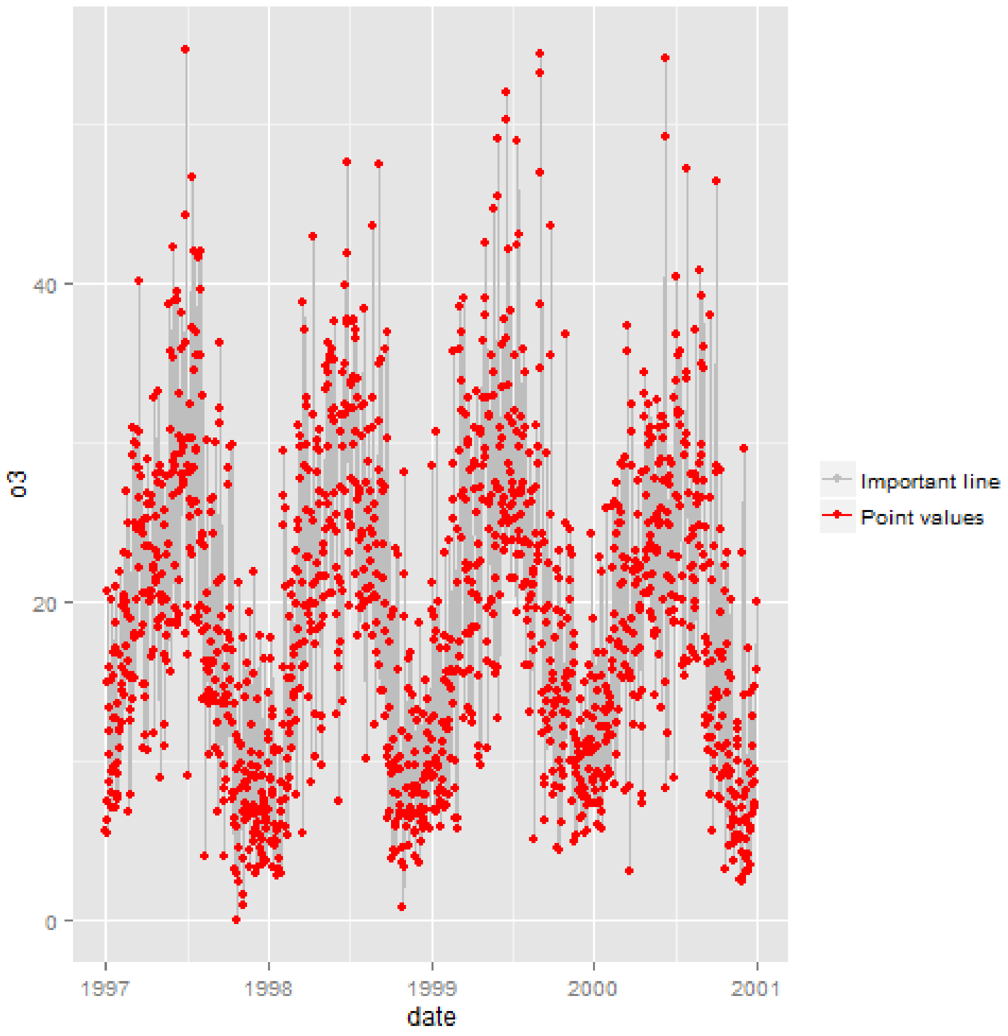
We can force a legend by mapping to a "variable". We are mapping the lines and the points using `aes` and we are mapping **not** to a variable in our dataset but to a single string (so that we get just one color for each).

```
ggplot(nmmaps, aes(x=date, y=o3))+geom_line(aes(color="Important line"))+
  geom_point(aes(color="My points"))
```



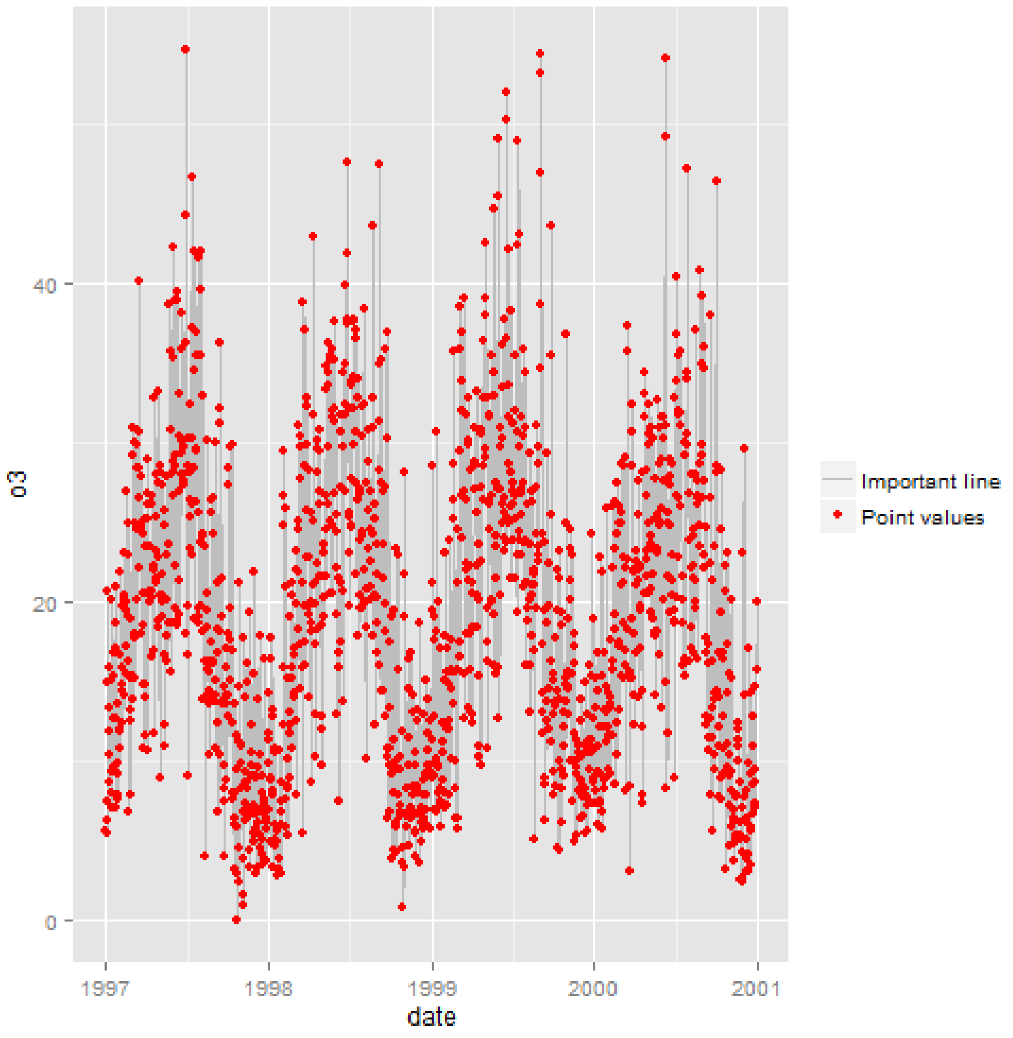
We're getting close but this is not what I want. I wanted grey and red. To change the color, we use scale_colour_manual().

```
ggplot(nmmaps, aes(x=date, y=o3))+geom_line(aes(color="Important line"))+
   geom_point(aes(color="Point values"))+
  scale_colour_manual(name='', values=c('Important line'='grey', 'Point values'='red'))
```



Tantalizingly close! But we don't want a line with a point for both. Line=grey and point=red. The final step is to override the aesthetics in the legend. The guide() function allows us to control guides like the legend:

```
ggplot(nmmaps, aes(x=date, y=o3))+geom_line(aes(color="Important line"))+
   geom_point(aes(color="Point values"))+
  scale_colour_manual(name='', values=c('Important line'='grey', 'Point values'='red'), g
  guides(colour = guide_legend(override.aes = list(linetype=c(1,0)
                                                   , shape=c(NA, 16))))
```



Voila!

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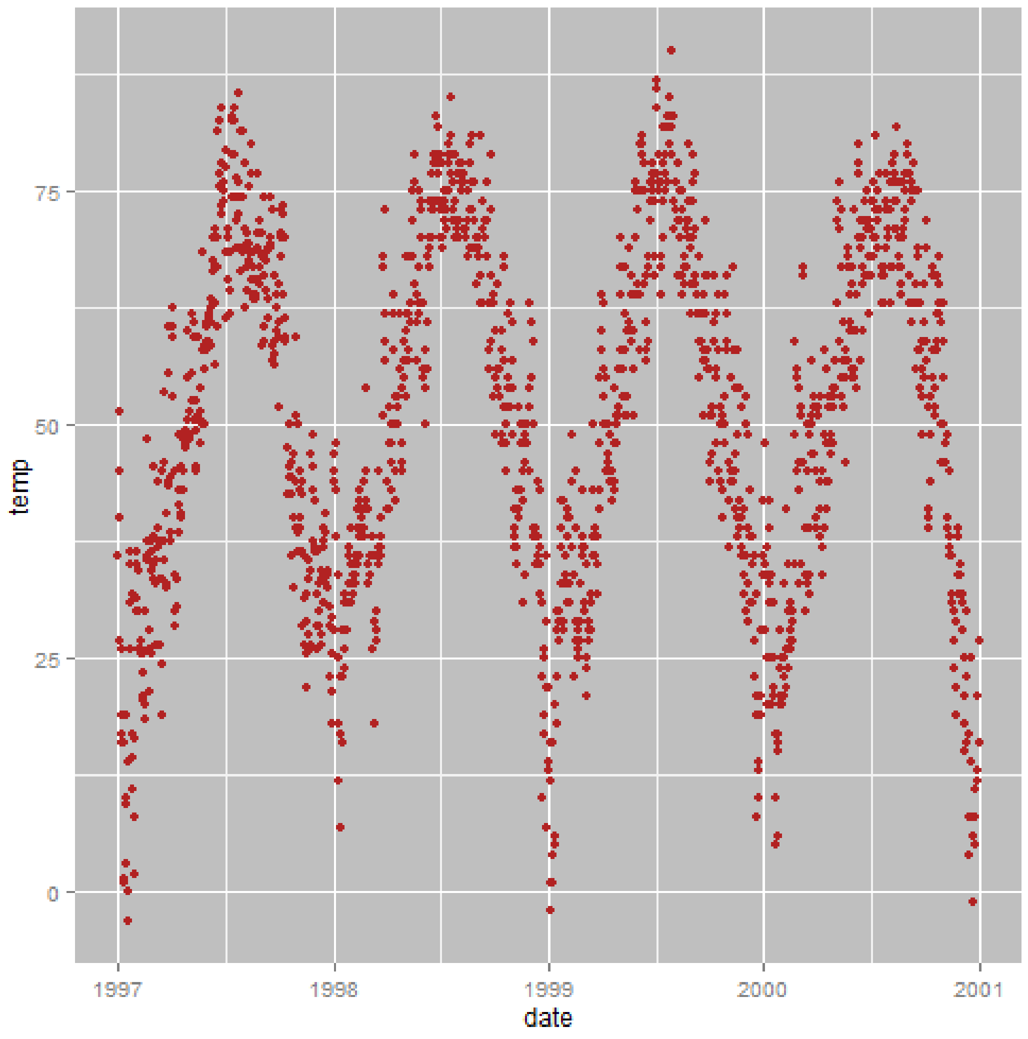
Working with the background colors

There are ways to change the entire look of your plot with one function (see below) but if you want to simply change the background color of the panel you can use the following:

Change the panel color (`panel.background`)

```
ggplot(nmmaps, aes(date, temp))+geom_point(color="firebrick")+
  theme(panel.background = element_rect(fill = 'grey75'))
```



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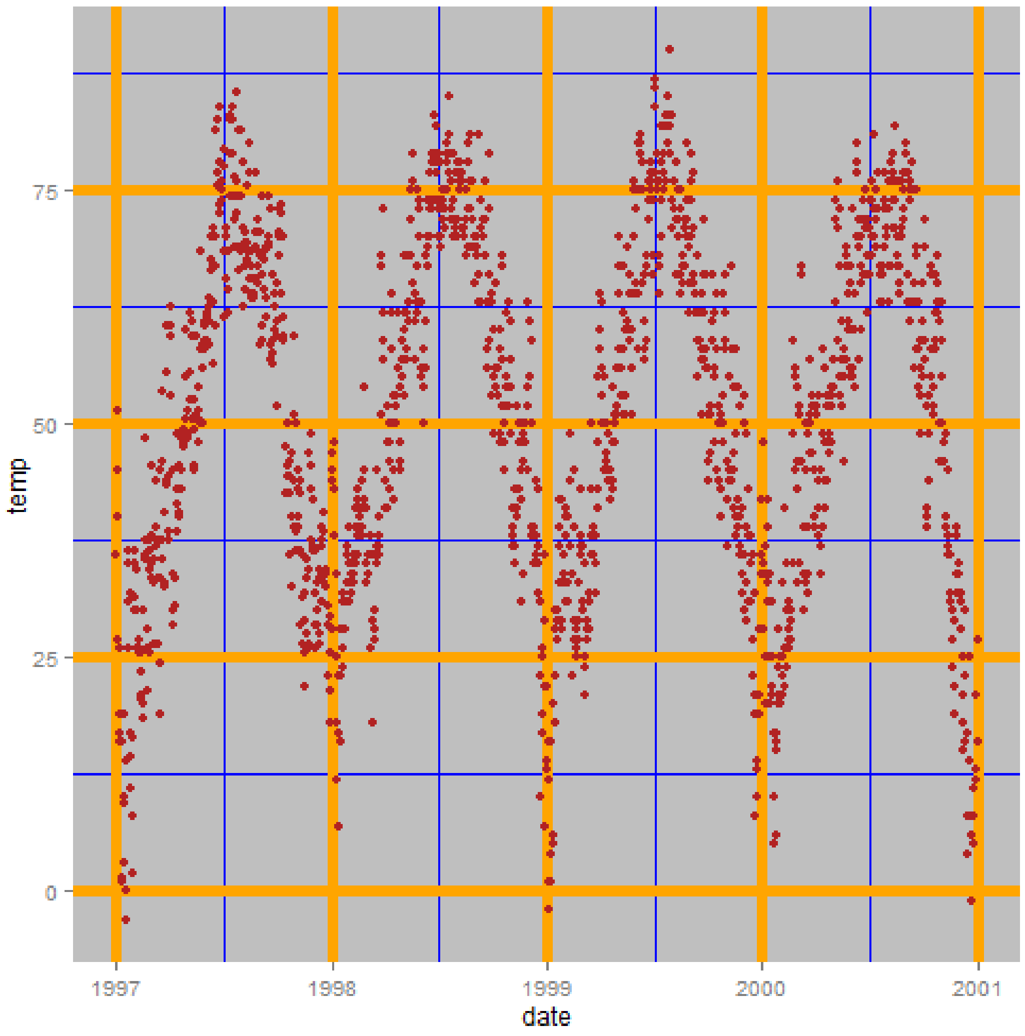
Change the grid lines (`panel.grid.major`)

```
ggplot(nmmaps, aes(date, temp))+geom_point(color="firebrick")+
  theme(panel.background = element_rect(fill = 'grey75'),
  panel.grid.major = element_line(colour = "orange", size=2),
  panel.grid.minor = element_line(colour = "blue"))
```



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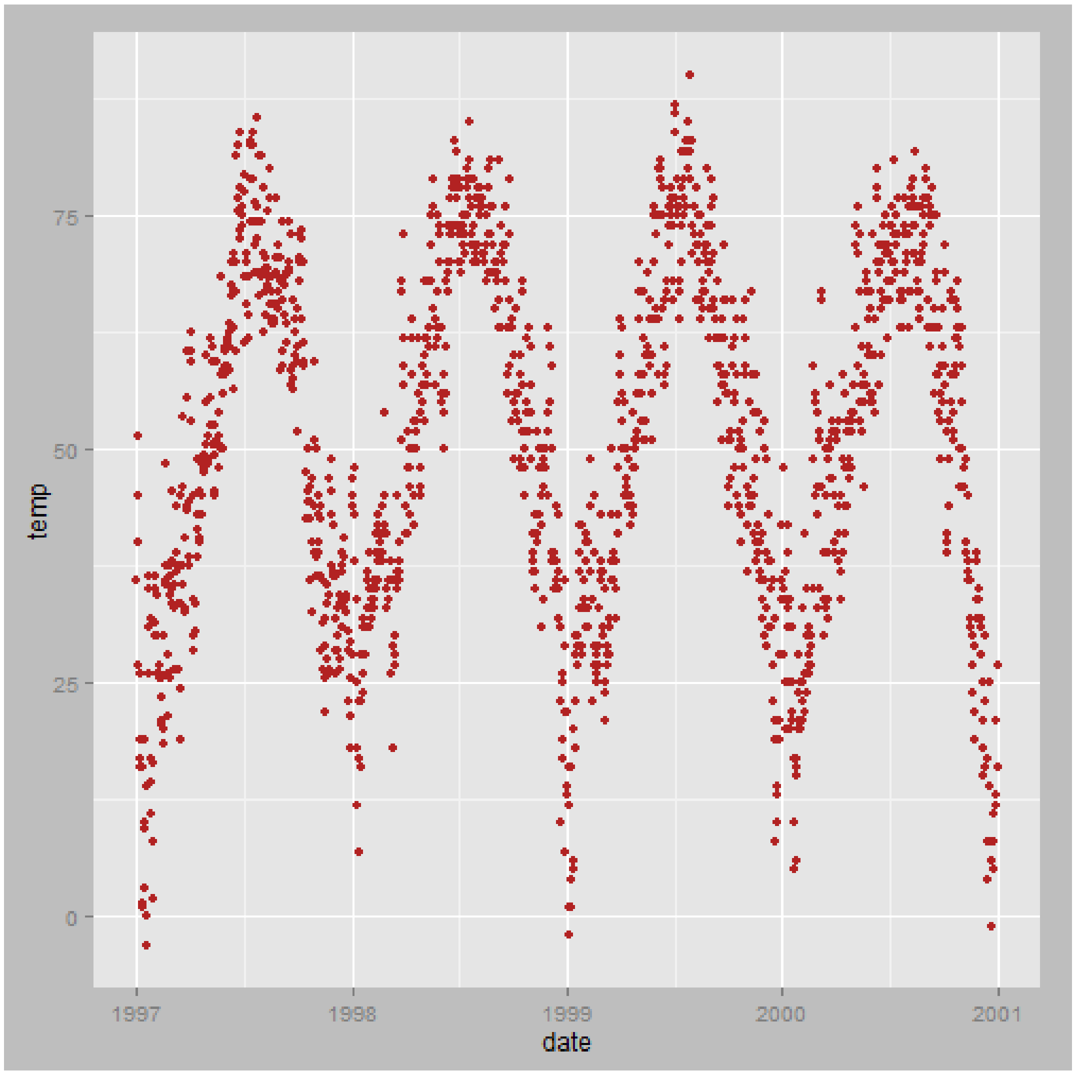
Change the plot background (not the panel) color (`plot.background`)

```
ggplot(nmmaps, aes(date, temp))+geom_point(color="firebrick")+
  theme(plot.background = element_rect(fill = 'grey'))
```



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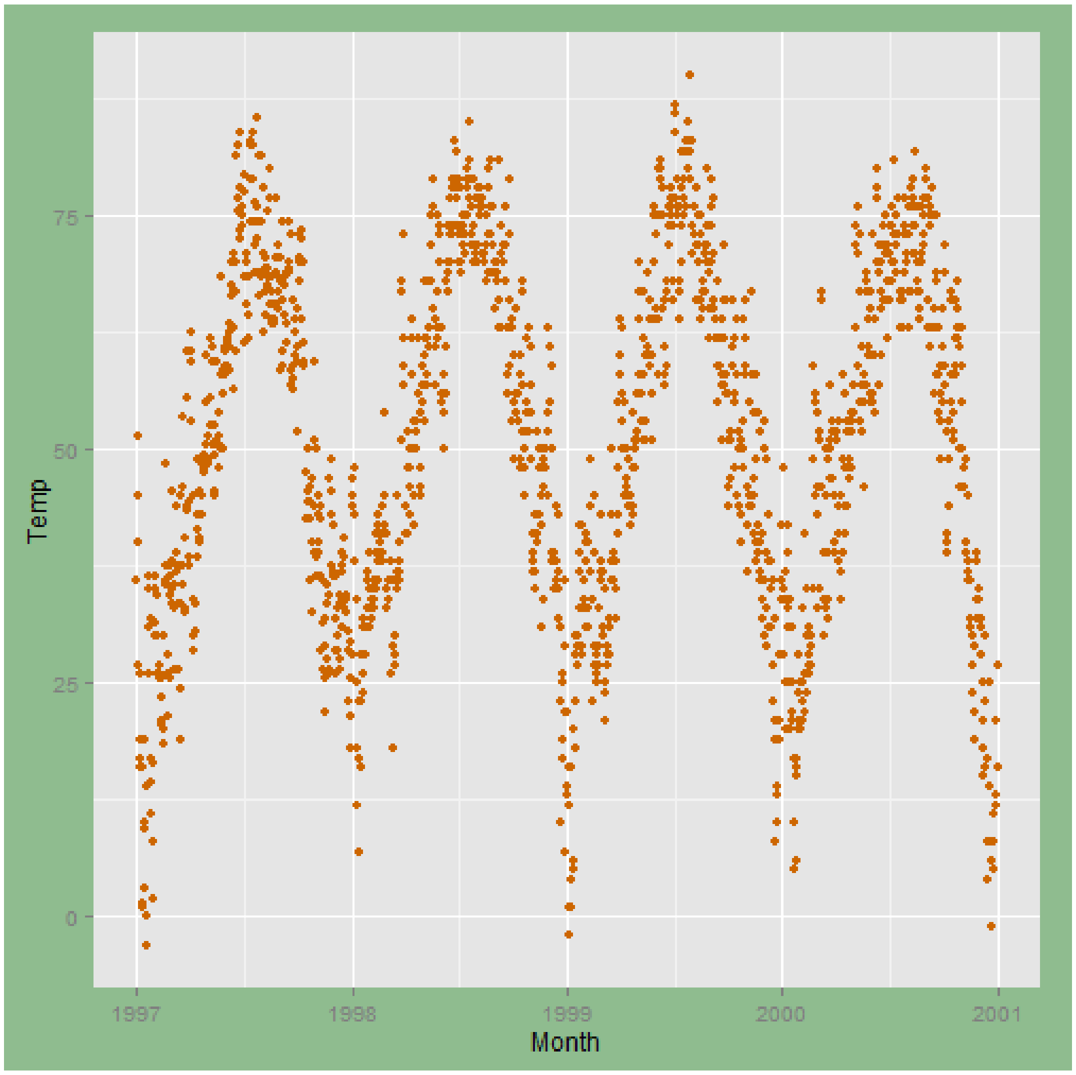
Working with margins

Changing the plot margin (`plot.margin`)

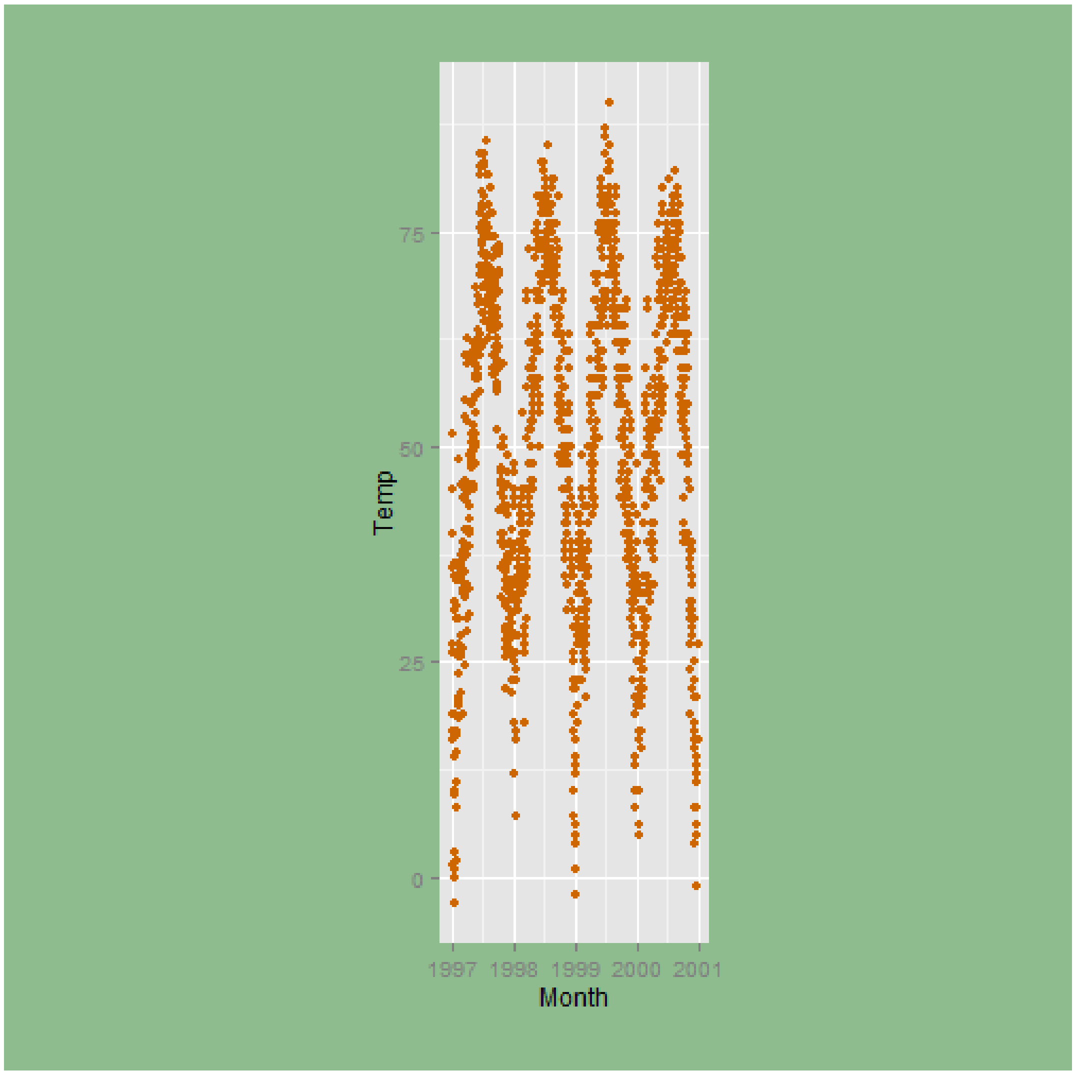
I sometimes find that I need to add a little space to one margin of my plot. Similar to the previous examples we can use an argument to the `theme()` function. In this case the argument is `plot.margin`. In order to illustrate I'm going to add a background color using `plot.background` so you can see the default:

```
# the default
ggplot(nmmaps, aes(date, temp))+
  geom_point(color="darkorange3")+
  labs(x="Month", y="Temp")+
  theme(plot.background=element_rect(fill="darkseagreen"))
```



Now let's add extra space to both the left and right. The argument, `plot.margin`, can handle a variety of different units (cm, inches etc) but it requires the use of the function `unit` from the package `grid` to specify the units. Here I'm using a 6 cm margin on the right and left.

```
library(grid)
ggplot(nmmaps, aes(date, temp))+
  geom_point(color="darkorange3")+
  labs(x="Month", y="Temp")+
  theme(plot.background=element_rect(fill="darkseagreen"),
        plot.margin = unit(c(1, 6, 1, 6), "cm")) #top, right, bottom, left
```



Again, not a pretty plot!

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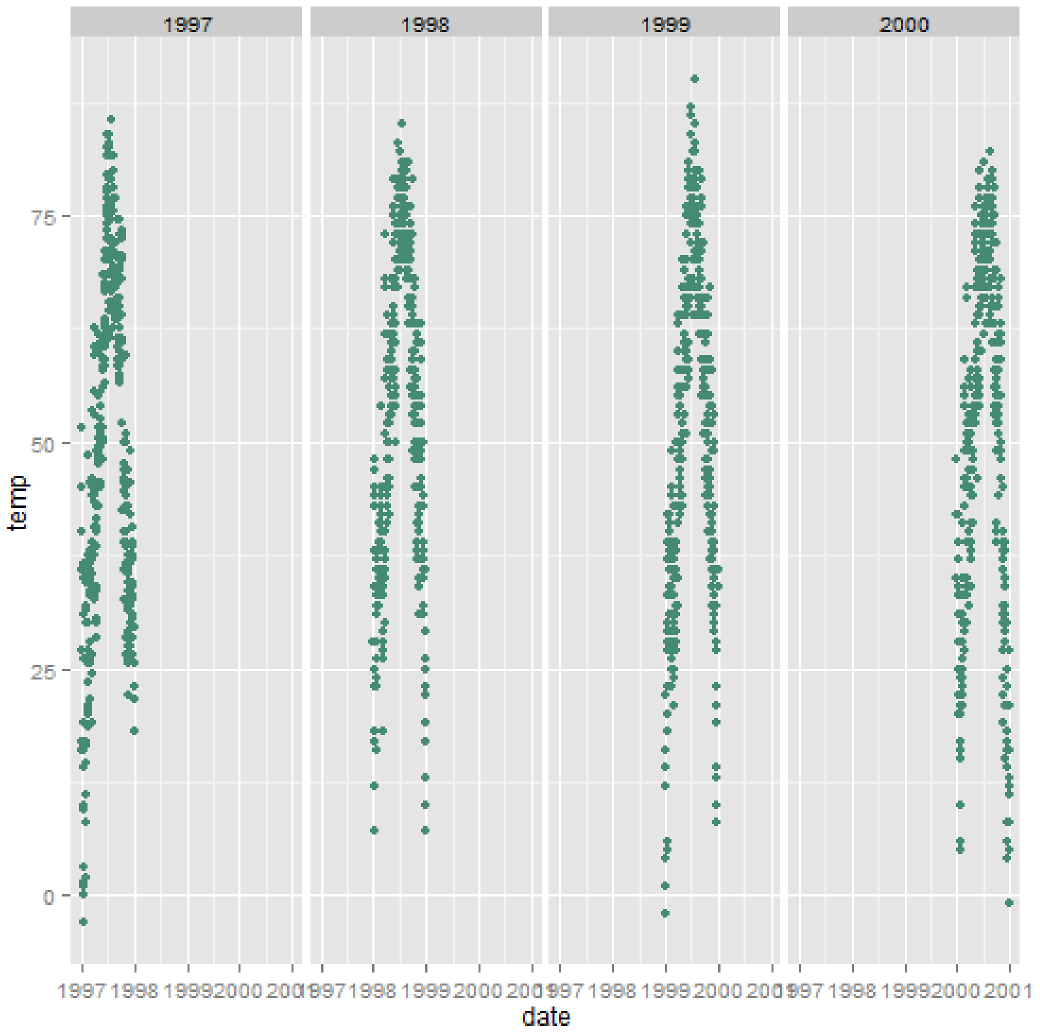
Creating multi-panel plots

The `ggplot2` package has two nice functions for creating multi-panel plots. They are related but a little different `facet_wrap` creates essentially a ribbon of plots based on a single variable while `facet_grid` can take two variables.

Create a single row of plots based on one variable (`facet_wrap()`)

```
ggplot(nmmaps, aes(date,temp))+geom_point(color="aquamarine4")+facet_wrap(~year, nrow=1)
```



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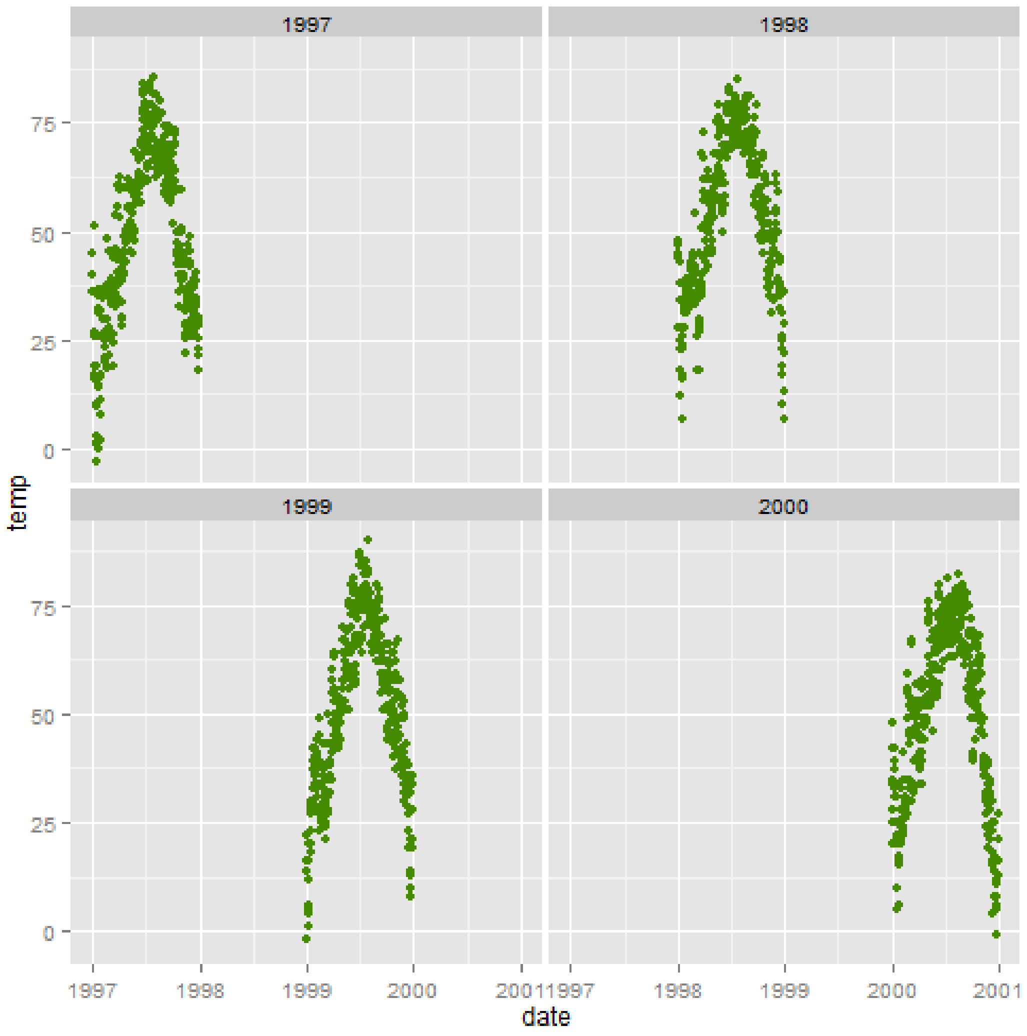
Create a matrix of plots based on one variable (`facet_wrap()`)

```
ggplot(nmmaps, aes(date,temp))+geom_point(color="chartreuse4")+
    facet_wrap(~year, ncol=2)
```



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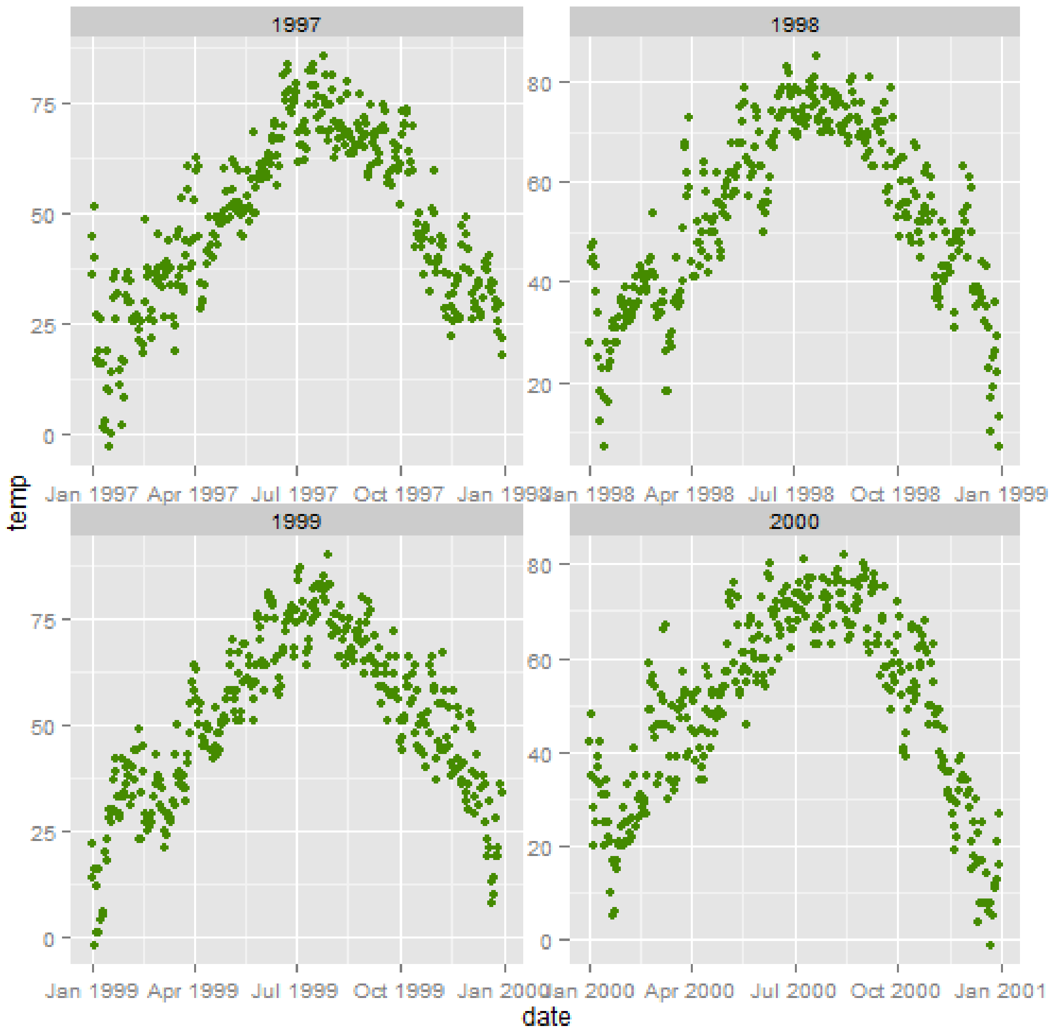
Allow scales to roam free (`scales`)

The default for multi-panel plots in `ggplot2` is to use equivalent scales in each panel. But sometimes you want to allow a panel's own data to determine the scale. This is not often a good idea since it may give your user the wrong impression about the data but to do this you can set `scales="free"` like this:

```
ggplot(nmmaps, aes(date,temp))+geom_point(color="chartreuse4")+
  facet_wrap(~year, ncol=2, scales="free")
```



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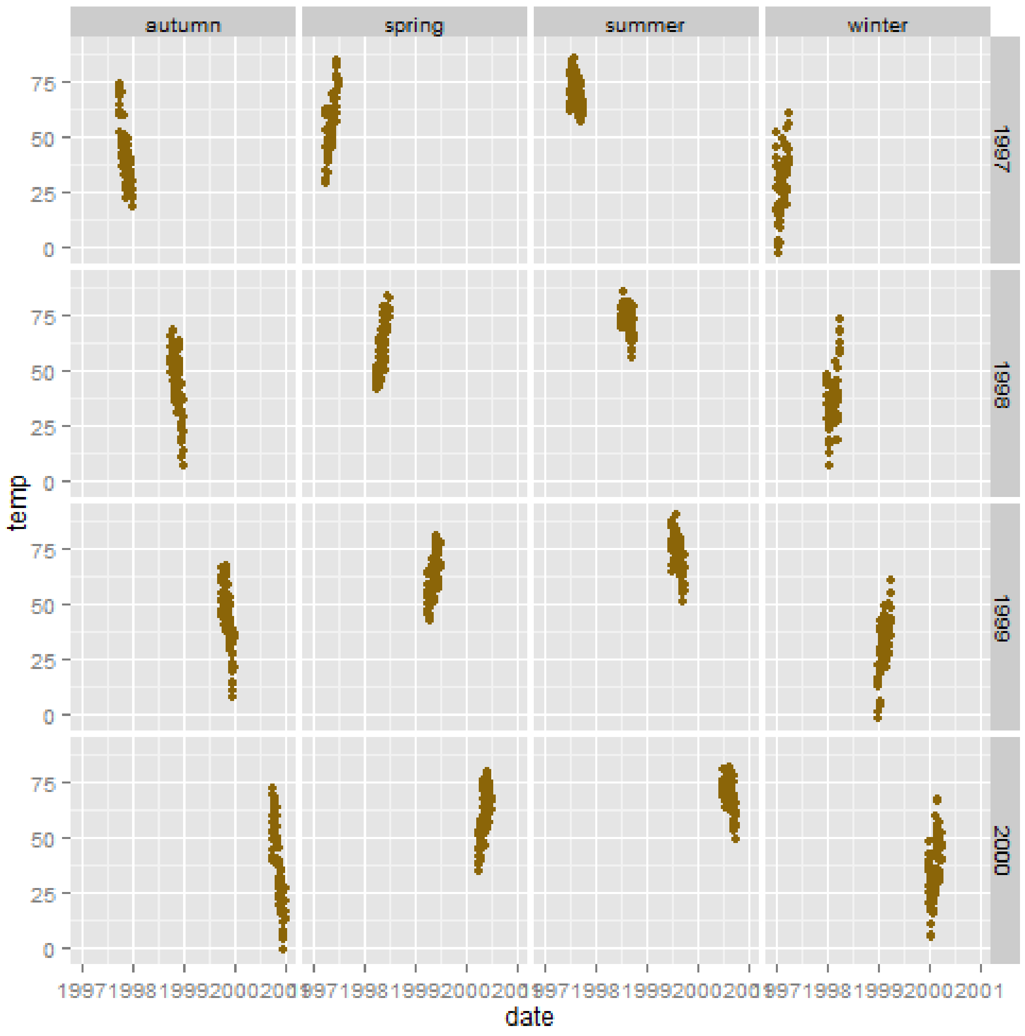
Create a grid of plots using two variables (`facet_grid()`)

```
ggplot(nmmaps, aes(date,temp))+geom_point(color="darkgoldenrod4")+
    facet_grid(year~season)
```



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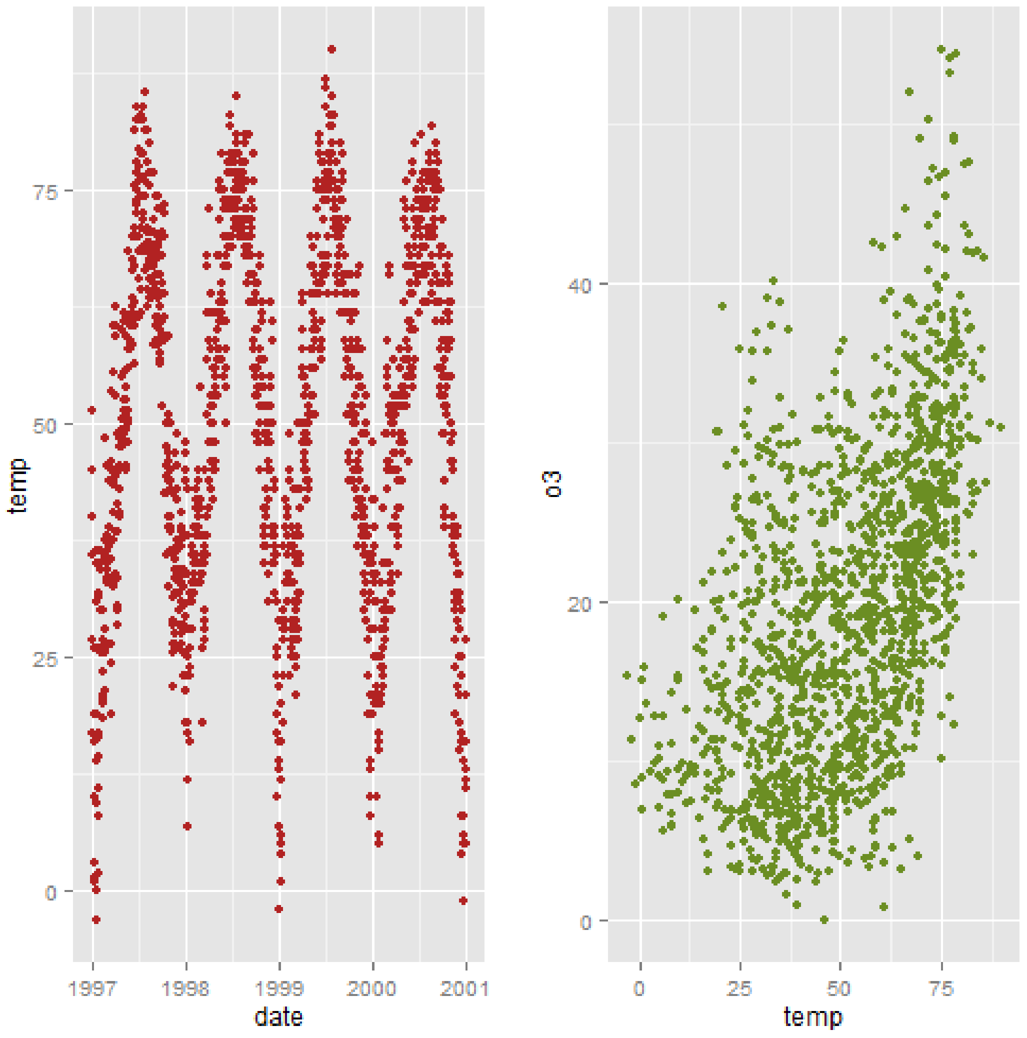
Put two (potentially unrelated) plots side by side (`pushViewport()`)

I find that doing this is not nearly as straightforward as traditional (base) graphics. Perhaps there is an easier way but here is the code I use:

```
myplot1<-ggplot(nmmaps, aes(date, temp))+geom_point(color="firebrick")
myplot2<-ggplot(nmmaps, aes(temp, o3))+geom_point(color="olivedrab")

library(grid)
pushViewport(viewport(layout = grid.layout(1, 2)))
print(myplot1, vp = viewport(layout.pos.row = 1, layout.pos.col = 1))
print(myplot2, vp = viewport(layout.pos.row = 1, layout.pos.col = 2))
```



To change from row to column arrangement you can change `facet_grid(season~year)` to `facet_grid(year~season)`.

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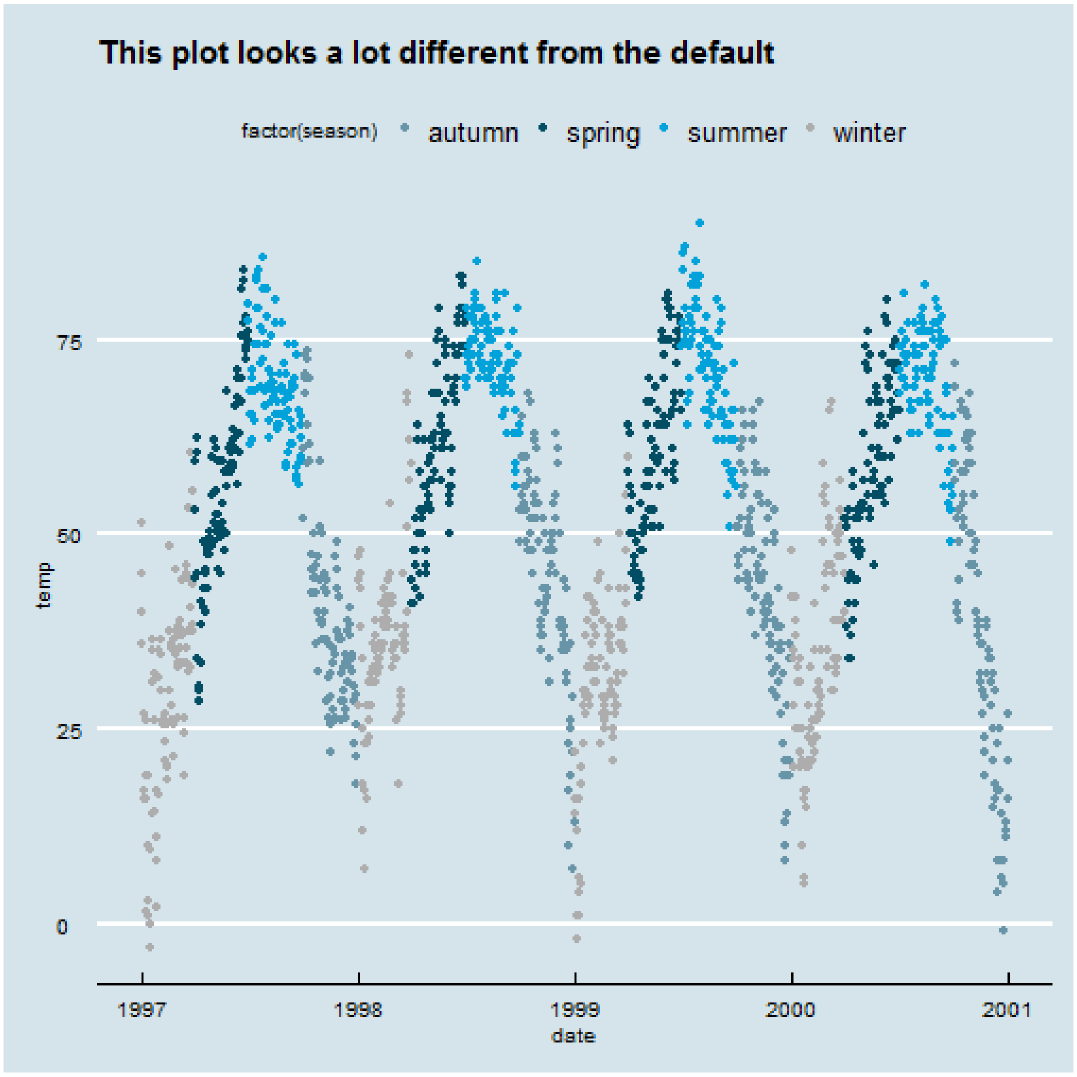
Working with themes

You can change the entire look of the plots by using custom theme. As an example, Jeffrey Arnold has put together the library `ggthemes` with several custom themes. For a list you can visit the ggthemes site. Here is an example:

Use a new theme (`theme_XX()`)

```
library(ggthemes)
```

```
ggplot(nmmaps, aes(date, temp, color=factor(season)))+
  geom_point()+ggtitle("This plot looks a lot different from the default")+
  theme_economist()+scale_colour_economist()
```



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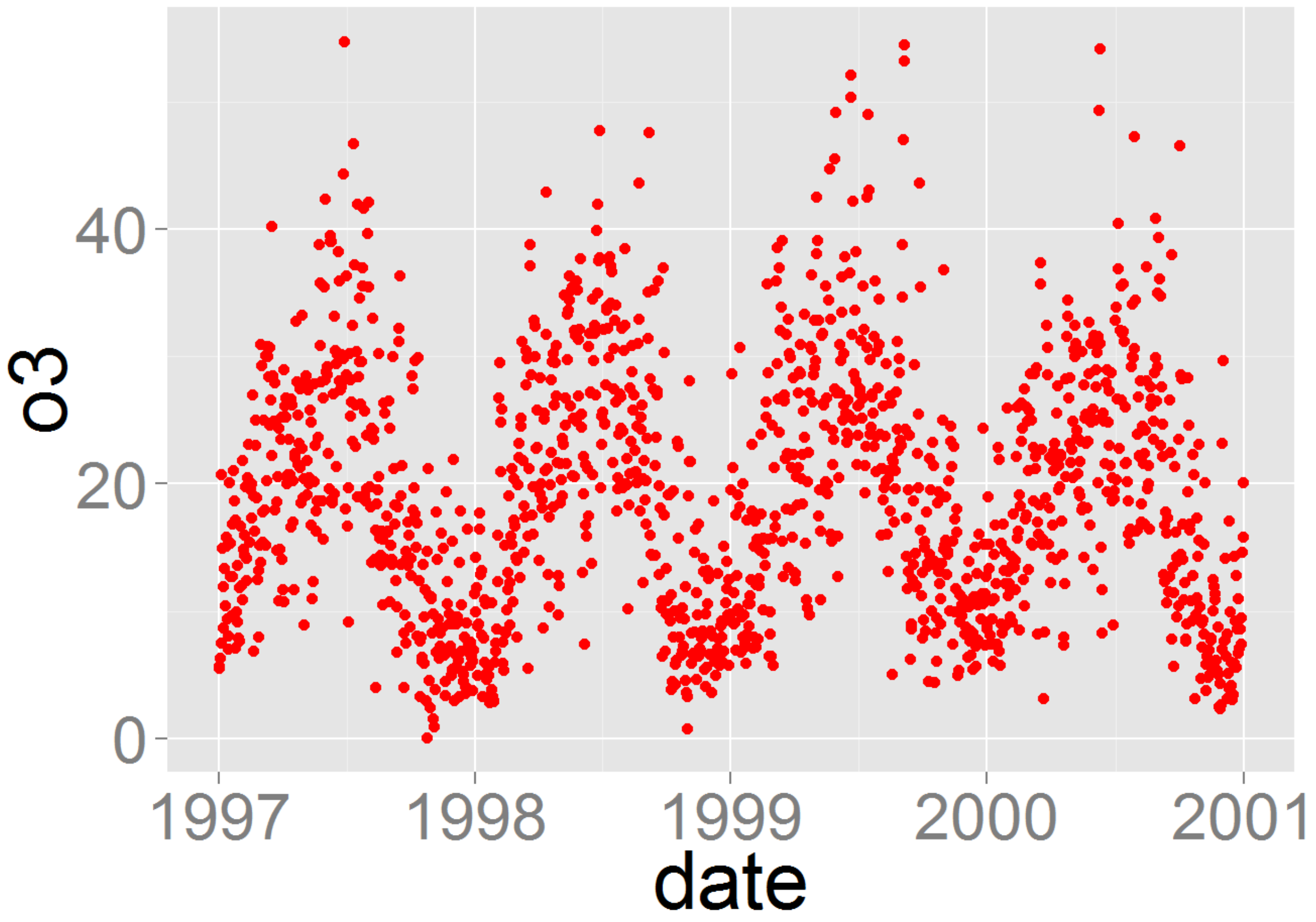
Change the size of all plot text elements

Personally, I find default size of the tick text, legends and other elements to be a little too small. Luckily it's incredibly easy to change the size of all the text elements at once. If you look below at the section on creating a custom theme you'll notice that the sizes of all the elements are relative (`rel()`) to the `base_size`. As a result, you can simply change the `base_size` and you're done. Here is the code:

```
theme_set(theme_gray(base_size = 30))
ggplot(nmmaps, aes(x=date, y=o3))+geom_point(color="red")
```



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Tip on creating a custom theme

If you want to change the theme for an entire session you can use `theme_set` as in `theme_set(theme_bw())`. The default is called `theme_gray`. If you wanted to create your own custom theme, you could extract the code directly from the gray theme and modify. Note that the `rel()` function change the sizes relative to the `base_size`.

```
theme_gray

function (base_size = 12, base_family = "")
{
  theme(
    line = element_line(colour = "black", size = 0.5, linetype = 1, lineend = "butt"),
    rect = element_rect(fill = "white", colour = "black", size = 0.5, linetype = 1),
    text = element_text(family = base_family, face = "plain", colour = "black", size = ba

    axis.text = element_text(size = rel(0.8), colour = "grey50"),
    strip.text = element_text(size = rel(0.8)),
    axis.line = element_blank(),
    axis.text.x = element_text(vjust = 1),
    axis.text.y = element_text(hjust = 1),
    axis.ticks = element_line(colour = "grey50"),
    axis.title.x = element_text(),
    axis.title.y = element_text(angle = 90),
    axis.ticks.length = unit(0.15, "cm"),
    axis.ticks.margin = unit(0.1, "cm"),

    legend.background = element_rect(colour = NA),
    legend.margin = unit(0.2, "cm"),
    legend.key = element_rect(fill = "grey95", colour = "white"),
    legend.key.size = unit(1.2, "lines"),
    legend.key.height = NULL,
    legend.key.width = NULL,
    legend.text = element_text(size = rel(0.8)),
    legend.text.align = NULL,
    legend.title = element_text(size = rel(0.8), face = "bold", hjust = 0),
    legend.title.align = NULL,
    legend.position = "right",
    legend.direction = NULL,
    legend.justification = "center",
    legend.box = NULL,

    panel.background = element_rect(fill = "grey90", colour = NA),
    panel.border = element_blank(),
    panel.grid.major = element_line(colour = "white"),
    panel.grid.minor = element_line(colour = "grey95", size = 0.25),
    panel.margin = unit(0.25, "lines"),
    panel.margin.x = NULL,
    panel.margin.y = NULL,

    strip.background = element_rect(fill = "grey80", colour = NA),
    strip.text.x = element_text(),
    strip.text.y = element_text(angle = -90),

    plot.background = element_rect(colour = "white"),
    plot.title = element_text(size = rel(1.2)),
    plot.margin = unit(c(1, 1, 0.5, 0.5), "lines"), complete = TRUE)
}
```

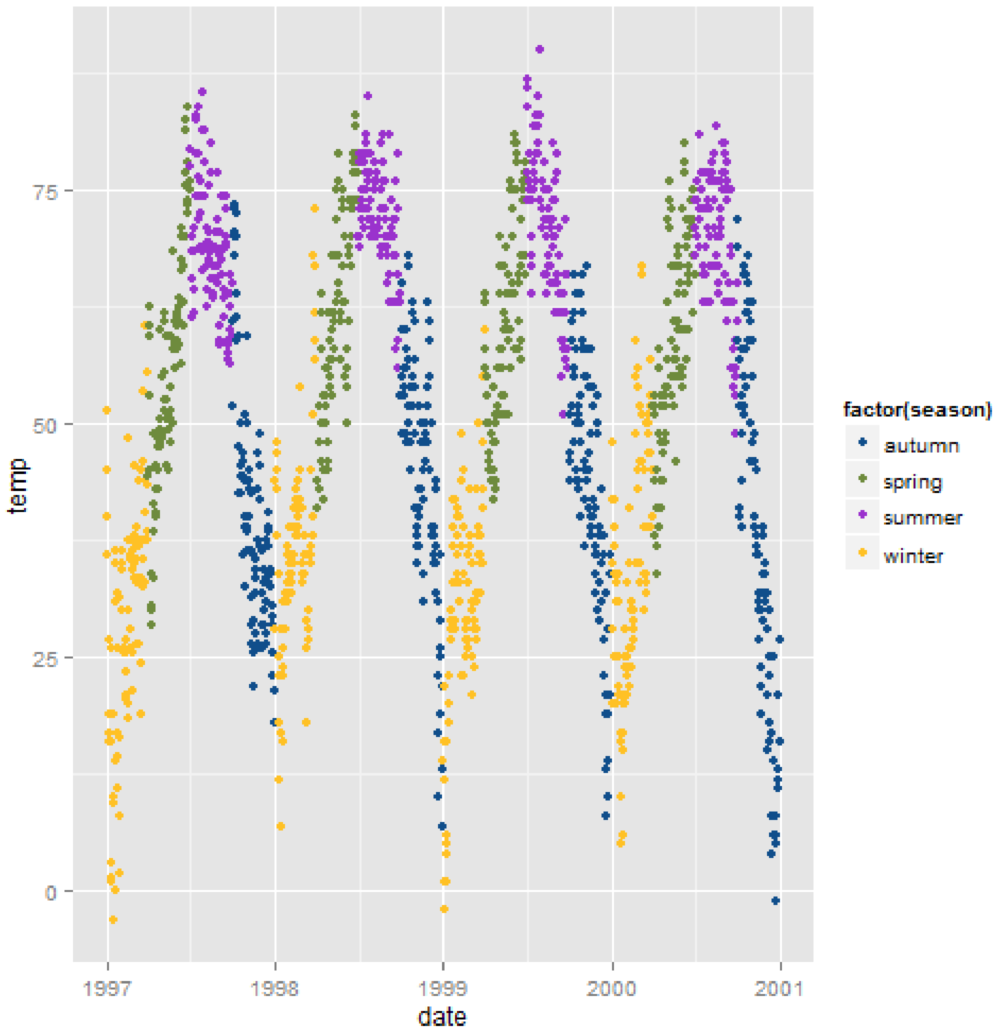
Working with colors

For simple applications working with colors is straightforward in `ggplot2` but when you have more advanced needs it can be a challenge. For a more advaned treatment of the topic you should probably get your hands on Hadley's book which has nice coverage. There are a few other good sources including the R Cookbook and the ggplot2 online docs. Tian Zheng at Columbia has created a useful PDF of R colors.

In order to use color with your data, most importantly, you need to know if you're dealing with a categorical or continuous variable.

Categorical variables: manually select the colors (`scale_color_manual()`)

```
ggplot(nmmaps, aes(date, temp, color=factor(season)))+
  geom_point() +
  scale_color_manual(values=c("dodgerblue4", "darkolivegreen4",
                              "darkorchid3", "goldenrod1"))
```



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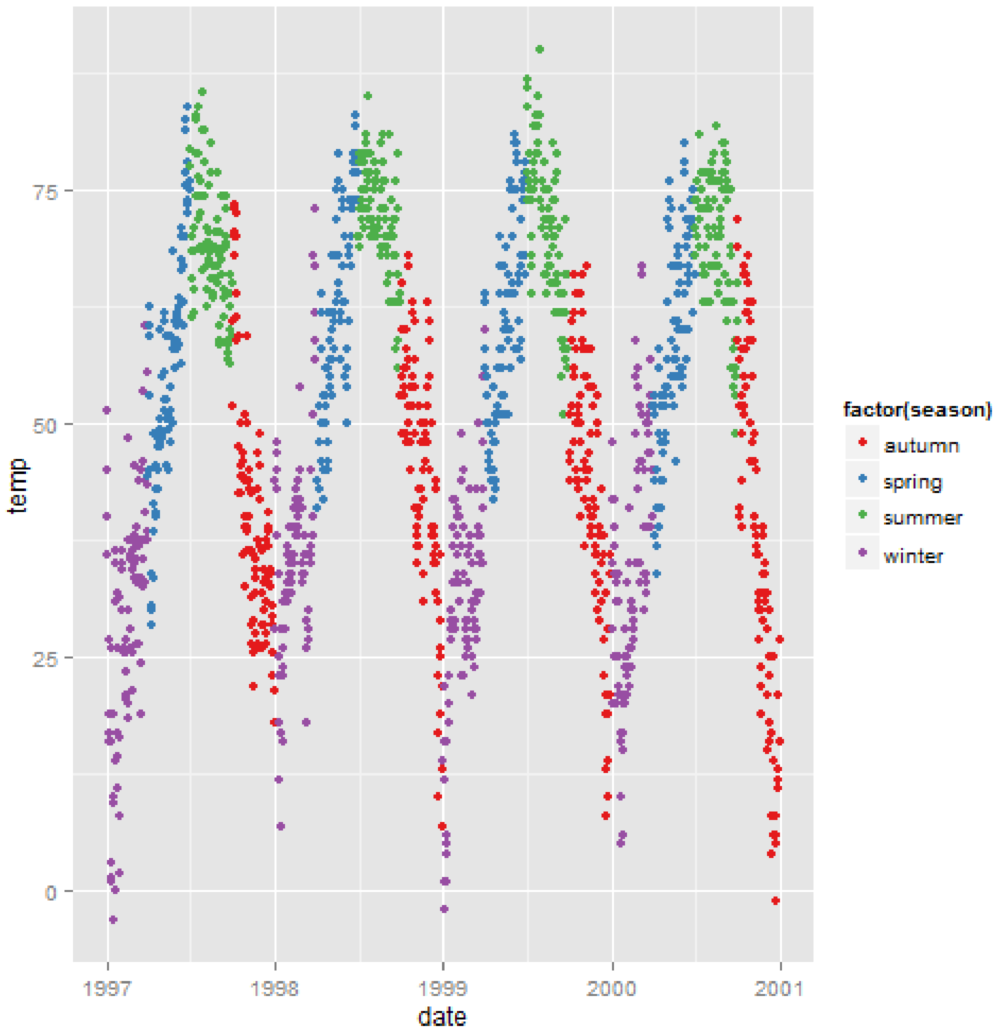
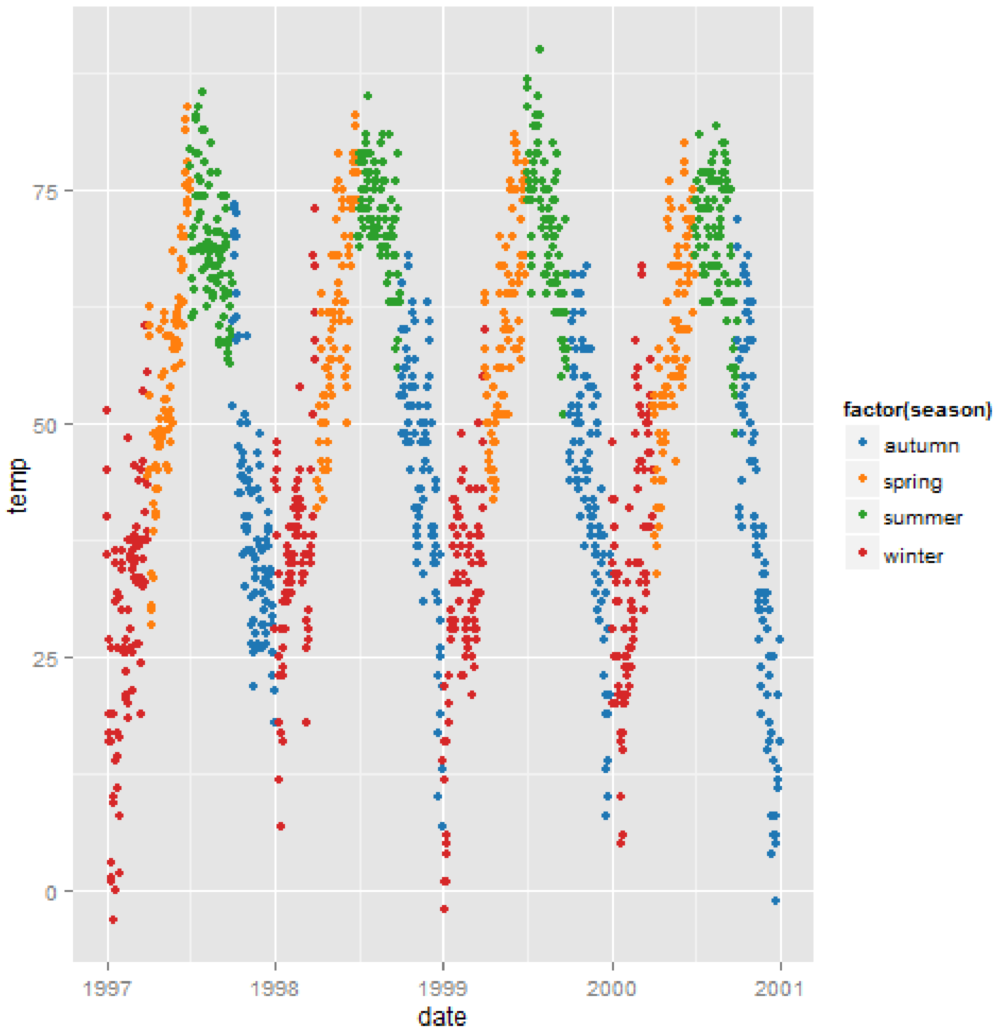
Categorical variables: try a built-in palette (based on colorbrewer2.org) (`scale_color_brewer()`):

```
ggplot(nmmaps, aes(date, temp, color=factor(season)))+
  geom_point() +
  scale_color_brewer(palette="Set1")
```



How about using the Tableau colors (but you need the library `ggthemes`):

```
library(ggthemes)
ggplot(nmmaps, aes(date, temp, color=factor(season)))+
  geom_point() +
  scale_colour_tableau()
```



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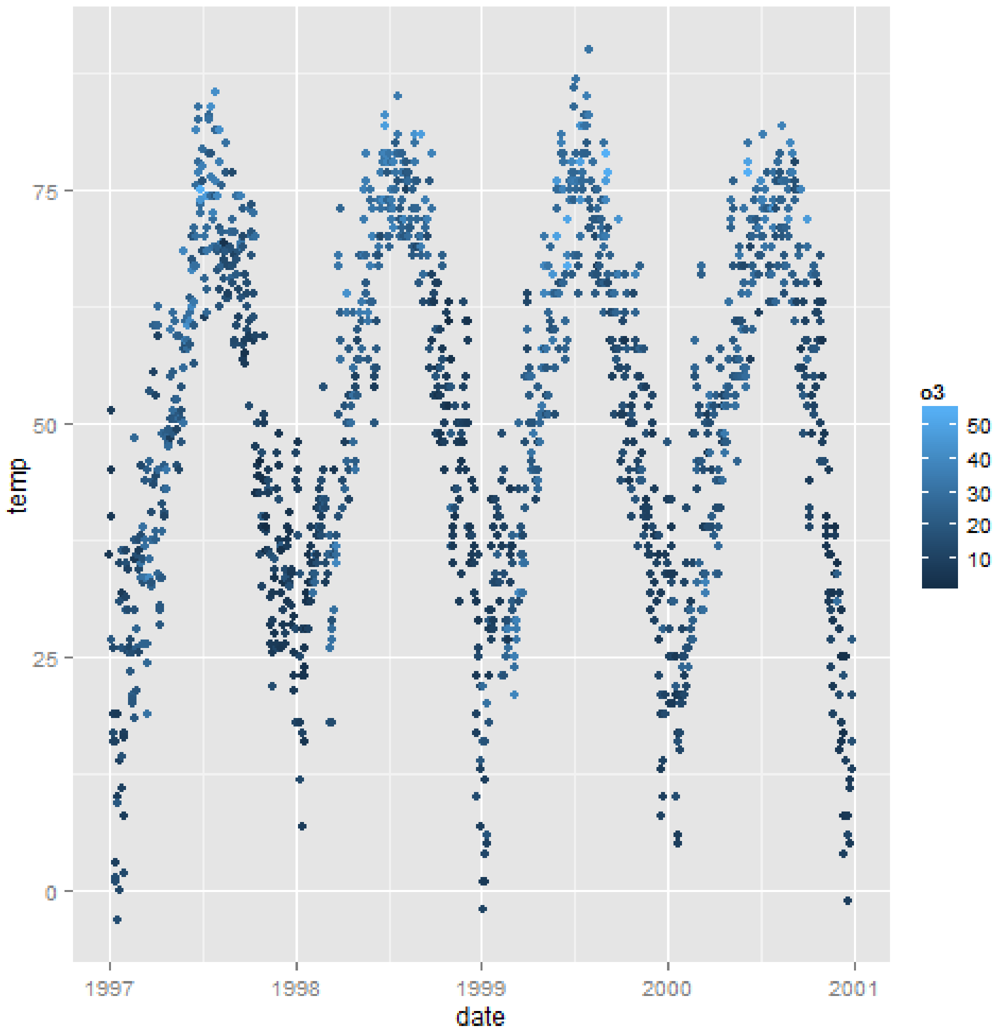
Color choice with continuous variables (`scale_color_gradient()`, `scale_color_gradient2()`)

In our example we will change the color variable to ozone, a continuous variable that is strongly related to temperature (higher temperature = higher ozone). The function `scale_color_gradient()` is a sequential gradient while `scale_color_gradient2()` is diverging.

Here is a default continuous color scheme (sequential color scheme):

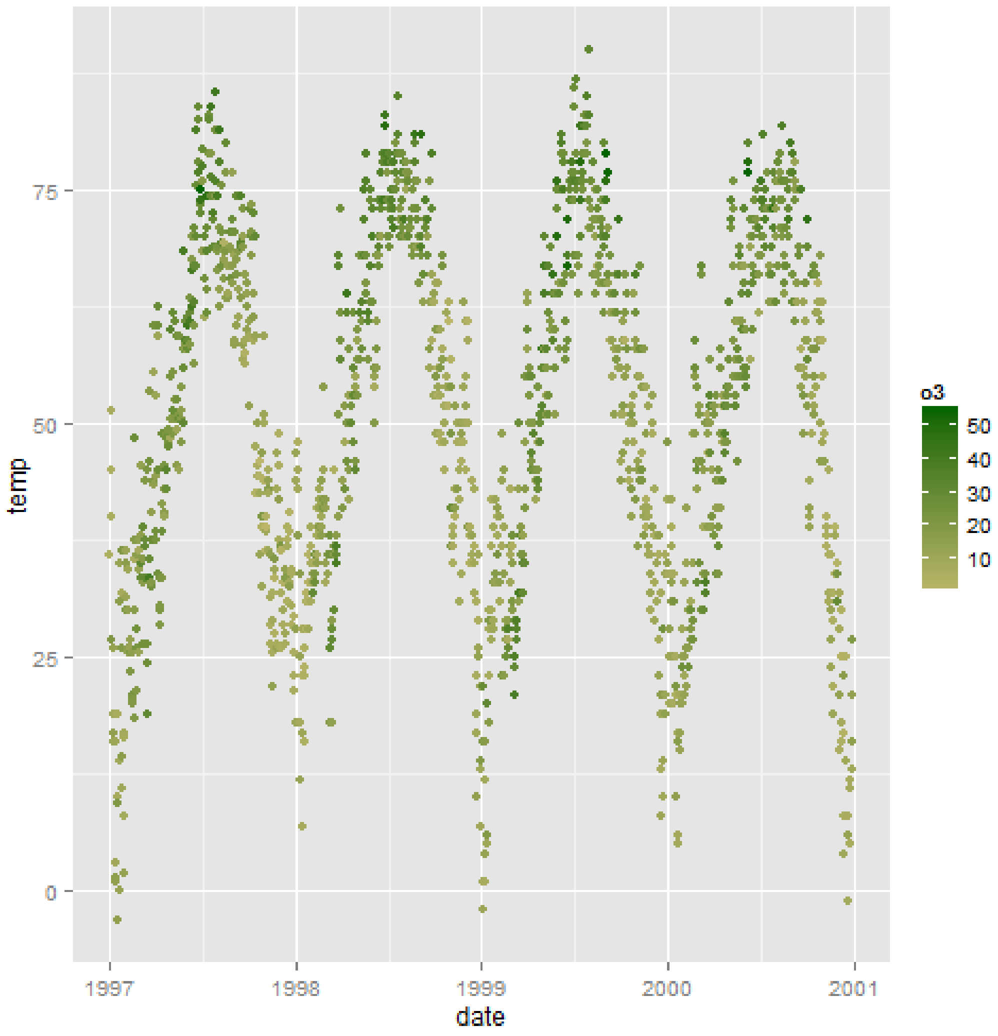
```
ggplot(nmmaps, aes(date, temp, color=o3))+geom_point()
```



```
# this code produces an identical plot
#ggplot(nmmaps, aes(date, temp, color=o3))+geom_point()+scale_color_gradient()
```

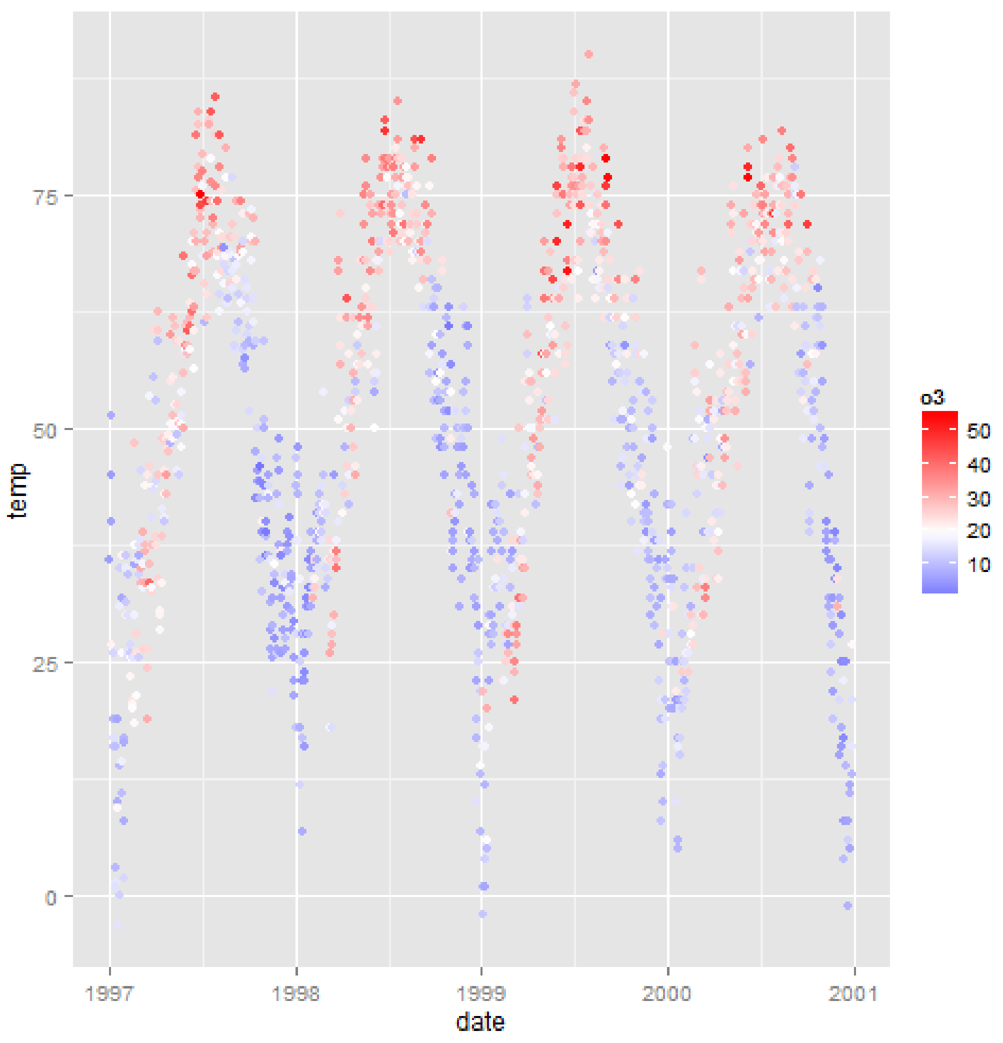
Manually change the low and high colors (sequential color scheme):

```
ggplot(nmmaps, aes(date, temp, color=o3))+geom_point()+
  scale_color_gradient(low="darkkhaki", high="darkgreen")
```



The temperature data is normally distributed so how about a diverging color scheme (rather than sequential). For diverging color you can use the `scale_color_gradient2` function.

```
mid<-mean(nmmaps$o3)
ggplot(nmmaps, aes(date, temp, color=o3))+geom_point()+
scale_color_gradient2(midpoint=mid,
                      low="blue", mid="white", high="red" )
```



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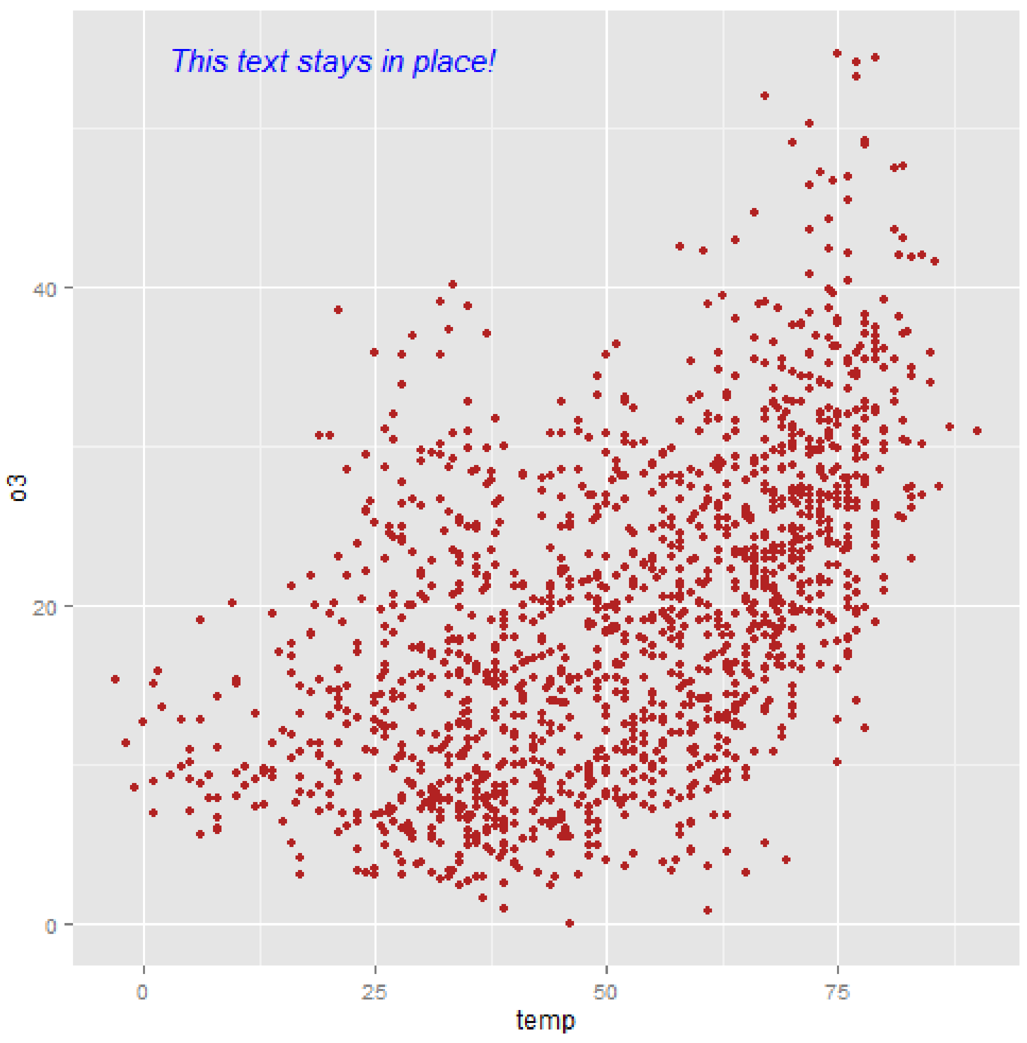
Working with annotation

Add text annotation in the top-right, top-left etc. (`annotation_custom()` and `textGrob()`)

I often have trouble figuring out the best way to add text to a plot in say, the top left corner, without using hard-coded coordinates. With `ggplot2` you can set annotation coordinates to `Inf` but I find this only moderately useful. Here is an example (based on code from here) using the library `grid` that allows you to specify the location based on scaled coordinates where 0 is low and 1 is high.

The `grobTree` function (from `grid`) creates a grid graphical object and `textGrob` creates the text graphical object. The annotation_custom() function comes from `ggplot2` and is designed to use a grob as input.

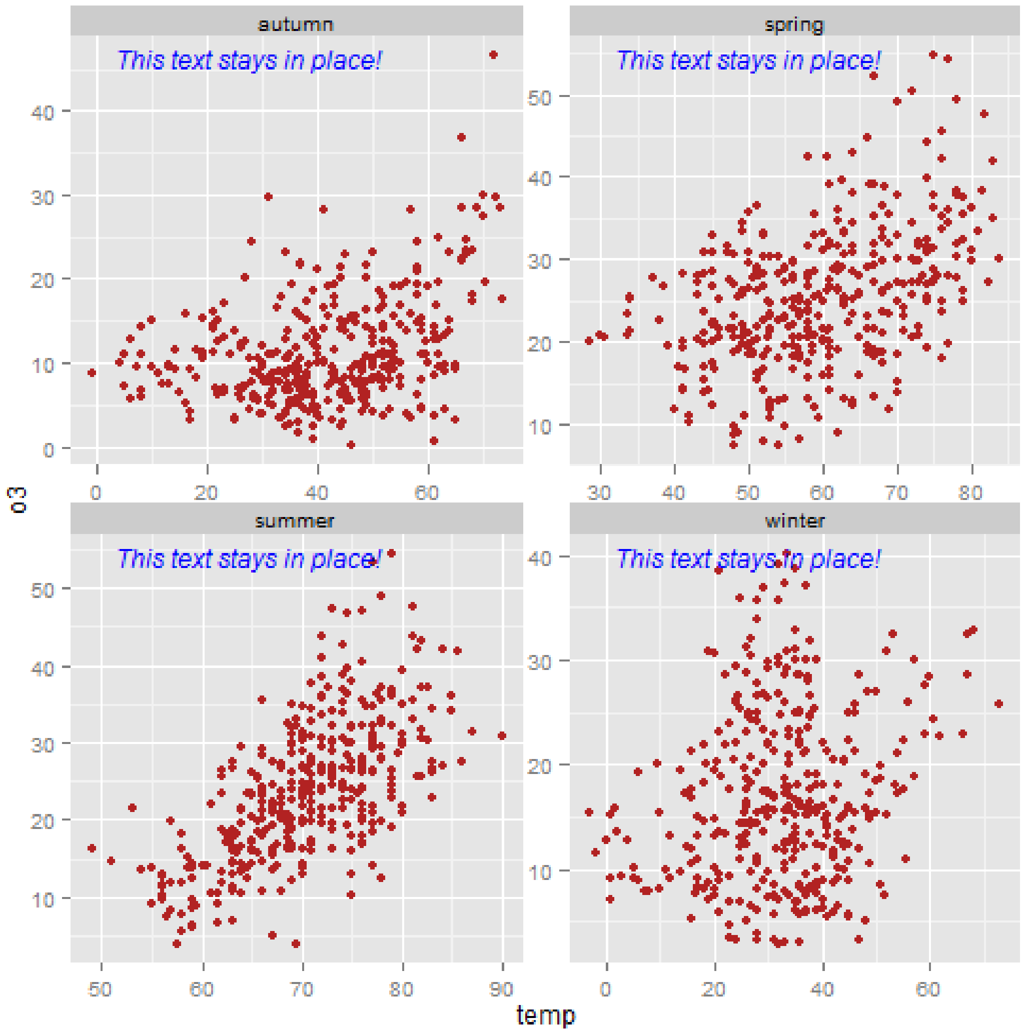
```
library(grid)

my_grob = grobTree(textGrob("This text stays in place!", x=0.1,  y=0.95, hjust=0,
  gp=gpar(col="blue", fontsize=15, fontface="italic")))

ggplot(nmmaps, aes(temp, o3))+geom_point(color="firebrick")+
  annotation_custom(my_grob)
```



'Big deal' you say!? It is a big deal. The value here is particularly evident when you have multiple plots with **different scales**. In the plot below you see that the axis scales vary yet the same code as above can be used to put the annotation is the same place on each facet. Nice!

```
library(grid)

my_grob = grobTree(textGrob("This text stays in place!", x=0.1,  y=0.95, hjust=0,
  gp=gpar(col="blue", fontsize=12, fontface="italic")))
```

```
ggplot(nmmaps, aes(temp, o3))+geom_point(color="firebrick")+facet_wrap(~season, scales="f
  annotation_custom(my_grob)
```

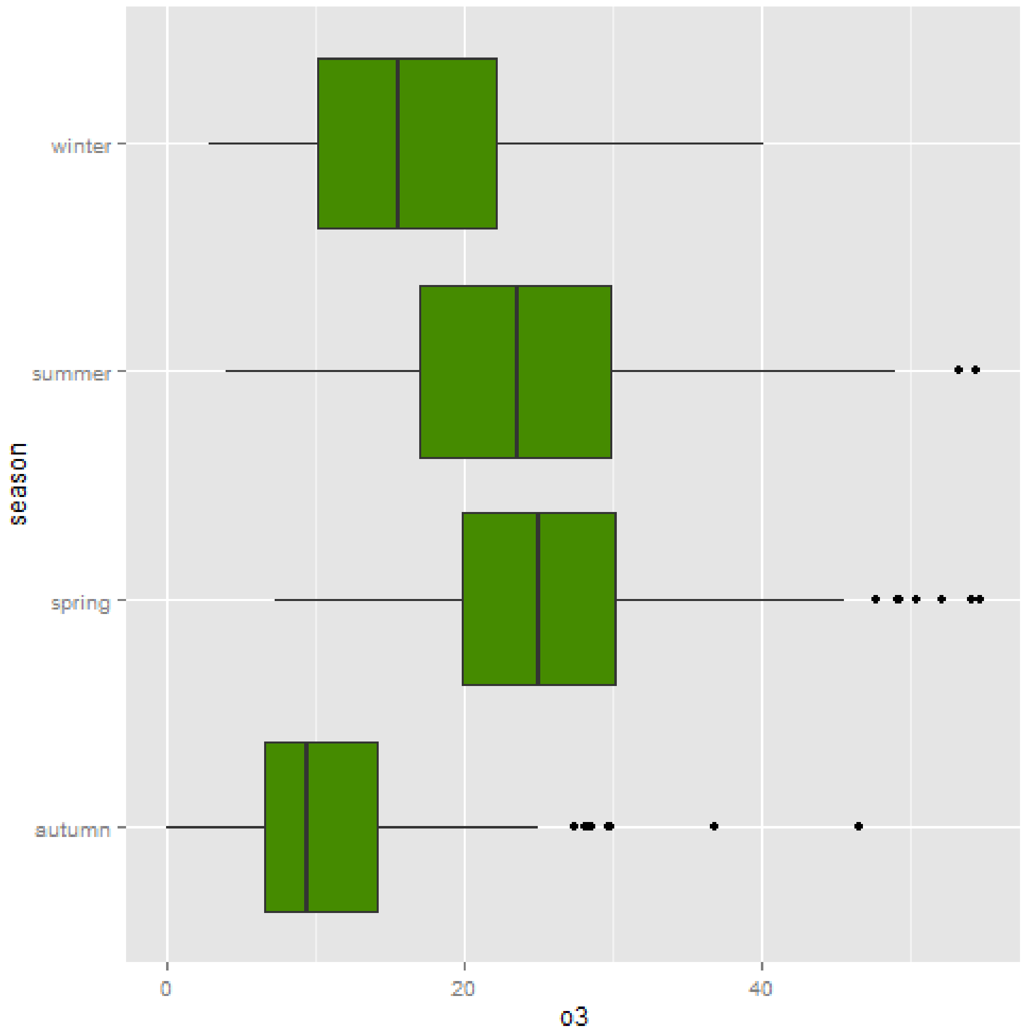


Working with coordinates

Flip a plot on it's side (`coord_flip()`)

It is incredibly easy to flip your plot on it's side. Here I've added the coord_flip() which is all you need to flip the plot.

```
ggplot(nmmaps, aes(x=season, y=o3))+geom_boxplot(fill="chartreuse4")+coord_flip()
```



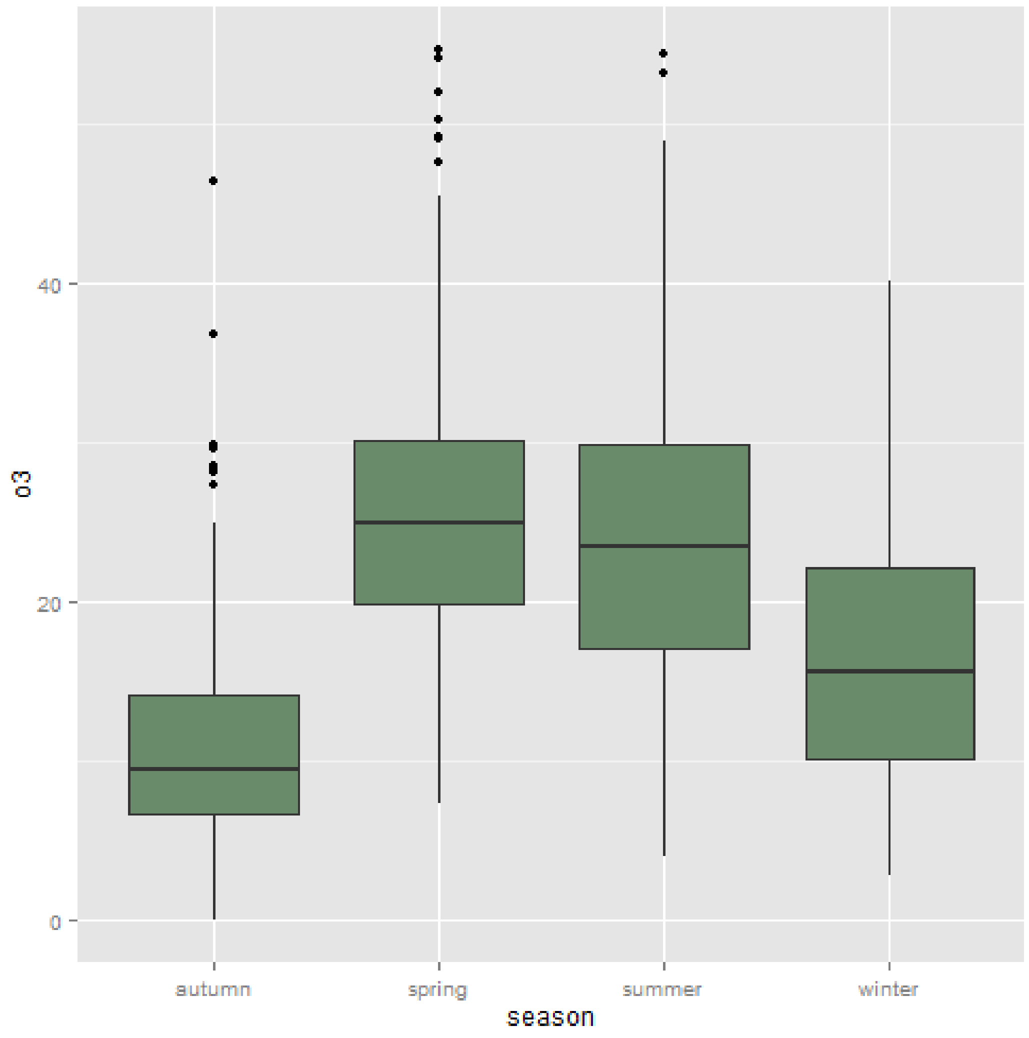
Working with plot types

Alternatives to the box plot (`geom_jitter()` and `geom_violin()`)

Start with a box plot

Box plots are great, but they can be so incredibly boring. There are alternatives, first – a box plot:

```
g<-ggplot(nmmaps, aes(x=season, y=o3))
g+geom_boxplot(fill="darkseagreen4")
```

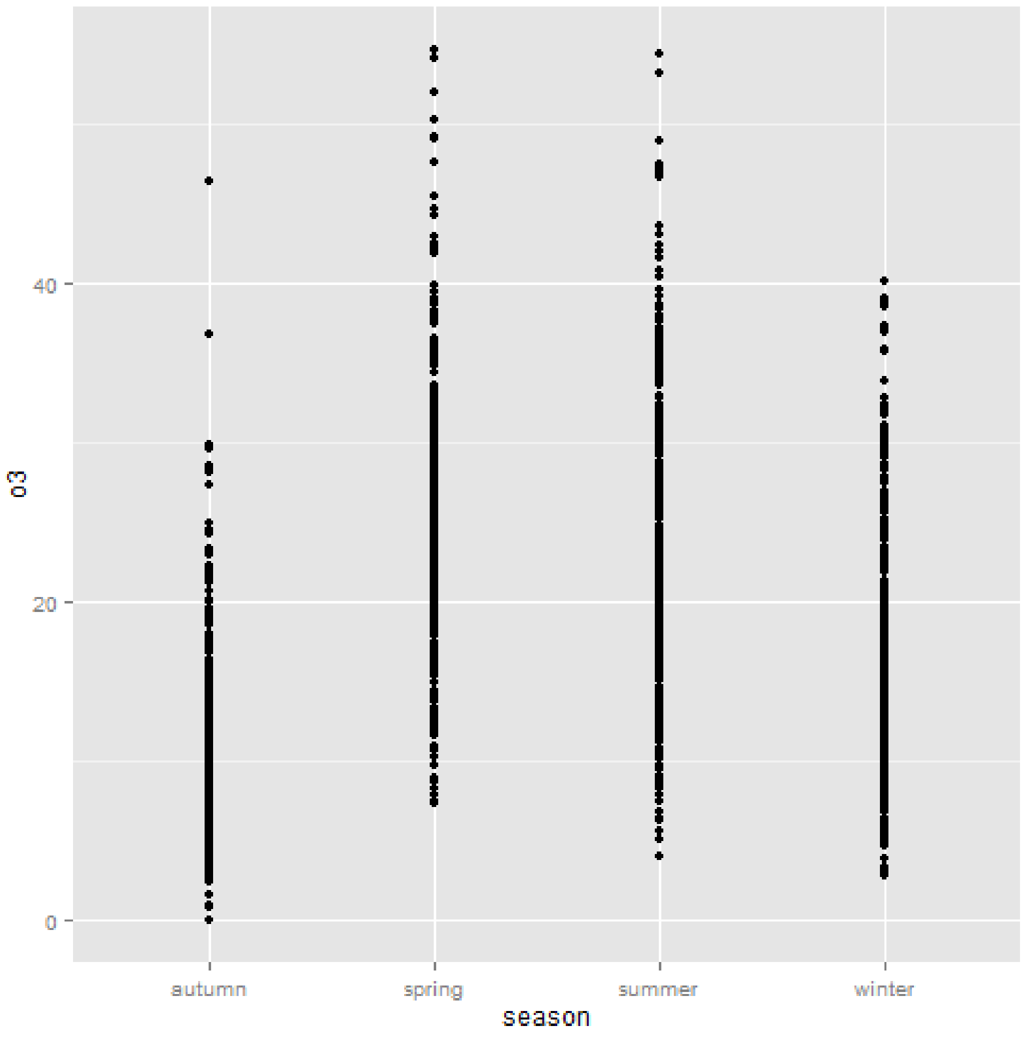


Effective, yes. Interesting, no.

Alternative to a box plot: plot of points

What if we plot the points themselves?

```
g+geom_point()
```

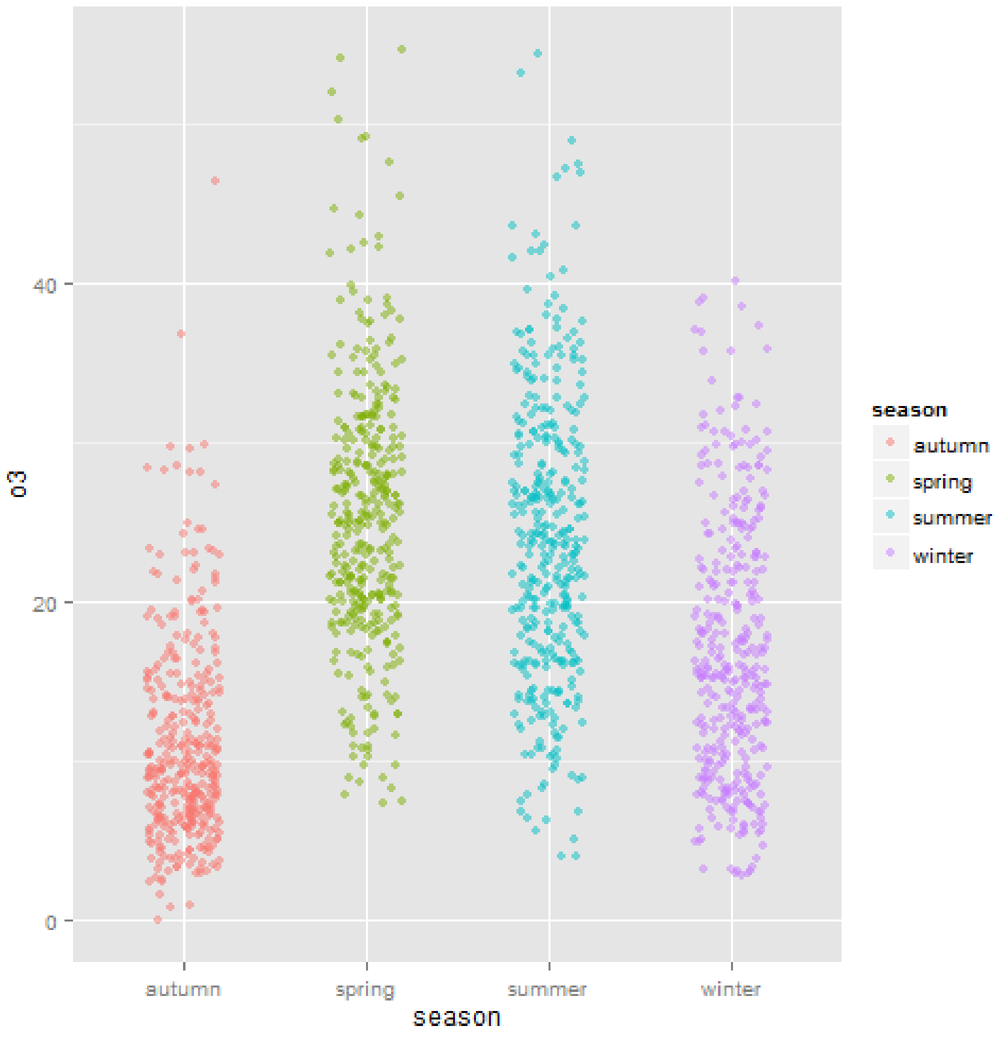


Not only boring but uninformative, you could add transparency to deal with overplotting, but this is not good either. Let's try something else.

Alternative to a box plot: jitter the points (`geom_jitter()`)

Try adding a little jitter to the data. I like this for in-house visualization but be careful using jittering because you're purposely adding noise to your data and this can result in misinterpretation of your data.

```
g+geom_jitter(alpha=0.5, aes(color=season),position = position_jitter(width = .2))
```

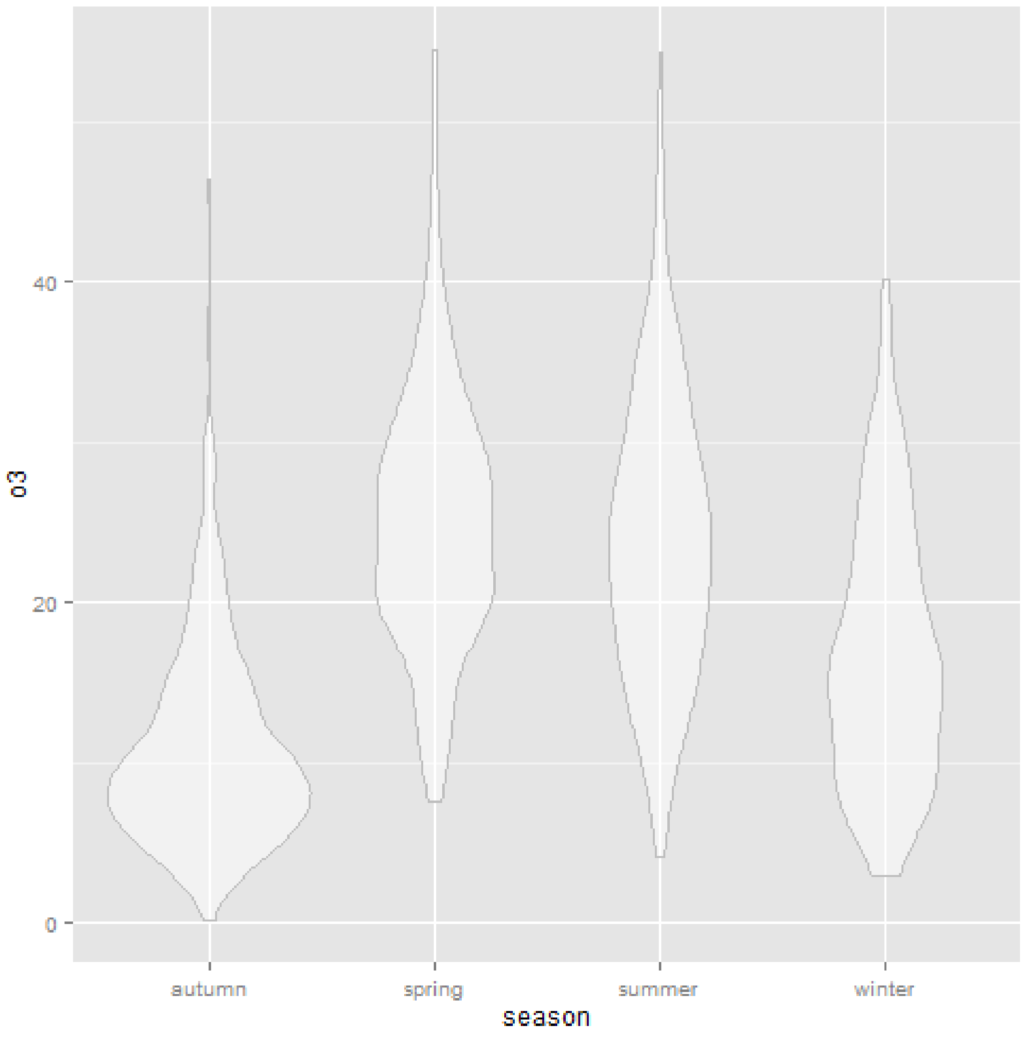


This is better and I think since we're working with season, a variable everyone will be familiar with, the extra noise will not likely lead to confusion.

Alternative to a box plot: violin plot perhaps (`geom_violin()`)

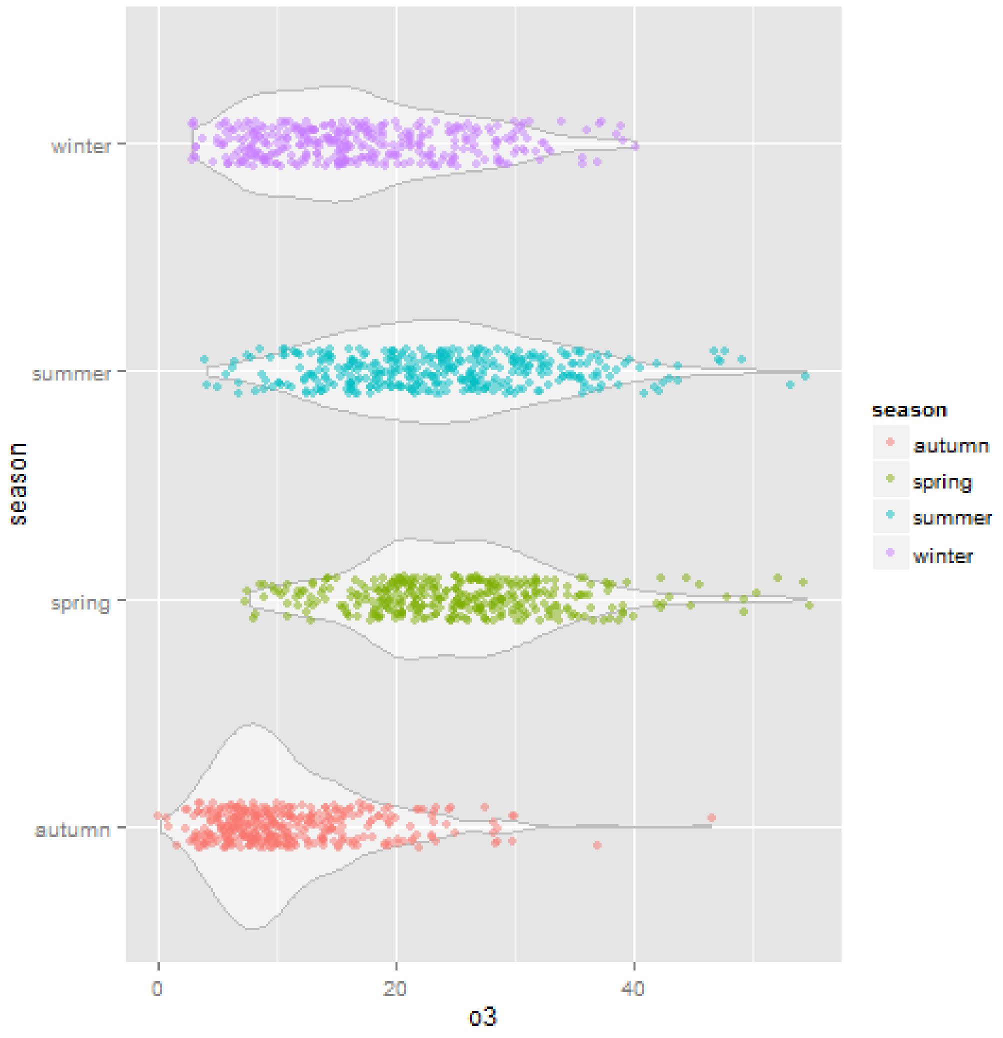
Violin plots, similar to box plots except you're using a kernel density to show where you have the most data, are a useful visualization.

```
g+geom_violin(alpha=0.5, color="gray")
```



What if we rotated and added the jittered points.

```
g+geom_violin(alpha=0.5, color="gray")+geom_jitter(alpha=0.5, aes(color=season),
      position = position_jitter(width = 0.1))+coord_flip()
```

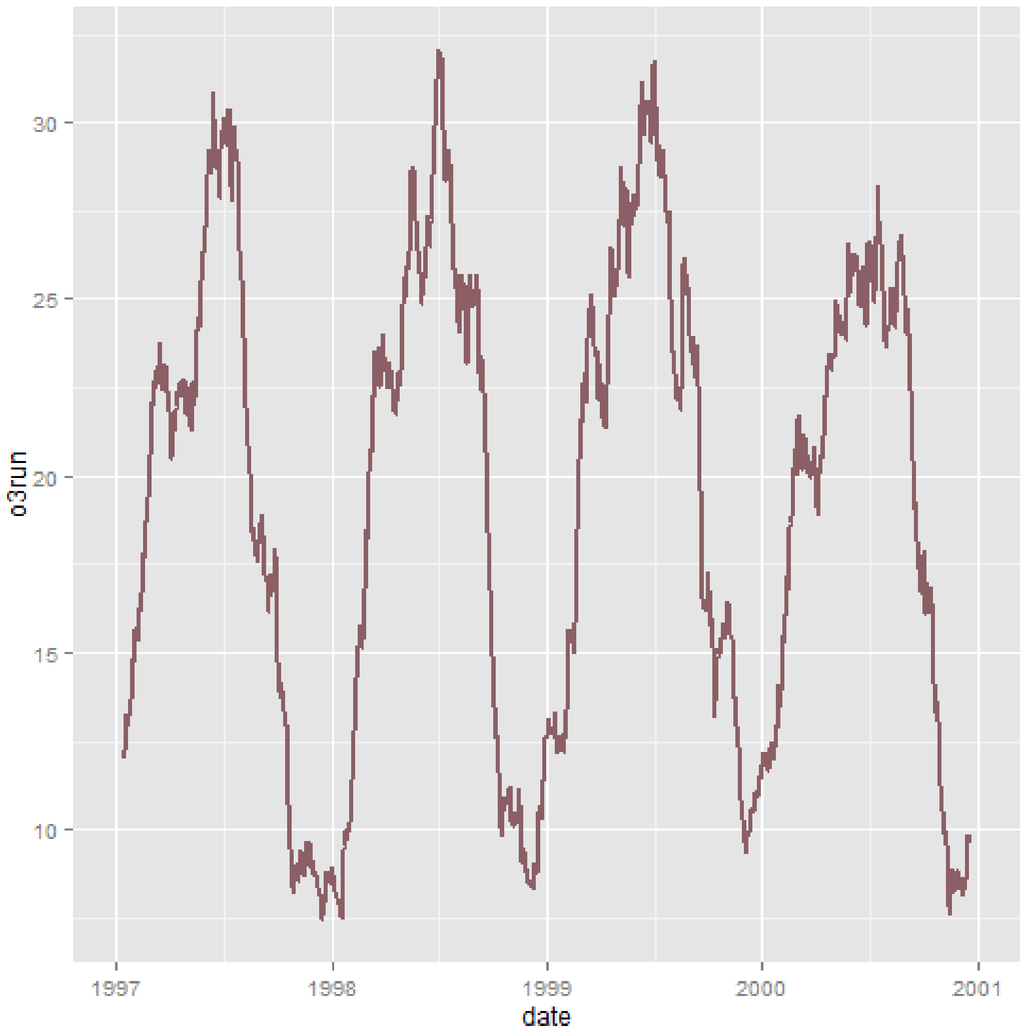


This is nice and I like it. But be wary of using unusual plot types, they take more time for your users to understand. Sometimes the simplest and most conventional plot type is your best bet when sharing with others. Box plots may be boring but people know how to interpret them immediately.

Add a ribbon to your plot (`geom_ribbon()`)

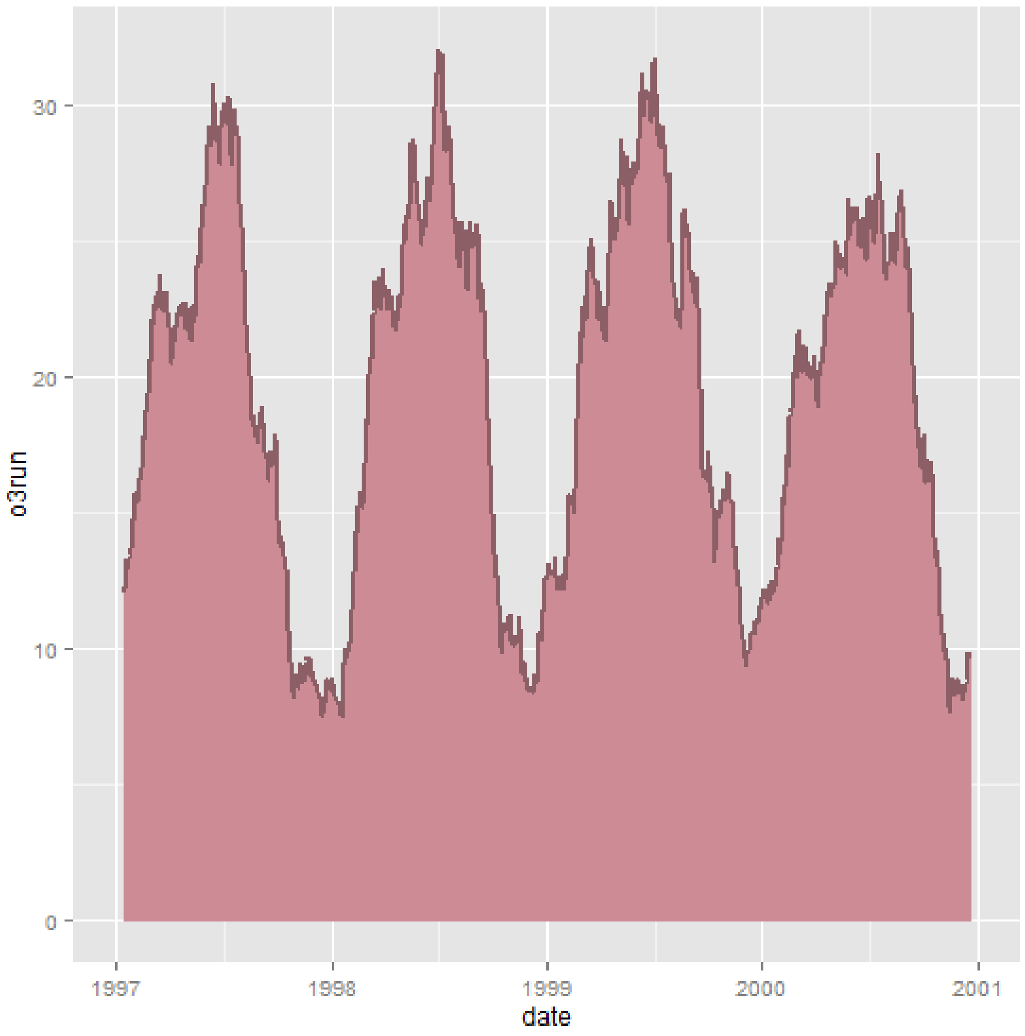
This is not the perfect dataset for this, but using ribbon can be useful. In this example we will create a 30-day running average using the `filter()` function so that our ribbon is not too noisy.

```
# add a filter
nmmaps$o3run<-as.numeric(filter(nmmaps$o3, rep(1/30,30), sides=2))
ggplot(nmmaps, aes(date, o3run))+geom_line(color="lightpink4", lwd=1)
```



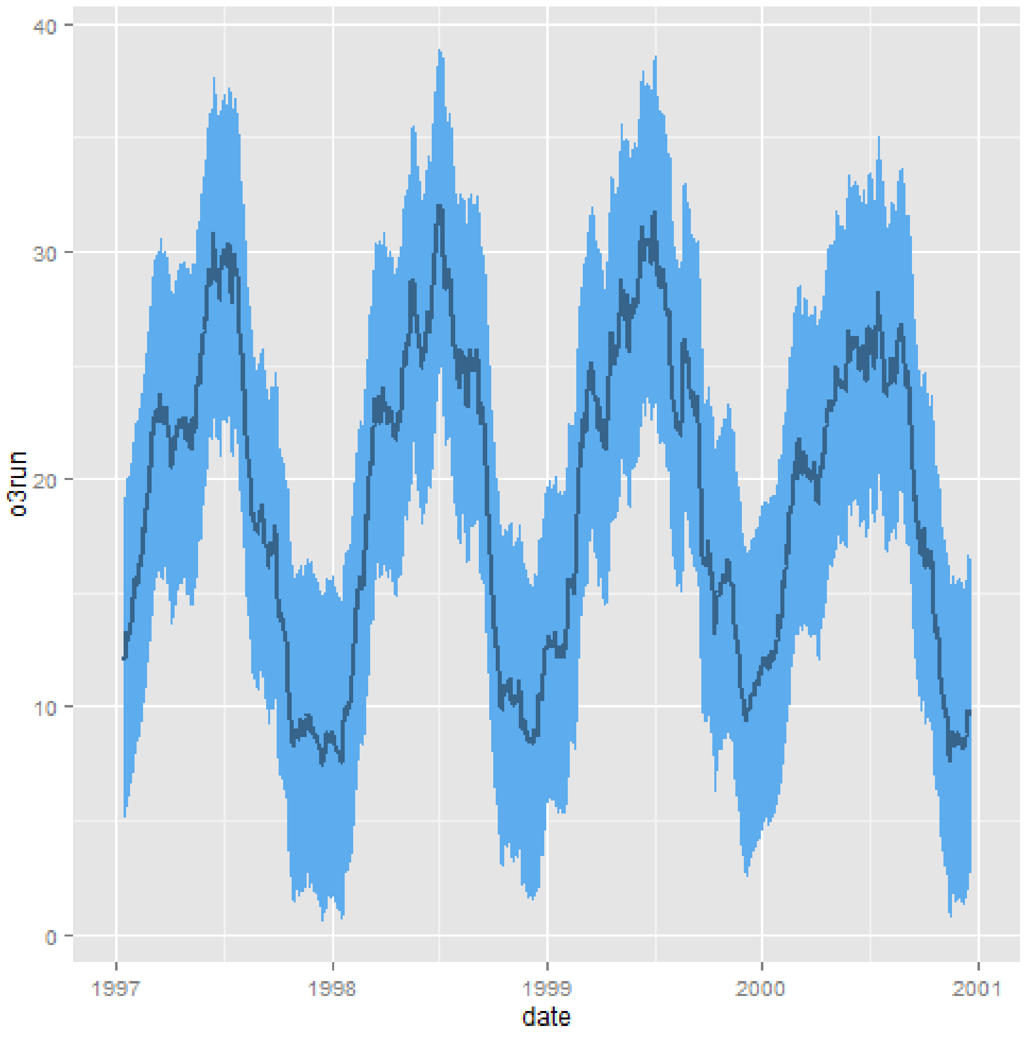
How does it look if we fill in the area below the curve using the `geom_ribbon()` function?

```
# add a filter

ggplot(nmmaps, aes(date, o3run))+geom_ribbon(aes(ymin=0, ymax=o3run), fill="lightpink3",
  geom_line(color="lightpink4", lwd=1)
```



Above is not really the conventional way to use `geom_ribbon()`. Instead, why don't we draw a ribbon that gives us one standard deviation above and below our data:

```
nmmaps$mino3<-nmmaps$o3run-sd(nmmaps$o3run, na.rm=T)
nmmaps$maxo3<-nmmaps$o3run+sd(nmmaps$o3run, na.rm=T)

ggplot(nmmaps, aes(date, o3run))+geom_ribbon(aes(ymin=mino3, ymax=maxo3), fill="steelblue
  geom_line(color="steelblue4", lwd=1)
```



Create a tiled correlation plot (`geom_tile()`)

I'll admit that I find creating tiled correlation plots a bit cumbersome, I always have to copy and paste code from a previous project. Nevertheless, it's a useful plot type so I'm posting the code here.

First step is to create the correlation matrix. I'm using Pearson because all the variables are fairly normally distributed – you may want to consider Spearman if your variables follow a different pattern. Note that since a correlation matrix has redundant information I'm setting half of it to NA.

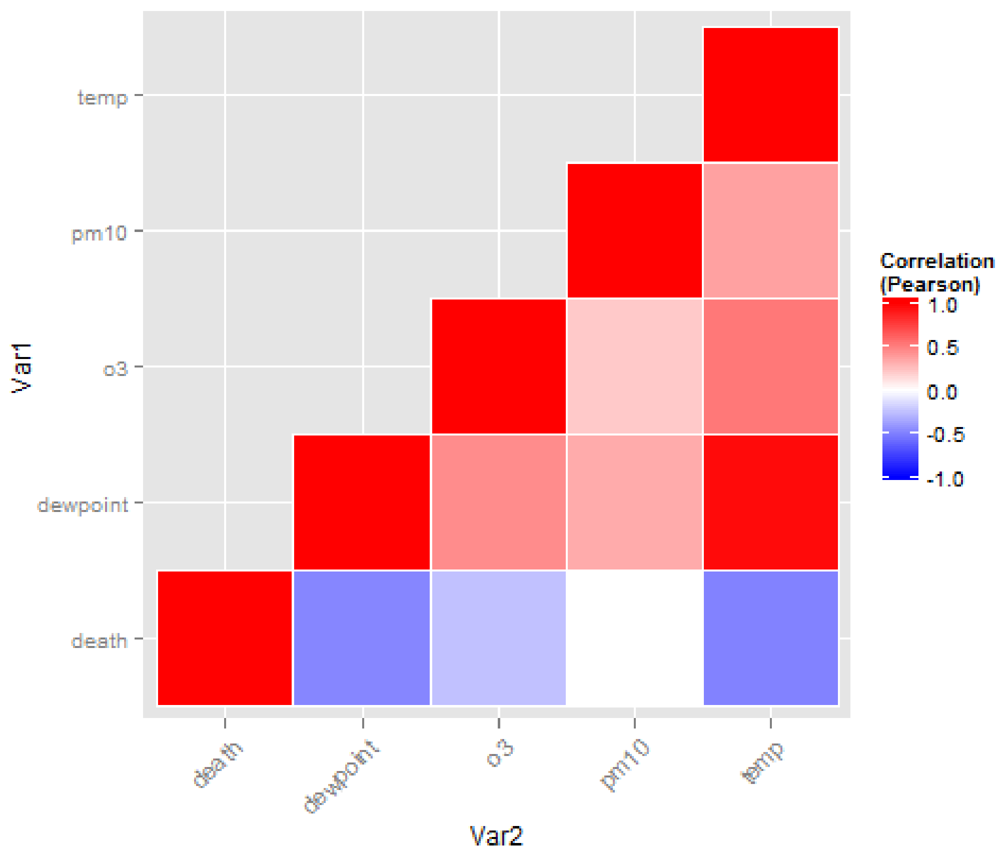
```
#careful, I'm sorting the field names so that the ordering in the final plot is correct
thecor<-round(cor(nmmaps[,sort(c("death", "temp", "dewpoint", "pm10", "o3"))], method="pe
thecor[lower.tri(thecor)]<-NA
thecor
##          death dewpoint    o3 pm10  temp
## death        1    -0.47 -0.24 0.00 -0.49
## dewpoint    NA     1.00  0.45 0.33  0.96
## o3          NA       NA  1.00 0.21  0.53
## pm10         NA       NA     NA 1.00  0.37
## temp         NA       NA     NA   NA  1.00
```

Now I'm going to put it in "long" format using the melt function from the `reshape2` package and I'll drop the records with NA values.

```
library(reshape2)

thecor<-melt(thecor)
thecor$Var1<-as.character(thecor$Var1)
thecor$Var2<-as.character(thecor$Var2)
thecor<-na.omit(thecor)
head(thecor)
##         Var1     Var2 value
## 1      death    death  1.00
## 6      death dewpoint -0.47
## 7   dewpoint dewpoint  1.00
## 11     death       o3 -0.24
## 12  dewpoint       o3  0.45
## 13        o3       o3  1.00
```

Now for the plot. I'm using `geom_tile` but if you have a lot of data you might consider `geom_raster` which can be much faster.

```
ggplot(thecor, aes(Var2, Var1))+
 geom_tile(data=thecor, aes(fill=value), color="white")+
 scale_fill_gradient2(low="blue", high="red", mid="white",
  midpoint=0, limit=c(-1,1),name="Correlation\n(Pearson)")+
 theme(axis.text.x = element_text(angle=45, vjust=1, size=11, hjust=1))+
 coord_equal()
```



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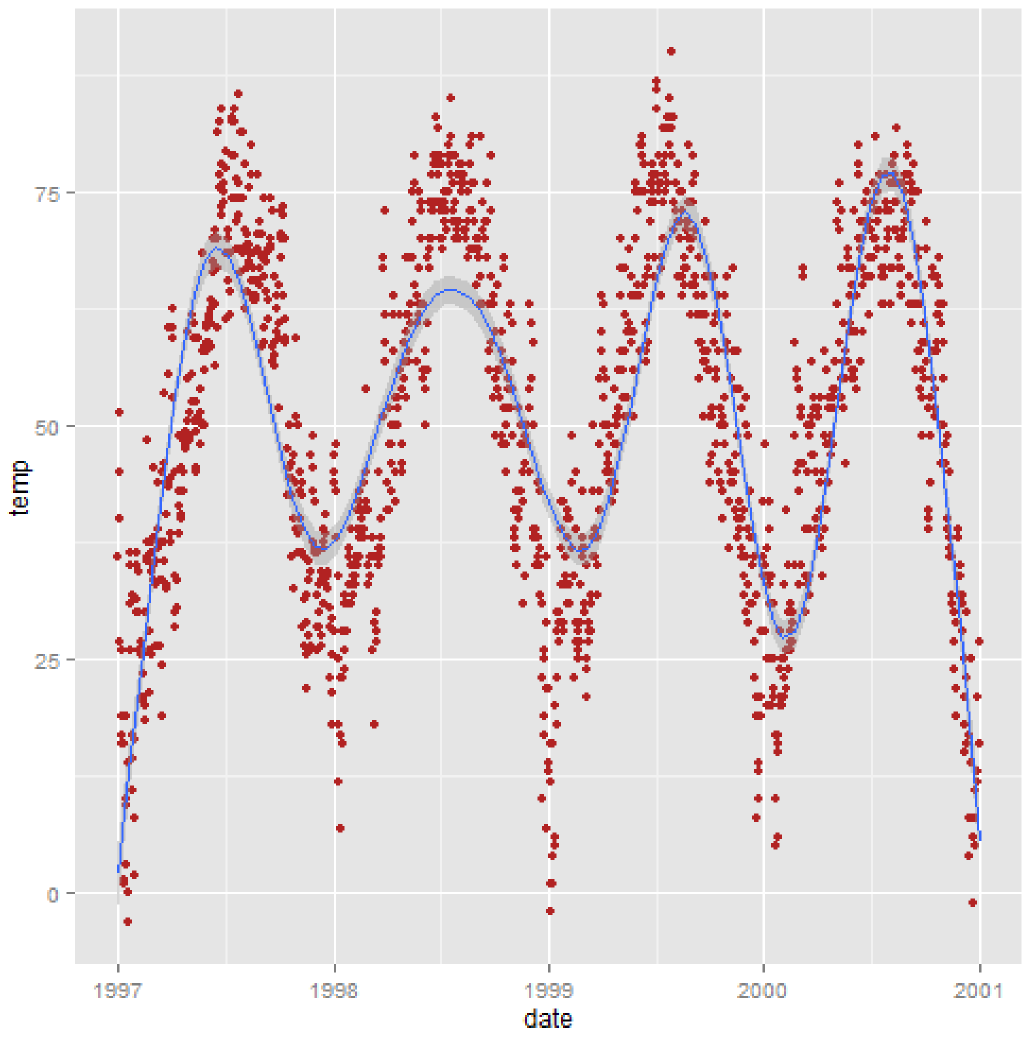
Working with smooths

You've likely already learned how amazingly easy it is to add a smooth to your data using `ggplot2`. You can simply use `stat_smooth()` which will add a LOESS smooth if you have fewer than 1000 points or a GAM otherwise. Since we have more than 1000 points the smooth is a GAM.

Default – adding LOESS or GAM (`stat_smooth()`)

Here it is at its simplest – no formula required:

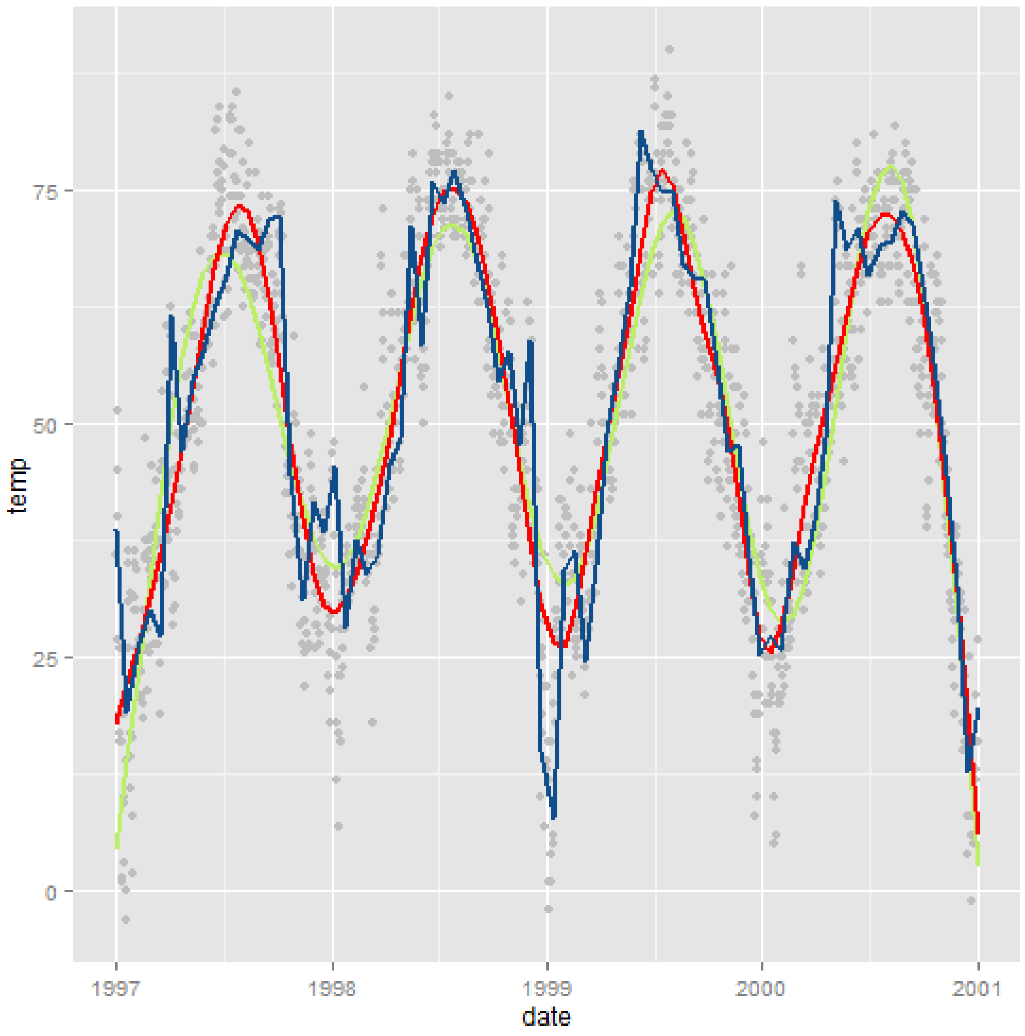
```
ggplot(nmmaps, aes(date, temp))+geom_point(color="firebrick")+
  stat_smooth()
```



Specifying the formula (`stat_smooth(formula=)`)

But `ggplot2` allows you to specify the model you want it to use. For example, let's say you want to increase the GAM dimension (add some additional wiggles to the smooth):

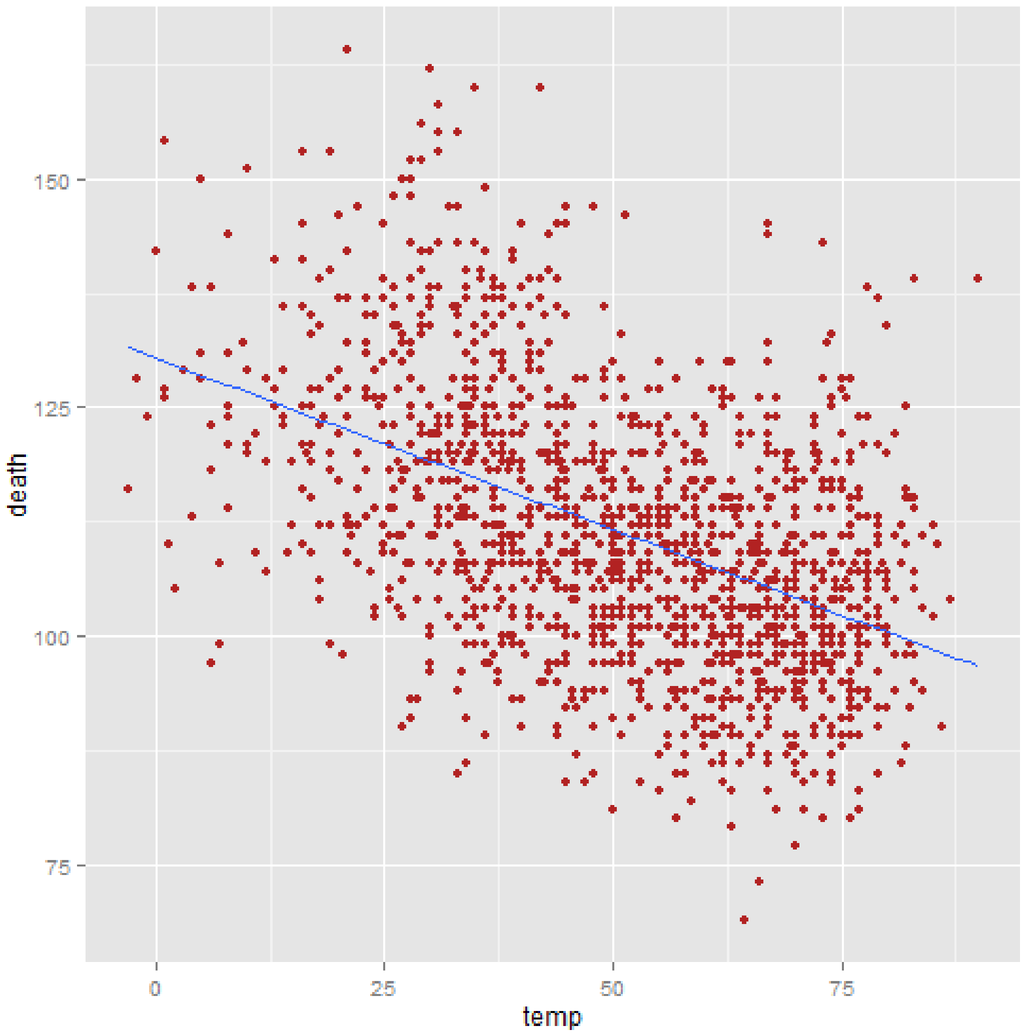
```
ggplot(nmmaps, aes(date, temp))+
  geom_point(color="grey")+
  stat_smooth(method="gam", formula=y~s(x,k=10), col="darkolivegreen2", se=FALSE, size=1)
  stat_smooth(method="gam", formula=y~s(x,k=30), col="red", se=FALSE, size=1)+
  stat_smooth(method="gam", formula=y~s(x,k=500), col="dodgerblue4", se=FALSE, size=1)
```



Adding a linear fit (`stat_smooth(method="lm")`)

Though the default is a smooth, it is also easy to add a standard linear fit:

```
ggplot(nmmaps, aes(temp, death))+geom_point(color="firebrick")+
  stat_smooth(method="lm", se=FALSE)
```

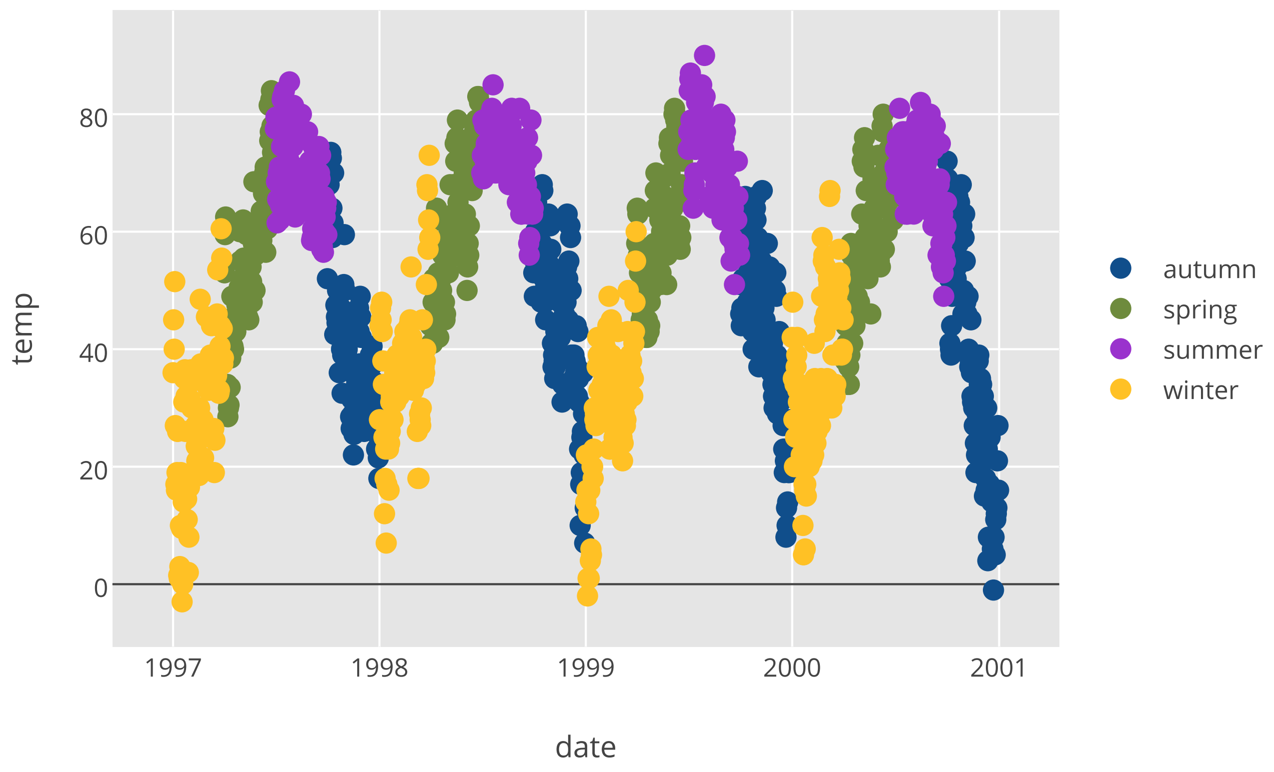


Note that the same could be achieved using the more cumbersome:

```
lmTemp<-lm(death~temp, data=nmmaps)
ggplot(nmmaps, aes(temp, death))+geom_point(col="firebrick")+
  geom_abline(intercept=lmTemp$coef[1], slope=lmTemp$coef[2])
```

Convert your plots to online, interactive graphics using Plot.ly

Plot.ly is a great tool for easily creating online, interactive graphics directly from your ggplot2 plots. The process is surprisingly easy, and can be done from within R, but there are enough steps that I describe how to create graphics like the one below in a separate post.



Play with this data! »

This post created in RStudio using knitr. R version 3.0.2 (2013-09-25) and ggplot2 version 0.9.3.1.

Posted in Data Visualization, ggplot2, R

9 responses

pssguy
August 5, 2014 at 12:25 pm

This is fantastic
Looking forward to the ggvis version!

zev@zevross.com
August 5, 2014 at 1:08 pm

Coming soon!

Tung
August 8, 2014 at 8:09 pm

Hi Zev,

Awesome job! One of the most comprehensive tutorials on ggplot2 I've ever come through. By the way, how can you increase the size of x- & y-axis legend? Sorry if I missed it in your post. Thank you so much!

Cheers,

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zev@zevross.com
August 11, 2014 at 9:27 am

Do you mean the x & y axis label? If so take a look at my "Move the labels away from the plot" and then look at the help for element_text (?element_text).

Tung
August 11, 2014 at 1:44 pm

I meant the size of numbers on x- & y-axis e.g. 0, 25, 50, 75 & 1997 to 2001 in your plot. Thanks!

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zev@zevross.com
August 11, 2014 at 2:27 pm

I added a new example under 'Change size of tick text'

Tung
August 11, 2014 at 3:10 pm

Awesome! Thanks so much!

Spyros
August 22, 2014 at 7:16 am

Hi, this looks really good, but I am not sure how to get hold of the data you are using. Any hints apart from consulting Dr Peng's book?

zev@zevross.com
August 29, 2014 at 10:37 am

I added a link to the CSV file used in the post.

Comments are closed.