Tutorial: Making Plots with Julia

Contents

Overview

This tutorial will give some examples of plotting and plotting features in Julia, as well as providing references to some relevant resources. The main plotting library is `Plots.jl`, but there are some others that provide useful features.

Some Resources

- `Plots.jl` useful tips
- `Plots.jl` examples
- Plot attributes
- Axis attributes
- Color names

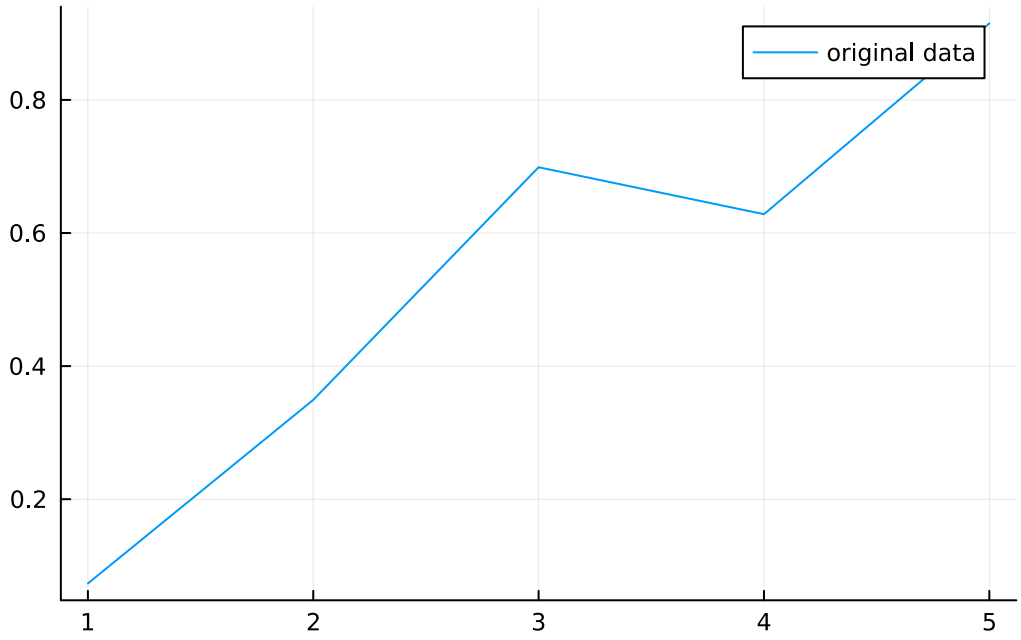
Demos

```
using Plots
using Random
Random.seed!(1);
```

Line Plots

To generate a basic line plot, use `plot`.

```
y = rand(5)
plot(y, label="original data", legend=:topright)
```

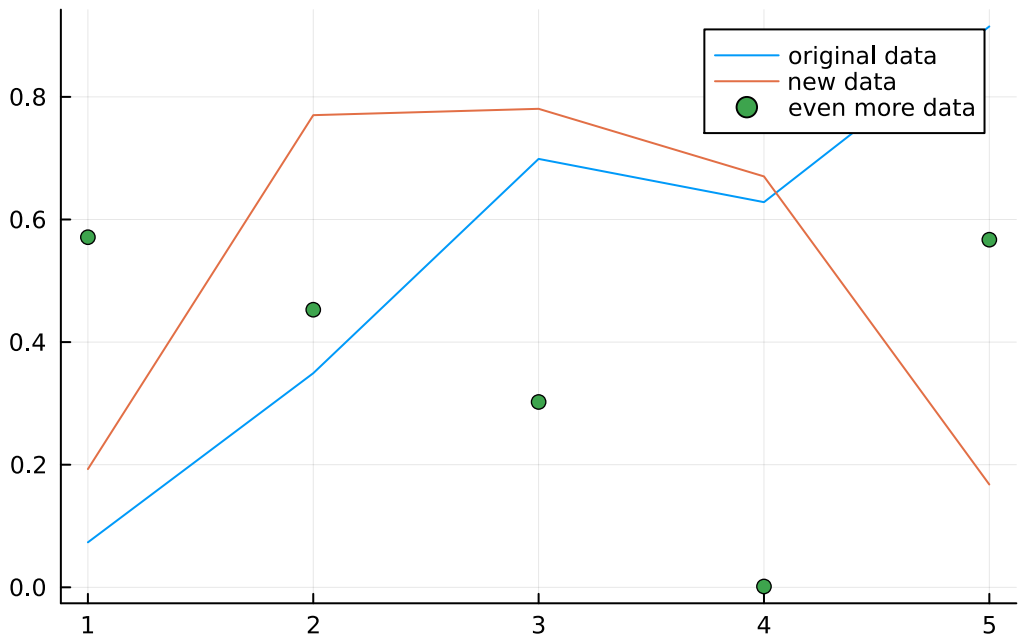


There's a lot of customization here that can occur, a lot of which is discussed in the docs or can be found with some Googling.

Adding Plot Elements

Now we can add some other lines and point markers.

```
y2 = rand(5)
y3 = rand(5)
plot!(y2, label="new data")
scatter!(y3, label="even more data")
```

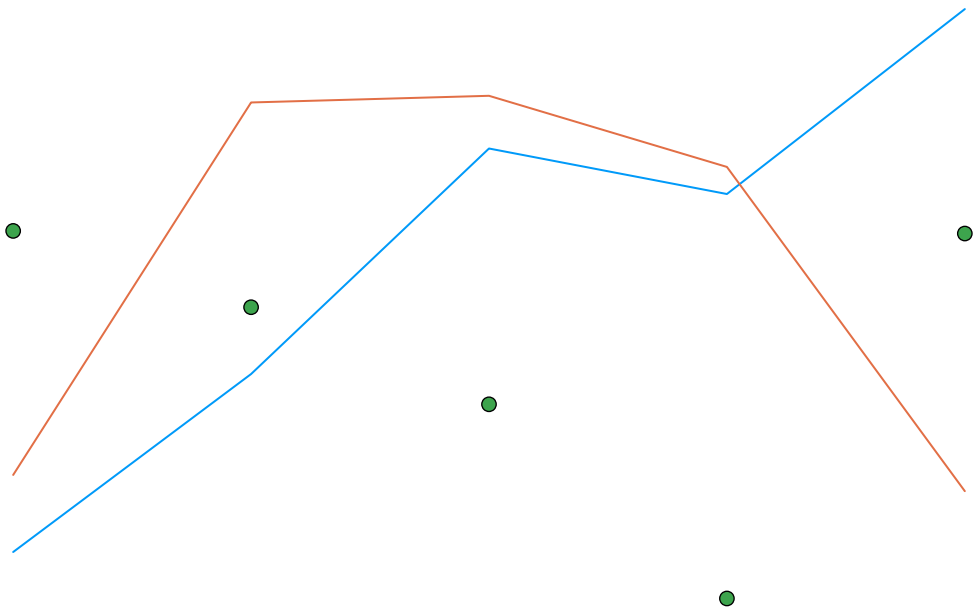


Remember that an exclamation mark (!) at the end of a function name means that function modifies an object in-place, so `plot!` and `scatter!` modify the current plotting object, they don't create a new plot.

Removing Plot Elements

Sometimes we want to remove legends, axes, grid lines, and ticks.

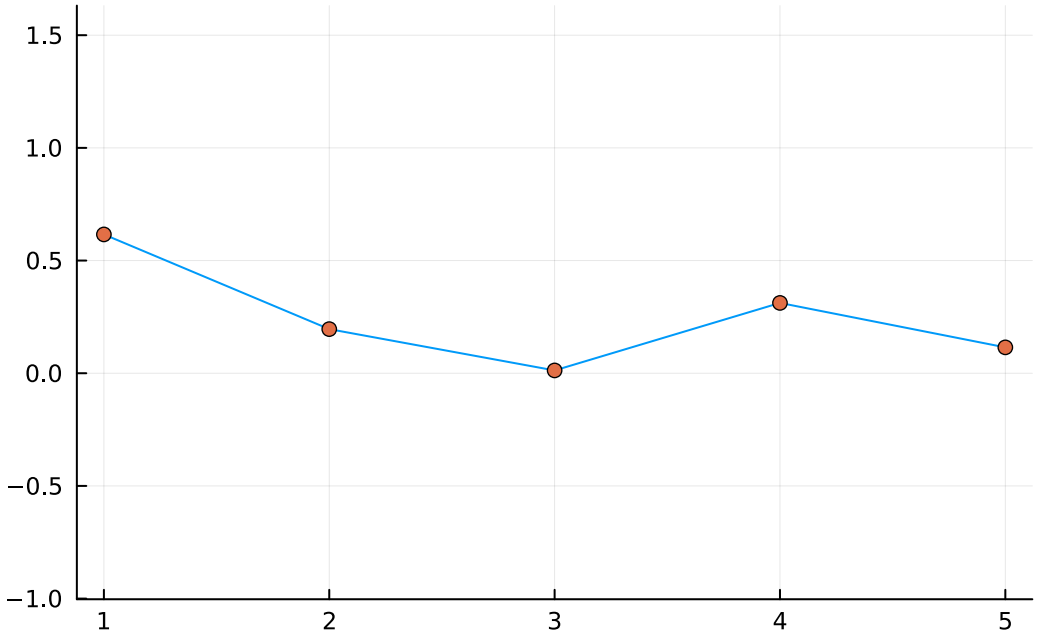
```
plot!(legend=false, axis=false, grid=false, ticks=false)
```



Aspect Ratio

If we want to have a square aspect ratio, use `ratio = 1`.

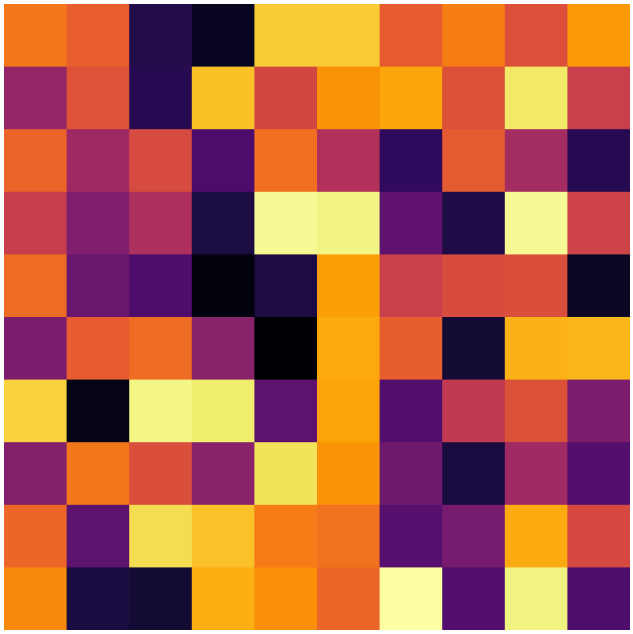
```
v = rand(5)
plot(v, ratio=1, legend=false)
scatter!(v)
```



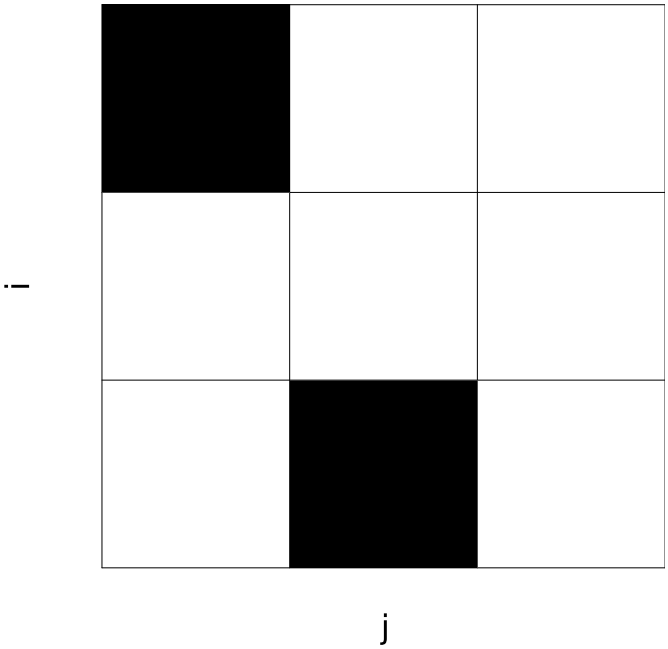
Heatmaps

A heatmap is effectively a plotted matrix with colors chosen according to the values. Use `clim` to specify a fixed range for the color limits.

```
A = rand(10, 10)
heatmap(A, clim=(0, 1), ratio=1, legend=false, axis=false, ticks=false)
```



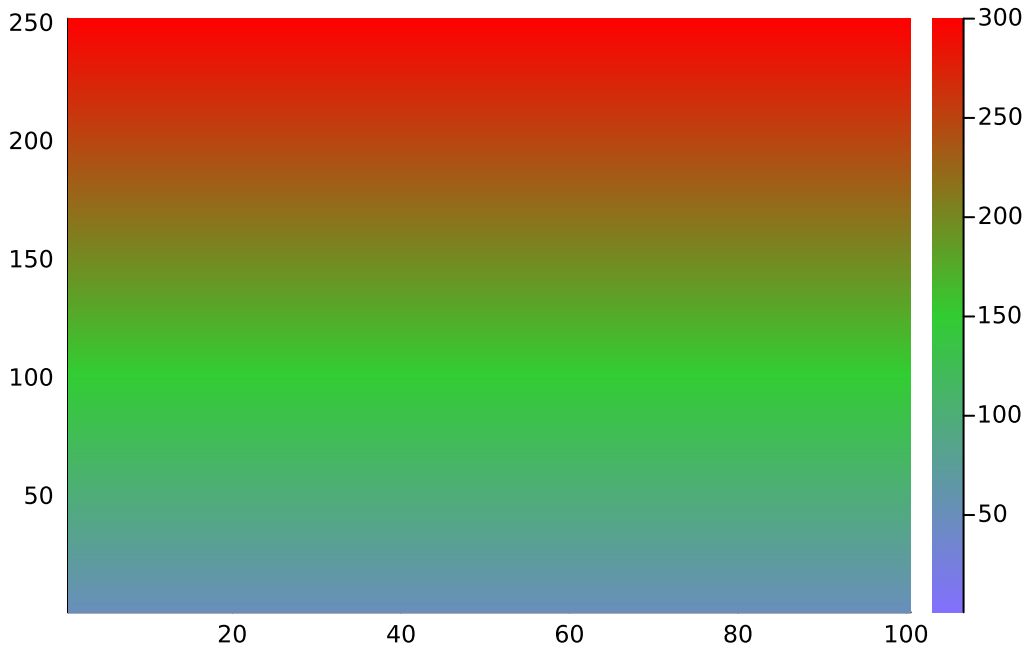
```
M = [ 0 1 0; 0 0 0; 1 0 0]
whiteblack = [RGBA(1,1,1,0), RGB(0,0,0)]
heatmap(c=whiteblack, M, aspect_ratio = 1, ticks=.5:3.5, lims=(.5,3.5), gridalpha=1,
legend=false, axis=false, ylabel="i", xlabel="j")
```



Custom Colors

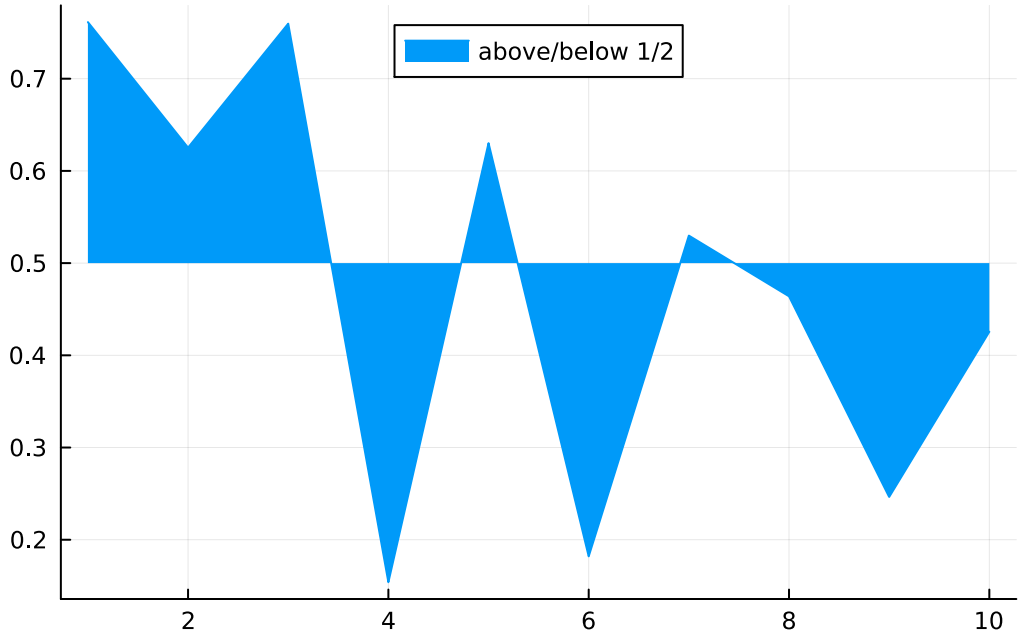
```
using Colors
```

```
mycolors = [colorant"lightslateblue",colorant"limegreen",colorant"red"]
A = [i for i=50:300, j=1:100]
heatmap(A, c=mycolors, clim=(1,300))
```

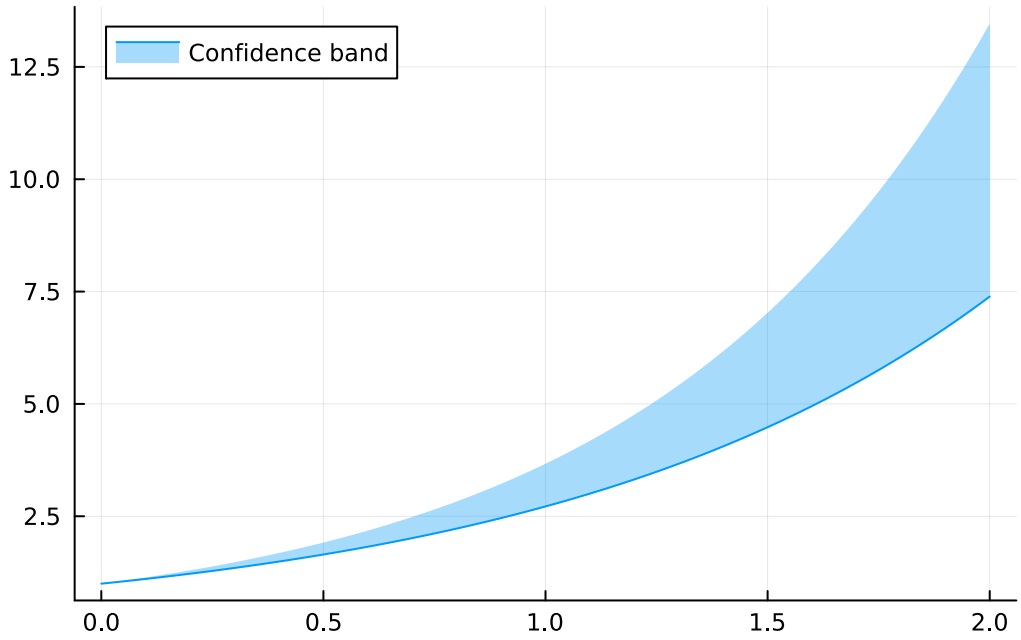


Plotting Areas Under Curves

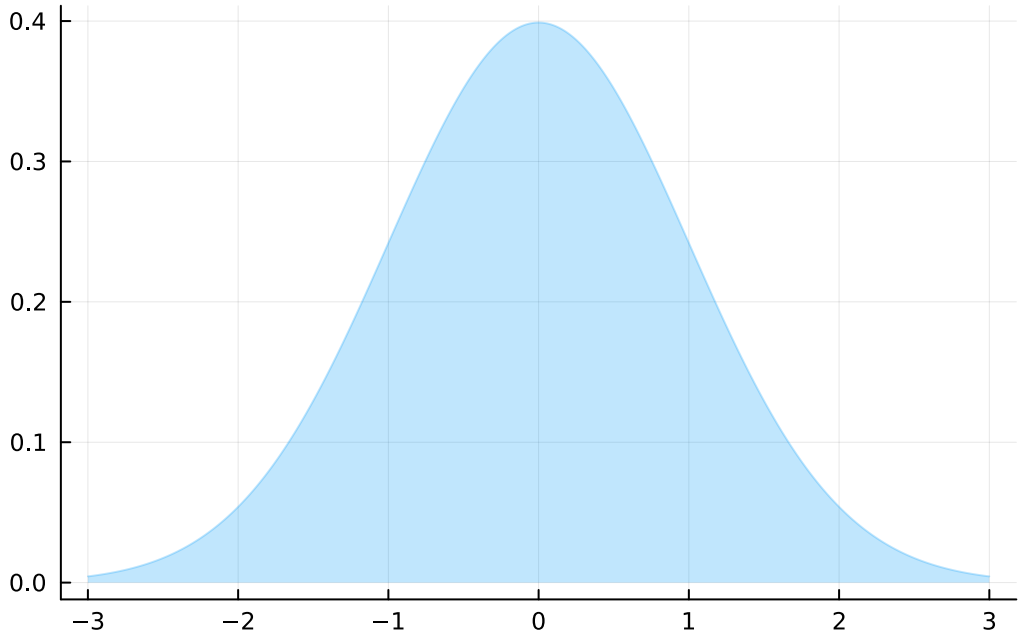
```
y = rand(10)
plot(y, fillrange= y.*0 .+ .5, label= "above/below 1/2", legend =:top)
```



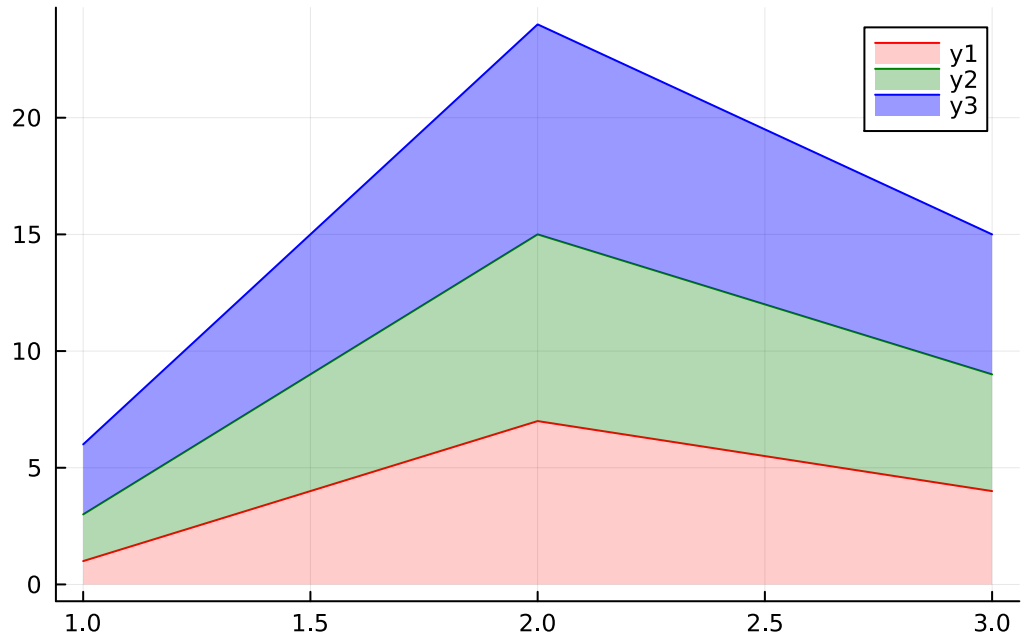
```
x = LinRange(0,2,100)
y1 = exp.(x)
y2 = exp.(1.3 .* x)
plot(x, y1, fillrange = y2, fillalpha = 0.35, c = 1, label = "Confidence band", legend
= :topleft)
```



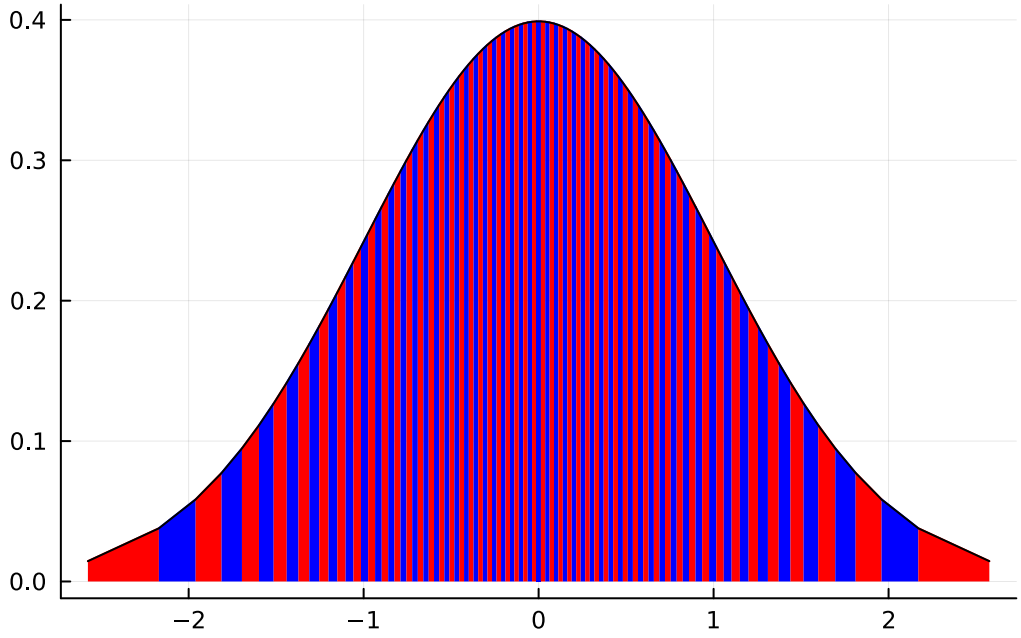

```
x = -3:.01:3
areaplot(x, exp.(-x.^2/2)/√(2π),alpha=.25,legend=false)
```



```
M = [1 2 3; 7 8 9; 4 5 6; 0 .5 1.5]
areaplot(1:3, M, seriescolor = [:red :green :blue ], fillalpha = [0.2 0.3 0.4])
```

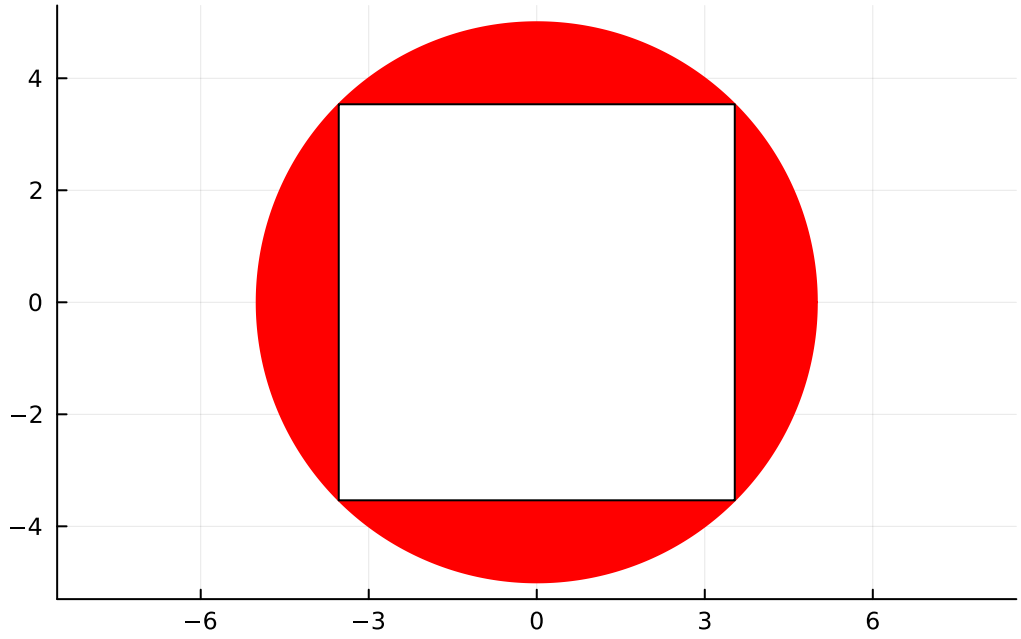



```
using SpecialFunctions
f = x->exp(-x^2/2)/√(2π)
δ = .01
plot()
x = √2 .* erfinv.(2 .*(δ/2 : δ : 1) .- 1)
areaplot(x, f.(x), seriescolor=[ :red,:blue], legend=false)
plot!(x, f.(x),c=:black)
```



Plotting Shapes

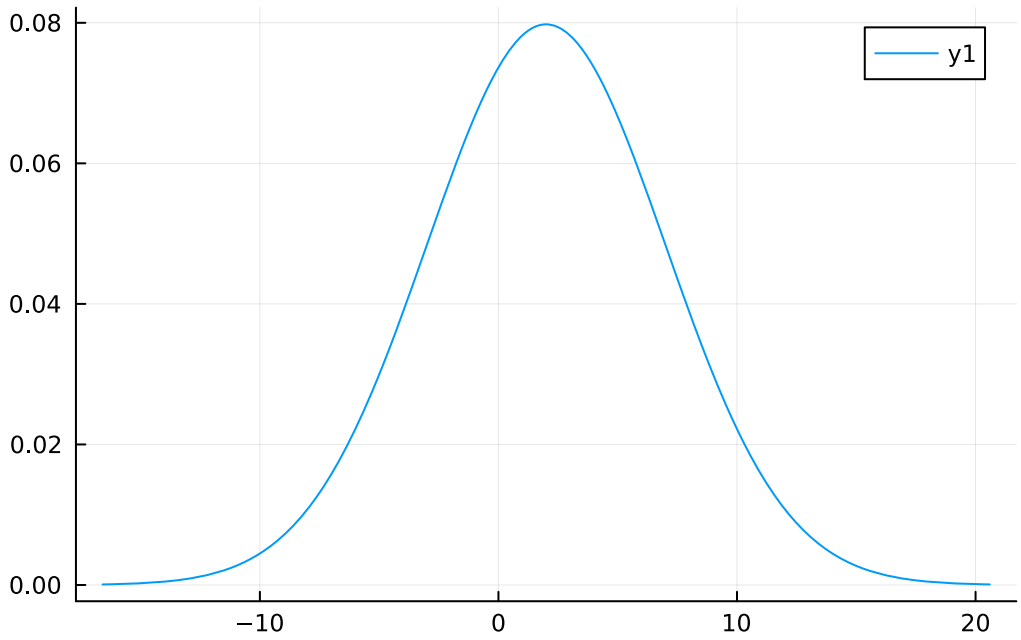
```
rectangle(w, h, x, y) = Shape(x .+ [0,w,w,0], y .+ [0,0,h,h])
circle(r,x,y) = (θ = LinRange(0,2π,500); (x.+r.*cos.(θ), y.+r.*sin.(θ)))
plot(circle(5,0,0), ratio=1, c=:red, fill=true)
plot!(rectangle(5*√2,5*√2,-2.5*√2,-2.5*√2),c=:white,fill=true,legend=false)
```



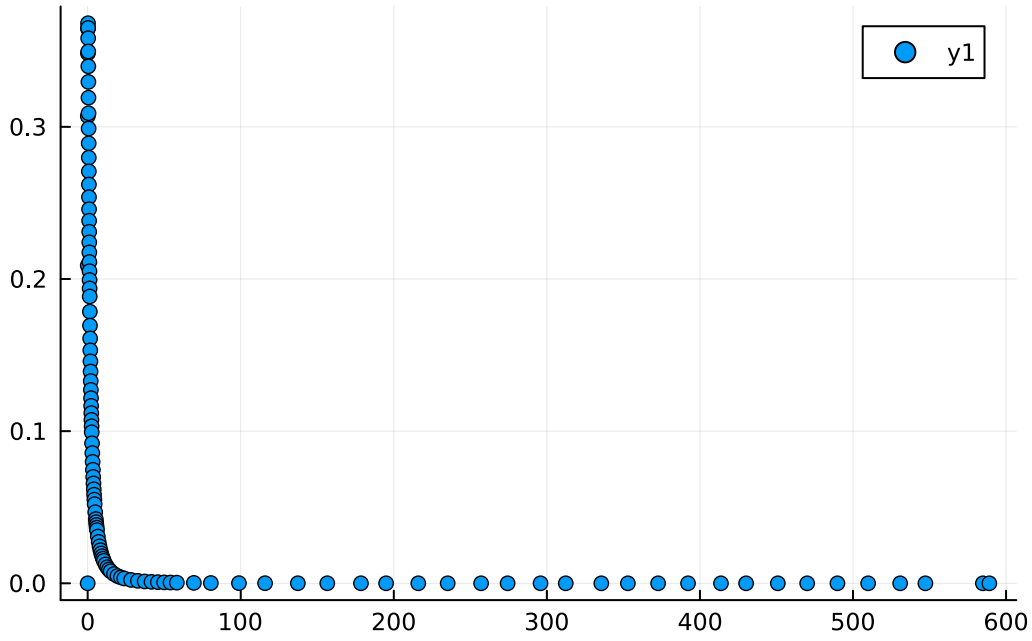
Plotting Distributions

The `StatsPlots.jl` package is very useful for making various plots of probability distributions.

```
using Distributions, StatsPlots
plot(Normal(2, 5))
```

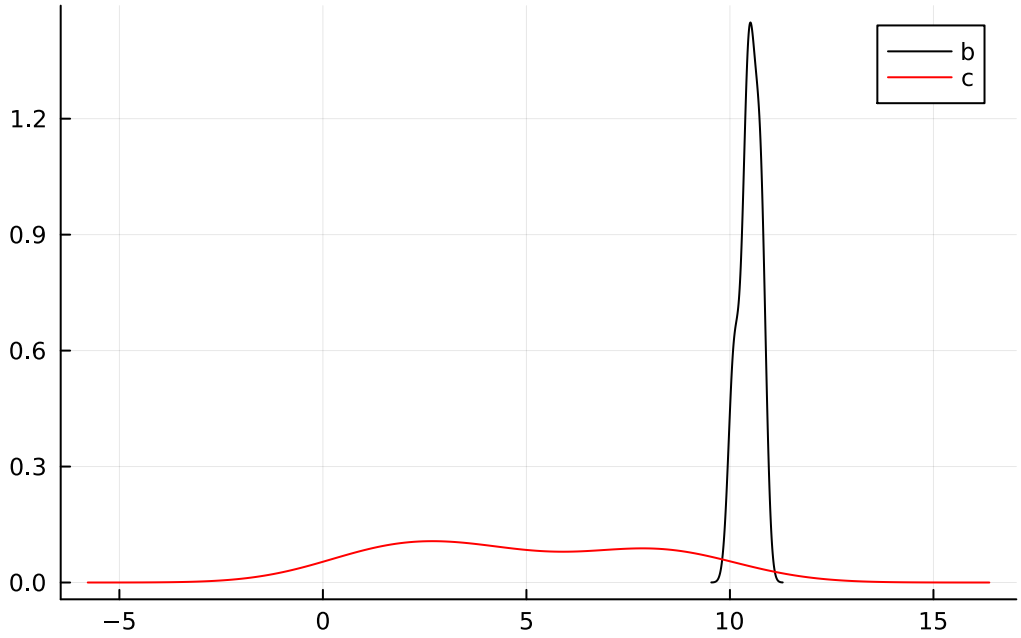



```
scatter(LogNormal(0.8, 1.5))
```



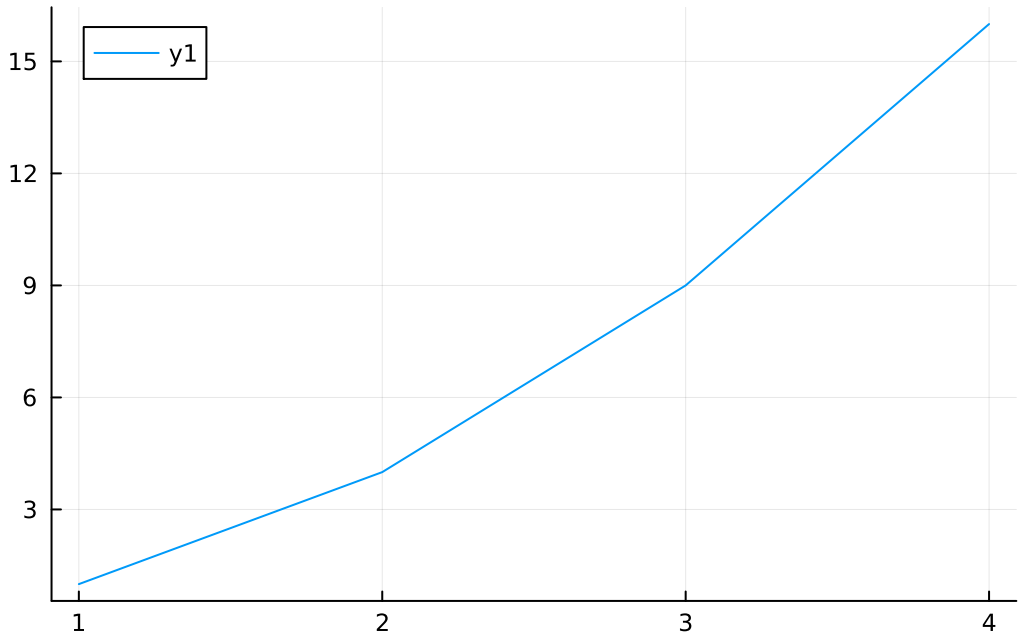
We can also use this functionality to plot distributions of data in tabular data structures like `DataFrames`.

```
using DataFrames
dat = DataFrame(a = 1:10, b = 10 .+ rand(10), c = 10 .* rand(10))
@df dat density([:b :c], color=[:black :red])
```



Editing Plots Manually

```
pl = plot(1:4,[1, 4, 9, 16])
```



```
pl.attr
```

```
RecipesPipeline.DefaultsDict with 30 entries:
  :dpi                      => 96
  :background_color_outside => :match
  :plot_titlefontvalign     => :vcenter
  :warn_on_unsupported      => true
  :background_color         => RGBA{Float64}(1.0, 1.0, 1.0, 1.0)
  :inset_subplots           => nothing
  :size                     => (528.0, 336.0)
  :display_type             => :auto
  :overwrite_figure         => true
  :html_output_format       => :auto
  :plot_titlefontfamily     => :match
  :plot_titleindex          => 0
  :foreground_color         => RGB{N0f8}(0.0, 0.0, 0.0)
  :window_title             => "Plots.jl"
  :plot_titlefontrotation   => 0.0
  :extra_plot_kwargs        => Dict{Any, Any}()
  :pos                      => (0, 0)
  :plot_titlefonthalign     => :hcenter
  :tex_output_standalone    => false
  ⋮                         => ⋮
```

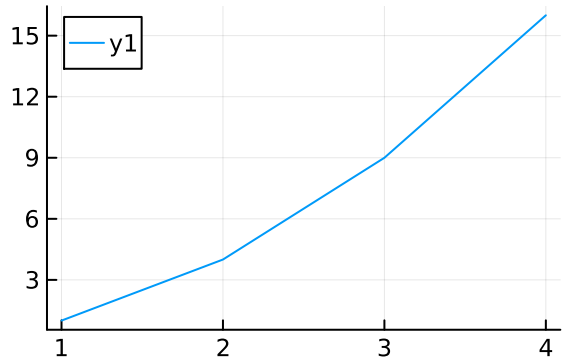
```
pl.series_list[1]
```

```
Plots.Series(RecipesPipeline.DefaultsDict(:plot_object => Plot{Plots.GRBackend()
n=1}, :subplot => Subplot{1}, :label => "y1", :fillalpha => nothing, :linealpha =>
nothing, :linecolor => RGBA{Float64}(0.0, 0.6056031704619725, 0.9786801190138923,
1.0), :x_extrema => (NaN, NaN), :series_index => 1, :markerstrokealpha =>
nothing, :markeralpha => nothing…))
```

```
pl[:size]=(300,200)
```

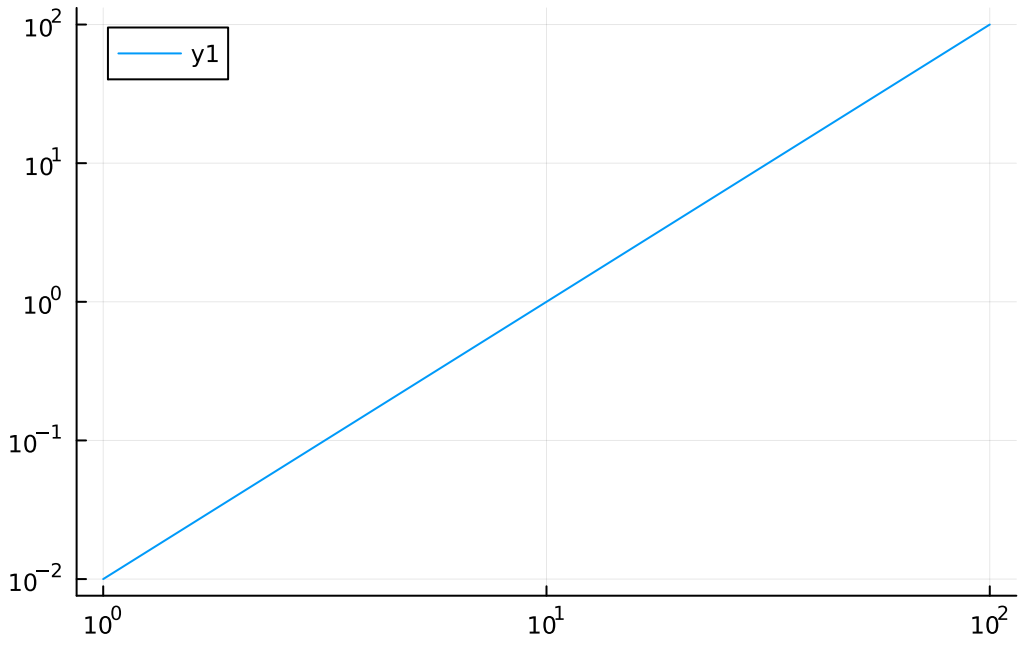
```
(300, 200)
```

```
pl
```



Log-Scaled Axes

```
xx = .1:.1:10
plot(xx.^2, xaxis=:log, yaxis=:log)
```




```
plot(exp.(x), yaxis=:log)
```