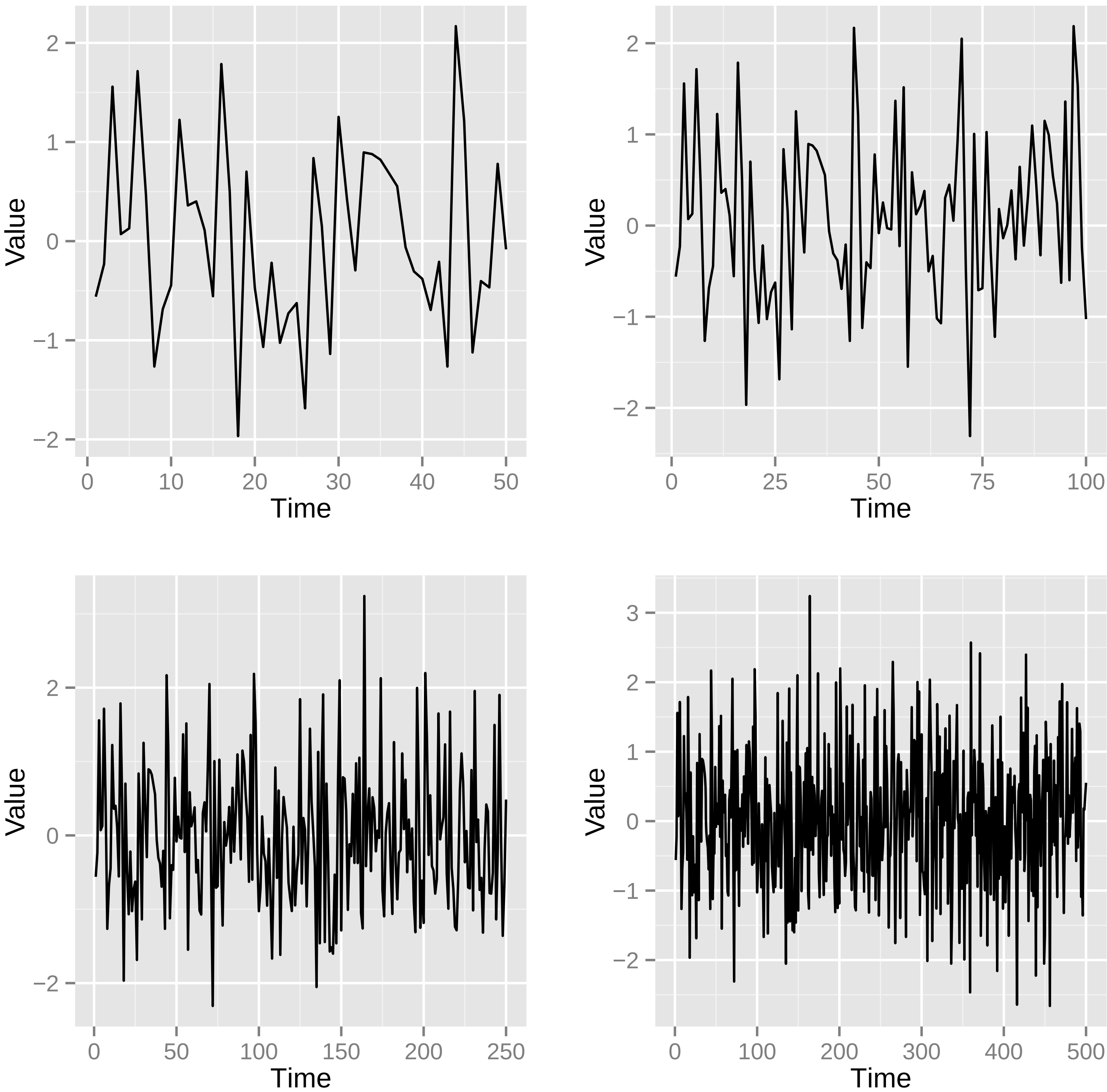
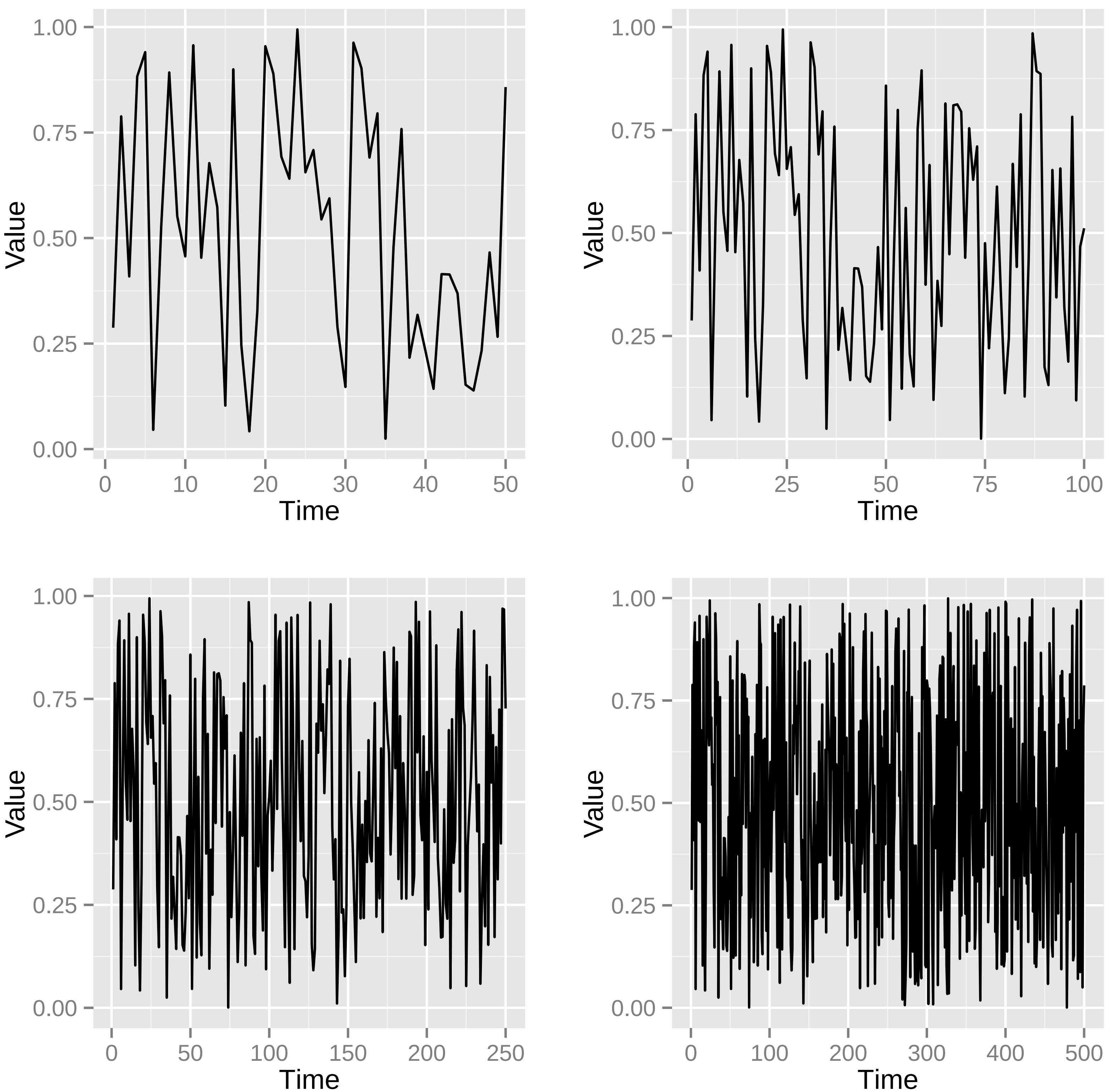
White Noise



White noise is just a Gaussian distribution ~N(0,1). Hence we have mostly values cluttered around mean = 0, mostly +- a couple of standard deviation apart. When sample is only 50 graph doesn't really look random. With 500 it does. However when there are too many data points it's actually hard to see what is going on.

With WN graph looks darker at the center at 0.

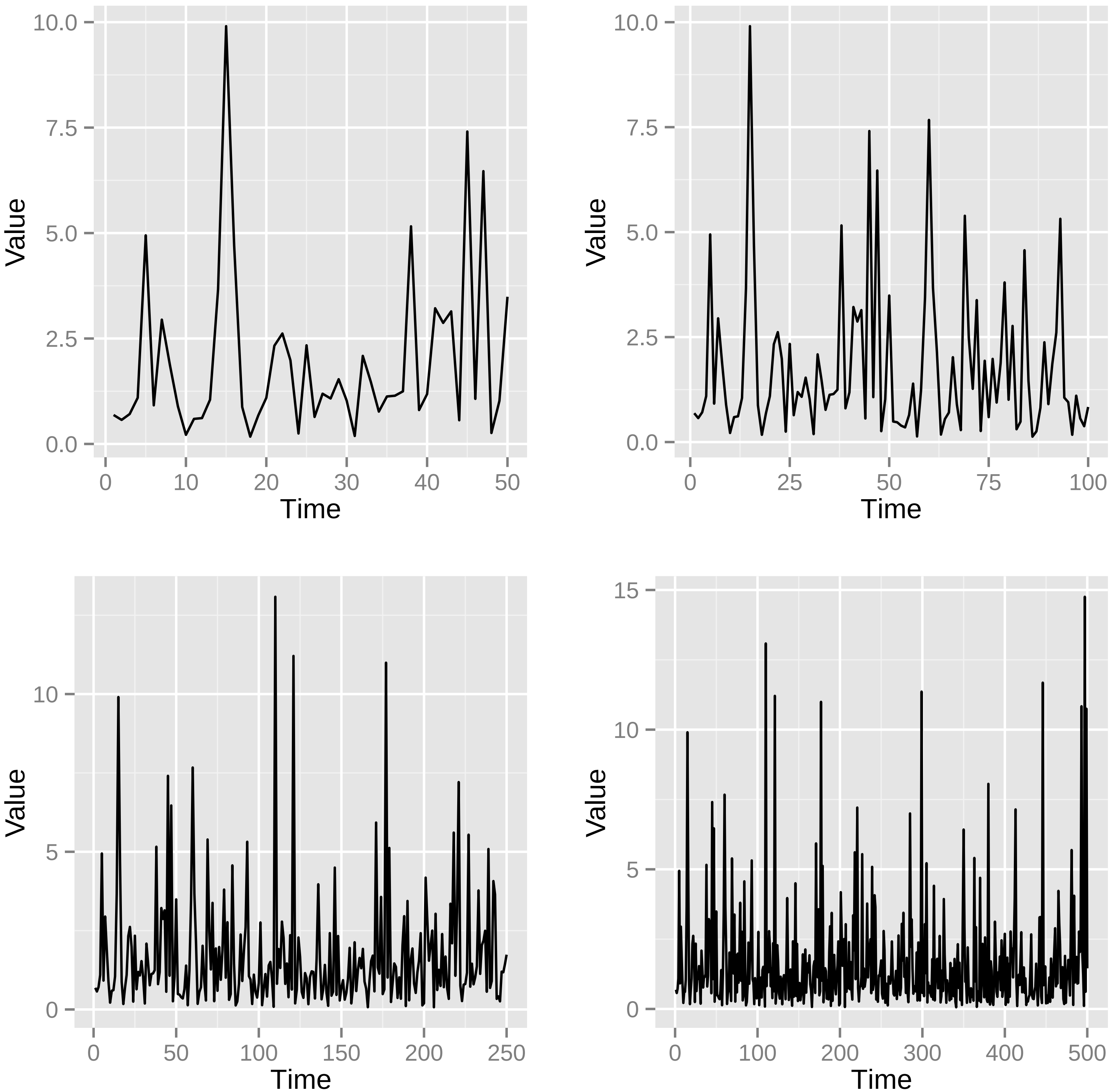
Uniform



Uniform produced values distributed between 0 and 1 with equal probability.

Graph looks equally dark between 0 and 1, unlike WN.

Log−Normal

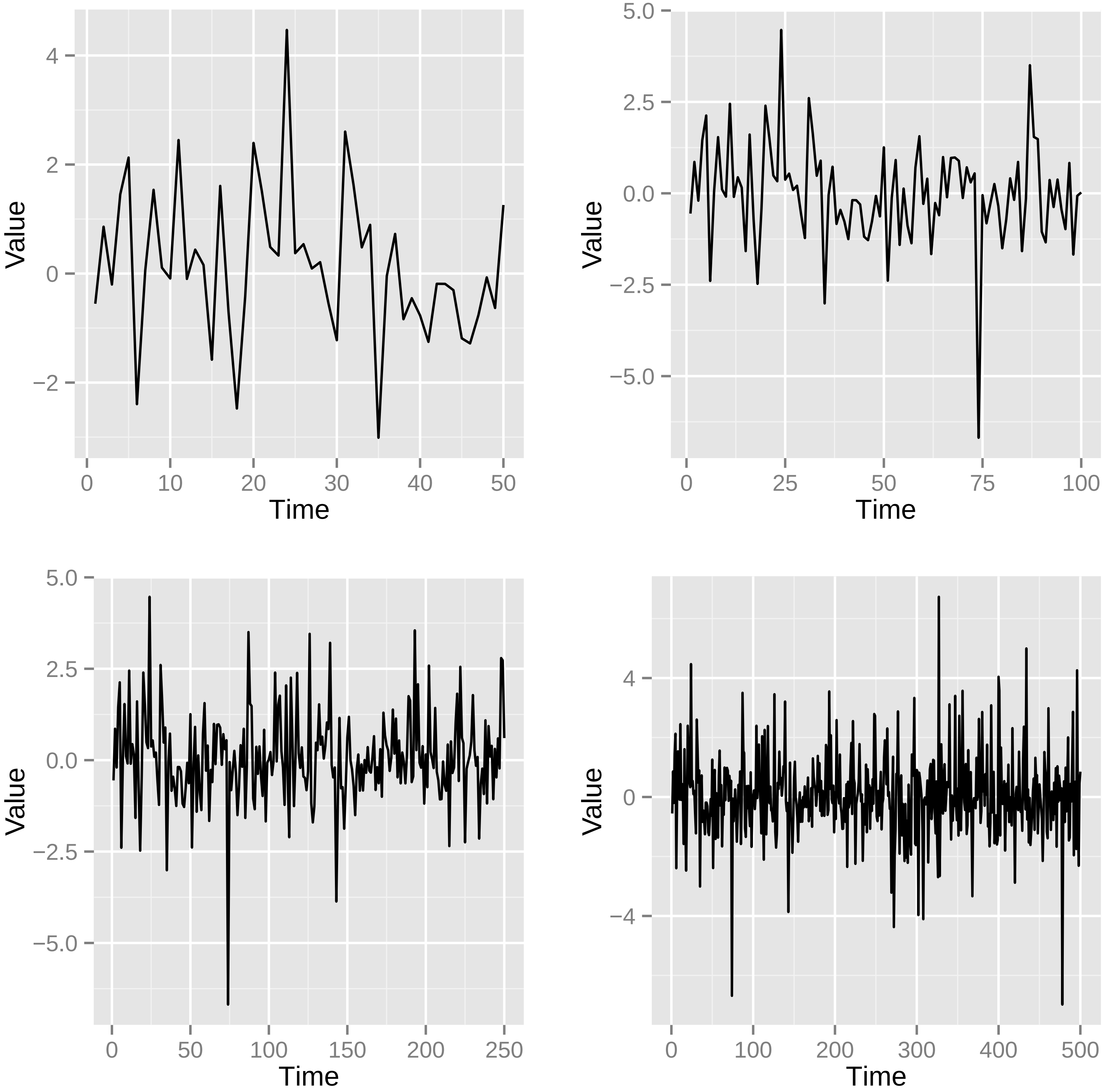


Since support of LogN is (0, +inf) we have can see that the longer the series the more likely we to observe high values.

Graphs look like some pretty stable values with occasional skyrocketing.

Looks very different from WN, since peaks are only toward bigger values.

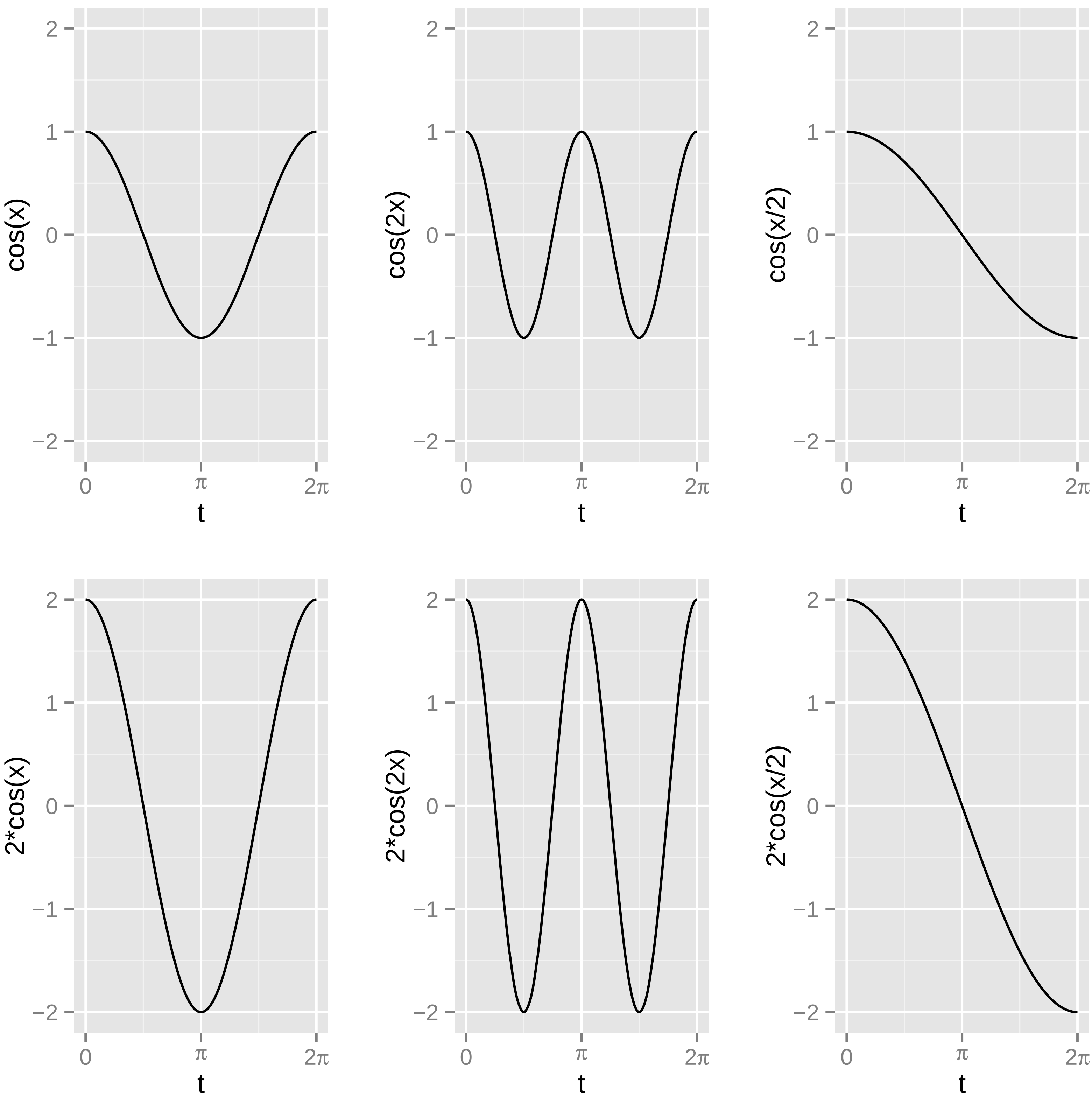
Double Exponential



Since support of dexp is (-inf, +inf) the longer the time series the more likely we to observe bigger or smaller values which look like outliers.

Comparatively to WN, dexp has higher extreme volatility.

C1.9



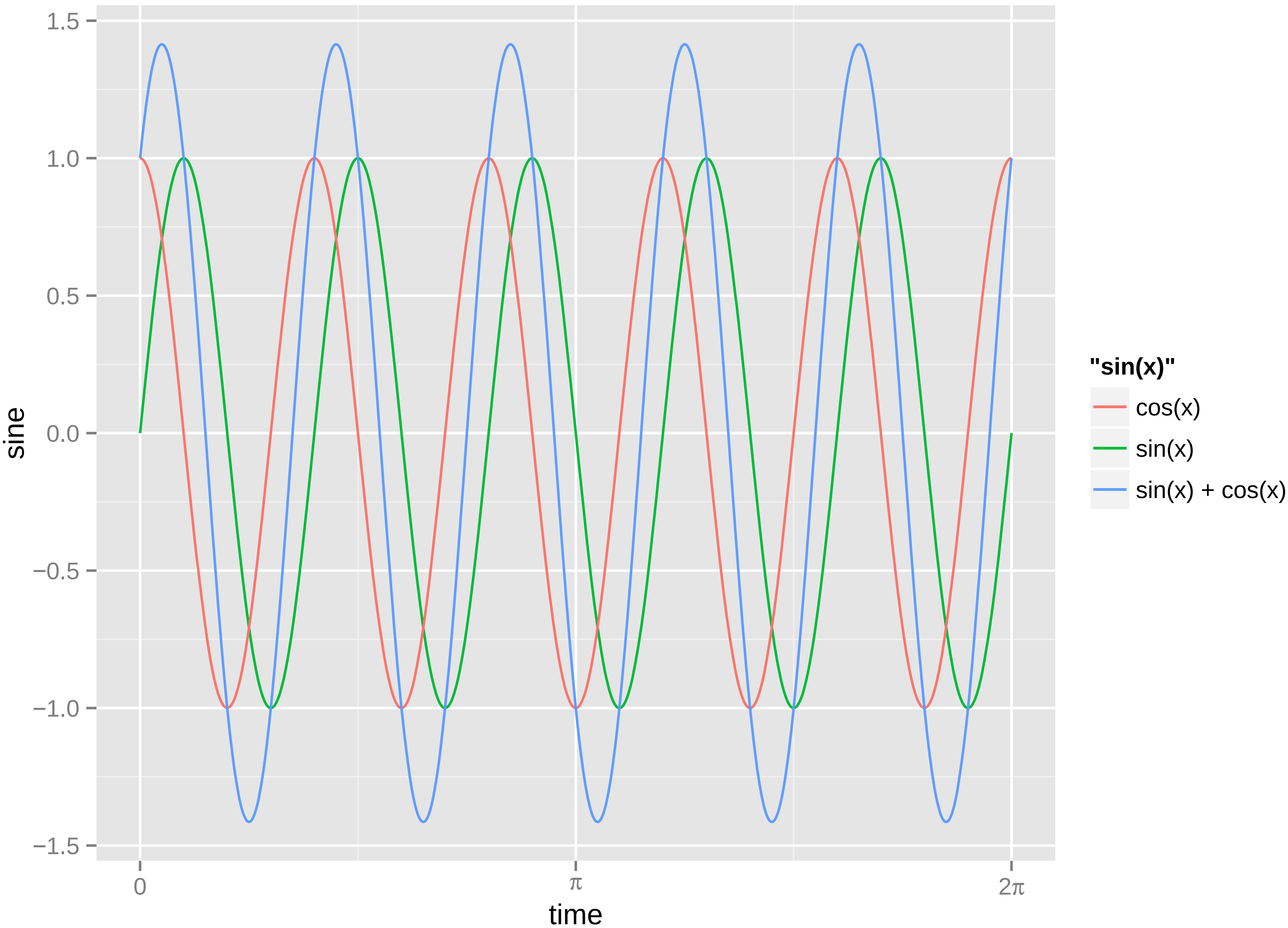
Multiply **x** by const -> increase (or decrease if c < 0) frequency;

Multiply **cos** * const -> increase (or decrease if c < 0) amplitude.

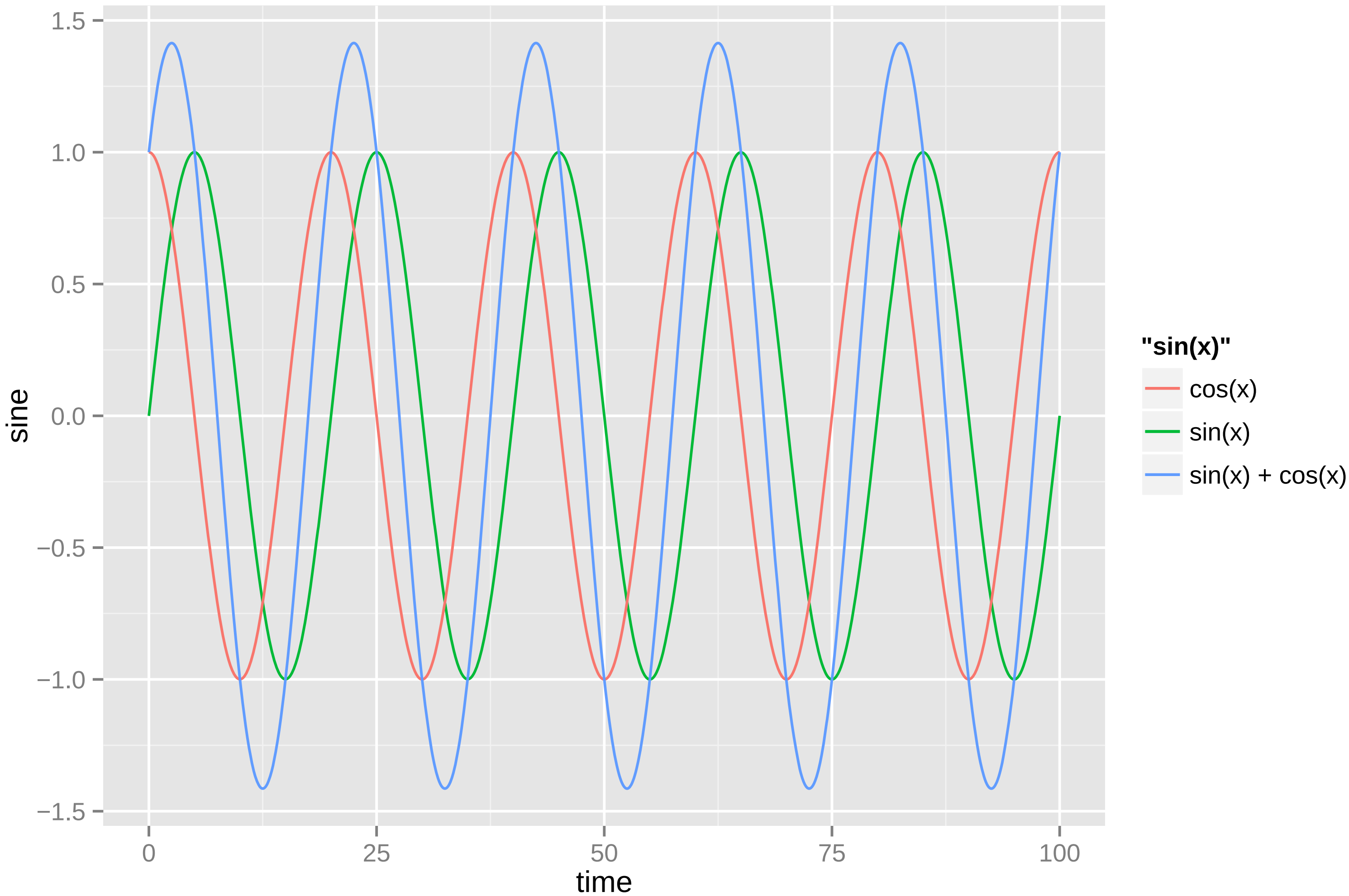
Code:

```
library(ggplot2)
library(gridExtra)
pic = expression(pi); pic2 = expression(2*pi);

# C1.9
N = 501
thetas = seq(0, 2*pi, length.out = N)

plot_thetas <- function(data, ylabel){
      df = data.frame(time = thetas, values = data)
      ggplot(data=df, aes(x=time, y=values)) + geom_line() +
      labs(x = "t", y = ylabel) + ylim(-2, 2) +
      scale_x_continuous(breaks=c(0,pi,2*pi), labels=c("0", pic, pic2))
}

grid.arrange(plot_thetas(cos(thetas), "cos(x)"),
                   plot_thetas(cos(2 * thetas), "cos(2x)"),
                   plot_thetas(cos(thetas / 2), "cos(x/2)"),
                   plot_thetas(2 * cos(thetas), "2*cos(x)"),
                   plot_thetas(2 * cos(2 * thetas), "2*cos(2x)"),
                   plot_thetas(2 * cos(thetas / 2), "2*cos(x/2)"),
                   ncol=3)
```

C1.10

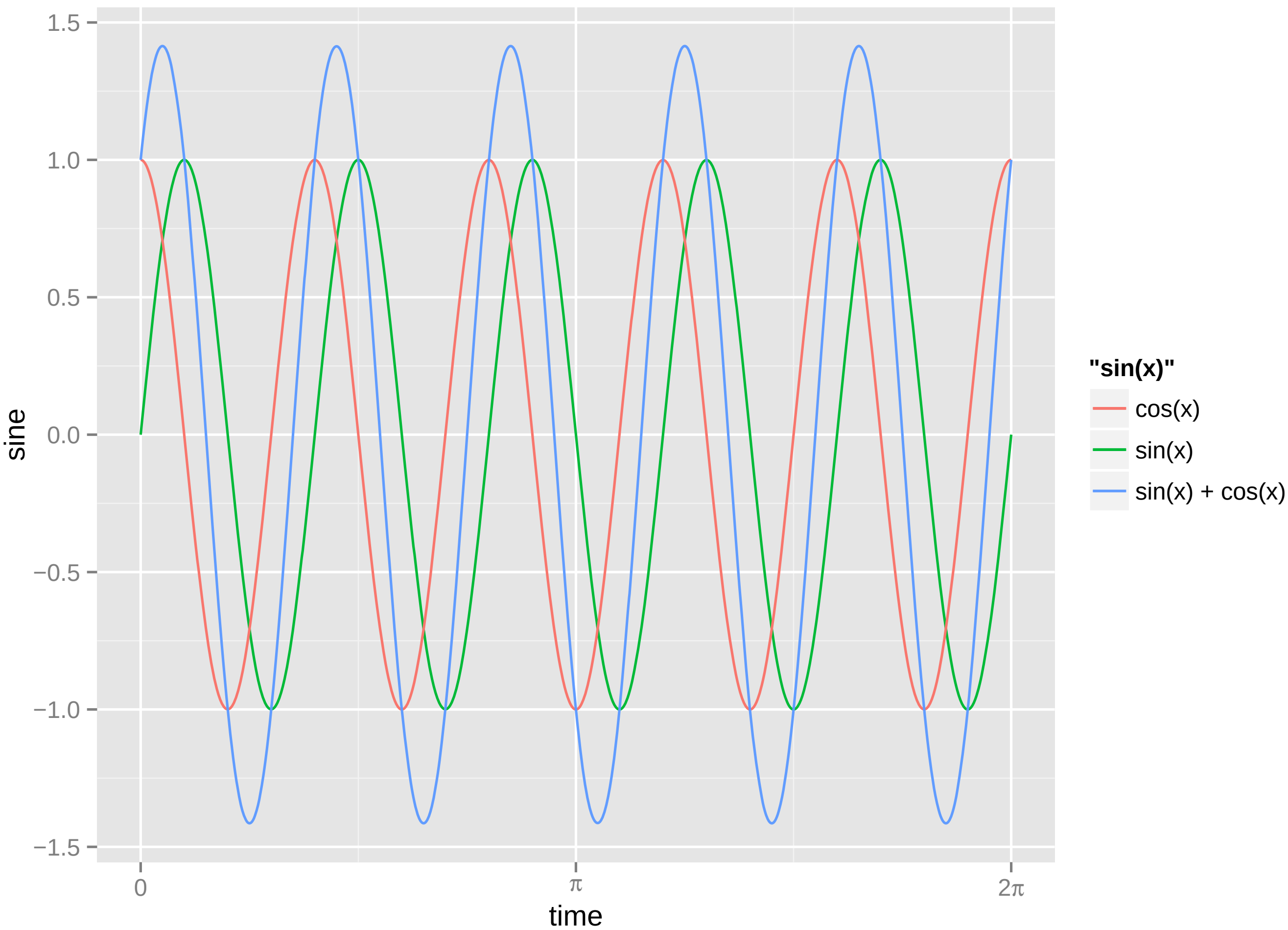



```
t = seq(0, 2*pi, length.out=1000)
pic = expression(pi); pic2 = expression(2*pi);
df = data.frame(time = t, sine = sin(t*5), cosine = cos(t*5),
      sincos = sin(t*5) + cos(t*5))
ggplot(data=df) + geom_line(aes(x=time, y=sine, colour="sin(x)")) +
                          geom_line(aes(x=time, y=cosine, colour="cos(x)")) +
                          geom_line(aes(x=time, y=sincos, colour="sin(x) + cos(x)")) +
            scale_x_continuous(breaks=c(0,pi,2*pi), labels=c("0", pic, pic2))
```



1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
sine
0
25
50
75
100
time
"sin(x)"
cos(x)
sin(x)
sin(x) + cos(x)

Corrections for Notebook Check #1



1. Original sinusoids are obviously out of phase by π
2. Sum of two sinusoid has larger amplitude with the peak in between of peaks of cosine and sine waves. Sum sinusoid also out of phase by π/2 with both sine and cosine.