

Johnson Noise 128AL

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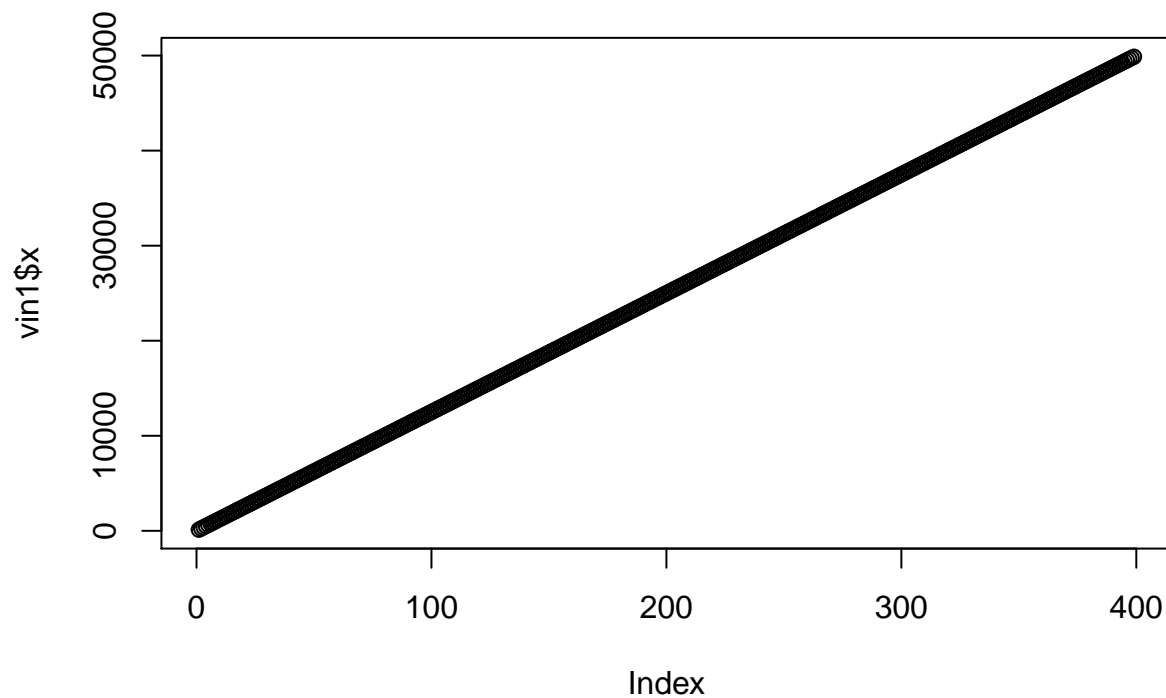
1/31/2019

Analysis: Step 1: $g(f)$

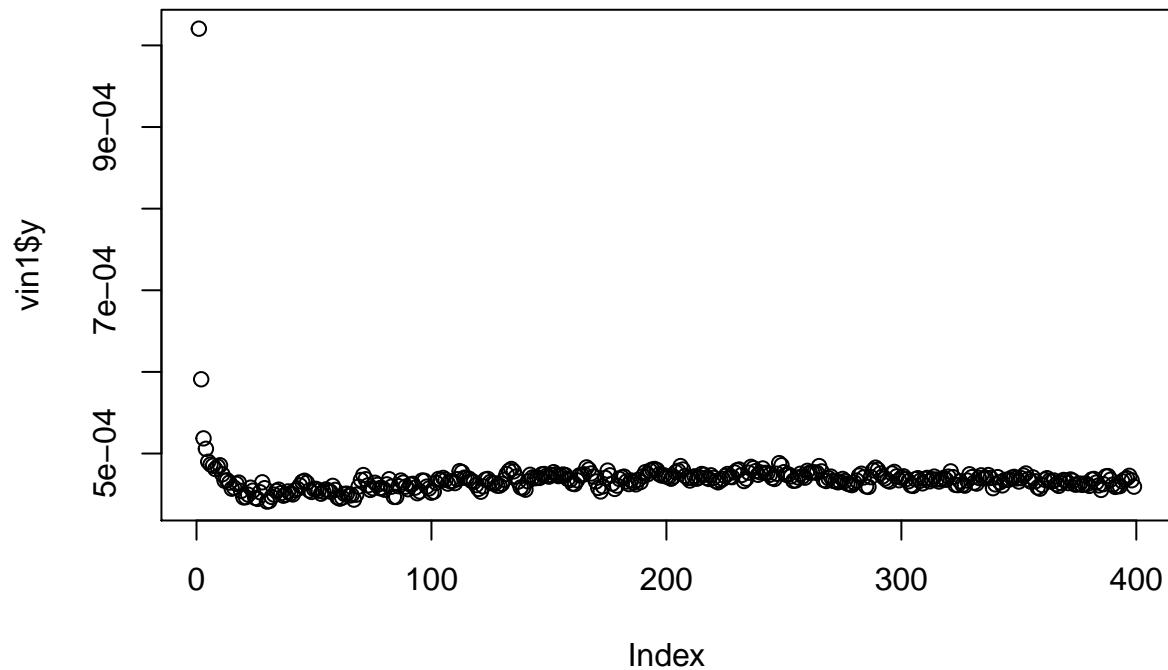
Make sure that the data is in the same folder as the R-script (should be automatic if you clone the git repo)
(btw I hate myself for saying “clone the git repo”)

Plots to verify what the data looks like.

```
vin1<-read.csv("/Users/mallen/Documents/128AL/JohnsonNoise128AL/VIN1.CSV")  
  
names(vin1)<-c("x", "y")  
plot(vin1$x)
```



```
plot(vin1$y)
```

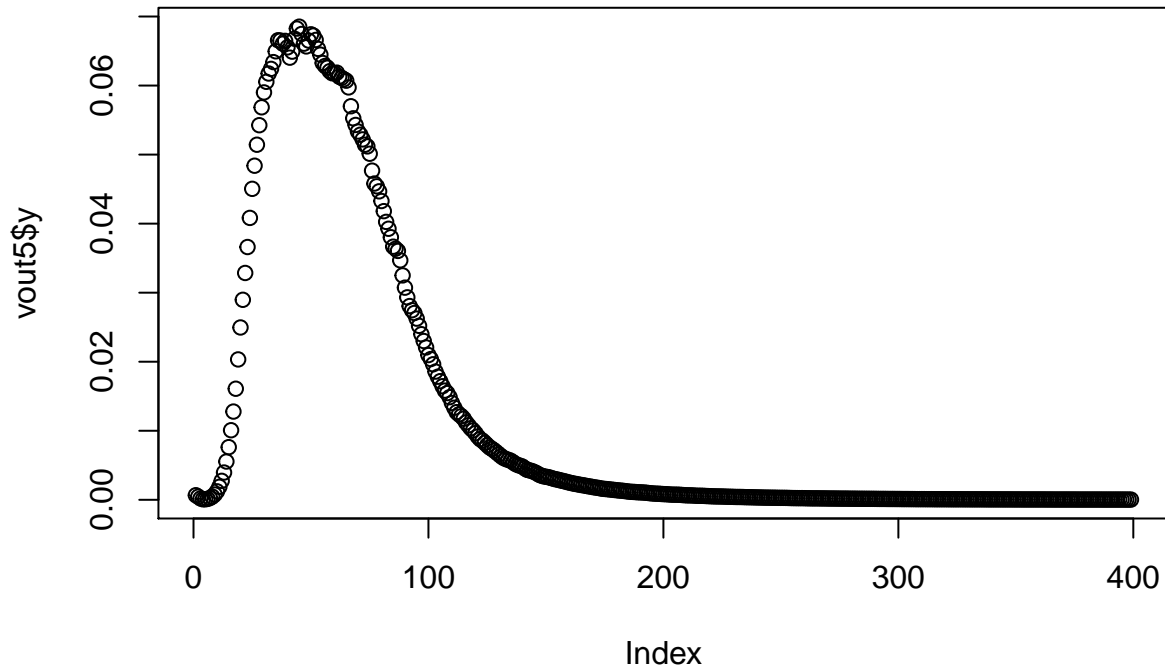


Now I'll upload the rest of the data. I'll plot an out graph for reference too.

```
vin2<-read.csv("/Users/mallen/Documents/128AL/JohnsonNoise128AL/VIN2.CSV")
names(vin2)<-c("x", "y")

vin3<-read.csv("/Users/mallen/Documents/128AL/JohnsonNoise128AL/VIN3.CSV")
names(vin3)<-c("x", "y")
vin4<-read.csv("/Users/mallen/Documents/128AL/JohnsonNoise128AL/VIN4.CSV")
names(vin4)<-c("x", "y")
vin5<-read.csv("/Users/mallen/Documents/128AL/JohnsonNoise128AL/VIN5.CSV")
names(vin5)<-c("x", "y")

vout1<-read.csv("/Users/mallen/Documents/128AL/JohnsonNoise128AL/VOUT1.CSV")
names(vout1)<-c("x", "y")
vout2<-read.csv("/Users/mallen/Documents/128AL/JohnsonNoise128AL/VOUT2.CSV")
names(vout2)<-c("x", "y")
vout3<-read.csv("/Users/mallen/Documents/128AL/JohnsonNoise128AL/VOUT3.CSV")
names(vout3)<-c("x", "y")
vout4<-read.csv("/Users/mallen/Documents/128AL/JohnsonNoise128AL/VOUT4.CSV")
names(vout4)<-c("x", "y")
vout5<-read.csv("/Users/mallen/Documents/128AL/JohnsonNoise128AL/VOUT5.CSV")
names(vout5)<-c("x", "y")
plot(vout5$y)
```



Find the mean of each value: It should be noted that the vin voltages are flat whereas the vout voltages are peaked, so only the peak region is selected (thus the ranges present in the y values for the vout values)

```
m_vin1<-mean(vin1$y)
m_vin2<-mean(vin2$y)
m_vin3<-mean(vin3$y)
m_vin4<-mean(vin4$y)
m_vin5<-mean(vin5$y)

m_in<- mean(m_vin1, m_vin2, m_vin3, m_vin4, m_vin5)

m_vout1<-mean(vout1$y[35:44])
m_vout2<-mean(vout2$y[37:54])
m_vout3<-mean(vout3$y[35:56])
m_vout4<-mean(vout4$y[35:53])
m_vout5<-mean(vout5$y[35:52])

m_out<- mean(m_vout1, m_vout2, m_vout3, m_vout4, m_vout5)
```

Now we have the mean in and the mean out so we can find the gain:

```
gF<- m_out/m_in
print(gF)
```

```
## [1] 142.857
```

Now to calculate the errors for each measurement (which will be propagated into the final error for the gain):

```
vin1_error= sd(vin1$y, na.rm=TRUE)/sqrt(length(vin1$y[!is.na(vin1$y)]))
vin2_error= sd(vin2$y, na.rm=TRUE)/sqrt(length(vin2$y[!is.na(vin2$y)]))
vin3_error= sd(vin3$y, na.rm=TRUE)/sqrt(length(vin3$y[!is.na(vin3$y)]))
vin4_error= sd(vin4$y, na.rm=TRUE)/sqrt(length(vin4$y[!is.na(vin4$y)]))
vin5_error= sd(vin5$y, na.rm=TRUE)/sqrt(length(vin5$y[!is.na(vin5$y)]))

vout1_error= sd(vout1$y[35:44], na.rm=TRUE)/sqrt(length(vout1$y[!is.na(vout1$y)]))
```

```
vout2_error= sd(vout2$y[37:54], na.rm=TRUE)/sqrt(length(vout2$y[!is.na(vout2$y)]))
vout3_error= sd(vout3$y[36:56], na.rm=TRUE)/sqrt(length(vout3$y[!is.na(vout3$y)]))
vout4_error= sd(vout4$y[35:53], na.rm=TRUE)/sqrt(length(vout4$y[!is.na(vout4$y)]))
vout5_error= sd(vout5$y[35:53], na.rm=TRUE)/sqrt(length(vout5$y[!is.na(vout5$y)]))
```

Now we have errors for every measurement. The averages used to calculate gain need errors too.

```
m_vin_error = sqrt(vin1_error^2+vin2_error^2 + vin3_error^2+ vin4_error^2+vin5_error^2)
m_vout_error = sqrt(vout1_error^2+vout2_error^2 + vout3_error^2+ vout4_error^2+vout5_error^2)
```

Now we can find the error in the gain function from the error in Vin and Vout

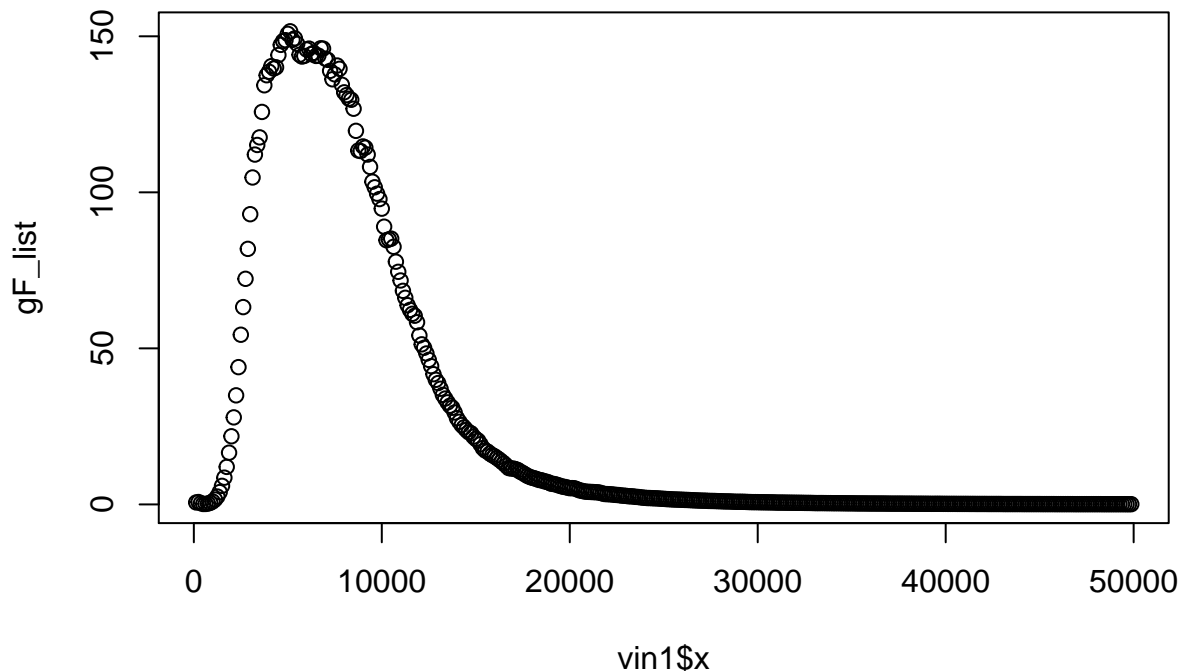
```
gF_error= sqrt(m_vin_error^2 +m_vout_error^2)
print(gF_error)
```

```
## [1] 0.0001223323
```

#seems a little small. not sure if I did it right then?

Graph g(f) against frequency

```
gF_list= vector()
for (i in 1:length(vin1$x))
{
  mean_vin = mean(vin1$y[i], vin2$y[i], vin3$y[i], vin4$y[i], vin5$y[i])
  mean_vout= mean(vout1$y[i], vout2$y[i], vout3$y[i], vout4$y[i], vout5$y[i])
  gF_list[i]=mean_vout/mean_vin
}
plot(vin1$x, gF_list) #is this what they mean by plot? Is this what it should look like?
```



Apply a fit to g(f). (Pretty sure this is wrong but that's just showbiz baby)

```
#fit first degree polynomial equation:
fit <- lm(gF_list~vin1$x)
#second degree
fit2 <- lm(gF_list~poly(vin1$x,2,raw=TRUE))
```

```

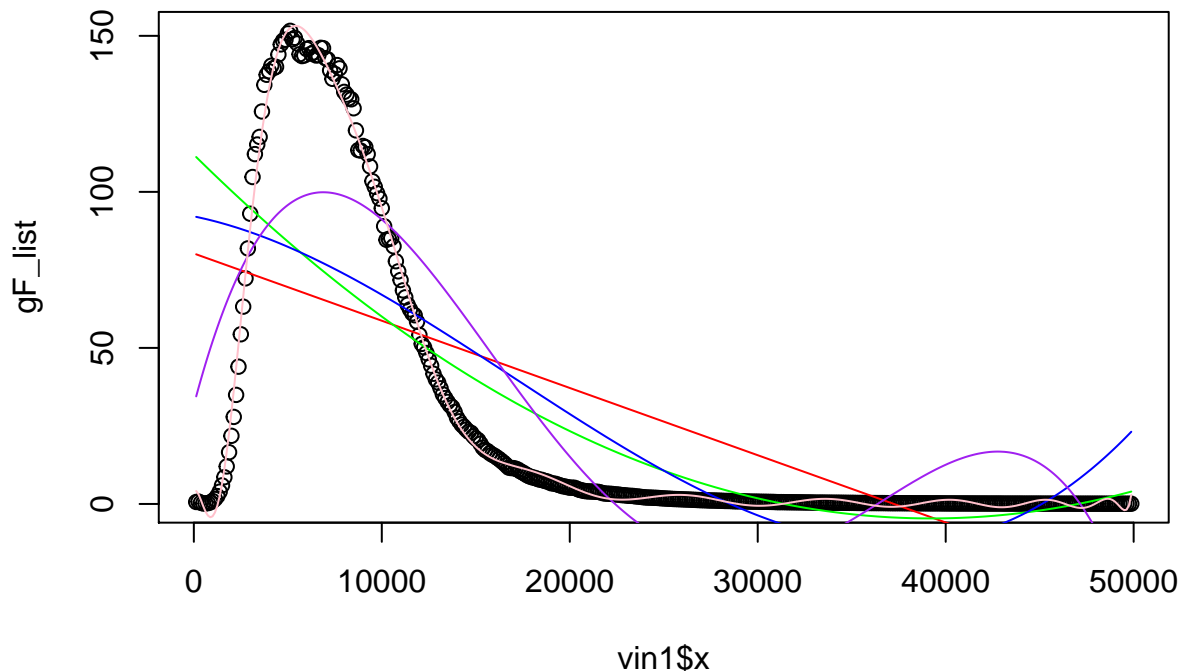
#third degree
fit3 <- lm(gF_list~poly(vin1$x,3,row=TRUE))
#fourth degree
fit4 <- lm(gF_list~poly(vin1$x,4,row=TRUE))
fit10 <-lm(gF_list~poly(vin1$x, 30, row=TRUE))
#generate range of 50 numbers starting from 30 and ending at 160
#xx <- seq(30,160, length=50)
plot(vin1$x,gF_list,pch=1) #1 through 24 (i think) are all different cool shapes!
lines(vin1$x, predict(fit, data.frame(vin1$x)), col="red")
lines(vin1$x, predict(fit2, data.frame(vin1$x)), col="green")
lines(vin1$x, predict(fit3, data.frame(vin1$x)), col="blue")
lines(vin1$x, predict(fit4, data.frame(vin1$x)), col="purple")
lines(vin1$x, predict(fit10, data.frame(vin1$x)), col = "pink")

```

```

## Warning in predict.lm(fit10, data.frame(vin1$x)): prediction from a rank-
## deficient fit may be misleading

```



#this is nice but it also sucks so im gonna try something that may suck less

```

#added the library "fitdistrplus"
#fit.gamma <- fitdist(gF_list, distr = "gamma", method = "mle")
#summary(fit.gamma)
#plot(fit.gamma)

#curve(dweibull(x, scale=2.5, shape=1.5),from=0, to=15, main="Weibull distribution")
#looks similar but I'm confused

```