# Johnson Noise 128AL

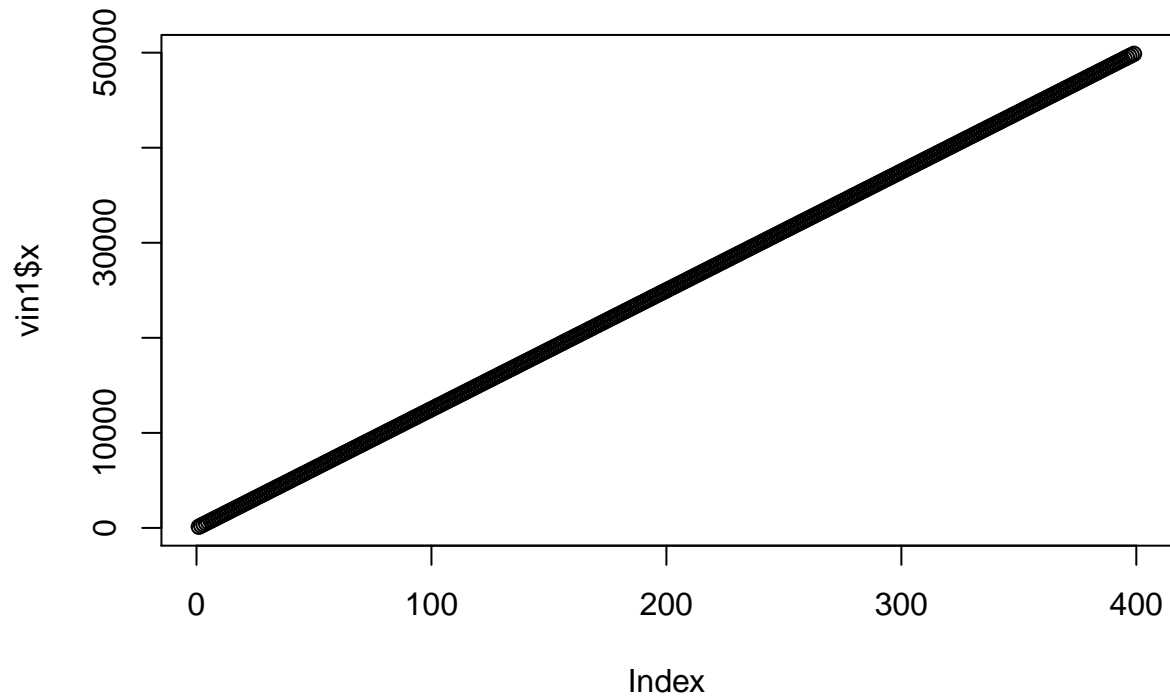*Madeleine Allen, Edward Piper*

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**Experiment 1: Find g(f)**
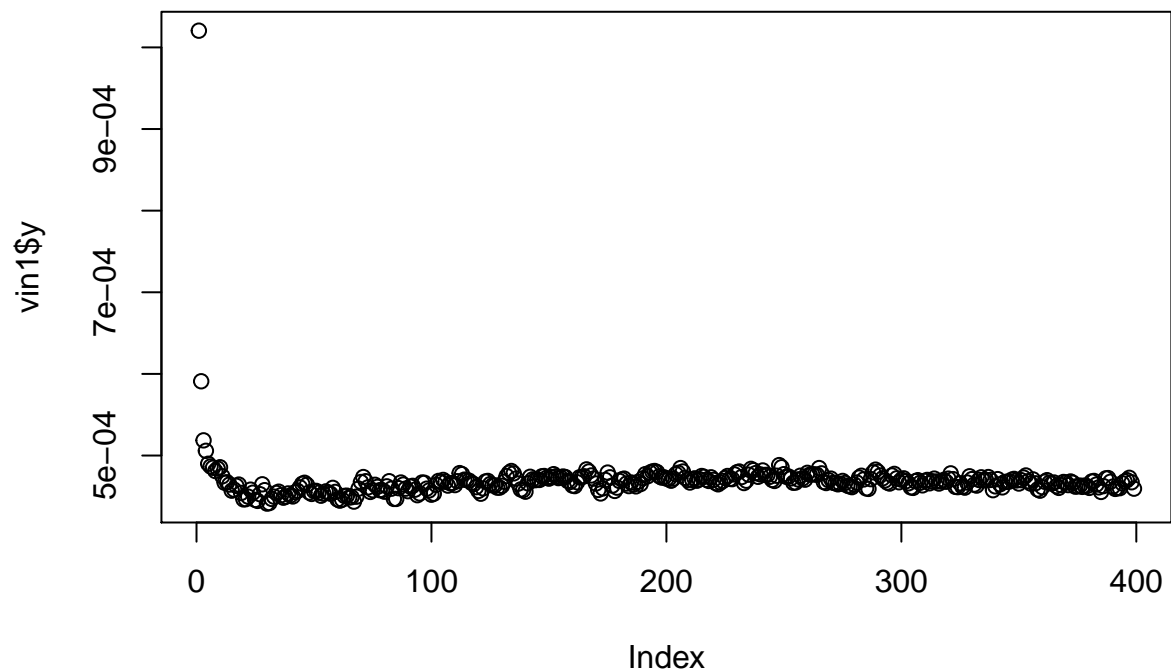
**Analysis: Step 1: g(f)**

Make sure that the data is in the same folder as the R-script.

Plots to verify what the data looks like.

```r
vin1<-read.csv("/Users/mallen/Documents/128AL/JohnsonNoise128AL/VIN1.CSV")

names(vin1)<-c("x", "y")
plot(vin1$x)
```



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

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

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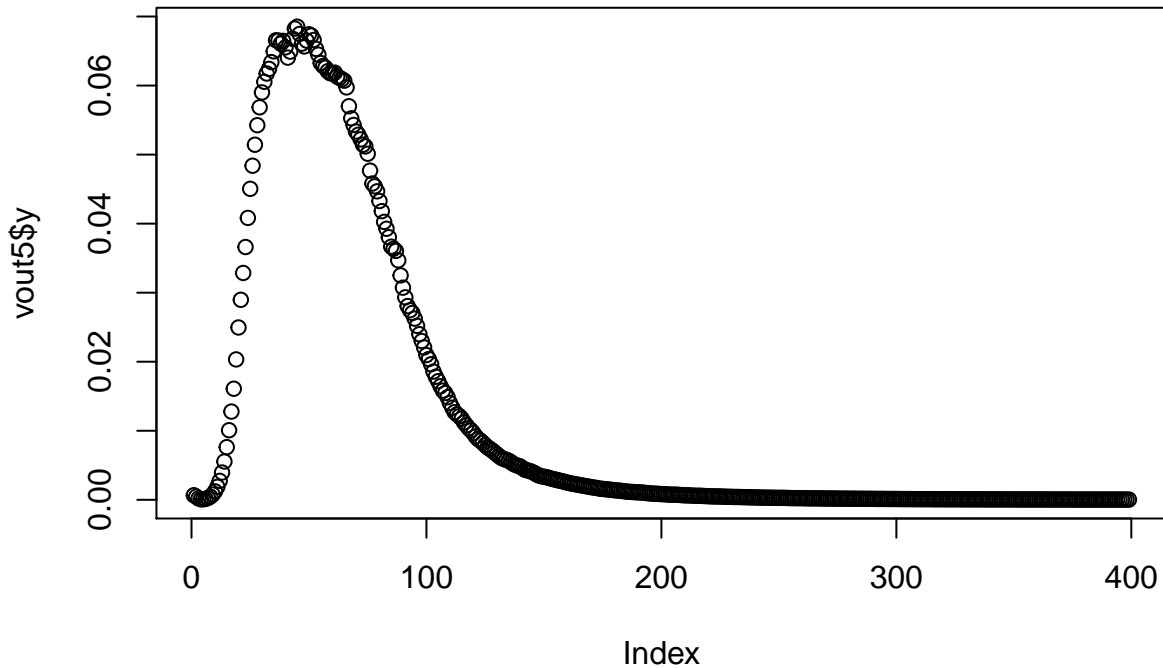
Now to calculate the errors for each measurement (which will be propagated into the final error for the gain):

```r
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)]))
```

Find the mean of each value: It should be noted that the vin voltages are flat whereas the vout voltages are peaked, so dont just take average

```r
m_in<- (vin1$y+vin2$y+vin3$y+vin4$y+vin5$y)/5
#take average of vouts
m_vout <- data.frame(Frequency = vout1$x, Volts = (vout1$y+vout2$y+vout3$y+vout4$y+vout5$y)/5)
```

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

```r
#compute gain using the average vouts and m_in
gain <- data.frame(Frequency = vout1$x, Gain = (m_vout[2]/m_in))
plot(gain)
```
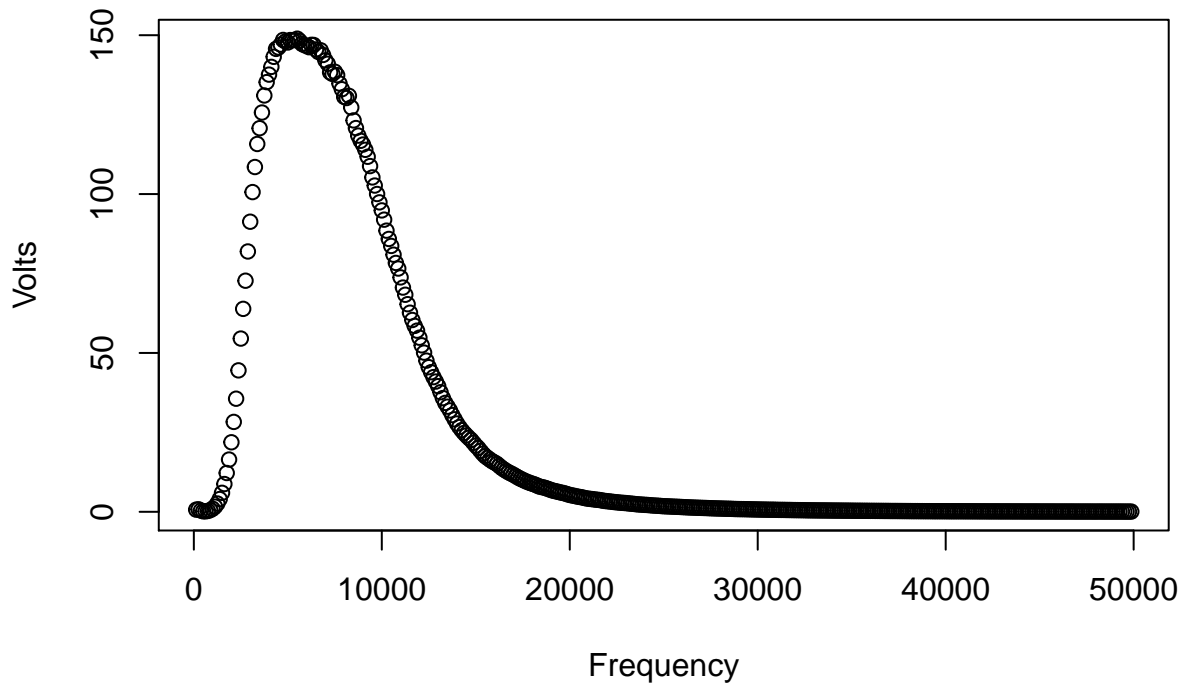
## Calculating Error

not really sure how to calculate error of a function. going to take RMSE for each.

```
rmserrors <- sqrt(data.frame(
  vin1 = sum(((m_in-vin1$y)^2))/399,
  vin2 = sum(((m_in-vin2$y)^2))/399,
  vin3 = sum(((m_in-vin3$y)^2))/399,
  vin4 = sum(((m_in-vin4$y)^2))/399,
  vin5 = sum(((m_in-vin5$y)^2))/399,
  vout1 = sum((m_vout$Volts-vout1$y)^2)/399,
  vout2 = sum((m_vout$Volts-vout2$y)^2)/399,
  vout3 = sum((m_vout$Volts-vout3$y)^2)/399,
  vout4 = sum((m_vout$Volts-vout4$y)^2)/399,
  vout5 = sum((m_vout$Volts-vout5$y)^2)/399
))
#error in gain, adding in quadrature:
vinerror <-sqrt(sum(rmserrors[1:5]^2))
vouterror <- sqrt(sum(rmserrors[6:10]^2))
gainerror <- gain[2]*sqrt((vinerror/m_in)^2+(vouterror*(m_vout[2])^-1)^2)
#g(f) error
plot(1:399,unlist(gainerror[1]))
```

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