# Johnson Noise 128AL

*Madeleine Allen, Edward Piper*

*2/3/2019*

### 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("VIN1.CSV")
names(vin1)<-c("x", "y")
```

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

```
vin2<-read.csv("VIN2.CSV")
names(vin2)<-c("x", "y")
vin3<-read.csv("VIN3.CSV")
names(vin3)<-c("x", "y")
vin4<-read.csv("VIN4.CSV")
names(vin4)<-c("x", "y")
vin5<-read.csv("VIN5.CSV")
names(vin5)<-c("x", "y")
vout1<-read.csv("VOUT1.CSV")
names(vout1)<-c("x", "y")
vout2<-read.csv("VOUT2.CSV")
names(vout2)<-c("x", "y")
vout3<-read.csv("VOUT3.CSV")
names(vout3)<-c("x", "y")
vout4<-read.csv("VOUT4.CSV")
names(vout4)<-c("x", "y")
vout5<-read.csv("VOUT5.CSV")
names(vout5)<-c("x", "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

```
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:

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

#this is consistent with the max gain of 150 calculated in class.
```

## 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 g(f)

```
library(ggplot2)
qplot(unlist(gain$Frequency[24:80]),unlist(gain$Volts[24:80]))+geom_errorbar(aes(x=unlist(gain$Frequency
```