GROUP\_PROJECT

JUSTIN\_PATE, DARRELL NELSON, TEVOR WITTA

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goal for team. The dataset is measurement data from actual airplane 3d measurements. The field “MAG” is the deviation from nominal. Nominal is the perfect location where magnitued would =0 in a perfect world/perfect airplane.

The goal for our team is to figure out correlation for each feature based on the field “SUB\_GROUP” and which way each subgroup is trending by airplane number increase. Are we getting better or worse?

The field SHIP, is the Airplane number meaning that each airplane number should have the same naumber of features.

This data set is actual data taken from critical dimmensions on a commercial business jet.

**KEY METRICS:**

They key fields in the data are shipset which is an indicator the product line unit and can be used to trend data over time. The sub group is the actual feature being measured and reflects the engineering requirement that we are trying to improve. Magnitude is the actual results. There is a minimum and maximum tolerance field. If the magnitude falls within these tolerances, then the part is in “Spec”, otherwise, the part is out of spec for that sub group.

**TOOLS TO BE USED:**

Within the RStudio Platform: not all reflected in PowerPoint

Histograms, GGplots, BoxPlots, Scatter Plots with LM on plot. Multiple LM analysis as we tried to find the most significant variables to use.

Within the RGui, we used the neural network library to create two models that would predict two different feature outputs.

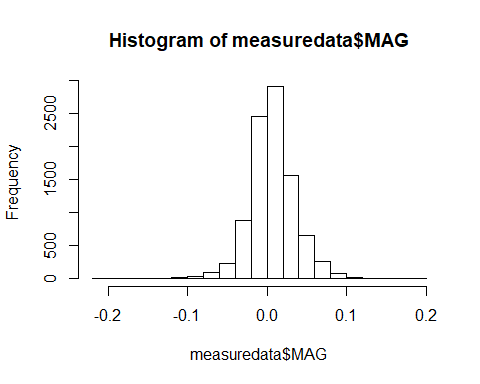
measuredata<- data.frame(read.csv(file="C:/School\_SYR/TERM2/IST\_687/PROJECT/SAMPLE\_WING\_CENTER\_MEASURE\_DATA.csv", header=TRUE, sep=","))  
measuredata<-measuredata[,-1]  
measuredata[1:10,]

## SHIP SIDE TYPE GROUP SUB\_GROUP  
## 1 70005 LEFT AFT Keel Fitting Line A KC-CIP KEEL FITTING  
## 2 70005 LEFT AFT Keel Fitting Profile C KC-CIP KEEL FITTING  
## 3 70005 LEFT AFT Keel Fitting Profile C KC-CIP KEEL FITTING  
## 4 70005 LEFT AFT Keel Fitting Profile C KC-CIP KEEL FITTING  
## 5 70005 LEFT Cruciform KC-CIP CRUCIFORM INTER LH  
## 6 70005 LEFT Cruciform KC-CIP CRUCIFORM INTER LH  
## 7 70005 LEFT Cruciform KC-CIP CRUCIFORM INTER LH  
## 8 70005 LEFT Cruciform KC-CIP CRUCIFORM INTER LH  
## 9 70005 LEFT Cruciform KC-CIP CRUCIFORM INTER LH  
## 10 70005 LEFT Cruciform KC-CIP CRUCIFORM INTER LH  
## VECTOR\_NAME X1 Y1 Z1 X2 Y2 Z2 DX  
## 1 RKB-LH -6.7580 40.9464 735.5023 -6.7580 40.9488 735.4980 0.0000  
## 2 RKB-LLUG1 -2.3491 42.9960 735.8859 -2.3580 42.9960 735.8859 -0.0090  
## 3 RKB-LLUG2 -2.3490 41.1164 737.5751 -2.3636 41.1164 737.5751 -0.0147  
## 4 RKB-LLUG3 -2.3488 38.7827 735.4377 -2.3567 38.7827 735.4377 -0.0079  
## 5 PWLOML-1 -47.6098 55.3186 725.9220 -47.5555 55.3186 725.9220 0.0543  
## 6 PWLOML-2 -47.6105 67.4166 717.2912 -47.6310 67.4166 717.2912 -0.0205  
## 7 PWLOML-3 -47.6105 67.3588 726.4256 -47.6418 67.3588 726.4256 -0.0313  
## 8 PWLOML-4 -47.6107 70.2046 716.6680 -47.6529 70.2046 716.6680 -0.0423  
## 9 PWLOML-5 -47.6106 70.1702 726.4103 -47.6707 70.1702 726.4103 -0.0601  
## 10 PWLOML-6 -47.9709 72.2572 717.3192 -48.0211 72.2429 717.3192 -0.0502  
## DY DZ MAG CMR MINTOL MAXTOL  
## 1 0.0024 -0.0043 0.0049 NA -0.0200 0.0200  
## 2 0.0000 0.0000 0.0090 NA -0.0300 0.0300  
## 3 0.0000 0.0000 0.0147 NA -0.0300 0.0300  
## 4 0.0000 0.0000 0.0079 NA -0.0300 0.0300  
## 5 0.0000 0.0000 -0.0543 NA -0.0275 0.0275  
## 6 0.0000 0.0000 0.0205 NA -0.0275 0.0275  
## 7 0.0000 0.0000 0.0313 NA -0.0275 0.0275  
## 8 0.0000 0.0000 0.0423 NA -0.0275 0.0275  
## 9 0.0000 0.0000 0.0601 NA -0.0275 0.0275  
## 10 -0.0143 0.0000 0.0522 NA -0.0275 0.0275

subsetofmeasure<-measuredata[measuredata[,5]=="FLOOR FITTINGS",]  
summary(subsetofmeasure)

## SHIP SIDE TYPE   
## Min. :70005 LEFT :151 Floor Fittings :340   
## 1st Qu.:70010 RIGHT:189 AFT Keel Fitting Line A : 0   
## Median :70018 AFT Keel Fitting Profile C : 0   
## Mean :70016 Cruciform : 0   
## 3rd Qu.:70022 Datum : 0   
## Max. :70027 Floor Sill BL : 0   
## (Other) : 0   
## GROUP SUB\_GROUP VECTOR\_NAME   
## KC-CIP:340 FLOOR FITTINGS :340 FLF-R2-LBL09: 22   
## CRUCIFORM INTER LH: 0 FLF-R2-LBL19: 22   
## CRUCIFORM INTER RH: 0 FLF-R2-LBL35: 22   
## DATUM : 0 FLF-R3-LBL09: 22   
## FLOOR SILL WL LH : 0 FLF-R3-LBL19: 22   
## FLOOR SILL WL RH : 0 FLF-R3-LBL35: 22   
## (Other) : 0 (Other) :208   
## X1 Y1 Z1 X2   
## Min. :-35.0038 Min. :67.96 Min. :556.5 Min. :-35.0344   
## 1st Qu.:-19.0000 1st Qu.:67.96 1st Qu.:556.5 1st Qu.:-18.9920   
## Median : -9.0000 Median :67.96 Median :575.9 Median : -8.9807   
## Mean : 0.1822 Mean :67.96 Mean :575.4 Mean : 0.1898   
## 3rd Qu.: 27.0000 3rd Qu.:67.96 3rd Qu.:595.4 3rd Qu.: 26.9789   
## Max. : 35.0014 Max. :67.96 Max. :595.4 Max. : 35.0513   
##   
## Y2 Z2 DX DY   
## Min. :67.91 Min. :556.4 Min. :-0.069500 Min. :-0.048800   
## 1st Qu.:67.94 1st Qu.:556.5 1st Qu.:-0.006725 1st Qu.:-0.019225   
## Median :67.95 Median :575.9 Median : 0.005550 Median :-0.009850   
## Mean :67.95 Mean :575.4 Mean : 0.007616 Mean :-0.006900   
## 3rd Qu.:67.96 3rd Qu.:595.3 3rd Qu.: 0.019200 3rd Qu.: 0.004925   
## Max. :68.03 Max. :595.4 Max. : 0.112200 Max. : 0.068500   
##   
## DZ MAG CMR MINTOL   
## Min. :-0.13990 Min. :0.00410 Mode:logical Min. :-0.058   
## 1st Qu.:-0.02020 1st Qu.:0.02227 NA's:340 1st Qu.:-0.058   
## Median :-0.00535 Median :0.03050 Median :-0.058   
## Mean :-0.01042 Mean :0.03695 Mean :-0.058   
## 3rd Qu.: 0.00615 3rd Qu.:0.04640 3rd Qu.:-0.058   
## Max. : 0.04570 Max. :0.16440 Max. :-0.058   
##   
## MAXTOL   
## Min. :0.058   
## 1st Qu.:0.058   
## Median :0.058   
## Mean :0.058   
## 3rd Qu.:0.058   
## Max. :0.058   
##

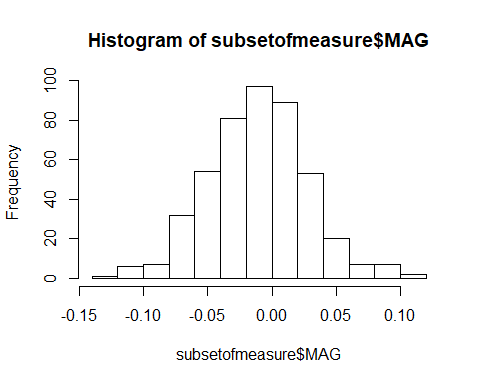
hist(measuredata$MAG)



subsetofmeasure<-measuredata[measuredata[,5]=="PRESSURE WALL BL LH",]  
summary(subsetofmeasure)

## SHIP SIDE TYPE   
## Min. :70005 LEFT :456 Pressure Fence :456   
## 1st Qu.:70011 RIGHT: 0 AFT Keel Fitting Line A : 0   
## Median :70017 AFT Keel Fitting Profile C : 0   
## Mean :70016 Cruciform : 0   
## 3rd Qu.:70022 Datum : 0   
## Max. :70027 Floor Fittings : 0   
## (Other) : 0   
## GROUP SUB\_GROUP VECTOR\_NAME X1   
## KC-CIP:456 PRESSURE WALL BL LH:456 PWLBL-1 : 24 Min. :-50.49   
## CRUCIFORM INTER LH : 0 PWLBL-10: 24 1st Qu.:-50.35   
## CRUCIFORM INTER RH : 0 PWLBL-11: 24 Median :-50.23   
## DATUM : 0 PWLBL-12: 24 Mean :-49.41   
## FLOOR FITTINGS : 0 PWLBL-13: 24 3rd Qu.:-47.65   
## FLOOR SILL WL LH : 0 PWLBL-14: 24 Max. :-47.39   
## (Other) : 0 (Other) :312   
## Y1 Z1 X2 Y2   
## Min. :51.09 Min. :523.7 Min. :-50.54 Min. :51.09   
## 1st Qu.:71.91 1st Qu.:561.2 1st Qu.:-50.36 1st Qu.:71.90   
## Median :80.71 Median :631.8 Median :-50.24 Median :80.71   
## Mean :76.06 Mean :635.1 Mean :-49.42 Mean :76.05   
## 3rd Qu.:81.15 3rd Qu.:726.2 3rd Qu.:-47.66 3rd Qu.:81.16   
## Max. :81.66 Max. :727.0 Max. :-47.33 Max. :81.67   
##   
## Z2 DX DY DZ   
## Min. :523.7 Min. :-0.13370 Min. :-0.038100 Min. :0   
## 1st Qu.:561.2 1st Qu.:-0.03515 1st Qu.:-0.008125 1st Qu.:0   
## Median :631.8 Median :-0.00995 Median : 0.000000 Median :0   
## Mean :635.1 Mean :-0.01058 Mean :-0.002527 Mean :0   
## 3rd Qu.:726.2 3rd Qu.: 0.01293 3rd Qu.: 0.001825 3rd Qu.:0   
## Max. :727.0 Max. : 0.10080 Max. : 0.028700 Max. :0   
##   
## MAG CMR MINTOL MAXTOL   
## Min. :-0.13900 Mode:logical Min. :-0.025 Min. :0.025   
## 1st Qu.:-0.03608 NA's:456 1st Qu.:-0.025 1st Qu.:0.025   
## Median :-0.01030 Median :-0.025 Median :0.025   
## Mean :-0.01104 Mean :-0.025 Mean :0.025   
## 3rd Qu.: 0.01330 3rd Qu.:-0.025 3rd Qu.:0.025   
## Max. : 0.10480 Max. :-0.025 Max. :0.025   
##

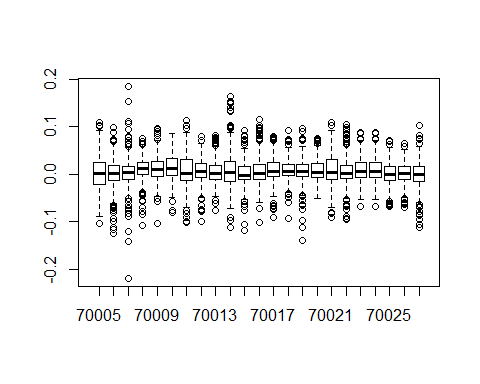
hist(subsetofmeasure$MAG)



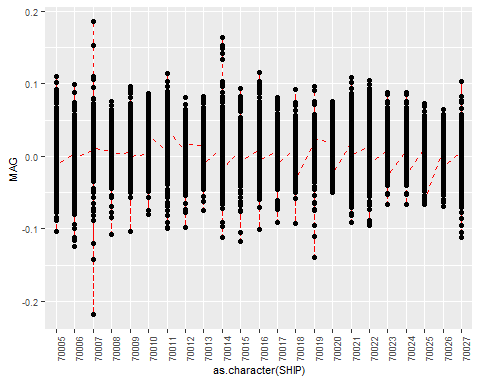
#make a pie chart for measure breakdown  
#with(measuredata, pie(table(SUB\_GROUP), labels=levels(SUB\_GROUP), xlab="",   
 # ylab="", main="SUB\_GROUP", col=rainbow\_hcl(28)))

MAKE A BOX PLOT TEAM: CAN YOU FIGURE OUT HOW TO TURN THE LABELS ON THE BOTTOM BY 90? Also, how do I show all ships on the bottom

library(ggplot2)  
library(scatterplot3d)  
library(tidyr)  
boxplot(MAG~as.character(SHIP), data=measuredata,id=list(method="y"),axis.text.x=element\_text(angle=90,hjust=2))



plotbyship<-ggplot(measuredata, aes(x=as.character(SHIP), y=MAG, group=1))+geom\_line(color="red", linetype="dashed")+geom\_point()+theme(text=element\_text(size=8),axis.text.x=element\_text(angle=90,hjust=2))  
plotbyship



#scatterplot(MAG~SHIP | SUB\_GROUP, regLine=FALSE, smooth=FALSE,boxplots=FALSE, by.groups=TRUE, data=measuredata)#HOW DO I GET RID OF THE COLOR WARNINGS?

MAKING DIFFERENT DATASETS FOR TEAM WITH sql AND SHOW BASIC SCATTER PLOTS

library(sqldf)

## Loading required package: gsubfn

## Loading required package: proto

## Loading required package: RSQLite

avgmagdf<-sqldf("SELECT SHIP, SUB\_GROUP, avg(mag) AS AVERAGEMAG FROM measuredata GROUP BY SUB\_GROUP, SHIP")  
avgmagdf[1:10,] #look at it

## SHIP SUB\_GROUP AVERAGEMAG  
## 1 70005 CRUCIFORM INTER LH 0.0410000  
## 2 70006 CRUCIFORM INTER LH 0.0358125  
## 3 70007 CRUCIFORM INTER LH -0.0434250  
## 4 70008 CRUCIFORM INTER LH 0.0182625  
## 5 70009 CRUCIFORM INTER LH 0.0128625  
## 6 70010 CRUCIFORM INTER LH -0.0428375  
## 7 70011 CRUCIFORM INTER LH -0.0356875  
## 8 70012 CRUCIFORM INTER LH 0.0367375  
## 9 70013 CRUCIFORM INTER LH 0.0018500  
## 10 70014 CRUCIFORM INTER LH -0.0207125

make a data set that shows range. This represents how unstable the process is over time. Process with larger ranges should be focused on more.

rangeofmagdfBYSHIP<-sqldf("SELECT SHIP, SUB\_GROUP, max(mag)-min(mag) AS rangeMAG FROM measuredata GROUP BY SHIP, SUB\_GROUP ORDER BY max(mag)-min(mag) DESC")  
rangeofmagdfBYSHIP[1:10,] #look at it

## SHIP SUB\_GROUP rangeMAG  
## 1 70007 PRESSURE WALL BL RH 0.2685  
## 2 70006 STUB FRAMES FS LH 0.2230  
## 3 70014 PRESSURE WALL BL LH 0.2003  
## 4 70009 FWD JUNCTION RH 0.1939  
## 5 70007 PRESSURE WALL EOP RH 0.1903  
## 6 70022 FLOOR SILL WL RH 0.1878  
## 7 70015 PRESSURE WALL BL RH 0.1842  
## 8 70019 PRESSURE WALL BL LH 0.1708  
## 9 70016 PRESSURE WALL BL RH 0.1705  
## 10 70021 PRESSURE WALL BL LH 0.1659

avgofranges<-sqldf("SELECT SUB\_GROUP, avg(rangeMAG) AS avgofrangeMAG FROM rangeofmagdfBYSHIP GROUP BY SUB\_GROUP ORDER BY avg(rangeMAG) DESC")  
avgofranges[1:15,] #look at it

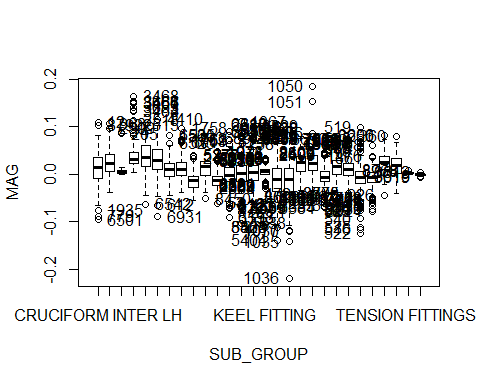
## SUB\_GROUP avgofrangeMAG  
## 1 PRESSURE WALL BL RH 0.12631304  
## 2 PRESSURE WALL BL LH 0.11893478  
## 3 FWD JUNCTION RH 0.08306087  
## 4 FWD JUNCTION LH 0.07917826  
## 5 FWD SPAR FRAME 0.07501739  
## 6 FLOOR SILL WL RH 0.06959130  
## 7 PRESSURE WALL EOP RH 0.06926522  
## 8 PRESSURE WALL EOP LH 0.06733043  
## 9 FLOOR SILL WL LH 0.06502174  
## 10 STUB FRAMES FS LH 0.06473913  
## 11 CRUCIFORM INTER LH 0.06460870  
## 12 STUB FRAMES FS RH 0.06224783  
## 13 CRUCIFORM INTER RH 0.05542174  
## 14 FLOOR SILLS BL LH 0.05332174  
## 15 STUB FRAMES BL RH 0.05130870

make a data set that shows in tolerance or out of tolerance binary. This represents how unstable the process is over time. Process with larger ranges should be focused on more.

inoroutdf<-sqldf("SELECT SHIP, SUB\_GROUP, min(case when mag <=maxtol and mag>=mintol then 1 else 0 end) AS passfail FROM measuredata GROUP BY SUB\_GROUP, SHIP")  
inoroutdf[1:10,] #look at it 1=pass and 0=faile

## SHIP SUB\_GROUP passfail  
## 1 70005 CRUCIFORM INTER LH 0  
## 2 70006 CRUCIFORM INTER LH 0  
## 3 70007 CRUCIFORM INTER LH 0  
## 4 70008 CRUCIFORM INTER LH 0  
## 5 70009 CRUCIFORM INTER LH 0  
## 6 70010 CRUCIFORM INTER LH 0  
## 7 70011 CRUCIFORM INTER LH 0  
## 8 70012 CRUCIFORM INTER LH 0  
## 9 70013 CRUCIFORM INTER LH 0  
## 10 70014 CRUCIFORM INTER LH 0

Boxplot(MAG~SUB\_GROUP, data=measuredata, id=list(method="y") + theme(text=element\_text(size=8),axis.text.x=element\_text(angle=90,hjust=2)))



## [1] "779" "1935" "6501" "12" "8799" "968" "2509" "14" "205" "3468"  
## [11] "3465" "3654" "3467" "3466" "3653" "3464" "3463" "2518" "2515" "6542"  
## [21] "612" "6931" "4410" "1560" "6523" "6525" "601" "1758" "1759" "1761"  
## [31] "1762" "240" "5376" "5377" "8450" "3689" "53" "54" "1974" "1973"  
## [41] "1975" "2169" "1976" "2166" "2550" "2554" "2168" "2167" "872" "1213"  
## [51] "3125" "3553" "6198" "8123" "874" "1258" "5435" "1838" "2221" "2559"  
## [61] "4483" "4868" "1067" "1452" "1792" "1793" "2176" "2605" "3829" "3830"  
## [71] "3828" "4949" "4950" "6474" "4951" "6088" "6475" "6089" "2558" "2364"  
## [81] "6589" "2363" "2557" "2362" "6593" "8020" "8789" "6591" "6977" "6979"  
## [91] "6981" "8211" "8212" "8980" "3524" "5403" "5404" "8855" "836" "2380"  
## [101] "3521" "6610" "6612" "1030" "1035" "1036" "4077" "1794" "472" "859"   
## [111] "860" "1050" "1051" "2206" "101" "296" "297" "6001" "6384" "6385"  
## [121] "6386" "8312" "8313" "2405" "2406" "2409" "8502" "8694" "8896" "8898"  
## [131] "6690" "315" "317" "319" "3370" "8705" "7566" "7951" "7564" "7949"  
## [141] "4887" "7567" "7952" "4869" "1071" "7560" "522" "516" "525" "540"   
## [151] "523" "521" "534" "515" "526" "513" "518" "519" "520" "528"   
## [161] "529" "531" "532" "537" "538" "3024" "3030" "3015" "732" "3796"  
## [171] "714" "3012" "7144" "7578" "7963" "1476" "1861" "3008" "926" "3606"  
## [181] "6250" "360" "8778" "8968" "3618" "3619" "3812"

measuredata<-measuredata[,-1]  
measuredata[1:10,]

## SIDE TYPE GROUP SUB\_GROUP VECTOR\_NAME  
## 1 LEFT AFT Keel Fitting Line A KC-CIP KEEL FITTING RKB-LH  
## 2 LEFT AFT Keel Fitting Profile C KC-CIP KEEL FITTING RKB-LLUG1  
## 3 LEFT AFT Keel Fitting Profile C KC-CIP KEEL FITTING RKB-LLUG2  
## 4 LEFT AFT Keel Fitting Profile C KC-CIP KEEL FITTING RKB-LLUG3  
## 5 LEFT Cruciform KC-CIP CRUCIFORM INTER LH PWLOML-1  
## 6 LEFT Cruciform KC-CIP CRUCIFORM INTER LH PWLOML-2  
## 7 LEFT Cruciform KC-CIP CRUCIFORM INTER LH PWLOML-3  
## 8 LEFT Cruciform KC-CIP CRUCIFORM INTER LH PWLOML-4  
## 9 LEFT Cruciform KC-CIP CRUCIFORM INTER LH PWLOML-5  
## 10 LEFT Cruciform KC-CIP CRUCIFORM INTER LH PWLOML-6  
## X1 Y1 Z1 X2 Y2 Z2 DX DY  
## 1 -6.7580 40.9464 735.5023 -6.7580 40.9488 735.4980 0.0000 0.0024  
## 2 -2.3491 42.9960 735.8859 -2.3580 42.9960 735.8859 -0.0090 0.0000  
## 3 -2.3490 41.1164 737.5751 -2.3636 41.1164 737.5751 -0.0147 0.0000  
## 4 -2.3488 38.7827 735.4377 -2.3567 38.7827 735.4377 -0.0079 0.0000  
## 5 -47.6098 55.3186 725.9220 -47.5555 55.3186 725.9220 0.0543 0.0000  
## 6 -47.6105 67.4166 717.2912 -47.6310 67.4166 717.2912 -0.0205 0.0000  
## 7 -47.6105 67.3588 726.4256 -47.6418 67.3588 726.4256 -0.0313 0.0000  
## 8 -47.6107 70.2046 716.6680 -47.6529 70.2046 716.6680 -0.0423 0.0000  
## 9 -47.6106 70.1702 726.4103 -47.6707 70.1702 726.4103 -0.0601 0.0000  
## 10 -47.9709 72.2572 717.3192 -48.0211 72.2429 717.3192 -0.0502 -0.0143  
## DZ MAG CMR MINTOL MAXTOL  
## 1 -0.0043 0.0049 NA -0.0200 0.0200  
## 2 0.0000 0.0090 NA -0.0300 0.0300  
## 3 0.0000 0.0147 NA -0.0300 0.0300  
## 4 0.0000 0.0079 NA -0.0300 0.0300  
## 5 0.0000 -0.0543 NA -0.0275 0.0275  
## 6 0.0000 0.0205 NA -0.0275 0.0275  
## 7 0.0000 0.0313 NA -0.0275 0.0275  
## 8 0.0000 0.0423 NA -0.0275 0.0275  
## 9 0.0000 0.0601 NA -0.0275 0.0275  
## 10 0.0000 0.0522 NA -0.0275 0.0275

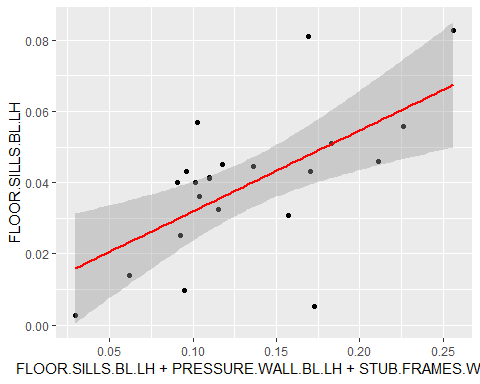
#with(measuredata, Hist(MAG, groups=SUB\_GROUP, scale="frequency", breaks="Sturges", col="darkgray"))

#rangedf<-sqldf("SELECT SUB\_GROUP, range(mag) AS range FROM measuredata GROUP BY SUB\_GROUP")  
#rangedf[1:10,] #look at it

mdpivotbyfeature<- data.frame(read.csv(file="C:/School\_SYR/TERM2/IST\_687/PROJECT/lh\_max\_pivot.csv", header=TRUE, sep=","))  
mdpivotbyfeature

## ï..no\_name shipset CRUCIFORM.INTER.LH CRUCIFORM.INTER.RH DATUM  
## 1 NA 70005 0.1095 0.0351 0.088000000  
## 2 NA 70006 0.0668 0.0880 0.008502353  
## 3 NA 70007 0.0422 0.1063 0.012000000  
## 4 NA 70008 0.0751 0.0191 0.011600862  
## 5 NA 70009 0.0393 0.0409 0.012830043  
## 6 NA 70010 -0.0158 0.0382 0.010400481  
## 7 NA 70011 -0.0263 0.0966 0.013730987  
## 8 NA 70012 0.0806 0.0100 0.003482815  
## 9 NA 70013 0.0325 0.0212 0.014202113  
## 10 NA 70014 -0.0054 0.0325 0.009219544  
## 11 NA 70015 0.0828 0.0930 0.011497826  
## 12 NA 70016 0.0372 0.0757 0.014000000  
## 13 NA 70017 0.0669 0.0240 0.008202439  
## 14 NA 70018 0.0252 0.0208 0.014782760  
## 15 NA 70019 0.0350 0.0959 0.004244997  
## 16 NA 70020 0.0153 -0.0047 0.002817801  
## 17 NA 70021 0.0692 0.0670 0.010141499  
## 18 NA 70022 0.0225 0.0622 0.005360037  
## 19 NA 70023 0.0237 0.0339 0.004242641  
## 20 NA 70024 0.0237 0.0339 0.004242641  
## 21 NA 70025 0.0725 0.0693 0.005099020  
## 22 NA 70026 0.0642 0.0285 0.008002500  
## 23 NA 70027 0.1035 0.0171 0.007071068  
## FLOOR.FITTINGS FLOOR.SILL.WL.LH FLOOR.SILL.WL.RH FLOOR.SILLS.BL.LH  
## 1 0.0852 0.1023 0.1013 0.0097  
## 2 0.0454 0.0635 -0.0049 0.0568  
## 3 0.0296 0.0281 0.0412 0.0447  
## 4 0.0695 0.0651 0.0426 0.0252  
## 5 0.0655 0.0675 0.0286 0.0810  
## 6 0.0825 0.0641 0.0689 0.0510  
## 7 0.1142 0.0891 0.0718 0.0459  
## 8 0.0466 0.0645 0.0577 0.0412  
## 9 0.0829 0.0422 0.0742 0.0451  
## 10 0.1644 0.1030 0.0789 0.0558  
## 11 NA 0.0790 0.0741 0.0431  
## 12 NA 0.0868 0.1161 0.0309  
## 13 0.0452 0.0774 0.0671 0.0401  
## 14 0.0370 0.0720 0.0928 0.0361  
## 15 0.0373 0.0520 0.0580 0.0416  
## 16 0.0396 0.0738 0.0619 0.0326  
## 17 0.0643 0.1088 0.0832 0.0051  
## 18 0.0522 0.0936 0.0986 0.0827  
## 19 0.0530 0.0566 0.0510 0.0432  
## 20 0.0530 0.0566 0.0510 0.0432  
## 21 0.0464 0.0453 0.0366 0.0138  
## 22 0.0429 0.0349 0.0344 0.0400  
## 23 0.0381 0.0449 0.0330 0.0028  
## FLOOR.SILLS.BL.RH FRONT.SPAR.CAP.BL FRONT.SPAR.CAP.FS FRONT.SPAR.CAP.WL  
## 1 0.0482 0.0341 0.0581 -0.0154  
## 2 0.0671 -0.0021 0.0202 -0.0055  
## 3 0.0378 0.0179 0.0472 0.0123  
## 4 0.0356 0.0049 0.0386 0.0066  
## 5 0.0964 -0.0084 0.0242 0.0096  
## 6 0.0550 0.0035 0.0086 0.0474  
## 7 0.0010 0.0306 0.0175 0.0323  
## 8 0.0315 0.0144 0.0348 0.0053  
## 9 0.0343 -0.0010 0.0229 -0.0085  
## 10 0.0156 0.0142 0.0751 0.0286  
## 11 0.0191 -0.0095 0.0493 -0.0017  
## 12 0.0208 -0.0090 0.0222 0.0137  
## 13 0.0646 0.0237 0.0655 0.0271  
## 14 0.0283 0.0205 0.0232 -0.0103  
## 15 0.0201 0.0398 0.0290 -0.0014  
## 16 0.0186 0.0101 0.0497 -0.0013  
## 17 0.0228 -0.0084 0.0630 0.0175  
## 18 0.0303 0.0192 0.0462 0.0087  
## 19 0.0434 -0.0200 0.0178 -0.0074  
## 20 0.0434 -0.0200 0.0178 -0.0074  
## 21 0.0378 -0.0081 0.0212 0.0005  
## 22 0.0507 0.0019 -0.0054 -0.0131  
## 23 0.0552 0.0010 0.0430 -0.0201  
## FWD.JUNCTION.LH FWD.JUNCTION.RH FWD.SPAR.FRAME KEEL.FITTING  
## 1 0.0255 0.0316 0.0325 0.0147  
## 2 0.0225 0.0512 0.0254 0.0162  
## 3 0.0707 0.1105 0.0338 0.0141  
## 4 0.0637 0.0758 0.0403 0.0115  
## 5 0.0456 0.0903 0.0300 0.0183  
## 6 0.0339 0.0808 0.0300 0.0137  
## 7 0.0177 0.0824 0.0572 0.0130  
## 8 0.0372 0.0257 0.0322 0.0134  
## 9 0.0414 0.0210 0.0369 0.0163  
## 10 0.0562 0.0422 0.1012 0.0177  
## 11 -0.0030 0.0182 0.0294 0.0185  
## 12 0.0121 0.0533 0.0297 0.0157  
## 13 0.0183 0.0516 0.0807 0.0102  
## 14 0.0410 0.0161 0.0299 0.0199  
## 15 0.0909 0.0539 0.0512 0.0220  
## 16 0.0099 0.0349 0.0751 0.0180  
## 17 0.0521 0.0319 0.0787 0.0266  
## 18 0.0411 0.0537 0.0347 0.0297  
## 19 0.0346 0.0200 0.0199 0.0153  
## 20 0.0346 0.0200 0.0199 0.0153  
## 21 0.0416 0.0370 0.0363 0.0340  
## 22 0.0257 0.0298 0.0317 0.0187  
## 23 0.0579 0.0268 0.0560 0.0280  
## PRESSURE.WALL.BL.LH PRESSURE.WALL.BL.RH PRESSURE.WALL.EOP.LH  
## 1 0.0208 0.0358 0.0572  
## 2 0.0221 0.0348 0.0725  
## 3 0.0952 0.0498 0.0724  
## 4 0.0371 0.0401 0.0641  
## 5 0.0511 0.0950 0.0552  
## 6 0.0783 0.0645 0.0754  
## 7 0.1033 0.0076 0.0546  
## 8 0.0363 0.0396 0.0321  
## 9 0.0523 0.0326 0.0605  
## 10 0.0886 0.0128 0.0792  
## 11 0.0158 0.0673 0.0368  
## 12 0.0745 0.0691 0.0439  
## 13 0.0029 0.0650 0.0569  
## 14 0.0318 0.0234 0.0461  
## 15 0.0318 0.0442 0.0561  
## 16 0.0368 0.0382 0.0515  
## 17 0.0867 0.0266 0.0685  
## 18 0.1048 0.0367 0.0648  
## 19 0.0859 0.0874 0.0417  
## 20 0.0859 0.0874 0.0417  
## 21 0.0125 0.0451 0.0489  
## 22 0.0078 0.0302 0.0424  
## 23 -0.0099 0.0549 0.0279  
## PRESSURE.WALL.EOP.RH REAR.SPAR.CAP STUB.FRAMES.BL.LH STUB.FRAMES.BL.RH  
## 1 0.0670 0.0190 0.0328 0.0225  
## 2 0.0329 0.0367 0.0408 0.0226  
## 3 0.1853 0.0165 0.0642 0.0632  
## 4 0.0581 0.0238 0.0492 0.0465  
## 5 0.0618 0.0129 0.0409 0.0299  
## 6 0.0868 0.0178 0.0611 0.0466  
## 7 0.0593 0.0461 0.0557 0.0114  
## 8 0.0718 0.0253 0.0532 0.0308  
## 9 0.0443 -0.0021 0.0424 0.0238  
## 10 0.0682 0.0148 0.0453 0.0180  
## 11 0.0463 0.0249 0.0203 0.0230  
## 12 0.0702 0.0277 0.0087 0.0123  
## 13 0.0531 0.0290 0.0366 0.0693  
## 14 0.0700 0.0253 0.0276 0.0432  
## 15 0.0432 0.0322 0.0412 0.0288  
## 16 0.0542 0.0160 0.0335 0.0295  
## 17 0.0567 0.0282 0.0086 0.0291  
## 18 0.0385 0.0136 0.0749 0.0311  
## 19 0.0548 0.0055 0.0498 0.0743  
## 20 0.0548 0.0055 0.0498 0.0743  
## 21 0.0233 -0.0054 0.0166 -0.0053  
## 22 0.0288 0.0436 0.0180 0.0320  
## 23 0.0169 0.0076 -0.0016 0.0490  
## STUB.FRAMES.FS.LH STUB.FRAMES.FS.RH STUB.FRAMES.WL.LH STUB.FRAMES.WL.RH  
## 1 0.0138 0.0115 0.0643 0.0800  
## 2 0.0987 0.0137 0.0239 -0.0189  
## 3 0.0145 0.0168 -0.0038 0.0155  
## 4 0.0402 0.0380 0.0299 0.0168  
## 5 0.0162 0.0348 0.0369 0.0525  
## 6 0.0204 0.0147 0.0538 0.0379  
## 7 0.0083 0.0101 0.0617 0.0640  
## 8 0.0265 0.0609 0.0323 0.0350  
## 9 0.0097 0.0297 0.0205 0.0477  
## 10 0.0269 0.0233 0.0818 0.0386  
## 11 0.0125 0.0342 0.0373 0.0495  
## 12 0.0160 0.0143 0.0516 0.0671  
## 13 0.0299 0.0291 0.0586 0.0296  
## 14 0.0370 0.0175 0.0359 0.0470  
## 15 0.0328 0.0229 0.0363 0.0286  
## 16 0.0182 0.0181 0.0460 0.0347  
## 17 0.0284 0.0139 0.0812 0.0506  
## 18 0.0111 0.0199 0.0688 0.0479  
## 19 0.0125 0.0168 0.0413 0.0318  
## 20 0.0125 0.0168 0.0413 0.0318  
## 21 0.0276 0.0191 0.0356 -0.0007  
## 22 0.0230 0.0231 0.0431 0.0162  
## 23 0.0276 0.0275 0.0366 0.0201  
## TENSION.FITTING.HOL TENSION.FITTINGS.WL Grand.Total  
## 1 0.0050 0.0019 0.1095  
## 2 0.0018 0.0028 0.0987  
## 3 0.0055 0.0013 0.1853  
## 4 0.0032 0.0008 0.0758  
## 5 0.0026 0.0012 0.0964  
## 6 0.0071 -0.0001 0.0868  
## 7 0.0030 -0.0003 0.1142  
## 8 0.0039 0.0030 0.0806  
## 9 0.0036 0.0026 0.0829  
## 10 0.0049 0.0046 0.1644  
## 11 0.0044 -0.0005 0.0930  
## 12 0.0033 0.0019 0.1161  
## 13 0.0026 0.0030 0.0807  
## 14 0.0023 0.0022 0.0928  
## 15 0.0044 0.0008 0.0959  
## 16 0.0023 0.0027 0.0751  
## 17 0.0027 0.0032 0.1088  
## 18 0.0065 0.0037 0.1048  
## 19 0.0050 0.0020 0.0874  
## 20 0.0050 0.0020 0.0874  
## 21 0.0060 0.0030 0.0725  
## 22 0.0087 0.0022 0.0642  
## 23 0.0074 0.0010 0.1035

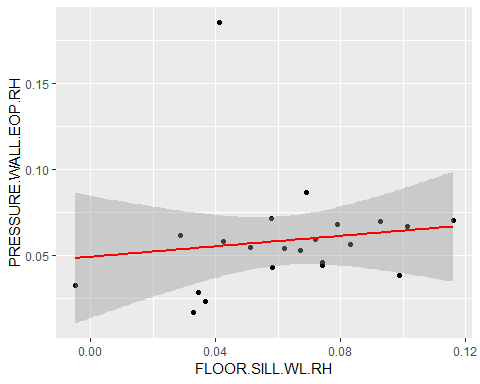
g<-ggplot(mdpivotbyfeature, aes(x=FLOOR.SILLS.BL.LH+PRESSURE.WALL.BL.LH+STUB.FRAMES.WL.LH, y=FLOOR.SILLS.BL.LH)) + geom\_point()  
g+ stat\_smooth(method="lm", col="red")



lmodeltest=lm(formula=STUB.FRAMES.BL.LH~FLOOR.SILLS.BL.LH+PRESSURE.WALL.BL.LH+STUB.FRAMES.WL.LH, data=mdpivotbyfeature)  
summary(lmodeltest)

##   
## Call:  
## lm(formula = STUB.FRAMES.BL.LH ~ FLOOR.SILLS.BL.LH + PRESSURE.WALL.BL.LH +   
## STUB.FRAMES.WL.LH, data = mdpivotbyfeature)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.029226 -0.007545 0.001354 0.007189 0.020011   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 0.015733 0.009014 1.745 0.09706 .   
## FLOOR.SILLS.BL.LH 0.475905 0.155297 3.064 0.00638 \*\*  
## PRESSURE.WALL.BL.LH 0.234484 0.090974 2.577 0.01845 \*   
## STUB.FRAMES.WL.LH -0.193425 0.150377 -1.286 0.21380   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.01311 on 19 degrees of freedom  
## Multiple R-squared: 0.6039, Adjusted R-squared: 0.5413   
## F-statistic: 9.655 on 3 and 19 DF, p-value: 0.0004371

g<-ggplot(mdpivotbyfeature, aes(x=FLOOR.SILL.WL.RH, y=PRESSURE.WALL.EOP.RH)) + geom\_point()  
g+ stat\_smooth(method="lm", col="red")



lmodeltest=lm(formula=PRESSURE.WALL.EOP.RH~FLOOR.SILL.WL.RH, data=mdpivotbyfeature)  
summary(lmodeltest)

##   
## Call:  
## lm(formula = PRESSURE.WALL.EOP.RH ~ FLOOR.SILL.WL.RH, data = mdpivotbyfeature)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -0.037308 -0.015184 -0.002126 0.005104 0.129854   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 0.04923 0.01704 2.889 0.00877 \*\*  
## FLOOR.SILL.WL.RH 0.15098 0.25298 0.597 0.55702   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.03287 on 21 degrees of freedom  
## Multiple R-squared: 0.01668, Adjusted R-squared: -0.03015   
## F-statistic: 0.3562 on 1 and 21 DF, p-value: 0.557

mdpivotbyfeature[1:10,]

## ï..no\_name shipset CRUCIFORM.INTER.LH CRUCIFORM.INTER.RH DATUM  
## 1 NA 70005 0.1095 0.0351 0.088000000  
## 2 NA 70006 0.0668 0.0880 0.008502353  
## 3 NA 70007 0.0422 0.1063 0.012000000  
## 4 NA 70008 0.0751 0.0191 0.011600862  
## 5 NA 70009 0.0393 0.0409 0.012830043  
## 6 NA 70010 -0.0158 0.0382 0.010400481  
## 7 NA 70011 -0.0263 0.0966 0.013730987  
## 8 NA 70012 0.0806 0.0100 0.003482815  
## 9 NA 70013 0.0325 0.0212 0.014202113  
## 10 NA 70014 -0.0054 0.0325 0.009219544  
## FLOOR.FITTINGS FLOOR.SILL.WL.LH FLOOR.SILL.WL.RH FLOOR.SILLS.BL.LH  
## 1 0.0852 0.1023 0.1013 0.0097  
## 2 0.0454 0.0635 -0.0049 0.0568  
## 3 0.0296 0.0281 0.0412 0.0447  
## 4 0.0695 0.0651 0.0426 0.0252  
## 5 0.0655 0.0675 0.0286 0.0810  
## 6 0.0825 0.0641 0.0689 0.0510  
## 7 0.1142 0.0891 0.0718 0.0459  
## 8 0.0466 0.0645 0.0577 0.0412  
## 9 0.0829 0.0422 0.0742 0.0451  
## 10 0.1644 0.1030 0.0789 0.0558  
## FLOOR.SILLS.BL.RH FRONT.SPAR.CAP.BL FRONT.SPAR.CAP.FS FRONT.SPAR.CAP.WL  
## 1 0.0482 0.0341 0.0581 -0.0154  
## 2 0.0671 -0.0021 0.0202 -0.0055  
## 3 0.0378 0.0179 0.0472 0.0123  
## 4 0.0356 0.0049 0.0386 0.0066  
## 5 0.0964 -0.0084 0.0242 0.0096  
## 6 0.0550 0.0035 0.0086 0.0474  
## 7 0.0010 0.0306 0.0175 0.0323  
## 8 0.0315 0.0144 0.0348 0.0053  
## 9 0.0343 -0.0010 0.0229 -0.0085  
## 10 0.0156 0.0142 0.0751 0.0286  
## FWD.JUNCTION.LH FWD.JUNCTION.RH FWD.SPAR.FRAME KEEL.FITTING  
## 1 0.0255 0.0316 0.0325 0.0147  
## 2 0.0225 0.0512 0.0254 0.0162  
## 3 0.0707 0.1105 0.0338 0.0141  
## 4 0.0637 0.0758 0.0403 0.0115  
## 5 0.0456 0.0903 0.0300 0.0183  
## 6 0.0339 0.0808 0.0300 0.0137  
## 7 0.0177 0.0824 0.0572 0.0130  
## 8 0.0372 0.0257 0.0322 0.0134  
## 9 0.0414 0.0210 0.0369 0.0163  
## 10 0.0562 0.0422 0.1012 0.0177  
## PRESSURE.WALL.BL.LH PRESSURE.WALL.BL.RH PRESSURE.WALL.EOP.LH  
## 1 0.0208 0.0358 0.0572  
## 2 0.0221 0.0348 0.0725  
## 3 0.0952 0.0498 0.0724  
## 4 0.0371 0.0401 0.0641  
## 5 0.0511 0.0950 0.0552  
## 6 0.0783 0.0645 0.0754  
## 7 0.1033 0.0076 0.0546  
## 8 0.0363 0.0396 0.0321  
## 9 0.0523 0.0326 0.0605  
## 10 0.0886 0.0128 0.0792  
## PRESSURE.WALL.EOP.RH REAR.SPAR.CAP STUB.FRAMES.BL.LH STUB.FRAMES.BL.RH  
## 1 0.0670 0.0190 0.0328 0.0225  
## 2 0.0329 0.0367 0.0408 0.0226  
## 3 0.1853 0.0165 0.0642 0.0632  
## 4 0.0581 0.0238 0.0492 0.0465  
## 5 0.0618 0.0129 0.0409 0.0299  
## 6 0.0868 0.0178 0.0611 0.0466  
## 7 0.0593 0.0461 0.0557 0.0114  
## 8 0.0718 0.0253 0.0532 0.0308  
## 9 0.0443 -0.0021 0.0424 0.0238  
## 10 0.0682 0.0148 0.0453 0.0180  
## STUB.FRAMES.FS.LH STUB.FRAMES.FS.RH STUB.FRAMES.WL.LH STUB.FRAMES.WL.RH  
## 1 0.0138 0.0115 0.0643 0.0800  
## 2 0.0987 0.0137 0.0239 -0.0189  
## 3 0.0145 0.0168 -0.0038 0.0155  
## 4 0.0402 0.0380 0.0299 0.0168  
## 5 0.0162 0.0348 0.0369 0.0525  
## 6 0.0204 0.0147 0.0538 0.0379  
## 7 0.0083 0.0101 0.0617 0.0640  
## 8 0.0265 0.0609 0.0323 0.0350  
## 9 0.0097 0.0297 0.0205 0.0477  
## 10 0.0269 0.0233 0.0818 0.0386  
## TENSION.FITTING.HOL TENSION.FITTINGS.WL Grand.Total  
## 1 0.0050 0.0019 0.1095  
## 2 0.0018 0.0028 0.0987  
## 3 0.0055 0.0013 0.1853  
## 4 0.0032 0.0008 0.0758  
## 5 0.0026 0.0012 0.0964  
## 6 0.0071 -0.0001 0.0868  
## 7 0.0030 -0.0003 0.1142  
## 8 0.0039 0.0030 0.0806  
## 9 0.0036 0.0026 0.0829  
## 10 0.0049 0.0046 0.1644

BELOW IS THE CODE USED FOR THE NEURAL NETS IN R:

neuralnet <- neuralnet(PRESSURE\_WALL\_BL\_LH ~ FLOOR\_SILLS\_BL\_LH+CRUCIFORM\_INTER\_LH+STUB\_FRAMES\_BL\_LH,Dataset, hidden=2, lifesign='minimal', linear.output=FALSE, threshold=0.1)