

HW4

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Question 1

Table 1: ANOVA table

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
chem	3	12.95	4.316667	2.376147	0.1211445
bolt	4	157.00	39.250000	21.605505	0.0000206
Residuals	12	21.80	1.816667	NA	NA

```
##
## Call:
## aov(formula = ts ~ chem + bolt, data = dat)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.3500 -0.7375 -0.3500  0.7000  1.8500
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   72.3500     0.8524   84.873 < 2e-16 ***
## chemC2         0.8000     0.8524    0.938 0.366507
## chemC3         1.8000     0.8524    2.112 0.056374 .
## chemC4         2.0000     0.8524    2.346 0.036968 *
## boltB2        -5.0000     0.9531   -5.246 0.000206 ***
## boltB3         2.0000     0.9531    2.098 0.057699 .
## boltB4        -0.7500     0.9531   -0.787 0.446584
## boltB5        -5.0000     0.9531   -5.246 0.000206 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.348 on 12 degrees of freedom
## Multiple R-squared:  0.8863, Adjusted R-squared:  0.82
## F-statistic: 13.36 on 7 and 12 DF,  p-value: 8.335e-05
##
## Tukey multiple comparisons of means
## 95% family-wise confidence level
##
## Fit: aov(formula = ts ~ chem + bolt, data = dat)
##
## $chem
##      diff      lwr      upr      p adj
## C2-C1  0.8 -1.7308322  3.330832 0.7852734
## C3-C1  1.8 -0.7308322  4.330832 0.2042593
## C4-C1  2.0 -0.5308322  4.530832 0.1417326
## C3-C2  1.0 -1.5308322  3.530832 0.6540138
## C4-C2  1.2 -1.3308322  3.730832 0.5182726
```

```
## C4-C3  0.2 -2.3308322 2.730832 0.9952030
##
## [1] "Chemical    Mean    SD"
## [1] "    C1        70.6    3.05"
## [1] "    C2        71.4    3.05"
## [1] "    C3        72.4    4.39"
## [1] "    C4        72.6    2.61"
```

Comment:

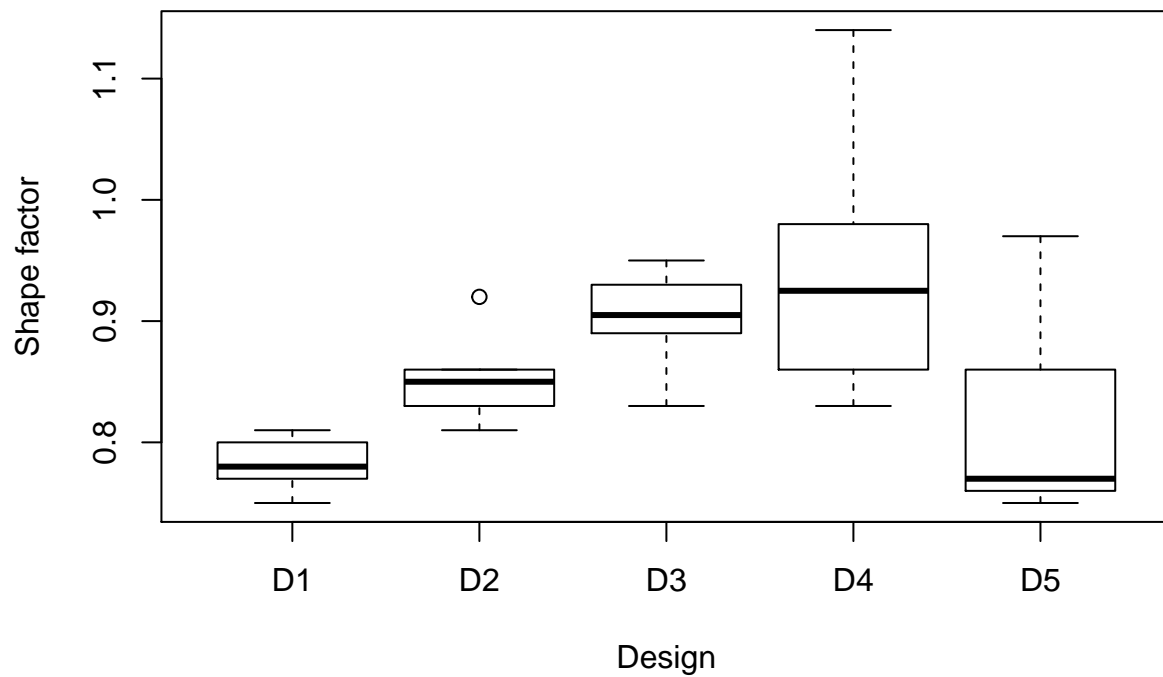
Question 2: potential differences between nozzle designs,with velocity

Table 2: ANOVA table

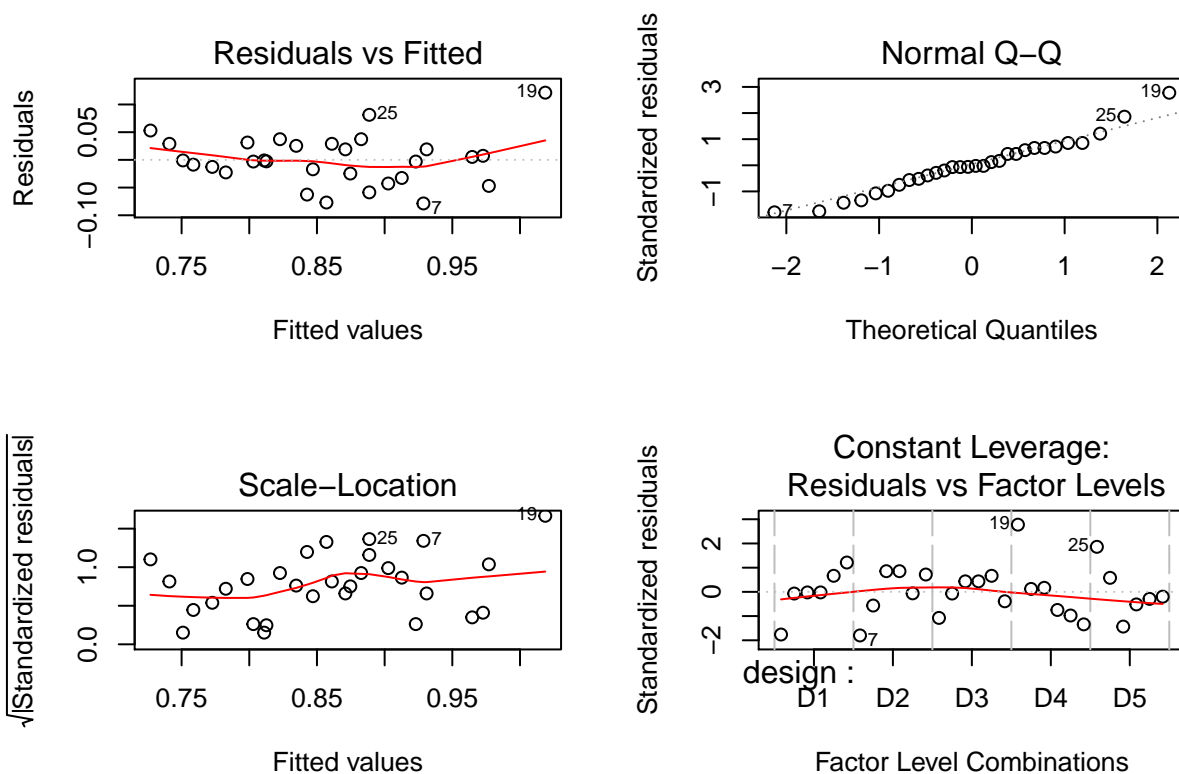
	Df	Sum Sq	Mean Sq	F value	Pr(>F)
design	4	0.1021800	0.0255450	8.916230	0.0002655
jev	5	0.0628667	0.0125733	4.388598	0.0073642
Residuals	20	0.0573000	0.0028650	NA	NA

```
##
## Call:
## aov(formula = sf ~ design + jev, data = dat)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.078667 -0.024167 -0.001833  0.028083  0.121333
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  0.85700    0.03090  27.732  < 2e-16 ***
## designD2     0.07167    0.03090   2.319  0.031091 *
## designD3     0.12000    0.03090   3.883  0.000925 ***
## designD4     0.16167    0.03090   5.231  4.05e-05 ***
## designD5     0.03167    0.03090   1.025  0.317736
## jev14.37    -0.05400    0.03385  -1.595  0.126360
## jev16.59    -0.04600    0.03385  -1.359  0.189329
## jev20.43    -0.10600    0.03385  -3.131  0.005259 **
## jev23.46    -0.11600    0.03385  -3.427  0.002672 **
## jev28.74    -0.13000    0.03385  -3.840  0.001022 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.05353 on 20 degrees of freedom
## Multiple R-squared:  0.7423, Adjusted R-squared:  0.6263
## F-statistic: 6.401 on 9 and 20 DF,  p-value: 0.0002787
```

```
## Tukey multiple comparisons of means
## 95% family-wise confidence level
##
## Fit: aov(formula = sf ~ design + jev, data = dat)
##
## $design
##          diff          lwr          upr      p adj
## D2-D1  0.07166667 -0.020806907  0.16414024 0.1799301
## D3-D1  0.12000000  0.027526427  0.21247357 0.0073198
## D4-D1  0.16166667  0.069193093  0.25414024 0.0003508
## D5-D1  0.03166667 -0.060806907  0.12414024 0.8410263
## D3-D2  0.04833333 -0.044140240  0.14080691 0.5356545
## D4-D2  0.09000000 -0.002473573  0.18247357 0.0588301
## D5-D2 -0.04000000 -0.132473573  0.05247357 0.6975222
## D4-D3  0.04166667 -0.050806907  0.13414024 0.6656605
## D5-D3 -0.08833333 -0.180806907  0.00414024 0.0655561
## D5-D4 -0.13000000 -0.222473573 -0.03752643 0.0035388
##
## [1] "Design      Mean      SD"
## [1] "  D1         0.7817   0.0214"
## [1] "  D2         0.8533   0.0372"
## [1] "  D3         0.9017   0.0422"
## [1] "  D4         0.9433   0.1136"
```



```
## [1] "Analyze the residuals"
```



Comment:

```
#Set location
loca="C:/Users/Duong Hung/OneDrive - University Of Houston/MSDS/Fall/6357/HW"
setwd(loca)
fil_nam="HW4.3.txt"
df = file(fil_nam, open = "r") #open file
dat=NULL
k=1 #index of dat set
f1=c('B1','B2','B3','B4','B5')
f2=c('C1','C2','C3','C4')
rows=1
#Read each line of the data file
while (length(oneLine <- readLines(df, n = 1, warn = FALSE)) > 0) {
  num_lis = (strsplit(oneLine, " ")) #List of values in 1 line
  num_lis = as.numeric(num_lis[[1]]) # Convert them to numeric
  #Category the imported data
  interval=length(num_lis)
```

```

for (i in 1:interval){
  dat$bolt[k]=f1[i]
  dat$chem[k]=f2[rows]
  dat$ts[k]=num_lis[i]
  k=k+1
}
rows=rows+1
}
close(df)
dat=data.frame(dat)
#####

fit=aov(ts~chem+bolt,data=dat)
kable(anova(fit),caption = 'ANOVA table')
summary.lm(fit)
TukeyHSD(fit, which = "chem")
print('Chemical    Mean    SD')
for (i in 1:4){
  rows=dat$ts[dat$chem==f2[i]]
  print(paste(' ',f2[i], ' ',mean(rows), ' ',round(sd(rows),2)))
}

```