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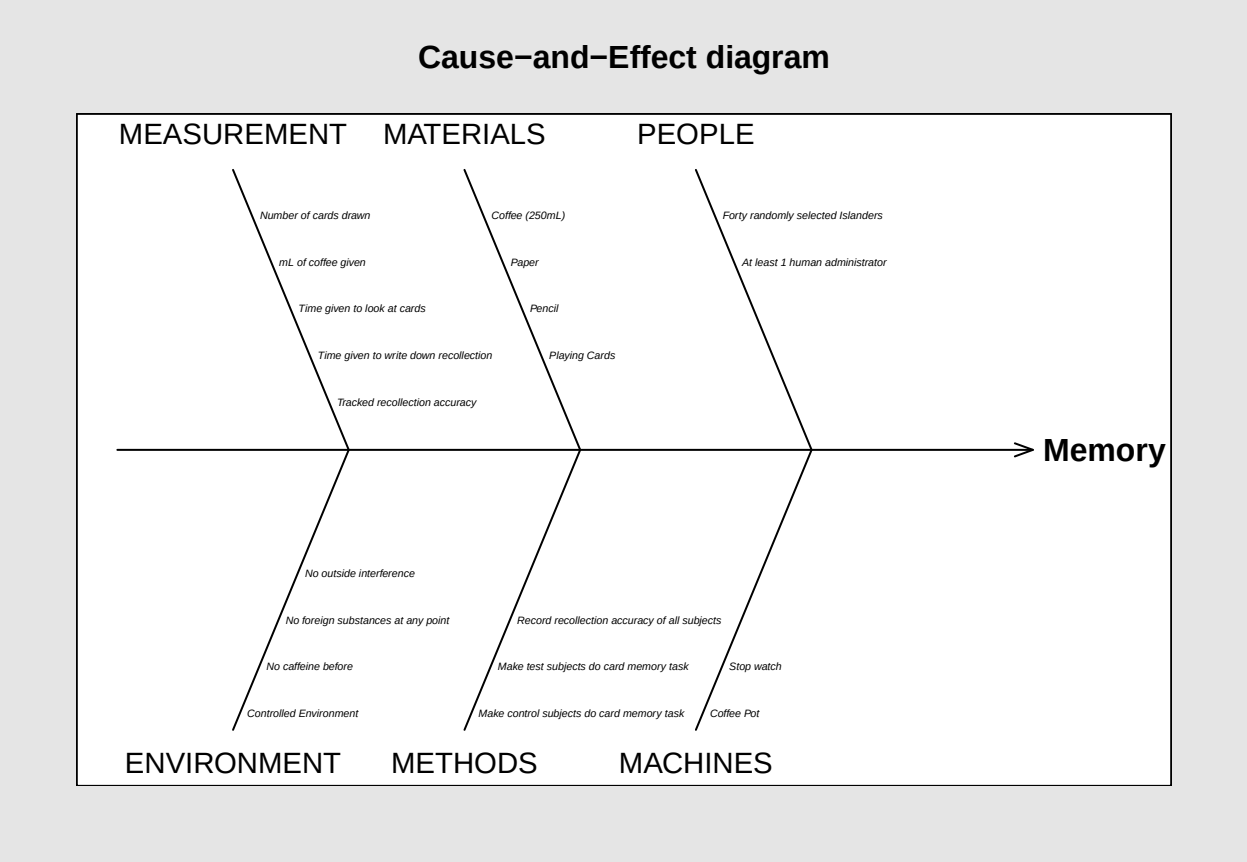
Discussion 1B

1a

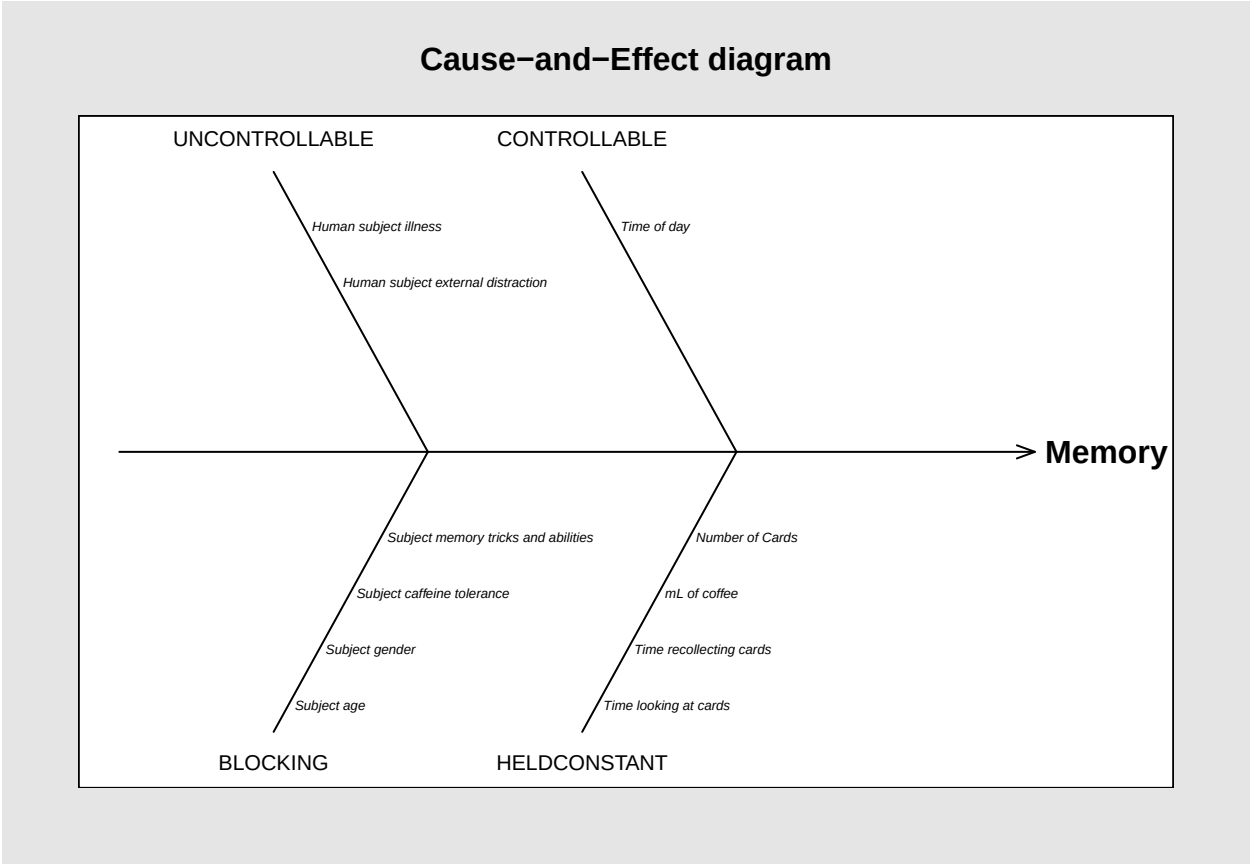
```
library(qcc)
cause.and.effect(
  cause=list(
    MEASUREMENT = c("Number of cards drawn","mL of coffee given",
                    "Time given to look at cards",
                    "Time given to write down recollection",
                    "Tracked recollection accuracy"),
    MATERIALS = c("Coffee (250mL)","Paper","Pencil","Playing Cards"),
    PEOPLE = c("Forty randomly selected Islanders", "At least 1 human administrator"),
    ENVIRONMENT = c("Controlled Environment","No caffeine before",
                    "No foreign substances at any point","No outside interference"),
    METHODS = c("Make control subjects do card memory task",
                "Make test subjects do card memory task",
                "Record recollection accuracy of all subjects"),
    MACHINES = c("Coffee Pot","Stop watch")
  ),
effect="Memory",cex = c(.9, 0.3, 1))
```




```
## There are 6 values in this test that can be varied or measured.
## These are all the items under measurement.
## All of the items under materials are either consumables or items of static items
## of low complexity. One could perhaps consider pencils machines,
## but they are consumable, very basic, and are controlled manually.
## The items under people are all of the people involved in this test.
## The items under environment make it such that it is controlled without outside interference,
##  which, for this test, is all that is needed.
## The items under methods describe how the order and nature of the tasks that are used for this
## experiment.The items under machines are the only mechanical appartus involved
```

1b)

```
library(qcc)
cause.and.effect(
  cause=list(
    UNCONTROLLABLE = c("Human subject illness","Human subject external distraction"),
    CONTROLLABLE = c("Time of day"),
    BLOCKING = c("Subject age", "Subject gender", "Subject caffeine tolerance",
                 "Subject memory tricks and abilities"),
    HELDCONSTANT = c("Time looking at cards","Time recollecting cards",
                     "mL of coffee", "Number of Cards")
  ),
effect="Memory",cex = c(.7, 0.4, 1))
```




```
## Personal or medical problems are often unforseen, unknown, and therefore very difficult to control.
## We can, however, control at what time the test is given and how long the subjects have to rest
## or relax before the test. Blocking variables, which also will cause variances, but are not directly
## related to the hypothesis are age, gender, caffeine tolerance, and memory tricks and abilities.
## All of these vary accross a population, but are not necessarily related to
## coffee's effect on memory. We choose to hold all of the test variables that do relate
## explicitly to coffee, memory, and our materials constant.
```

1c)

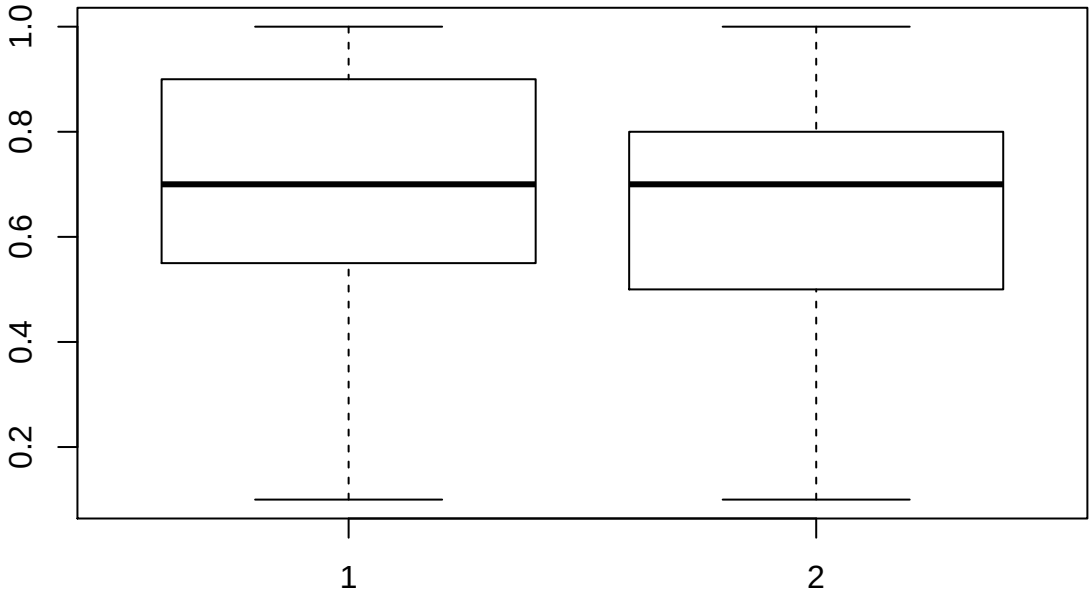
```
##  [1]  2  6  7  8  9 11 13 15 17 18 20 21 22 23 32 33 34 35 38 40
```

```
coffeeScores <- c(0.6, 0.8, 1.0, 0.2, 0.8, 0.7, 0.7, 0.9, 0.9, 0.5, 1, 0.3, 0.9, 0.9, 0.1, 0.5, 0.6, 0.
noCoffeeScores <- c(0.6, 0.6, 0.7, 0.6, 0.2, 1, 0.7, 0.7, 0.4, 0.8, 0.1, 0.8, 0.4, 0.7, 0.7,1, 0.8, 0.7


allScores <- as.double(c(0.6, 0.8, 1.0, 0.2, 0.8, 0.7, 0.7, 0.9, 0.9, 0.5, 1, 0.3, 0.9, 0.9, 0.1, 0.5, 

theTest <- as.character(c(rep("testGroup",20),rep("none",20)))
df <- cbind(allScores, coffeeScores)
df <- as.data.frame(df)
df$allScores <- as.numeric(as.character(df$allScores))

boxplot(coffeeScores, noCoffeeScores)
```




```
print("We can see very similar medians for the two groups but the third and first quartiles are better
```

```
## [1] "We can see very similar medians for the two groups but the third and first quartiles are better
```

```
t.test(coffeeScores,noCoffeeScores)
```

```
##
##  Welch Two Sample t-test
##
## data:  coffeeScores and noCoffeeScores
## t = 0.65893, df = 37.927, p-value = 0.5139
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1139853  0.2239853
## sample estimates:
## mean of x mean of y
##     0.685     0.630
```

```
print("With a p-value 0f 0.5139, we cannot confirm the that coffee improves memory.")
```

```
## [1] "With a p-value 0f 0.5139, we cannot confirm the that coffee improves memory."
```

1d)

```
clm <- lm(df$allScores ~ df$coffeeScores)
anova(clm)
```

```
## Analysis of Variance Table
##
## Response: df$allScores
##                  Df  Sum Sq  Mean Sq F value  Pr(>F)
## df$coffeeScores   1 0.30215 0.302153  4.8332 0.03408 *
## Residuals        38 2.37560 0.062516
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
print("Again, we can see via the F-statistic, that coffee cannot definitely improve memory.")
```

```
## [1] "Again, we can see via the F-statistic, that coffee cannot definitely improve memory."
```

2

```r
error_ss <- 196.14 - 36.15
factor_ms <- 36.15/3
error_ms <- error_ss/16
fvalue <- factor_ms/error_ms
pvalue <- pf(fvalue,3,16)
df2 <- c(3,16,19)
ss <- c(36.15, error_ss, 196.14)
ms <- c(factor_ms,error_ms,NA)
p <- c(fvalue, NA, NA)
q <- c(pvalue, NA, NA)
table1 <- cbind(df2,ss,ms,p,q)
table1
```

```
##      df2     ss        ms        p         q
## [1,]   3  36.15 12.050000 1.205075 0.6602178
## [2,]  16 159.99  9.999375       NA        NA
## [3,]  19 196.14        NA       NA        NA
```

3

```r
HW2_Q3_Data <- read.csv("~/Downloads/HW2 Q3 Data.csv")

sham <- HW2_Q3_Data$Sham
h1 <- HW2_Q3_Data$PEMF.1h.day
h2 <- HW2_Q3_Data$PEMF.2h.day
h4 <- HW2_Q3_Data$PEMF.4h.day
all <- c(sham,h1,h2,h4)
names2 <- c(rep("sham",20),rep("h1",20),rep("h2",20),rep("h4",20))
arm_results <- as.data.frame(cbind(names2, all))
arm_results$names2 <- as.character(arm_results$names2)
arm_results$all <- as.numeric(as.character(arm_results$all))
arm_lm <- lm(arm_results$all ~ arm_results$names2) #summary(arm_lm)
anova(arm_lm)
```

```
## Analysis of Variance Table
##
## Response: arm_results$all
##                     Df  Sum Sq Mean Sq F value Pr(>F)
## arm_results$names2  3  10.044  3.3478  1.2979 0.2813
## Residuals          76 196.030  2.5793
```

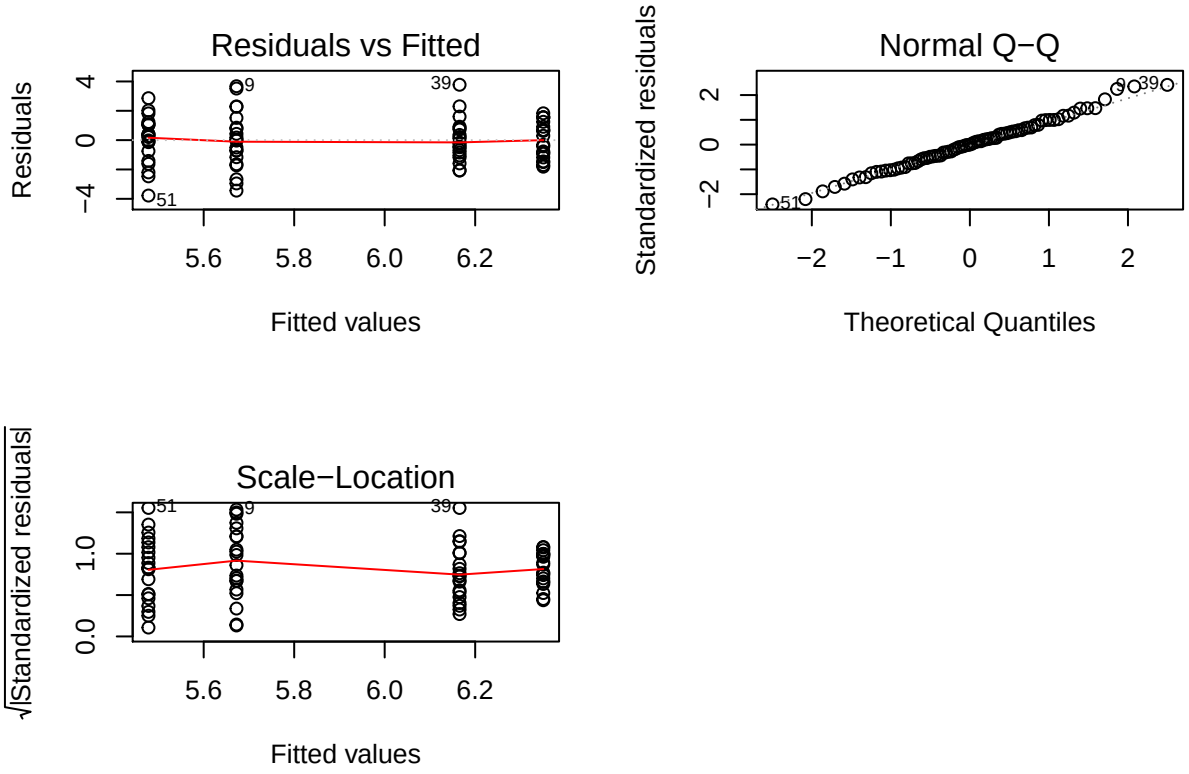
```r
print("PEMF usage does not affect BMD loss at a 5% level. p=0.28  which is less than 0.05.")
```

```
## [1] "PEMF usage does not affect BMD loss at a 5% level. p=0.28  which is less than 0.05."
```

3b)

```
par(mfrow = c(2,2))
plot(arm_lm)
```

```
## hat values (leverages) are all = 0.05
##  and there are no factor predictors; no plot no. 5
```




```
print("All of the residual graphs looks pretty good. In the Scale-Location graph, there are some sharp
```

```
## [1] "All of the residual graphs looks pretty good. In the Scale-Location graph, there are some sharp
```

4a

```
roddingLevel <- list(10,15,20,25)

strength1 <- list(1530,1610,1560,1500)
strength2 <- list(1530,1650,1730,1490)
strength3 <- list(1440,1500,1530,1510)
fullData <- as.data.frame(cbind(unlist(roddingLevel),unlist(strength1),unlist(strength2),unlist(strengt
fullData
```

```
##   V1   V2   V3   V4
## 1 10 1530 1530 1440
## 2 15 1610 1650 1500
## 3 20 1560 1730 1530
## 4 25 1500 1490 1510
```

```r
level10 <- as.numeric(fullData[1,2:4])
level15 <- as.numeric(fullData[2,2:4])
level20 <- as.numeric(fullData[3,2:4])
level25 <- as.numeric(fullData[4,2:4])

allLevelData <- c(level10,level15,level20,level25)

allLevels<- c(rep("10",3),rep("15",3),rep("20",3),rep("25",3))
levelsAndScores <- cbind(allLevels,allLevelData)
levelsAndScores <- as.data.frame(levelsAndScores)
levelsAndScores$allLevels <- as.character(levelsAndScores$allLevels)
levelsAndScores$allLevelData <- as.numeric(as.character(levelsAndScores$allLevelData))
m1 <- lm(levelsAndScores$allLevelData ~ levelsAndScores$allLevels)
anova(m1)
```

```
## Analysis of Variance Table
##
## Response: levelsAndScores$allLevelData
##                            Df Sum Sq Mean Sq F value Pr(>F)
## levelsAndScores$allLevels  3  28633  9544.4  1.8654 0.2138
## Residuals                   8  40933  5116.7
```

```r
print("Anova table tells us that there isn't a statistically significant diffence in compressive streng
```

```
## [1] "Anova table tells us that there isn't a statistically significant diffence in compressive streng
```

4b

```r
fourB <- anova(m1)
fourB$`F value`[1]
```

```
## [1] 1.865364
```

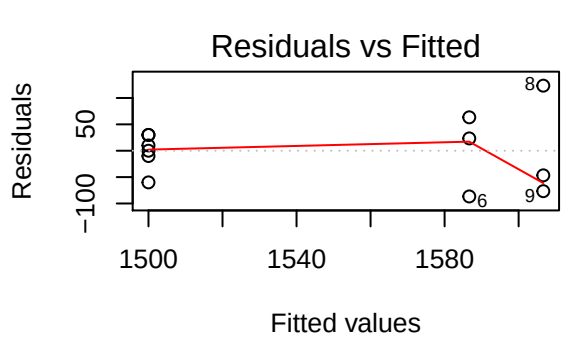
```r
cat("The P-value for the F statistic in part (a) is", fourB$`Pr(>F)`[1])
```

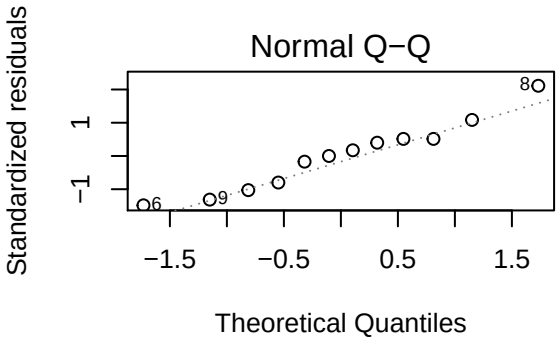
```
## The P-value for the F statistic in part (a) is 0.2137815
```

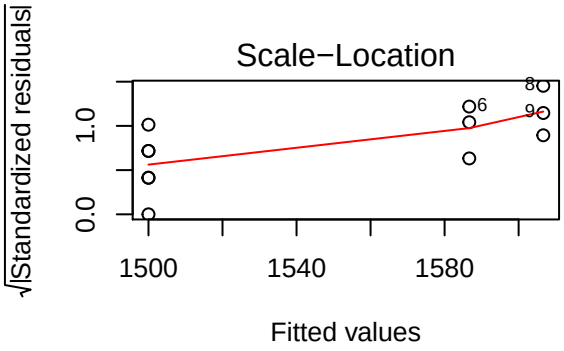
4c

```r
par(mfrow = c(2,2))
plot(m1)
```

```
## hat values (leverages) are all = 0.3333333
##  and there are no factor predictors; no plot no. 5
```





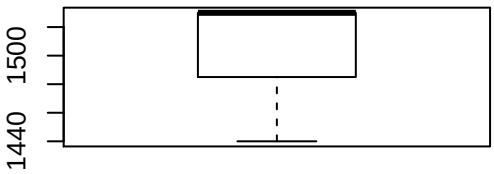


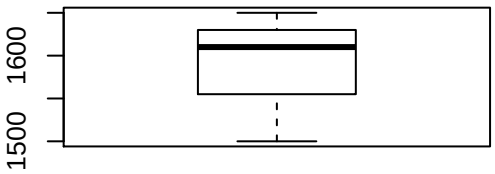

```
print("You can't really draw any conclusions - the residual graphs look pretty poor and there are just
```

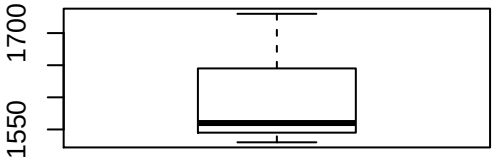
```
## [1] "You can't really draw any conclusions - the residual graphs look pretty poor and there are just
```

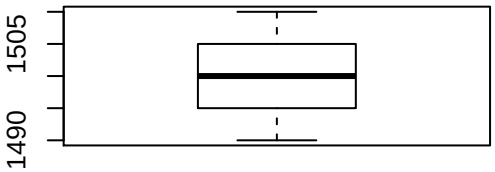
4d

```
par(mfrow=c(2,2))
boxplot(level10)
boxplot(level15)
boxplot(level20)
boxplot(level25)
```


1440
1500


1500
1600


1550
1700


1490
1505