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Activity Sheet - 10 – DESIGN OF EXPERIMENTS

1)

AIM: To find ANOVA using CRD to test the null hypothesis against alternative hypothesis with level of significance alpha=0.05

SYNTAX:

group<-data.frame(cbind(group1,group2,group3,group4,group5))

summary(group)

stgr<-stack(group)

crd<-aov(values~ind,data=stgr)

summary(crd)

boxplot(group,ylab="Aggregates",main="Absorption of Moisture")

CODE:

```
1  group1<-c(551,457,450,731,499,632)
2  group2<-c(595,580,508,583,633,517)
3  group3<-c(639,615,511,573,648,677)
4  group4<-c(417,449,517,438,415,555)
5  group5<-c(563,631,522,613,656,679)
6  group<-data.frame(cbind(group1,group2,group3,group4,group5))
7  summary(group)
8  stgr<-stack(group)
9  crd<-aov(values~ind,data=stgr)
10 summary(crd)
11 boxplot(group,ylab="Aggregates",main="Absorption of Moisture")
```

OUTPUT:

```
> summary(group)
     group1           group2           group3           group4
 Min.   :450.0    Min.   :508.0    Min.   :511.0    Min.   :415.0
 1st Qu.:467.5    1st Qu.:532.8    1st Qu.:583.5    1st Qu.:422.2
 Median :525.0    Median :581.5    Median :627.0    Median :443.5
 Mean   :553.3    Mean   :569.3    Mean   :610.5    Mean   :465.2
 3rd Qu.:611.8    3rd Qu.:592.0    3rd Qu.:645.8    3rd Qu.:500.0
 Max.   :731.0    Max.   :633.0    Max.   :677.0    Max.   :555.0
     group5
 Min.   :522.0
 1st Qu.:575.5
 Median :622.0
 Mean   :610.7
 3rd Qu.:649.8
 Max.   :679.0
> stgr<-stack(group)
> crd<-aov(values~ind,data=stgr)
> summary(crd)
            Df Sum Sq Mean Sq F value  Pr(>F)
ind          4  85356   21339   4.302 0.00875 **
Residuals   25 124020    4961
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
> boxplot(group,ylab="Aggregates",main="Absorption of Moisture")
```

GRAPH:

Absorption of Moisture
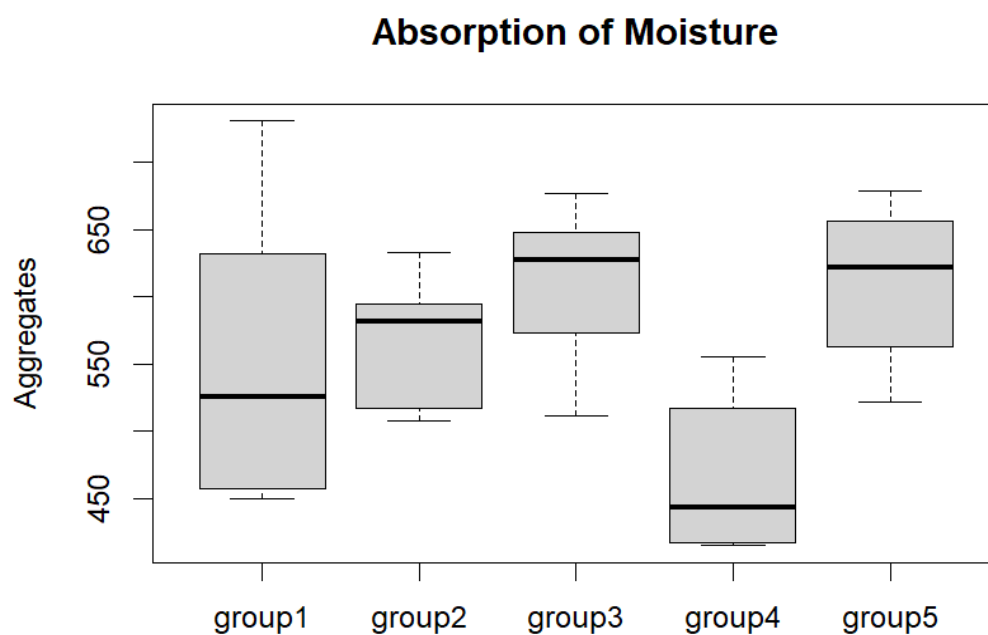
2)

AIM: To test the hypothesis H0 at the 0.05 level of significance, that the machines perform at the same mean rate of speed and there is no significant difference between the performances of the operators

SYNTAX:

data=read.table(file.choose(),header=TRUE)

time=c(t(as.matrix(data)))

f=c("Oper1","Oper2","Oper3","Oper4","Oper5","Oper6")

g=c("M1","M2","M3","M4")

k=ncol(data)

n=nrow(data)

Operators=gl(k,1,n*k,factor(f))

Machines=gl(n,k,n*k,factor(g))

anova=aov(time~Machines+Operators)

summary(anova)

interaction.plot(Operators,Machines,time)

par(mfrow=c(1,2))

plot(time~Machines+Operators,main="product time")

CODE:

```
13  #q2
14  data<-read.table(file.choose(),header=TRUE)
15  time=c(t(as.matrix(data)))
16  f=c("Oper1","Oper2","Oper3","Oper4","Oper5","Oper6")
17  g=c("M1","M2","M3","M4")
```

```
18  k=ncol(data)
19  n=nrow(data)
20  Operators=gl(k,l,n*k,factor(f))
21  Machines=gl(n,k,n*k,factor(g))
22  anova=aov(time~Machines+Operators)
23  summary(anova)
24  interaction.plot(Operators,Machines,time)
25  par(mfrow=c(1,2))
26  plot(time~Machines+Operators,main="Products in time")
```

OUTPUT:

```
> time=c(t(as.matrix(data)))
> f=c("Oper1","Oper2","Oper3","Oper4","Oper5","Oper6")
> g=c("M1","M2","M3","M4")
> k=ncol(data)
> n=nrow(data)
> Operators=gl(k,1,n*k,factor(f))
> Machines=gl(n,k,n*k,factor(g))
> anova=aov(time~Machines+Operators)
> summary(anova)
            Df Sum Sq Mean Sq F value  Pr(>F)
Machines     2  10.53   5.267   5.229 0.02790 *
Operators    5  37.72   7.545   7.490 0.00365 **
Residuals   10  10.07   1.007
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
> interaction.plot(Operators,Machines,time)
> par(mfrow=c(1,2))
> plot(time~Machines+Operators,main="product time")
Hit <Return> to see next plot:
```

GRAPH: