Balances Incomplete Block design (BIBD)

R code for metal harness data

```
# R code for BIBD hardness data

bibd=read.table("C:/Users/Mihinda/Desktop/bibd.txt", header=1) #the data file

bibd

bibd$Coupon <- as.factor(bibd$Coupon)

bibd$Tip <- as.factor(bibd$Tip)

fit <- lm(Hardness~Coupon+Tip, data=bibd) # Correct model

anova(fit)


#Incorrect Analysis

fit <- lm(Hardness~Tip+Coupon, data=bibd)

anova(fit)
```

R output

```
> # R code for BIBD hardness data
> bibd=read.table("C:/Users/Mihinda/Desktop/bibd.txt", header=1)
#the data file
> bibd
   Tip Coupon Hardness
1    1      1      9.3
2    1      2      9.4
3    1      4     10.0
4    2      2      9.3
5    2      3      9.8
6    2      4      9.9
7    3      1      9.2
8    3      2      9.4
9    3      3      9.5
10   4      1      9.7
11   4      3     10.0
12   4      4     10.2
> bibd$Coupon <- as.factor(bibd$Coupon)
> bibd$Tip <- as.factor(bibd$Tip)
> fit <- lm(Hardness~Coupon+Tip, data=bibd) # Correct model
> anova(fit)
Analysis of Variance Table

Response: Hardness
          Df  Sum Sq  Mean Sq F value   Pr(>F)
Coupon     3 0.90917 0.303056 29.3280 0.001339 **
Tip        3 0.26833 0.089444  8.6559 0.020067 *
Residuals  5 0.05167 0.010333
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
>
> #Incorrect Analysis
> fit <- lm(Hardness~Tip+Coupon, data=bibd)
> anova(fit)
Analysis of Variance Table

Response: Hardness
          Df  Sum Sq  Mean Sq F value   Pr(>F)
Tip        3 0.56250 0.187500  18.145 0.004054 **
Coupon     3 0.61500 0.205000  19.839 0.003311 **
Residuals  5 0.05167 0.010333
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
> Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```