# HW10

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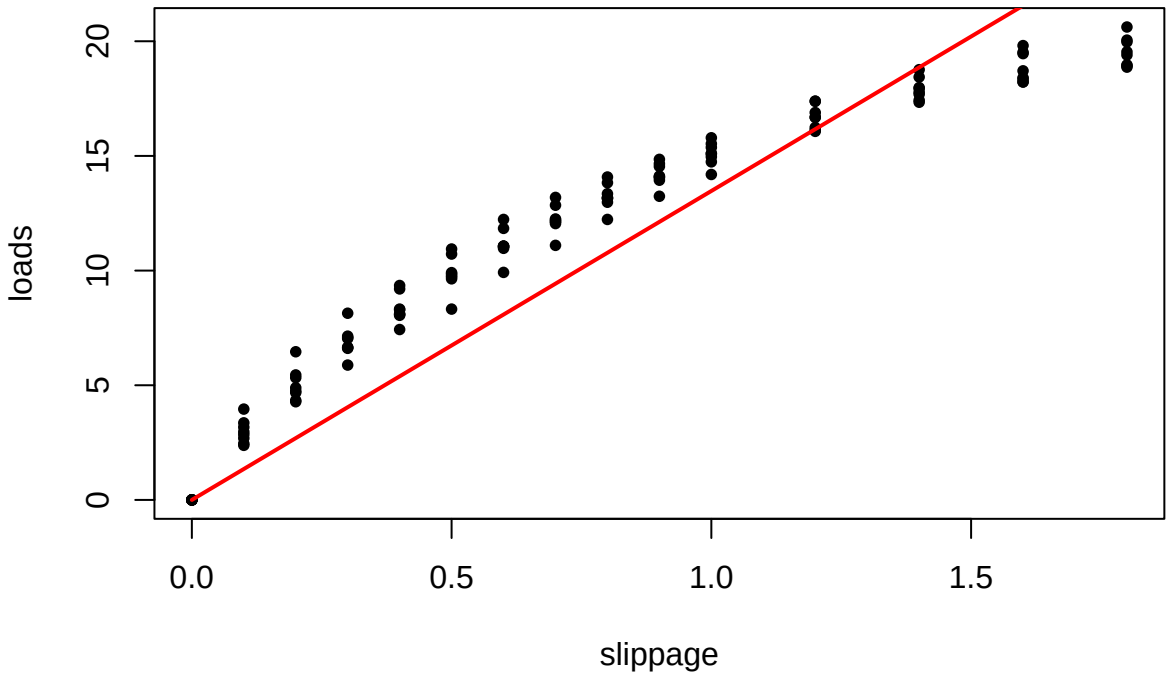
### Ex 8.1

```
timber <- read.table("timber.txt", header = TRUE)

model <- lm(loads ~ slippage -1 , data = timber)
x_new <- seq(min(timber$slippage), max(timber$slippage), length.out = 100)
y_pred <- predict(model, newdata = data.frame(slippage = x_new))

plot(timber$slippage, timber$loads, pch = 16, cex = 0.8, xlab = "slippage", ylab = "loads")
lines(x_new, y_pred, col = "red", lwd = 2)
```



## Ex 8.2

```
plasma <- read.table("plasma.txt", header = TRUE)
data1 <- plasma[,c(1,2,3,4)]
data2 <- plasma[,c(5,6,7,8)]
data2 <- rename(data2, Subject = Subject.1, group = group.1, time = time.1, plasma = plasma.1)
plasma <- rbind(data1, data2)
```

```
library(lme4)
```

```
## Loading required package: Matrix
```

```
lme <- lmer(plasma ~ time*group + (1+time+I(time^2)|Subject), data = plasma)
summary(lme)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: plasma ~ time * group + (1 + time + I(time^2) | Subject)
##    Data: plasma
##
## REML criterion at convergence: 438.6
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.9873 -0.4628  0.0236  0.4922  2.8422
##
## Random effects:
##  Groups   Name        Variance Std.Dev. Corr
##  Subject  (Intercept) 2.829863 1.68222
##           time        0.698274 0.83563  -0.94
##           I(time^2)   0.007664 0.08754   0.92 -1.00
##  Residual             0.134203 0.36634
## Number of obs: 264, groups:  Subject, 33
##
## Fixed effects:
##                 Estimate Std. Error t value
## (Intercept)      3.15794    0.16242  19.443
## time             0.04653    0.02203   2.112
## groupobese       1.06721    0.25878   4.124
## time:groupobese -0.12519    0.03510  -3.567
##
## Correlation of Fixed Effects:
##             (Intr) time   gropbs
## time        -0.678
## groupobese  -0.628  0.425
## time:gropbs  0.425 -0.628 -0.678
```

## Ex 8.3

```r
library(nlme)
```

```
##
## Attaching package: 'nlme'
```

```
## The following object is masked from 'package:lme4':
##
##     lmList
```

```
## The following object is masked from 'package:dplyr':
##
##     collapse
```

```r
BtheB <- read.table("BtheB.txt", header = TRUE)
BtheB$subject <- factor(rownames(BtheB))
nobs <- nrow(BtheB)
BtheB_long <- reshape(BtheB, idvar = "subject", varying = c("bdi.2m", "bdi.3m", "bdi.5m", "bdi.8m"),dir
BtheB_long$time <- rep(c(2, 3, 5, 8), rep(nobs, 4))
fit_ind <- lm(bdi ~ bdi.pre + time + treatment + drug + length, data = BtheB_long)
BtheB_lme1 <- lme(bdi ~ bdi.pre + time + treatment + drug +
                  length, random = ~ 1 | subject, data = BtheB_long,
                  na.action = na.omit)

ci_ind <- confint(fit_ind, "treatment", level = 0.95)
ci_lme1 <- intervals(BtheB_lme1, which = "fixed", level = 0.95, type = "profile")

ci_ind
```

```
##           2.5 % 97.5 %
## treatment    NA     NA
```

```r
ci_lme1
```

```
## Approximate 95% confidence intervals
##
##  Fixed effects:
##                    lower       est.      upper
## (Intercept)  -1.2663441  3.2666818  7.7997077
## bdi.pre       0.4753623  0.6331682  0.7909740
## time         -0.9905955 -0.7006036 -0.4106118
## treatmentTAU -1.0847523  2.3345544  5.7538611
## drugYes      -6.1452482 -2.6023289  0.9405903
## length>6m    -2.8391344  0.6674542  4.1740429
## length6m     -6.7207511 -1.3617483  3.9972546
```

## Ex 8.4

```
predict(BtheB_lme1)
```

```
##          1          2          3          4          5          6          7
##  6.0237934 20.6950381 18.7164772 14.6488114 20.1829127  1.8143492  8.1021977
##          8          9         10         11         12         13         14
## 19.5157009 15.5008498  9.3932886 19.5302436 33.4630995 24.5667906 28.6117723
##         15         16         17         18         19         20         21
## 16.7307394  7.1237456 28.2284326  9.1197423 30.4862711 12.7957606  9.2063121
##         22         23         24         25         26         27         28
## 18.5117905 17.6909043 19.8683827 23.9009589 13.1840995 13.1066775 39.4090899
##         29         30         31         32         33         34         35
##  5.7998615  6.9075821 12.3358720 10.5765777  8.4790690  5.7154981 23.9644972
##         36         37         38         39         40         41         42
## 34.8230064 13.0407779 14.6125710  4.4694442 25.8134824 36.2125218 19.8857260
##         43         44         45         46         47         48         49
##  9.8823406 18.0199875 10.0011722 27.0187555 23.3635188  2.4062858  3.5417434
##         50         51         52         53         54         55         56
## 44.2445244 28.8129520 18.8349465 40.1115709  5.9562879 22.3517136  5.5295220
##         57         58         59         60         61         62         63
## 13.6971407 33.8128403 24.7241411  5.7391443 20.5405189 21.5009155 12.1791596
##         64         65         66         67         68         69         70
## 16.2483434 15.4331613  4.6796625  5.7961046 17.8974114 20.4226072 26.3991483
##         71         72         73         74         75         76         77
##  6.1701953 22.6188557  8.6263268  8.6192934 22.2237595 16.8495157 13.1196830
##         78         79         80         81         82         83         84
## 10.1950967 12.1845995 23.8173093 25.1194921 12.9759507 14.5910057  8.2996320
##         85         86         87         88         89         90         92
## 41.7723473 15.6702339 16.1823840  5.7605343 13.5510855 10.6449349 25.5784160
##         93         94         95         96         98         99          1
##  9.9470417  6.0337869  7.3897842 12.4610715 14.4073230  6.4726543  5.3231898
##          2          4          6          7          8          9         10
## 19.9944344 13.9482078  1.1137456  7.4015941 18.8150973 14.8002462  8.6926849
##         11         13         14         15         16         17         18
## 18.8296400 23.8661869 27.9111686 16.0301358  6.4231420 27.5278290  8.4191387
##         19         20         22         23         26         28         29
## 29.7856675 12.0951569 17.8111869 16.9903007 12.4834959 38.7084863  5.0992578
##         30         31         32         33         35         37         38
##  6.2069784 11.6352684  9.8759741  7.7784654 23.2638935 12.3401743 13.9119673
##         39         40         42         43         45         47         48
##  3.7688405 25.1128787 19.1851223  9.1817370  9.3005686 22.6629151  1.7056821
##         50         53         54         55         56         57         58
## 43.5439208 39.4109672  5.2556843 21.6511100  4.8289183 12.9965371 33.1122367
##         61         62         63         64         66         67         68
## 19.8399152 20.8003118 11.4785559 15.5477397  3.9790589  5.0955010 17.1968078
##         71         72         73         75         76         77         78
##  5.4695916 21.9182521  7.9257231 21.5231559 16.1489121 12.4190793  9.4944930
##         80         81         83         84         85         86         88
## 23.1167057 24.4188884 13.8904021  7.5990283 41.0717437 14.9696303  5.0599307
##         89         90         92         93         94         95         96
## 12.8504819  9.9443313 24.8778124  9.2464381  5.3331833  6.6891805 11.7604678
##         98         99          2          4          6          7          8
## 13.7067194  5.7720506 18.5932272 12.5470005 -0.2874617  6.0003868 17.4138900
##          9         10         11         14         15         16         18
```

```
## 13.3990389  7.2914777 17.4284327 26.5099614 14.6289285  5.0219347  7.0179314
##         19         20         22         28         29         30         31
## 28.3844602 10.6939497 16.4099796 37.3072790  3.6980506  4.8057711 10.2340611
##         32         33         35         37         38         40         42
##  8.4747668  6.3772581 21.8626863 10.9389670 12.5107601 23.7116715 17.7839150
##         43         45         47         48         50         53         56
##  7.7805297  7.8993613 21.2617079  0.3044749 42.1427135 38.0097600  3.4277111
##         61         62         63         64         66         67         71
## 18.4387080 19.3991046 10.0773486 14.1465325  2.5778516  3.6942937  4.0683844
##         75         76         77         78         80         81         83
## 20.1219486 14.7477048 11.0178721  8.0932857 21.7154984 23.0176812 12.4891948
##         84         86         88         89         90         93         94
##  6.1978210 13.5684230  3.6587234 11.4492746  8.5431240  7.8452308  3.9319760
##         95         96         98         99          2          4          6
##  5.2879733 10.3592606 12.3055121  4.3708433 16.4914163 10.4451896 -2.3892726
##          7          8          9         10         11         14         15
##  3.8985759 15.3120791 11.2972280  5.1896667 15.3266218 24.4081505 12.5271176
##         16         18         19         20         22         29         30
##  2.9201238  4.9161205 26.2826493  8.5921388 14.3081687  1.5962396  2.7039602
##         31         32         33         35         37         38         40
##  8.1322502  6.3729559  4.2754472 19.7608754  8.8371561 10.4089492 21.6098606
##         42         43         45         47         50         53         56
## 15.6821041  5.6787188  5.7975504 19.1598970 40.0409026 35.9079491  1.3259001
##         61         62         67         71         75         76         77
## 16.3368970 17.2972937  1.5924828  1.9665735 18.0201377 12.6458939  8.9160611
##         78         80         81         83         84         86         88
##  5.9914748 19.6136875 20.9158703 10.3873839  4.0960101 11.4666121  1.5569125
##         89         90         94         95         96         98         99
##  9.3474637  6.4413131  1.8301651  3.1861623  8.2574497 10.2037012  2.2690324
## attr(,"label")
## [1] "Fitted values"
```

```
BtheB_long$predicted <- predict(BtheB_lme1,BtheB_long)
mean_profiles <- aggregate(bdi ~ treatment + time, data = BtheB_long, FUN = mean)
predicted_profiles <- aggregate(predicted ~ treatment + time, data = BtheB_long, FUN = mean)
mean_profiles
```

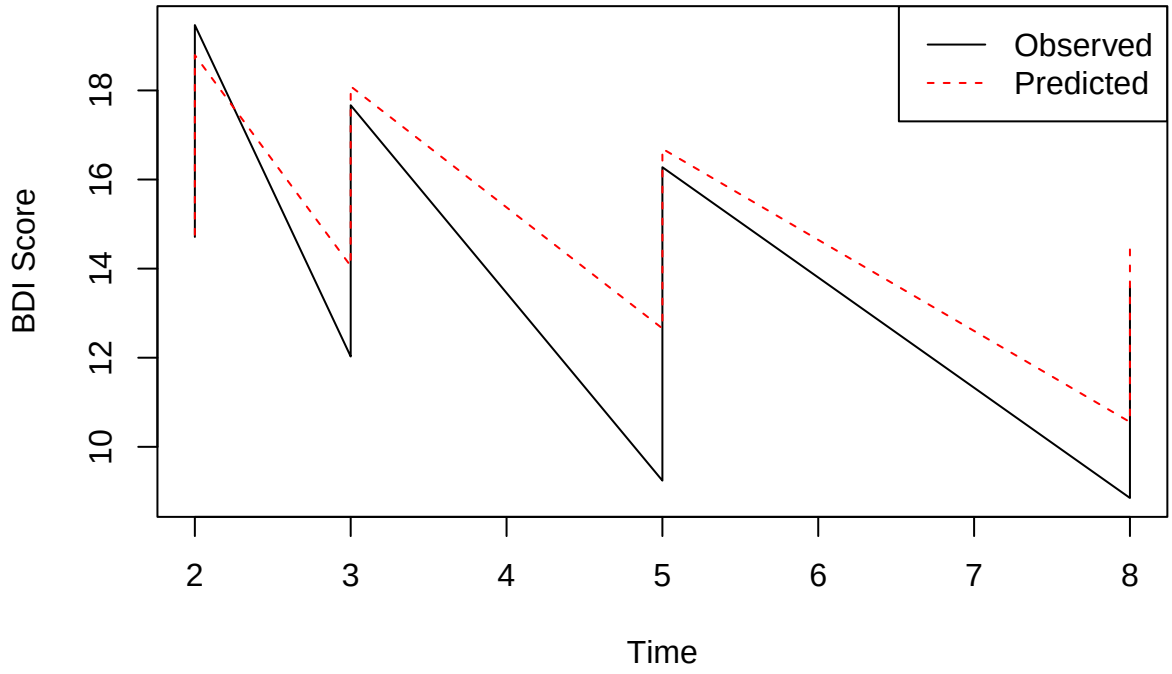
```
##   treatment time       bdi
## 1     BtheB    2 14.711538
## 2       TAU    2 19.466667
## 3     BtheB    3 12.027027
## 4       TAU    3 17.666667
## 5     BtheB    5  9.241379
## 6       TAU    5 16.275862
## 7     BtheB    8  8.851852
## 8       TAU    8 13.600000
```

```
predicted_profiles
```

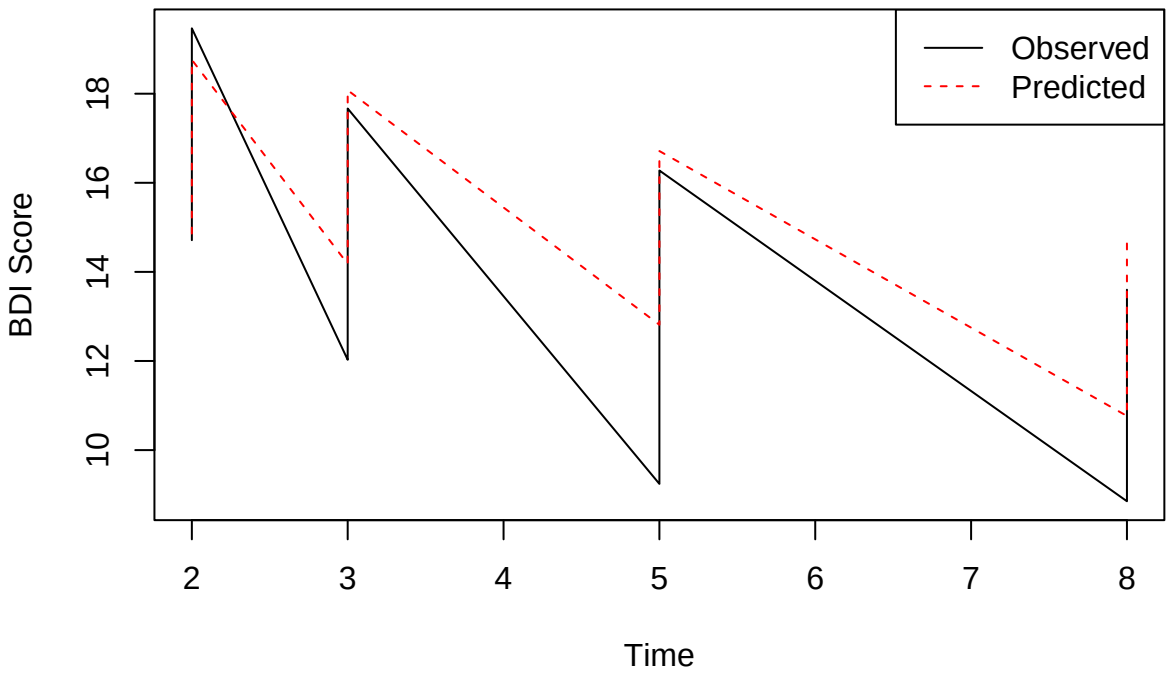
```
##   treatment time predicted
## 1     BtheB    2  14.76003
## 2       TAU    2  18.79269
## 3     BtheB    3  14.05942
```

```
## 4       TAU    3  18.09209
## 5     BtheB    5  12.65822
## 6       TAU    5  16.69088
## 7     BtheB    8  10.55641
## 8       TAU    8  14.58907
```

```r
# Plot mean profiles and predicted values
plot(mean_profiles$time, mean_profiles$bdi, type = "l", lty = 1, col = "black",
     xlab = "Time", ylab = "BDI Score")
lines(mean_profiles$time,predicted_profiles$predicted, type = "l", lty = 2, col = "red")
legend("topright", legend = c("Observed", "Predicted"), lty = c(1, 2), col = c("black", "red"))
```




```r
BtheB_lme_time <- lme(bdi ~ time + treatment,
                      random = ~ 1 | subject, data = BtheB_long, na.action = na.omit)
BtheB_long$predicted2 <- predict(BtheB_lme_time,BtheB_long)
mean_profiles2 <- aggregate(bdi ~ treatment + time, data = BtheB_long, FUN = mean)
predicted_profiles2 <- aggregate(predicted2 ~ treatment + time, data = BtheB_long, FUN = mean)
# Plot mean profiles and predicted values
plot(mean_profiles2$time, mean_profiles2$bdi, type = "l", lty = 1, col = "black",
     xlab = "Time", ylab = "BDI Score")
lines(mean_profiles2$time,predicted_profiles2$predicted, type = "l", lty = 2, col = "red")
legend("topright", legend = c("Observed", "Predicted"), lty = c(1, 2), col = c("black", "red"))
```




### Ex 8.5

From the ANOVA table we can see that The F-value associated with the interaction is 65.9338, which suggests that there may be evidence for an interaction effect. However, the p-value is 0.1435397, which is not significant at a conventional alpha level of 0.05. Therefore, it may be difficult to conclude definitively whether there is an interaction between treatment and time.

```
BtheB_lme2 <- lme(bdi ~ bdi.pre + time + treatment + drug + length + time*treatment,
                  random = ~ 1 | subject, data = BtheB_long, na.action = na.omit)

summary(anova(BtheB_lme2))
```

```
##      numDF           denDF          F-value           p-value
##  Min.   :1.000   Min.   : 91.0   Min.   :  0.2847   Min.   :0.0000000
##  1st Qu.:1.000   1st Qu.: 91.0   1st Qu.:  2.7668   1st Qu.:0.0000017
##  Median :1.000   Median : 91.0   Median :  3.8550   Median :0.0526499
##  Mean   :1.143   Mean   :129.6   Mean   : 65.9338   Mean   :0.1435397
##  3rd Qu.:1.000   3rd Qu.:181.0   3rd Qu.: 45.3020   3rd Qu.:0.0996054
##  Max.   :2.000   Max.   :181.0   Max.   :361.2591   Max.   :0.7529139
```