makiwaraboard\_Assignment.R

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library(stats4)  
library(matlib)  
maki = read.table("makiwaraboard.txt",header = TRUE)  
head(maki)

## WoodType BoardType Deflection  
## 1 Cherry Stacked 144.3  
## 2 Cherry Stacked 125.9  
## 3 Cherry Stacked 263.2  
## 4 Cherry Stacked 114.6  
## 5 Cherry Stacked 242.5  
## 6 Cherry Stacked 141.9

tail(maki)

## WoodType BoardType Deflection  
## 331 Oak Tapered 56.6  
## 332 Oak Tapered 123.5  
## 333 Oak Tapered 12.0  
## 334 Oak Tapered 62.0  
## 335 Oak Tapered 73.3  
## 336 Oak Tapered 44.9

maki$WoodType = factor(maki$WoodType,labels=c(2,1,3,4))  
maki$BoardType = factor(maki$BoardType,labels=c(1,2))  
X1 = maki$WoodType  
X2 = maki$BoardType  
Y = maki$Deflection  
# Building model without interactions  
loglik1 = function(beta0,beta2,beta3,beta4,alpha2,mu,sigma) {  
 R = Y - I(X1==2)\*beta2 - I(X1==3)\*beta3 - I(X1==4)\*beta4 - I(X2==2)\*alpha2 - beta0  
 R = suppressWarnings(dnorm(R, mu, sigma))  
 -sum(log(R))  
}  
m = mle(loglik1, start=list(beta0 = 100, beta2= 6.5,beta3=-17,beta4=-21,alpha2=-37, sigma=55,mu=0))  
summary(m)

## Warning in sqrt(diag(object@vcov)): NaNs produced

## Maximum likelihood estimation  
##   
## Call:  
## mle(minuslogl = loglik1, start = list(beta0 = 100, beta2 = 6.5,   
## beta3 = -17, beta4 = -21, alpha2 = -37, sigma = 55, mu = 0))  
##   
## Coefficients:  
## Estimate Std. Error  
## beta0 108.270322 NaN  
## beta2 -6.538042 8.605201  
## beta3 -23.620758 8.663445  
## beta4 -27.781775 8.379743  
## alpha2 -37.269039 6.087052  
## mu 8.270322 NaN  
## sigma 55.562630 2.143232  
##   
## -2 log L: 3653.325

# Building model with interactions  
loglik2 = function(beta0,beta2,beta3,beta4,alpha2,gam22, gam32, gam42, mu,sigma) {  
 R = Y - I(X1==2)\*beta2 - I(X1==3)\*beta3 - I(X1==4)\*beta4 - I(X2==2)\*alpha2 - beta0 - (I(X1==2)\*I(X2==2))\*gam22 -(I(X1==3)\*I(X2==2))\*gam32 - (I(X1==4)\*I(X2==2))\*gam42  
 R = suppressWarnings(dnorm(R, mu, sigma))  
 -sum(log(R))  
}  
m\_inter = mle(loglik2, start=list(beta0 = 100, beta2= 6.5,beta3=-17,beta4=-21,alpha2=-37, gam22=0, gam32=0, gam42=0, sigma=55,mu=0))  
summary(m\_inter)

## Warning in sqrt(diag(object@vcov)): NaNs produced

## Maximum likelihood estimation  
##   
## Call:  
## mle(minuslogl = loglik2, start = list(beta0 = 100, beta2 = 6.5,   
## beta3 = -17, beta4 = -21, alpha2 = -37, gam22 = 0, gam32 = 0,   
## gam42 = 0, sigma = 55, mu = 0))  
##   
## Coefficients:  
## Estimate Std. Error  
## beta0 108.8703208 NaN  
## beta2 -11.8640240 12.68251  
## beta3 -23.6109606 12.87948  
## beta4 -27.5924620 11.98833  
## alpha2 -39.6436529 11.98822  
## gam22 9.8407079 17.25916  
## gam32 0.4930419 17.40421  
## gam42 -0.5771224 16.75573  
## mu 8.8703208 NaN  
## sigma 55.5259043 0.00000  
##   
## -2 log L: 3652.858

# 2a   
pred\_42 = (coef(m)["beta0"] + coef(m)["beta4"] + coef(m)["alpha2"])  
pred\_42

## beta0   
## 43.21951

# 2b  
# Testing for significance of interaction effect  
K = rbind(matrix(c(0,0,0,0,0,1,0,0),nrow=1,ncol=8),matrix(c(0,0,0,0,0,0,1,0),nrow=1,ncol=8),matrix(c(0,0,0,0,0,0,0,1),nrow=1,ncol=8))  
K # K matrix

## [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8]  
## [1,] 0 0 0 0 0 1 0 0  
## [2,] 0 0 0 0 0 0 1 0  
## [3,] 0 0 0 0 0 0 0 1

# Wald Statistic  
W = ((((coef(m\_inter)["sigma"]\*\*2)\*(336-8)) - ((coef(m)["sigma"]\*\*2))\*(336-5))/3)/(coef(m\_inter)["sigma"]\*\*2)  
W

## sigma   
## -1.145999

# 2c  
diff = (coef(m\_inter)["beta0"] + coef(m\_inter)["beta4"] + coef(m\_inter)["alpha2"] + coef(m\_inter)["gam42"])-coef(m\_inter)["beta0"]  
X = cbind(1,X1,X2)  
V = (t(X)%\*%X)  
V= inv(V)  
NewX = matrix(c(1,2,1))  
s\_err = (coef(m\_inter)["sigma"])\*sqrt(2 + t(NewX)%\*%V%\*%(NewX))  
t\_value = diff/s\_err  
t\_value

## [,1]  
## [1,] -0.8620412

pt(t\_value,df=328,lower.tail = FALSE)# Accept Null hypothesis as p\_value > 0.05

## [,1]  
## [1,] 0.8053527