

```

y11<-c(30.9,31.9,31.3,32.1,30.9,31.3,31.3,32.1,30.3,32.2)
y12<-c(30.7,31.6,31.1,31.0,31.2,31.7,31.8,33.0,30.9,32.1)
y13<-c(30.9,31.6,31.0,31.7,30.5,31.4,31.8,31.7,30.8,32.2)
y14<-c(30.9,31.7,31.3,31.3,30.8,31.2,31.7,31.5,30.6,32.4)
y1<-cbind(y11,y12,y13,y14)

y21 <- c(31.5, 31.2, 31.3, 30.4, 30.7, 29.8, 31.4, 30.9, 31.1, 31.3)
y22 <- c(30.6, 31.2, 31.3, 30.8, 30.9, 30.8, 32.0, 32.4, 31.3, 31.5)
y23 <- c(30.8, 31.1, 31.5, 30.4, 30.9, 30.9, 31.7, 31.8, 31.2, 31.6)
y24 <- c(31.0, 31.3, 31.4, 30.2, 30.9, 30.8, 31.6, 31.9, 31.2, 31.7)
y2 <- cbind(y21, y22, y23, y24)

y <- rbind(y1, y2)

group <- rep(1:2, c(10, 10))

```

Exploratory

```

### group 1

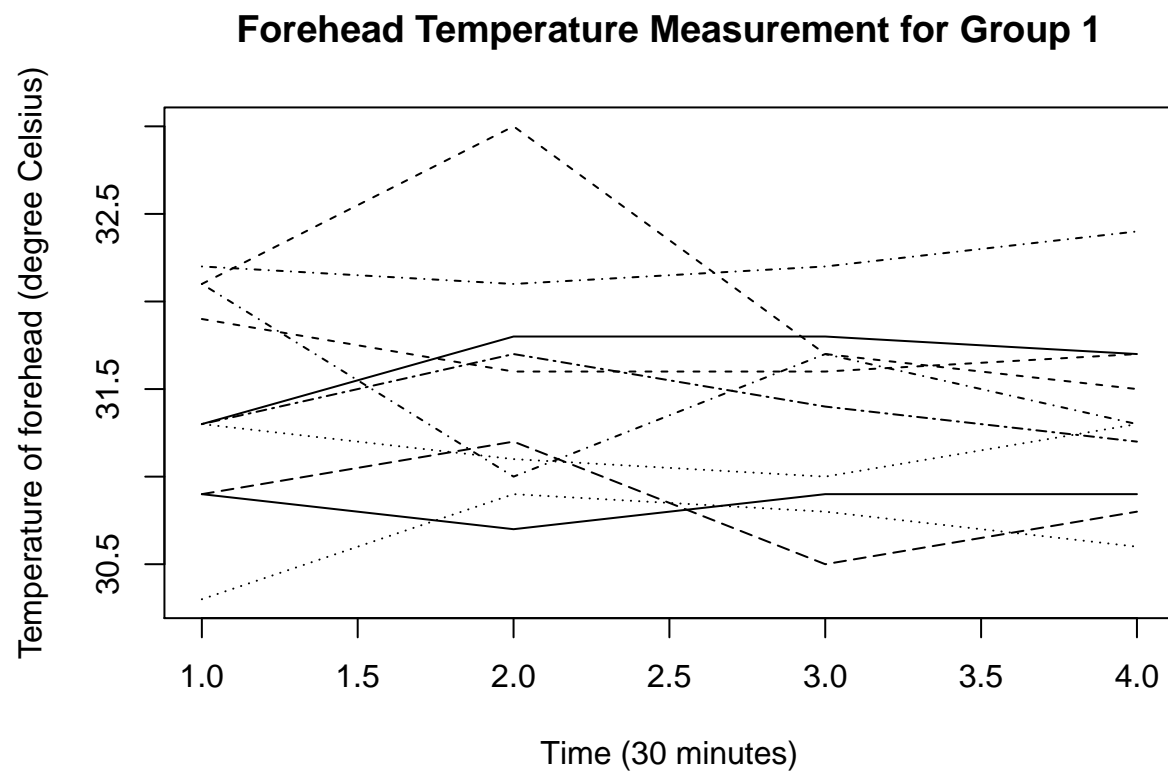
id <- rep(1:10,rep(4,10))

time <- rep(c(1:4),10)

meas <- as.vector(t(y[1:10,]))

long.plot(id, time, meas,
          xlabel = 'Time (30 minutes)',
          ylabel = 'Temperature of forehead (degree Celsius)',
          main= 'Forehead Temperature Measurement for Group 1',cex=1.5)

```

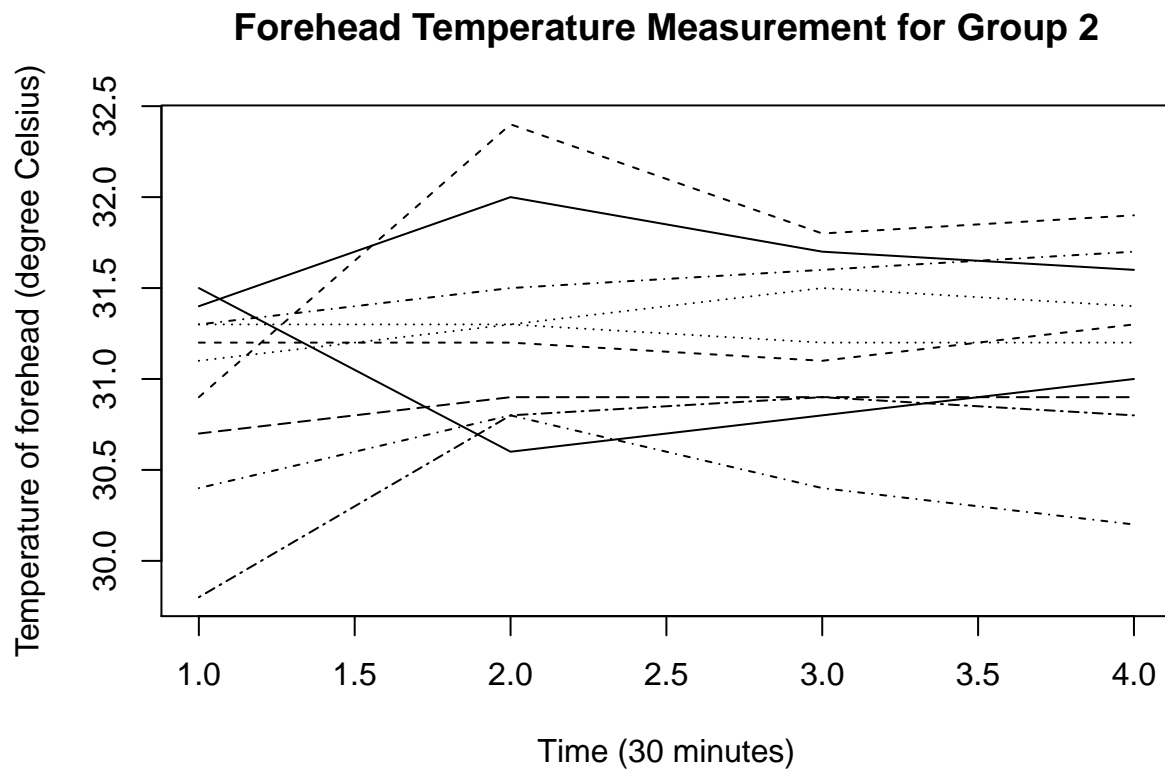


- The trend overtime for group 1 seems like there is not a clear trend overall for all subjects.

```
### group 2

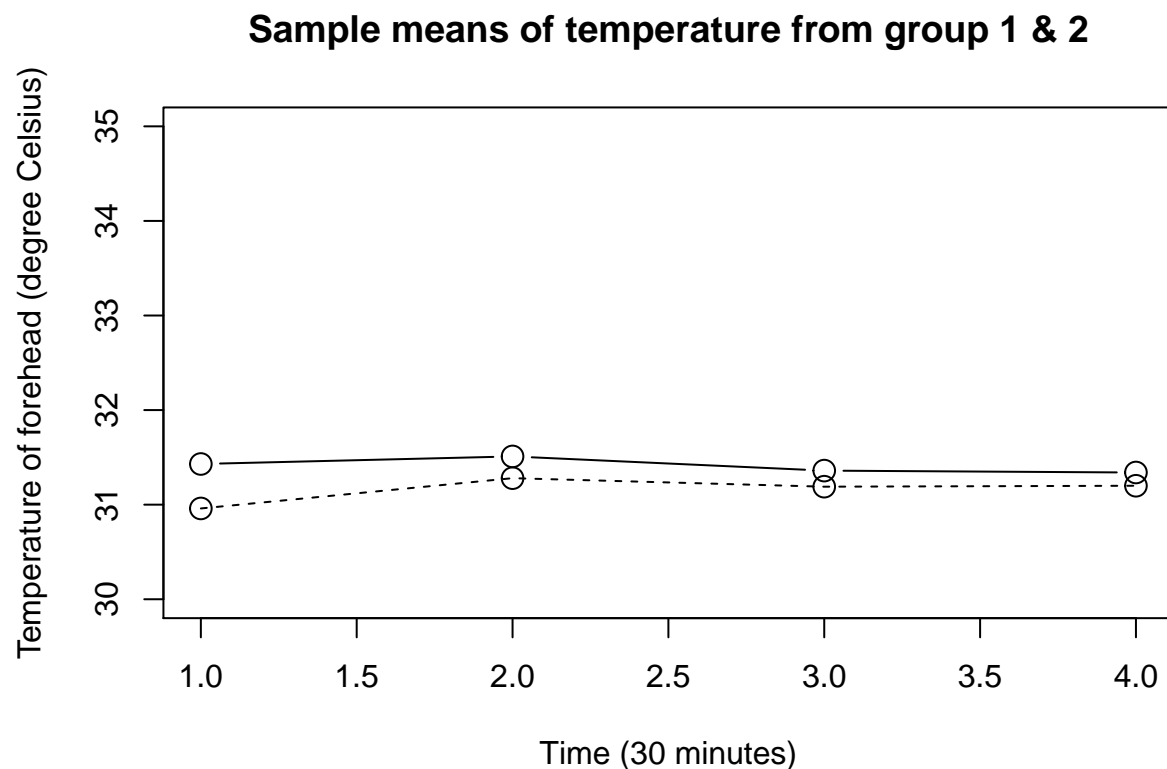
meas <- as.vector(t(y[11:20,]))

long.plot(id, time, meas,
  xlabel = 'Time (30 minutes)',
  ylabel = 'Temperature of forehead (degree Celsius)',
  main= 'Forehead Temperature Measurement for Group 2',cex=1.5)
```



- The time trend for group 2 seems like on average as time interval increase, the temperature increases.

```
plot(c(1, 2, 3, 4), apply(y[1:10,], 2, mean),
     xlab='Time (30 minutes)',
     ylab='Temperature of forehead (degree Celsius)',
     type='b', cex=1.5,
     ylim=c(30, 35),
     main='Sample means of temperature from group 1 & 2')
lines(c(1, 2, 3, 4), apply(y[11:20,], 2, mean), lty=2)
points(c(1, 2, 3, 4), apply(y[11:20,], 2, mean), cex=1.5)
legend(8, 30, c('Boys', 'Girls'), lty=1:2)
```



- The sample mean of two groups look very close to each other.

Test for Group Effect

```
fit1 <- manova(y ~ group)
summary(fit1, test = "Hotelling")
```

```
##           Df Hotelling-Lawley approx F num Df den Df Pr(>F)
## group      1           0.24502  0.91882     4    15 0.4786
## Residuals 18
```

- Since p-value is very high compare to alpha level = 0.05, we can conclude that there is no statistically significant in group effect

Test for Group by Time Interaction

```
S1<-cov(y[1:10,])
S2<-cov(y[11:20,])
S<-((10-1)*S1+(10-1)*S2)/(20-2)
```

```

y1bar<-apply(y[1:10,],2,mean)
y2bar<-apply(y[11:20,],2,mean)

C<-matrix(c(-1,1,0,0,0,-1,1,0,0,0,-1,1),byrow=T,ncol=4)

CSC <- C %*% S %*% t(C)

Cdiffy <- C %*% (y1bar-y2bar)

T2_int <- (10*10)/20 * t(Cdiffy) %*% solve(CSC) %*% Cdiffy

F_int = (20-3-1)/((20-2)*3)*T2_int

1-pf(F_int,3,16)

```

```

##           [,1]
## [1,] 0.4444887

```

- There is no evidence to conclude that group by time interaction is significant

Overall time trend

```

newy1 <- c(y11, y21) - c(y12, y22)
newy2 <- c(y12, y22) - c(y13, y23)
newy3<- c(y13, y23) - c(y14, y24)
newy<-cbind(newy1,newy2,newy3)

Sstar<-cov(newy)
ybarstar <- apply(newy,2,mean)
T2_trend <- 20*t(ybarstar) %*% solve(Sstar) %*% ybarstar

F_trend <- (20-4+1)/(19*3) *T2_trend

1-pf(F_trend, 3, 17)

```

```

##           [,1]
## [1,] 0.5641254

```

- There is no evidence to conclude that overall time trend is significant