HW3 STAT512 Fall2014

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October 8, 2014

3.

Sol:

```
t <- 9 # number of treatment
N <- 36 # number of experiment units
ni <- N/t # number of experiment units per treatment
df1.crd <- t - 1 # numerator degree of freedom for CRD
df2.crd <- N - t # denuminator degree of freedom for CRD
trt <- rep(c(0.5, 0.25, 0), each = 3) # treatment mean
trt.bar <- mean(trt)
sigma2.crd <- 0.1 # sigma2_CRD
q.trt <- sum((trt - trt.bar)^2)
ncp.crd <-q.trt/sigma2.crd # non cemtral parameter
alpha <- 0.05 # alpha level
ftest.crd <- qf(1-alpha, df1.crd,df2.crd, ncp = 0) # F test value
power.crd <- 1 - pf(ftest.crd, df1.crd, df2.crd, ncp = ncp.crd) # power of CRD
power.crd

## [1] 0.1764

## We calculate the same quantities for BIBD

b <- 12
k <- 3
t <- 9
r <- b*k/t
q.bibd <- sum((trt - trt.bar)^2)

df1.bibd <- t-1
df2.bibd <- b*k - t - b +1
## the function below calculates the difference between powers of BIBD and CRD
diff.power<- function(sigma2){
  ftest.bibd <- qf(1-alpha, df1.bibd,df2.bibd, ncp = 0) # F test value
  out <- 1 - pf(ftest.bibd, df1.bibd, df2.bibd, ncp = t*(t-1)/(k*(k-1))*q.bibd/sigma2) # pou
```

```
  return(out-power.crd) # difference of the two powers
}

## Root of the diff.power is the value of sigma2_BIBD that we need
uniroot(diff.power, c(0.0001,2) )$root

## [1] 1.031
```

Hence, $\sigma^2_{BIBD} = 1.031$ is the value of the response variance for the BIBD such that the power of the F-test of the BIBD at the $\alpha = 0.05$ equal to that of CRD.