Ch6 Question 12.

Solution 1. *This is a question of power analysis (sample size computation).*

We have $\Delta_A = \Delta_B = 4, \alpha = 0.05, \sigma^2 < 7.5, a = b = 3, power = 0.9$. *We need to compute group sample size(by saying group we mean group of treatment combination here)* n.

We have:

$$n = \frac{2a\sigma^2\phi^2}{b\Delta_A^2}$$

for factor A *(word type) and*

$$n = \frac{2b\sigma^2\phi^2}{a\Delta_B^2}$$

for factor B *(distraction type).*

We have an issue here though, the response is not really normal, instead it is binomial. To properly do this problem, we need adjust our code for appropriate approximation. However we temporarily pretend we do not have this issue and just 'play along':

Compute the effect size:

$$f = \sqrt{\frac{\frac{1}{3}(\frac{\Delta_{A\ or\ B}}{2})^2 + \frac{1}{3}(\frac{\Delta_{A\ or\ B}}{2})^2}{\sigma^2}} = \sqrt{\frac{\Delta^2}{6\sigma^2}}$$

and we got the following code to compute our sample size needed for each factor:

```
library(pwr)
delta = 4
alpha = 0.05
sigma_sqr = 7.5
#effective size
f <- sqrt(4*4/6/7.5)
#compute sample size
power <- pwr.anova.test(k = 3, n= NULL, f = f, sig.level=0.05, power = 0.9)
power

##
##      Balanced one-way analysis of variance power calculation
##
##               k = 3
##               n = 12.92108
##               f = 0.5962848
##       sig.level = 0.05
##           power = 0.9
##
## NOTE: n is number in each group
```

So for both factor A and B, we need at least 13 *at each level (either A or B), which makes the total sample size be at least* $13 \times 3 = 39$. *However considering we are having a balanced study, we need the total sample size be the multiple of* 9, *thus we need* 45 *subjects in total, and* 5 *in each treatment combination.*