Homework Assignment 4
Solutions

1. Please also see the code.
   (a) You need 17 subjects per group, for a total of 34.
   (b) The power is 56%.
   (c) The power is up to 69% now.
   [ 3 points ]

2. Please see the code. The type I error is not affected by the incorrect analysis, but we lose some power by not using the two-sample t-test (51% versus 57%).
   [ 4 points ]

3. Please also see the code.
   (a) Only one hypothesis test would be considered significant when controlling the FWER at 5% using the Bonferroni correction (the one with p=0.003).
   (b) When controlling the FDR at 5% with Benjamini-Hochberg, four brain regions would would be called significant (the ones with p < 0.016).
   [ 3 points ]

4. Please see the code.
   [ 2 points ]

5. (a) We have $H_0 : \mu = 7250/mm^3$ versus $H_a : \mu < 7250/mm^3$.
   (b) Using the information provided, the test statistic is $T = (4767-7250)/(3204/\sqrt{15}) = -3.00$. Using a t-distribution with 14 degrees of freedom, the critical value is $qt(0.05,14) = -1.76$, and thus, we reject the null hypothesis. The actual p-value is $pt(-3.00,14) = 0.0048$.
   (c) There is strong evidence that persons infected with E.canis do on average have lower white blood cell counts.
   [ 3 points ]

6. Please also see the code.
   (a) We assume that the variance of the observations in the case group is the same as in the control group of healthy individuals.
(b) The standard deviation of the measurements in the 10 healthy individuals is 3.4, and is used in the power calculations. With `power.t.test(n=40, sd=3.4, power=0.8, sig.level=0.01)` you can find in the output that \( \delta = 2.655605 \), so about 2.66. This is the true difference in population mean lipid levels between cases and controls you can detect with 80% power at a 1% significance level in the hypothesis test.

(c) The detectable difference in means is 3.00.

(d) The detectable difference in means is 2.16.

(e) The detectable difference in means is 2.50.

(f) When your desired power increases, the detectable difference in means has to increase, all other parameters being the same. When your desired type I error rate decreases for a fixed power level, the detectable difference in means has to increase. You are being more stringent about making a type I error, thus, you need a stronger signal to surpass this stringency.

[ 4 points ]