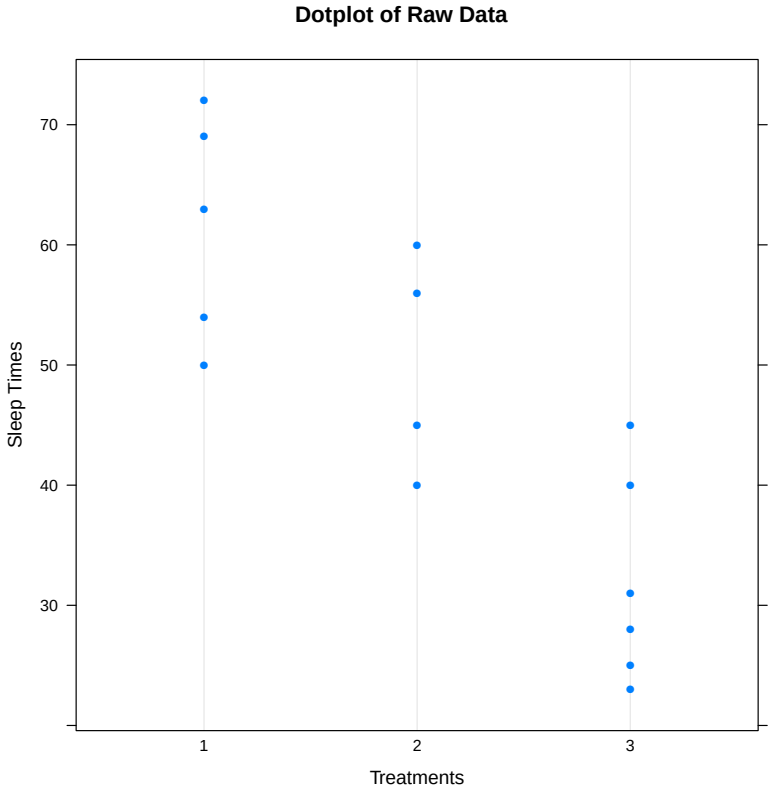
Assignment #8 — Solutions

1. A study was conducted to explore the effects of ethanol on sleep time. Fifteen rats were randomized to one of three treatments. Treatment 1 got only water (control). Treatment 2 got 1g of ethanol per kg of body weight, and treatment 3 got 2g/kg of ethanol. The amount of REM sleep in a 24hr period was recorded, in minutes. Data are below:

   Treatment 1: 63, 54, 69, 50, 72
   Treatment 2: 45, 60, 40, 56
   Treatment 3: 31, 40, 45, 25, 23, 28

   (a) Make a preliminary graph of the data. Why did you choose the graph that you did and what does it tell you? A dotplot is a good idea. It's better than a boxplot because there isn't much data:



   Sleep time seems to decrease with increasing ethanol. There are no visible outliers, and the variance seems pretty similar.

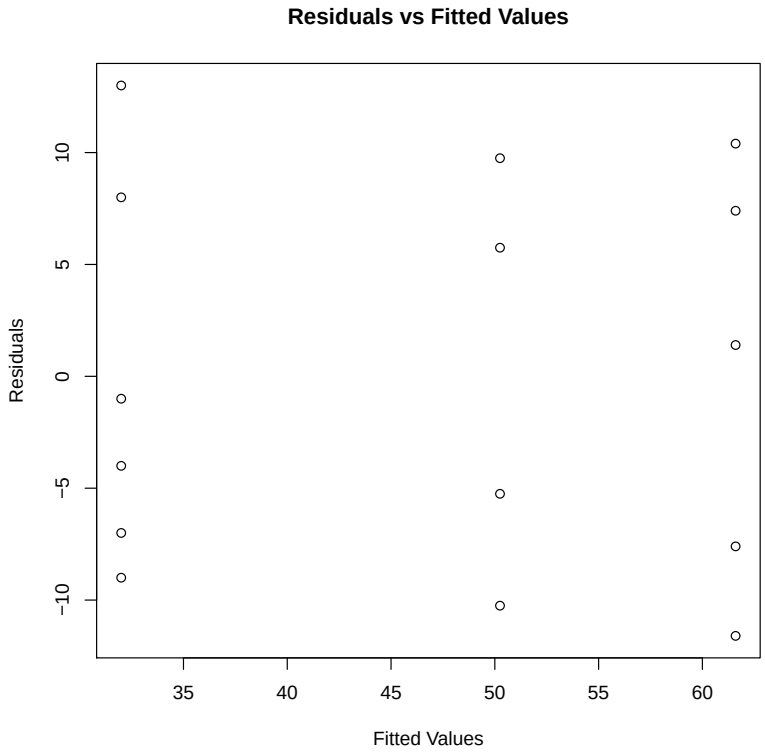
   (b) State hypotheses relevant to the problem if it is desired to determine whether there are any differences in the mean sleep times for the three treatments. The hypotheses are:

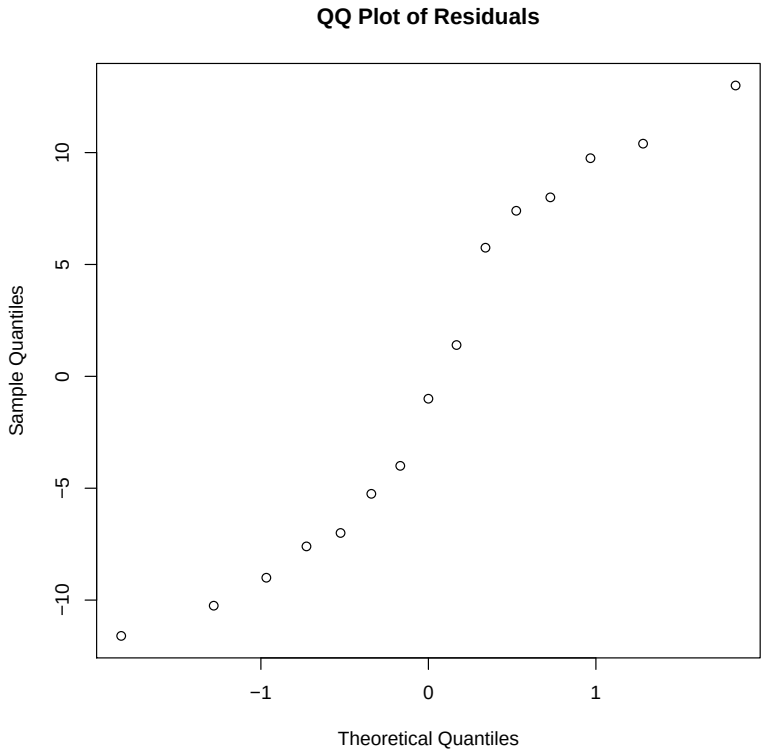
$$H_0 : \mu_1 = \mu_2 = \mu_3$$
vs.
H_A: At least one mean differs from one other mean

(c) Create the complete ANOVA table for this data using the formulas provided in class. Show your work. You may use R to check your answers and compute a more exact p-value. The ANOVA table is as follows:

Source	SS	df	MS	F	p-value
Treat (between)	2456.98	2	1228.49	14.77	0.0006
Error (within)	997.95	12	83.16		
Total	3454.93	14			

(d) Evaluate the ANOVA assumptions graphically. Was ANOVA appropriate here? We need to make a residuals vs fitted graph, and a QQ plot of residuals:





The residuals vs fitted plot shows the variance to be fairly constant across treatments. The QQ plot shows some s-shape, but should be close enough.

(e) Based on the ANOVA table, make a conclusion in the context of the problem using $\alpha = 0.1$. The p-value is smaller than 0.1, so we reject the null. At least one of the treatment means differs from one other treatment mean. Ethanol seems to have some sort of effect on REM sleep time.