HW 6: Ch. 12 #19, 22, 23, 28, and 31
Due sometime next week (ideally by Nov. 4th)

19. Researchers studying the number of electric fish species living in various parts of the Amazon basin were interested in whether the presence of tributaries affected the local number of electric fish species in the main rivers (Fernandes et al. 2004). They counted the number of electric fish species above and below the entrance point of a major tributary at 12 different river locations. Here's what they found:

Tributary	Upstream number of species	Downstream number of species
Içá	14	19
Jutaí	11	18
Japurá	8	8
Coari	5	7
Purus	10	16
Manacapuru	5	6
Negro	23	24
Madeira	29	30
Trombetas	19	16
Tapajós	16	20
Xingu	25	21
Tocantins	10	12

a. What is the mean difference in the number of species between areas upstream and downstream of a tributary? What is the 95% confidence interval of this mean difference?

b. Test the hypothesis that the tributaries have no effect on the number of species of electric fish.

22. Weddell seals live in the Antarctic and feed on fish during long, deep dives in freezing water. The seals benefit from these feeding dives, but the food they gain comes at a metabolic cost. The dives are strenuous. A set of researchers wanted to know whether feeding per se was also energetically expensive, over and above the exertion of a regular

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dive (Williams et al. 2004). They determined the metabolic cost of dives by measuring the oxygen use of seals as they surfaced for air after a dive. They measured the metabolic cost of 10 feeding dives and for each of these also measured a nonfeeding dive by the same animal that lasted the same amount of time. The data, in (ml O_2 kg^{-1}), are as follows:

Individual	Oxygen consumption after nonfeeding dive	Oxygen consumption after feeding dive
1	42.2	71.0
2	51.7	77.3
3	59.8	82.6
4	66.5	96.1
5	81.9	106.6
6	82.0	112.8
7	81.3	121.2
8	81.3	126.4
9	96.0	127.5
10	104.1	143.1

a. Estimate the mean change in oxygen consumption during feeding dives compared with nonfeeding dives.
b. What is the 99% confidence interval for the population mean change?
c. Test the hypothesis that feeding does not change the metabolic costs of a dive.

23. Hyenas, famously, laugh. (The technical term used by hyena biologists is "giggle.") Mathevon et al. (2010) investigated the information content of hyena giggles. In one analysis, they compared the giggles of pairs of hyenas, in which one member of each pair was the more dominant and the other socially subordinate. They measured the spectral variability of the hyena giggles using the coefficient of variation (CV) of sound spectrum features. Here are the data with these measures for each member of the pairs:

Spectral CV of dominant individual	Spectral CV of subordinate individual
0.384	0.507
0.386	0.569
0.252	0.235
0.226	0.415
0.323	0.436
0.287	0.451
0.303	0.399
0.317	0.220
0.277	0.338

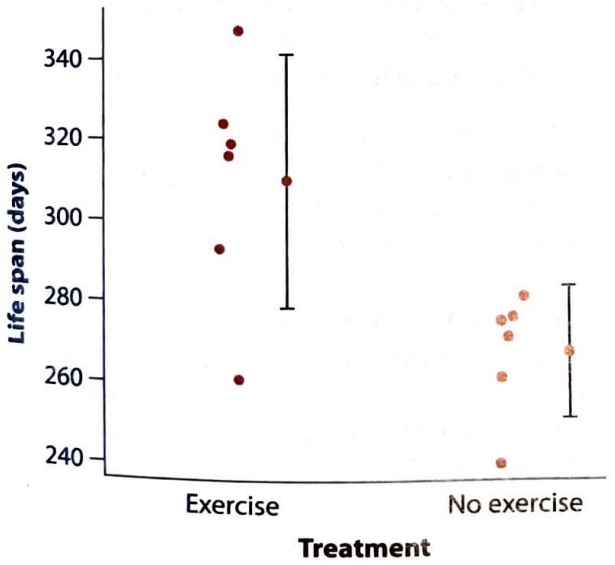
Do dominant and subordinate individuals differ in the means of giggle spectral CV?

a. What type of graph is shown?
b. Using only the graph, is it possible to predict the outcome of a formal test of whether mean life span differs between the two treatments? Explain.
c. Test whether exercise affects life span in mice affected by the disease.
d. By how many days does exercise increase life span on average? Use a confidence interval to answer this question.

28. Spinocerebellar ataxia type 1 is a neurodegenerative disease marked by the gradual loss of motor skills and culminating in early death. It is caused by an expanded CAG repeat in the coding region of the *Ataxin-1* gene. Fryer et al. (2011) investigated the possible beneficial effects of exercise in treating the disease. They used a mild exercise regimen in a mouse model of the disease (a mouse strain in which an expanded CAG repeat was "knocked in" to the mouse version of the same gene, and that had similar symptoms). The life spans (in days) are given below for six exercised mice and six mice not given the exercise regimen. The data and 95% confidence intervals are shown in the accompanying graph.

No exercise: 240, 261, 271, 275, 276, 281

Exercise: 261, 293, 316, 319, 324, 347



31. Individuals with sleep apnea have pauses in their breathing while sleeping that disrupt their normal sleep. A didgeridoo instructor noticed that several of his students reported sleeping better after practicing with this instrument. This led to a randomized clinical trial to determine whether playing the didgeridoo would improve sleep (Puhan et al. 2006). Twenty-five volunteers with sleep apnea were recruited for the study. Didgeridoo lessons were randomly assigned to 14 subjects, whereas the remaining 11 subjects formed the control group without didgeridoo playing. All subjects were assessed before the trial and after 8 weeks using the Epsworth scale, which gives values of 0 for no daytime sleepiness to >11 for excessive daytime sleepiness. The change in Epsworth scales for each patient over the course of the experiment is below. A negative change in score indicates improvement.

Didgeridoo group: −10, −10, −7, −1, −3, −4, −9, −2, −6, −7, 0, −2, 0, −1

Control group: −5, 0, −4, −1, −1, 4, −2, −5, −1, −1, 0

a. Use an appropriate method to test whether means of the two treatment groups differ significantly in their change in Epsworth scale. Which group improved more?

b. Calculate a 95% confidence interval for the difference between the means of the didgeridoo-playing and control groups for Epsworth scale change.

c. How big is the effect of didgeridoo playing on sleepiness score? Consider a true difference lower than −5 (or greater than 5) to be a *large* effect, and a true difference between −1 and 1 to be a *small* effect. Based on the confidence interval you calculated in (b), can we say that the effect size is large, small, or uncertain (i.e., the data aren't conclusive, and it might be large or small)?