Assignment #7, due on April 27

1. A dairy scientist is testing a new feed additive. She chooses 13 cows at random from a large population of cows. She randomly assigns $n_{old} = 8$ to get the old diet, and $n_{new} = 5$ to get the new diet including the additive. The cows are housed in 13 separated pens and each gets separate feed, with or without additive as appropriate. After two weeks, she picks a day and milks each cow using standard procedures and records the milk produced in pounds. The data are below:

$$\text{Old Diet: 43, 51, 44, 47, 38, 46, 40, 35}$$
$$\text{New Diet: 47, 75, 85, 100, 58}$$

Let μ_{new} and μ_{old} be the population mean milk productions for the new and old diets, respectively. She wishes to test:

$$H_0 : \mu_{new} - \mu_{old} = 0$$
$$\text{vs.}$$
$$H_A : \mu_{new} - \mu_{old} \neq 0$$

using $\alpha = 0.05$.

(a) Comment on the assumption that the cows are independent both within and between treatments.

(b) Graph the data as you see fit. Why did you choose the graph(s) that you did and what does it (do they) tell you?

(c) Choose a test appropriate for the hypotheses above, and justify your choice based on your answers to parts (a) and (b). Then perform the test by computing a p-value, and making a reject or not reject decision. You may use R to compute means and SDs for the groups, but do not use `t.test()` to perform the test. Show your work. State your conclusion in the context of the problem. If a difference exists, could you infer that the additive caused the change?

2. A shoe manufacturer compared two new materials for the soles of shoes, call them A and B. Twelve adult volunteers, from locations spread around the USA, each got two shoes. One was randomly assigned to be made with material A, and the other was made with material B. On both shoes, the material was exactly 1 inch thick. They were instructed to wear the shoes as they would normal shoes, and ship them back to the manufacturer after 2 months. Technicians then re-measured the thickness of the soles, and recorded the amount of wear (in microns). The data is below:

Participant	1	2	3	4	5	6	7	8	9	10	11	12
Sole A	379	378	328	372	325	304	356	309	354	318	355	392
Sole B	372	376	328	368	283	252	369	321	379	303	328	411

They wish to test:

$$H_0 : \mu_A - \mu_B = 0$$
$$\text{vs.}$$
$$H_A : \mu_A - \mu_B \neq 0,$$

using $\alpha = 0.05$.

(a) Are the two populations paired or independent? Explain your answer.

(b) Graph the data as you see fit. Why did you choose the graph(s) that you did and what does it (do they) tell you?

(c) Choose a test appropriate for the hypotheses above, and justify your choice based on your answers to parts (a) and (b). Then perform the test by computing a p-value, and making a reject or not reject decision. You may use R to compute means and SDs, but do not use `t.test()` to perform the test. Show your work. Finally, state your conclusion in the context of the problem.