**Homework #9**

*Submit your homework to your support TA’s mailbox anytime prior to the due date/time. The mailboxes are to the left as you enter the Medical Science Center (1300 University Ave.) from the main University Ave. entrance.

*No late homework will be accepted for credit!

*If a problem asks you to use R, include a copy of the code and output. Please edit your code and output to include only the relevant portions.

*If a problem does not specify how to compute the answer, you may use any appropriate method.

1. A random survey of teachers found that 224 of 395 elementary school teachers, and 126 of 266 high school teachers, were very satisfied with their work. Find a 95% confidence interval for the difference (elementary minus high school) in proportions of teachers who are very satisfied with their work.

2. 34 petri dishes are prepared with a growth medium. 16 are randomly selected and treated with antibiotic A. The other 18 are treated with antibiotic B. Each dish is inoculated with a bacteria. Several hours later, the diameter of the bacteria colony in each dish is measured in mm, with these results:
   A: 8.59, 7.80, 4.11, 8.08, 7.86, 6.97, 8.21, 1.72, 8.13, 7.48, 6.33, 8.32, 8.65, 3.06, 8.90
   B: 5.59, 6.96, 5.25, 6.46, 0.09, 7.70, 3.10, 0.94, 7.00, 7.91, 6.39, 7.45, 5.79, 6.66, 5.91, 6.62, 5.07, 7.25

   Let \( \mu_A \) and \( \mu_B \) be the respective population mean diameters across many similar hypothetical experiments. Consider a test at level \( \alpha = 0.10 \) of \( H_0 : \mu_A - \mu_B = 0 \) vs. \( H_A : \mu_A - \mu_B \neq 0 \).

   (a) Do you think it is plausible that the samples came from approximately normal distributions? Why or why not?

   (b) Run a bootstrap test to evaluate \( H_0 \).

   (c) Run a Wilcoxon Rank Sum test to evaluate \( H_0 \).

3. 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. In each pair, material A was put on a random choice of left or right shoe, and material B was put on the other shoe. On both shoes, the material was 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). Here are the data:

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

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. Do not use R for this and show your work. (You may use R to check your work if you wish.) Finally, state your conclusion in the context of the problem.