1

Which one of these is definitely wrong:

1. $H_0: \bar{x} = 0$
2. $H_a: \mu = 0$
3. $H_0: \mu < 0$
4. $H_a: \mu > 20$
5. $H_a: \mu > 20$ or $\mu < 20$

2

When do we reject $H_0$?

- When the p-value is low.
- When the p-value is high.
- Never.

3

When do we accept $H_0$?

- When the p-value is low.
- When the p-value is high.
- Never.
If $P$ is low, $H_0$ must go!

4

Do ethanol gas (E85) and regular gasoline (90 octane) differ significantly in the car gas mileage they provide? A study selected a random sample of 9 different car models. Two cars of each model were used and, at random, one was fitted with an ethanol system and the other car was fitted with a regular gasoline system. For consistency, all cars were driven over the same course by a professional driver and gas mileage (in miles per gallon) was recorded. Here are the findings.

<table>
<thead>
<tr>
<th>Car model</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>
</tr>
</thead>
<tbody>
<tr>
<td>Gas 90 octane</td>
<td>28.2</td>
<td>29</td>
<td>27.2</td>
<td>30.0</td>
<td>28.0</td>
<td>27.0</td>
<td>31.2</td>
<td>32.2</td>
<td>29.0</td>
</tr>
<tr>
<td>Ethanol E85</td>
<td>29.1</td>
<td>29.4</td>
<td>27.3</td>
<td>30.9</td>
<td>29.3</td>
<td>28.1</td>
<td>32.3</td>
<td>32.5</td>
<td>30.3</td>
</tr>
</tbody>
</table>

4.1 Confidence Interval

a. Consider the study design. Are the samples of regular gasoline and ethanol gas miles per gallon independent?
b. Obtain a 95% confidence interval for the mean difference in gas mileage between regular and ethanol fuels.
c. Based on this confidence level, can you conclude that these two fuel types differ significantly in fuel economy, on average?

4.2 Hypothesis Testing

a. Write the null and alternative hypotheses for the appropriate test, using proper math symbols.
b. Give the values of the test statistic and test P-value. Show what you typed in your calculator.
c. At a significance level of 0.05, we
   (i) reject $H_0$
   (ii) fail to reject $H_0$
   (iii) reject $H_A$
   (iv) fail to reject $H_A$
A study published last month examined the accuracy of smartphone apps for tracking physical activity. The data show that in a random sample of 28 individuals each walking exactly 500 steps, the iPhone 5s Moves App reported an average of 531 steps with a standard deviation of 55 steps. Does the study provide evidence that this app reports inaccurate numbers of steps on average?

a. Write the null and alternative hypotheses for this test, using proper math symbols.
b. Give the values of the test statistic and test P-value. Show what you typed in your calculator.
c. Assuming that inference conditions are met, conclude in context using a significance level of 0.05.
Do students sleep more in Pennsylvania or in California? Data from surveys in elementary statistics classes at Penn State University and the University of California at Davis resulted in the following summary statistics for the number of hours students sleep:

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Mean</th>
<th>St. Dev.</th>
<th>S.E. Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC Davis</td>
<td>173</td>
<td>6.93</td>
<td>1.71</td>
<td>0.13</td>
</tr>
<tr>
<td>Penn State</td>
<td>190</td>
<td>7.11</td>
<td>1.95</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Assume that these students are representative of all students at those two schools. Is there sufficient evidence to conclude that the mean hours of sleep are different at the two schools? Carry out all steps of the hypothesis test, and define all parameters.