Paired t-test: College Learning Communities Example

Many colleges and universities are establishing “learning communities” for their students. This is especially true for the new students who are, frequently, quite far from home and a guiding support network. These communities are often based on things like major, religious preference, extracurricular activities, etc. It has been proposed that participation in these learning communities leads to higher student confidence, GPAs, self-esteem and retention. In order to assess the effect on self-esteem, a SRS of 12 incoming freshman who were planning on living together in a learning community for psychology majors was taken. These students were given a pre-test which reflected their level of self esteem at the beginning of the semester. At the end of the semester a follow-up self-esteem survey was administered. The data along with some descriptive statistics and hypothesis test results follow. Let α= 0.025 and test the hypothesis that living in the learning community is associated with increased self-esteem.

Table 1: Raw data for the Learning community effects on self esteem study

<table>
<thead>
<tr>
<th>ID</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>Pre</td>
<td>18</td>
<td>14</td>
<td>11</td>
<td>23</td>
<td>19</td>
<td>21</td>
<td>21</td>
<td>22</td>
<td>12</td>
<td>24</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Post</td>
<td>17</td>
<td>17</td>
<td>15</td>
<td>28</td>
<td>22</td>
<td>22</td>
<td>25</td>
<td>20</td>
<td>18</td>
<td>24</td>
<td>17</td>
<td>20</td>
</tr>
<tr>
<td>Diff</td>
<td>-1</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>-2</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Diff = Post - Pre

Output 1: Descriptive statistics and hypothesis test results for the learning community effects on self esteem study

Paired T-Test and CI: Post, Pre

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post</td>
<td>12</td>
<td>20.4167</td>
<td>3.8954</td>
<td>1.1245</td>
</tr>
<tr>
<td>Pre</td>
<td>12</td>
<td>17.7500</td>
<td>4.5751</td>
<td>1.3207</td>
</tr>
<tr>
<td>Difference</td>
<td>12</td>
<td>2.66667</td>
<td>2.57023</td>
<td>0.74196</td>
</tr>
</tbody>
</table>

95% lower bound for mean difference: 1.33419
T-Test of mean difference = 0 (vs > 0): T-Value = 3.59  P-Value = 0.002

1) How can you tell that this is a paired experiment?

2) This study can be classified as:

<table>
<thead>
<tr>
<th>Observational</th>
<th>Controlled</th>
</tr>
</thead>
</table>
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3) In 1 or 2 sentences defend the answer you got in Problem 2

4) Perform the hypothesis test:

Step 1
\[ H_0: \mu \leq 0 \]
\[ H_a: \mu > 0 \]

Step 2
\[ \alpha = 0.025 \]

Step 3
\[ \checkmark \checkmark \times \]

Continue with the rest of the hypothesis test even if the assumptions do not hold.

Step 4
\[ t_{test} = \frac{\bar{X}_d - \mu}{\sigma / \sqrt{n}} = \frac{2.67}{2.57 \sqrt{12}} = 3.59 \]

Step 5
\[ p-value: P(t_{11} > 3.59) \]
\[ p-value < 0.005 \]

Step 6
\[ p-value < 0.025 = \alpha \]
\[ \Rightarrow \text{reject } H_0 \]

Step 7

We have enough evidence at the \( \alpha = 0.025 \) significance level to conclude that living in a learning community is associated with an increased level of self-esteem.
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Change the setting a and rework the problem with the new test value

Since there is considerable effort and expense involved with setting up and maintaining these learning communities, the university’s office of academic life doesn’t want to commit resources to this program unless there is convincing evidence that there is a minimum 2 point enhancement in student self esteem. Does the current data set support the conjecture that participation in learning communities is associated with a 2 point (on average) increase in student self esteem?

5) Perform the hypothesis test:

Step 1

Step 2

Step 3

Continue with the rest of the hypothesis test even if the assumptions do not hold.

Step 4

Step 5

Step 6

Step 7