Entering and Formatting Data

Open Excel. Set up the spreadsheet page (Sheet 1) so that anyone who reads it will understand the page (Figure 1).

- Type a **title** in the cell in the upper lefthand corner, cell A1
- **Label column** A as the data from the 0.5 McFarland culture with gentamicin (GM10) in cell A3
- **Label column** B as the data from the other McFarland culture with gentamicin. (In this example, the 1 McFarland culture.)
- Repeat with the trimethoprim/sulfamethoxazole (SXT) data.
- **Enter the appropriate data** (diameter of zones of inhibition in mm) in each column (Fig. 1).

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Disk Diffusion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Assay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>GM10, 0.5</td>
<td>GM10, 1</td>
<td>SXT, 0.5</td>
<td>SXT, 1</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>24</td>
<td>30</td>
<td>29</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>25</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>6</td>
<td>24</td>
<td>25</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>7</td>
<td>25</td>
<td>24</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>8</td>
<td>25</td>
<td>25</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>9</td>
<td>24</td>
<td>26</td>
<td>30</td>
<td>34</td>
</tr>
<tr>
<td>10</td>
<td>24</td>
<td>25</td>
<td>31</td>
<td>30</td>
</tr>
<tr>
<td>11</td>
<td>25</td>
<td>26</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>12</td>
<td>24</td>
<td>25</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>13</td>
<td>24</td>
<td>25</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1**

Calculating the Mean and Standard Deviation (should this be desired)

You can **calculate the mean and standard deviation** for each column using the functions “=average()” and “=stdev()”, respectively (Fig 2).

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>GM10, 0.5</td>
<td>GM10, 1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>24</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>25</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>25</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>24</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>24</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>25</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>24</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>24</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>=average(</td>
<td>=average(</td>
<td>=stdev(</td>
</tr>
<tr>
<td></td>
<td>A4:A15)</td>
<td>A4:A15</td>
<td>A4:A15</td>
</tr>
</tbody>
</table>

**Figure 2**
• The data for each column goes inside the parentheses and may be entered by left-clicking and dragging the mouse over the values after typing the open parenthesis.
• Finish by typing the close parenthesis and hitting the “Enter” button.
• **Copy the functions** (left-click and drag to select, right click and “Copy”) and paste them under the other columns (left-click and drag to select, right click and “Paste”) (Fig 3).

The **t-test**

The easiest way to perform **statistical analyses** with a spreadsheet is to use the built-in functions. With Excel, they can be found by clicking on “Tools” on the toolbar and selecting “Data Analysis” (Fig. 4).
If the “Data Analysis” selection is not listed it means that the functions haven’t been installed. To install them, you must have access to the installation program, either on CD or through a network.

- Select “Add-Ins” under the “Tools” menu (Fig. 4).
- When the “Add-Ins” menu comes up, choose “Analysis ToolPak” (Fig. 5) and click on “OK.”

![Figure 5]

When you select “Data Analysis” on the “Tools” menu (Fig. 5), the “Data Analysis” menu pops up (Fig. 6).

![Figure 6]

- Scroll down and select “t-test: Two-Sample Assuming Equal Variances.”
- After you click “OK,” the “t-test: Two-Sample Assuming Equal Variances” menu pops up (Fig. 7) and you need to select your data.
• Click on the red arrow on the right side of the box next to the “Variable 1 Range:” label.
• A menu pops up for data input (Fig. 8).

![Figure 7](image1)

**Figure 7**

• Enter data by dragging the mouse over the values in the appropriate column, for example Column A, cells 3-13. Hit “Enter” when done. This will input the values for the zones of inhibition with gentamicin (GM10) on the plates inoculated from the 0.5 McFarland culture, as well as the column label.
• Repeat this process, clicking on the arrow for “Variable 2 Range:” and entering the other gentamicin data in Column B.
• Leave the “Hypothesized Mean Difference” selection blank, check the “Labels” box, and leave “Alpha” at 0.05.
• Select a cell on the spreadsheet, for example F3, where you want the results of the *t*-test to be placed.
• The completed “*t*-test: Two-Sample Assuming Equal Variances” menu should look similar to Figure 9.
• **Click on “OK”** and the table of information for the $t$-test should appear, beginning in cell F3.

• Move the cursor to the right hand border of the Column F label so that the **column resize cursor** appears (Fig. 10).

![Figure 9](image1.png)

**Figure 9**

![Figure 10](image2.png)

**Figure 10**

• Drag the column to the right until the labels can be read (Fig. 11).
Compare the calculated $t$ value ($t$ Stat) with the critical value for $t$ ($t$ Critical) for alpha = 0.05 and with 18 degrees of freedom (df). We might expect that with a higher concentration of cells the zone of inhibition would be equal to or smaller than the zone produced with the 0.5 McFarland culture, so a one-tailed $t$-test would be appropriate. Therefore, if the calculated $t$ value (-2.45786, in this example) is less than the negative critical value for $t$ (-1.734073), we reject the null hypothesis that there is no difference between the zones of inhibition from the 0.5 and 1 McFarland cultures.

**ANOVA**

To set up a spreadsheet for ANOVA, list the measurements of zones of inhibition made by each student according to antibiotic and McFarland culture (Fig. 12). Calculate means and standard deviations, if desired.

![Figure 11]

![Figure 12]
For ANOVA, use the “Data Analysis” menu under the “Tools” menu.

- Click on “Tools” on the toolbar
- Select “Data Analysis” (Fig. 4)
- Choose “ANOVA: Single Factor” (Fig. 13).

![Data Analysis](image)

**Figure 13**

- For “Input Range:” select the **data in all four columns**, including the headings in Row 4.
- Make sure that “Columns” is selected in “Grouped By:”
- Select “Labels in First Row.”
- “Alpha:” should be 0.05.
- For “Output Range” select a cell near the data. (In this example, F3.)
- When complete, the “ANOVA: Single Factor” menu should look like Figure 14. Click “OK” and a table will be generated, starting with Cell F3 (Fig. 15).

![ANOVA: Single Factor](image)

**Figure 14**
• **Adjust column widths** so that the table looks like Figure 15.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Count</th>
<th>Sum</th>
<th>Average</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>298</td>
<td>29.8</td>
<td>0.844444</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
<td>302</td>
<td>30.2</td>
<td>1.511111</td>
</tr>
<tr>
<td>C</td>
<td>10</td>
<td>304</td>
<td>30.4</td>
<td>0.256667</td>
</tr>
<tr>
<td>D</td>
<td>10</td>
<td>298</td>
<td>29.8</td>
<td>2.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P-value</th>
<th>F crit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>2.7</td>
<td>3</td>
<td>0.9</td>
<td>0.716814</td>
<td>0.548441</td>
<td>2.866265</td>
</tr>
<tr>
<td>Within Groups</td>
<td>45.2</td>
<td>36</td>
<td>1.255556</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>47.9</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 15**

• **Compare the calculated** $F$ **value** (0.716814, in this example) with the **critical** $F$ **value** ($F_{crit}$) (2.866265). Since the $F$ value is less than the critical $F$ value, we cannot reject the null hypothesis that there is no difference between the measurements of zones of inhibition made by the four group members.