Interpreting t-test output

Total depression score by gender

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig</td>
</tr>
<tr>
<td>Total Depression Score</td>
<td>Equal variances assumed</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed</td>
<td>- .187</td>
</tr>
</tbody>
</table>

One-way Analysis of Variance (ANOVA)


Want to determine which of four methods of teaching introductory psychology produces the best results: lecture, films and video tapes, discussion groups, or self-study

- 200 college students are available
- Randomly assign 50 to each group
- All 200 students are given a final exam covering basic psychological principles at the end of the semester
Assume that 50 scores per group are normally distributed

No overlap between any groups

Sources of Variation
Self-study group had highest scores and the lecture group had the lowest scores

Three kinds of variability shown:
1. variability in the distribution of all 200 scores; exemplified by \( X_i - \bar{X}_T \);
   contribution to total variability of a single score
   199 more of these that contribute to total variability
2. \( X_i - \bar{X}_T \) can be broken down into two separate components:
   - Deviation of a given score from its group mean: \( X_i - \bar{X}_i \)
     (variability within groups)
   - Deviation of the group mean from the total mean: \( \bar{X}_i - \bar{X}_T \)
     (variability between groups)

These two pieces are additive both graphically and algebraically:
\[
(X_i - \bar{X}_i) + (\bar{X}_i - \bar{X}_T) = X_i - \bar{X}_T
\]
Significant difference between means
Aim is to determine if there are significant differences between the group means

\[ H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 \]

\[ H_a: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \] for at least one pair of means

Will conduct test by comparing the variability between groups with the variability within groups

Within any single distribution of scores there will be variability due to sampling variation—always expect to find within group variability

If there are no significant differences between the means of the groups would expect only a small amount of between group variability (sampling error)
Significant differences between the means

One-way grouped on Socioeconomic status

ANOVA

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>13.853</td>
<td>4</td>
<td>3.463</td>
<td>.899</td>
<td>.472</td>
</tr>
<tr>
<td>Within Groups</td>
<td>192.583</td>
<td>50</td>
<td>3.852</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>206.436</td>
<td>54</td>
<td>3.852</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mean square $= \frac{\text{Sum of Squares}}{\text{df}}$

$F = \frac{\text{Mean square between}}{\text{Mean square within}}$

Expect ratio to be about 1.0 under the null hypothesis because both values are estimates of the same population variance.

If ratio is quite a bit larger than 1.0, reject the null hypothesis.

### One-way grouped on Socioeconomic status

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<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>791.327</td>
<td>4</td>
<td>197.832</td>
<td>2.246</td>
<td>.077</td>
</tr>
<tr>
<td>Within Groups</td>
<td>4491.173</td>
<td>51</td>
<td>88.062</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5282.500</td>
<td>55</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>