1) It is desired to compare two methods for alleviating test anxiety. A relaxation training course vs. a 10mg dose of propanolol prior to the exam. A group of 24 students with test anxiety is selected and randomly divided into 2 groups. Joe Blow suggests a crossover design for this study.

\[\begin{array}{ccc}
\text{Group 1} & \text{relaxation training course} & \rightarrow \text{Exam 1} \\
\text{Group 2} & \rightarrow \text{propanolol} & \rightarrow \text{Exam 1}
\end{array}\] \[\begin{array}{ccc}
\text{Time 1} & \rightarrow & \text{time 2} \\
\text{relaxation training course} & \rightarrow \text{Exam 2} & \rightarrow \text{propanolol} & \rightarrow \text{Exam 2}
\end{array}\]

The relaxation training course is designed to teach the students how to relax. Propanolol blocks the binding site of adrenaline. Assume that the washout for propanolol is effective and both exams are supposed to be equivalent.

a) What is Joe’s ANOVA table with EMS?

b) Name the one main reason this is a bad design.
2) You have been called in as a statistical consultant to salvage something from Joe Blow's study. You point out that there are two different ways to take a subset of the data and then do a t-test on each subset. They are:

a) 

b) 

Would either way have an advantage over the other?
3a) Come up with a resolution V design for a $2^{8-2}$ (i.e. specify the identity). Don't give me the answer in the back of the book.

b) What is the ANOVA table for this design?
6. Betty Crocker has been convinced by Dr. Tom to get into total quality management (TQM). As part of this, she decides to do an experiment with one of her cake mixes. She randomly selects four boxes of her Super Chocolate Cake Mix. The mixture from each box is divided in two and each received one of two levels of oil and egg (this is one factor). After mixing separately the mixtures were split again into 3 parts. Each of the 3 parts was baked for 40, 45 or 50 minutes. The fluffiness of each part after baking was the response variable.

a) Write out the ANOVA table with df.

b) Which are the whole plot, split plot and split-split plot terms?
1) Four faculty members and four students were randomly selected to play in a golf tournament. The tournament lasted four days. Each player's score total was recorded for the first nine holes and the second nine holes on each day.

a) Sketch the layout.

b) Write out the model.

c) Which are between subjects and which are within subjects terms?

d) Write out the ANOVA table with degrees of freedom.
2. Three lots of manufactured items were randomly selected for an experiment involving a chemical treatment with three levels. Two workers were randomly selected to perform the experiment. Each worker randomly selected six items from each lot, then randomized the six items to the three chemical treatments.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MS</th>
<th>EMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>3.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lot</td>
<td>.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worker</td>
<td>.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T \times L$</td>
<td>.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T \times W$</td>
<td>.14</td>
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</tr>
<tr>
<td>$L \times W$</td>
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<td></td>
</tr>
<tr>
<td>$T \times L \times W$</td>
<td>.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>error</td>
<td>.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a) Fill in d.f. column.

b) Using the algorithm, work out the EMS on back of this page and fill it in on this page.

c) Assuming CRD, use pooling rule to find the error and simplify the EMS.
3. An experimenter would like to investigate the effects of a treatment with five levels A, B, C, D and E. However she could only afford to take 20 observations in five blocks which could only be of size four each.

    a) What advantage and disadvantage would there be to running a balanced incomplete block design?

    b) Given the constraint on block number and size, how could you run a RCBD?

    c) What advantage and disadvantage would there be to the approach in b)?
1. Dr. Tom has been asked to evaluate a thumb dynamometer which is designed to measure a characteristic of hand strength. There were 20 subjects of each sex. Subjects were measures three times on their dominant hand, then three times on their non-dominant hand.

   a) Write out the ANOVA table with source, d.f. and EMS (use the algorithm).

   b) Joe Blow analyzed Dr. Tom's data but left subject out of the model. Which of Joe's F-tests are conservative or liberal and Why?
2. I have a $2^6-2$ design with

$$ I = ABCD = CDEF = ABEF $$

In my model statement I have all main effects and 2 way interactions. Write out the ANOVA table with both Type I and Type III degrees of freedom.
3. You are involved in a project to study the effects of various factors on the time required to dissolve tablets. There are 2 formulations to study and four batches are made of each formulation. Each batch is divided in half and one half is aged for one hour and the other half eyed for five hours. After aging, the half batches are used to make four tablets at each of three specific pressures. Each tablet is then measured for the time it takes to dissolve.

a) Work out the ANOVA with source, d.f. and EMS using the algorithm.

b) If you were going to pool any terms, what would you pool and why?
5. The following is a layout from an experiment with two fixed factors.

<table>
<thead>
<tr>
<th>A</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$x$</td>
<td>$x$</td>
<td>$x$</td>
<td>$x$</td>
</tr>
<tr>
<td>2</td>
<td>$x$</td>
<td>$x$</td>
<td>$x$</td>
<td>$x$</td>
</tr>
<tr>
<td>3</td>
<td>$x$</td>
<td>$x$</td>
<td>$x$</td>
<td>$x$</td>
</tr>
</tbody>
</table>

a) Joe analyzed the data by running two one-way ANOVA's

\[ Y_{ij} = \mu + A_i + \epsilon_{ij} \]

\[ Y_{ij} = \mu + B_j + \epsilon_{ij} \]

Are either of Joe's F-tests liberal or conservative and why?

b) Is there a better way for Joe to analyze his data and why?