Chapter 11: Using factorWiz for Factorial Designs

An old question in psychology is the question, is the whole is equal to the sum of its parts? Imagine someone who might be described as *sincere and mean*. How much do you think you would like that person? Is the personality impression of the combination just a sum or weighted average of the separate impressions produced by the separate words?

In contrast with the early mental chemists, who thought that complex psychological ideas could be analyzed into their elements, Gestalt psychologists argued that psychological impressions and perceptions were more than just the sums of their parts. The term, *Gestalt*, which in German means "form" or "configuration," was used to indicate the idea that in addition to the elements were the relationships among the component stimuli that make up the integrated impression.

Factorial designs allow one to assess if the data can be represented as the sum of the main effects of the separate factors, or if there is also an interaction, or *nonadditivity*, in the data. A factorial design has two or more independent variables manipulated by the experimenter. In a factorial design, every level of each independent variable is paired with every level of the other variables (see also Chapter 1).

This chapter will show you how to use factorWiz, a Web page included on your CD, to set up within-subjects factorial designs that allow one to test for interactions. The chapter will use an experiment on impression formation to illustrate how to use factorWiz. The example experiment is designed to test if judgments of liking of a person are the sum (or weighted average) of the liking of the person's traits. This study replicates via the Web an experiment by Birnbaum (1974) that was done in the lab. Birnbaum (1974) found systematic violations of additivity, contradicting the conclusions of Anderson (1962), who

disputed the Gestalt ideas of Asch (1946). Results of the study will be analyzed in Chapter 12.

In this experiment, the factorial design will combine the effects of two adjectives. Each factor has five levels, corresponding to a set of adjectives. The factorial design is displayed in Table 11.1.

Table 11.1. Factorial design of Adjective 1 by Adjective 2. There are 25 cells (5 x 5), produced by pairing each Row adjective with each Column adjective. How much would you like each person (i.e., each combination)?

	Adjective 2				
Adjective 1	*Mean*	*listless*	*solemn*	*light-hearted*	*Trustworthy*
Phony	*Phony & mean*	*Phony & listless*	*Phony & solemn*	*Phony & light-hearted*	*Phony & trustworthy*
Squeamish	*Squeamish & mean*	*Squeamish & listless*	*Squeamish & solemn*	*Squeamish & light-hearted*	*Squeamish & trustworthy*
Blunt	*Blunt & mean*	*Blunt & listless*	*Blunt & solemn*	*Blunt & light-hearted*	*Blunt & trustworthy*
Informal	*Informal & mean*	*Informal & listless*	*Informal & solemn*	*Informal & light-hearted*	*Informal & trustworthy*
Sincere	*Sincere & mean*	*Sincere & listless*	*Sincere & solemn*	*Sincere & light-hearted*	*Sincere & trustworthy*

The factorial design in Table 11.1 contains 25 different combinations of Row and Column adjectives, each of which describes a person. How much would you like each one?

To do the experiment, you need to randomize the order of presentation of the pairs. Also, from Chapter 9, you learned that there should be a warm-up of trials to allow the judge to become accommodated to the response scale and the range and distribution of stimuli. The next section will show you how to set up this experiment with factorWiz.

A. How to Use FactorWiz

To make the HTML for a factorial design with factorWiz, carry out the steps in the following example. Load *factorWiz.htm* in your browser. Give the experiment a name (which will be printed as the title of the page), and give it a short name (which will be inserted as the first variable in the data file). Name the Row and Column factors. In this case, name the experiment, *Impression Formation*, and give it the short name, *like5x5*. The factors are *Adjective 1* and *Adjective 2*. Type in the number of levels of the Row and Column factors in the spaces provided (5 and 5, in this example). Then enter the stimuli that define Rows and Columns. In this case, type in the adjectives as shown in Figure 11.1.

Each person will be described as a combination of one of the adjectives from the first set (Row = *phony*, *squeamish*, *blunt*, *informal*, *sincere*) with one from the second set (Column = *mean*, *listless*, *solemn*, *lighthearted*, *trustworthy*). Each subject will receive all possible combinations, in random order. Replace the separator (default is " & ") with " and "; be careful to leave a space before and after the word "and," and do not type in the quotes. The separator will be printed between the Row and Column adjectives; in this case, a person might be described as *sincere and mean*, for example. Figure 11.1 shows the appearance of the window.

Insert Figure 11.1 about here.

Now push the *Make the Form* button to make the stimuli, randomize the trials, and write the HTML, which appears in the text window. If you use Netscape Navigator or the latest version of Internet Explorer (4.5 or above), you can display the form at this point by pushing the *Display* button. Next, scroll to the end of this text window, and select all of the HTML, being sure to get the beginning of the document. Choose *Copy* from the **Edit** menu. The window will now appear as in Figure 11.2.

Insert Figure 11.2 about here.

Figure 11.1. Making a factorial design for impression formation experiment by means of factorWiz. There are spaces around the word "and" in the *separator* box.

Figure 11.2. Pressing the button, *Make the Form*, creates the trials, randomizes them, and displays the HTML page in the textarea within the window. Note the scroll bar on the textarea window. The *Display* key opens a new window, showing how the page will display in the browser. Be sure to select the entire contents and copy it to a text editor; save it as *like.htm*. The *Save* key reminds you to copy to a text editor. The *Reset* key erases everything from the form. To get another random order of the same design, press *Make the Form* again (without pushing the *Reset* button).
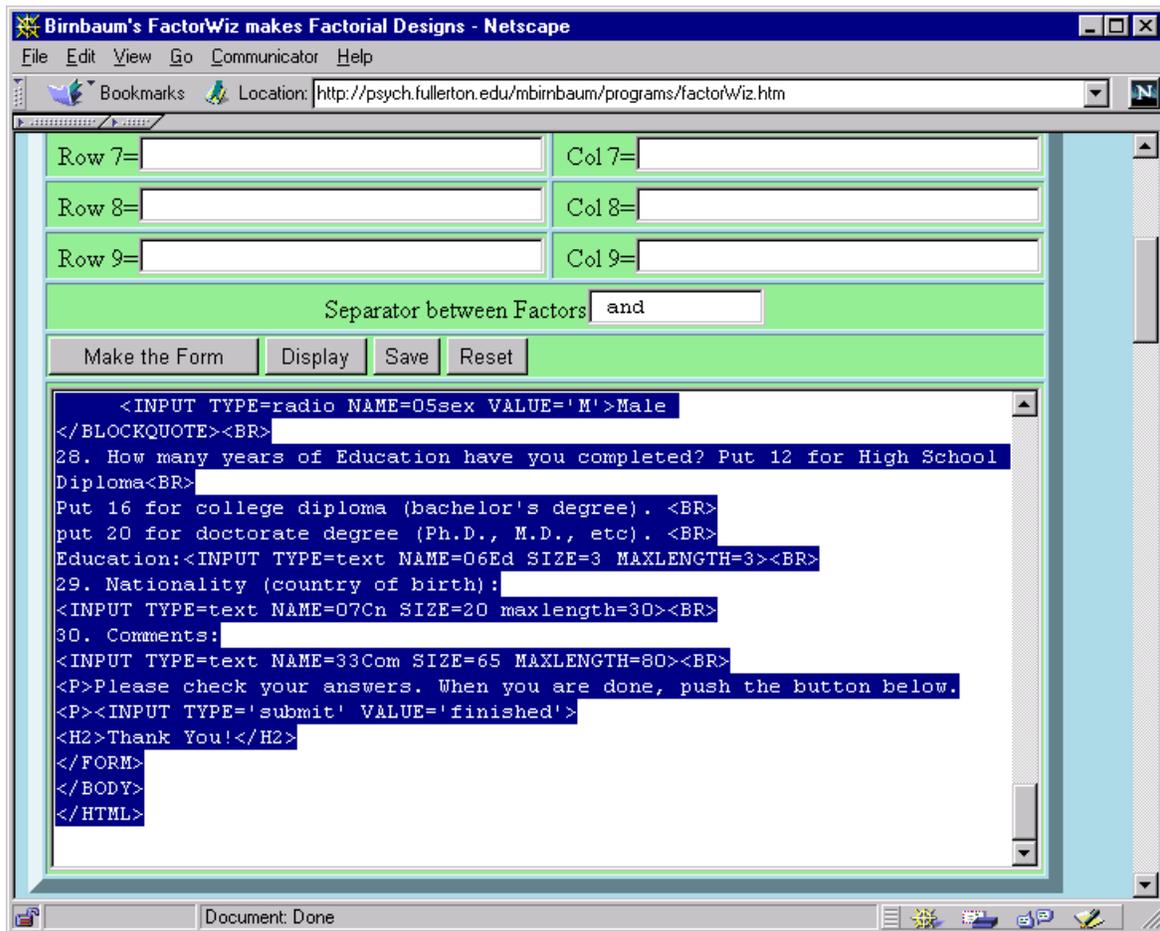
B. Copy the HTML to a Text Editor and Save

Next, paste the entire contents of the window into your text, and save it with an extension of *.htm*. In this case, illustrated in Figure 11.3, the file was named, *like.htm*.

Insert Figure 11.3 about here.

C. Add Instructions and Warmup trials

 In the text editor, replace the phrase, *(put your instructions here)* with appropriate instructions for the task (see Fig. 11.3), and also copy a few more of the trials from the main experiment to the warmup, changing their trial numbers. In Figure 11.4, the number of warmup trials has been increased from 4 to 7. It is a good practice to include not only the 4 extremes, which are automatically inserted by factorWiz as warmups, but also to include at least one trial with each of the levels of each factor, so that the participant will experience all of the adjectives before the main experiment. The warmup trials must be placed within the first FORM, as shown in Figure 11.4.

Insert Figure 11.4 about here.

Note that the warmups used guarantee that the participant will see in the warmup the best combination, the worst combination, and each of the adjectives in the study. The names given to the variables in the warmup are not important, because none of the variables in this FORM will be sent to the data file (there is no ACTION for the warmup form, nor is there a submit button). The purpose of the warmups is allow the subject to become aquainted with the stimuli and the response scale.

Figure 11.3. Appearance of the HTML, copied from factorWiz to NotePad. The

instructions were added, replacing the sentence, *(put your instructions here).*
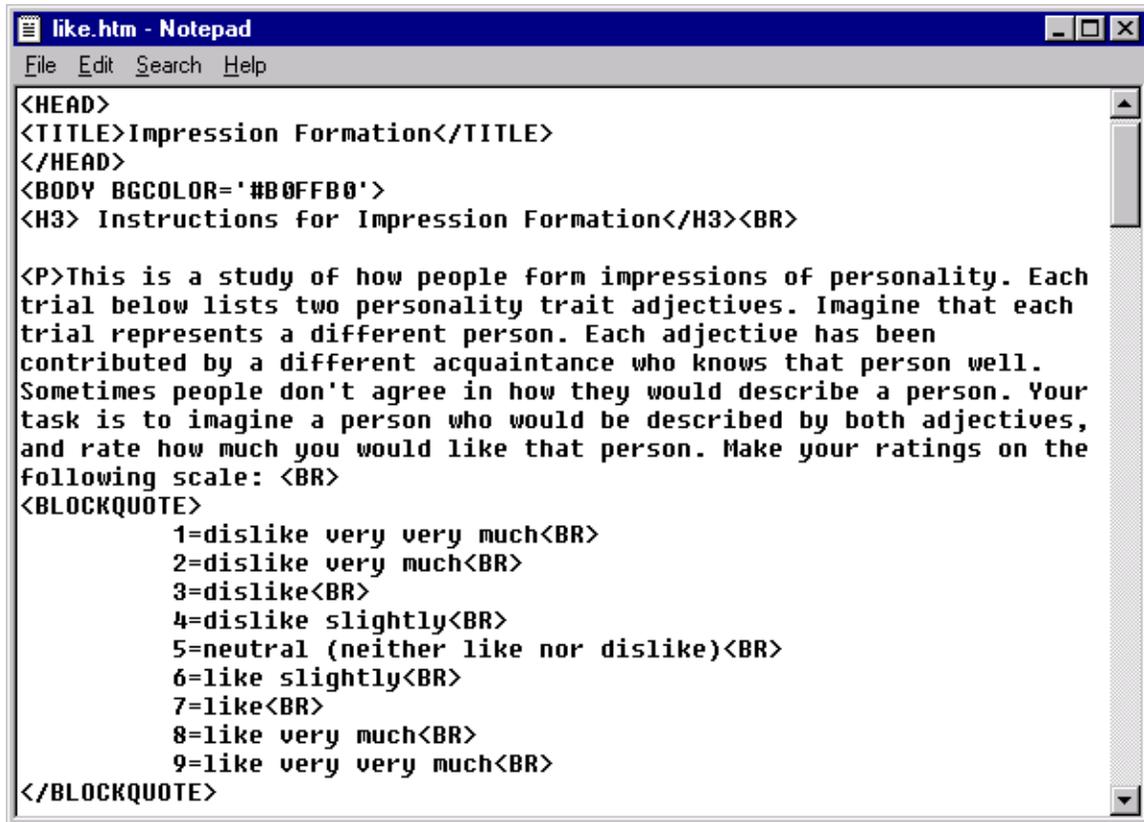
```
like.htm - Notepad                                           _ □ ✕
File  Edit  Search  Help
<HEAD>                                                          ▲
<TITLE>Impression Formation</TITLE>
</HEAD>
<BODY BGCOLOR='#B0FFB0'>
<H3> Instructions for Impression Formation</H3><BR>

<P>This is a study of how people form impressions of personality. Each
trial below lists two personality trait adjectives. Imagine that each
trial represents a different person. Each adjective has been
contributed by a different acquaintance who knows that person well.
Sometimes people don't agree in how they would describe a person. Your
task is to imagine a person who would be described by both adjectives,
and rate how much you would like that person. Make your ratings on the
following scale: <BR>
<BLOCKQUOTE>
        1=dislike very very much<BR>
        2=dislike very much<BR>
        3=dislike<BR>
        4=dislike slightly<BR>
        5=neutral (neither like nor dislike)<BR>
        6=like slightly<BR>
        7=like<BR>
        8=like very much<BR>
        9=like very very much<BR>
</BLOCKQUOTE>                                                   ▼
```

 Figure 11.4. Add warmups. Four warmups are automatically created by the program; here

three additional warmups were made to include at least one presentation of each of the

adjectives in the warmup. Note that the warmup trials are nested in a FORM that has no

action. The warmups accustom the judge to the stimuli and the response scale.
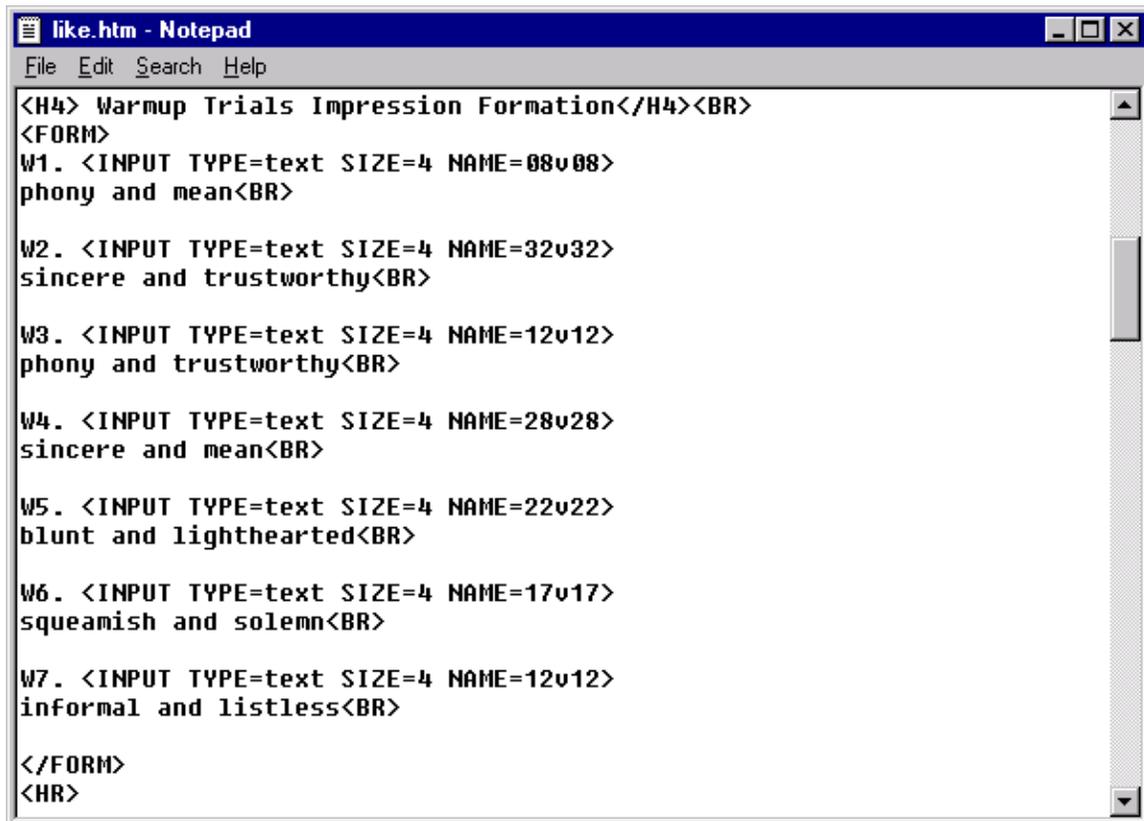
```
like.htm - Notepad
File  Edit  Search  Help

<H4> Warmup Trials Impression Formation</H4><BR>
<FORM>
W1. <INPUT TYPE=text SIZE=4 NAME=08v08>
phony and mean<BR>

W2. <INPUT TYPE=text SIZE=4 NAME=32v32>
sincere and trustworthy<BR>

W3. <INPUT TYPE=text SIZE=4 NAME=12v12>
phony and trustworthy<BR>

W4. <INPUT TYPE=text SIZE=4 NAME=28v28>
sincere and mean<BR>

W5. <INPUT TYPE=text SIZE=4 NAME=22v22>
blunt and lighthearted<BR>

W6. <INPUT TYPE=text SIZE=4 NAME=17v17>
squeamish and solemn<BR>

W7. <INPUT TYPE=text SIZE=4 NAME=12v12>
informal and listless<BR>

</FORM>
<HR>
```

D. View the File with Your Browser

Now open the file from the browser to see how it looks. (It is not necessary to close the file in the text editor; in fact, it will be easier to make corrections and modifications if you keep the file open in the text editor as well as the browser.) You can edit the file to modify instructions or adjust formatting if needed. When you have a script on your local server, you can also change the URL in the ACTION of the form to that of your local script. As noted in Chapter 5, you could also send the form by email, by changing ACTION=*URL* to ACTION='mailto:*user@address.domain*'

In Netscape, the file created appears as in Figure 11.5. You can load this file from the CD, where it is named, *like.htm*.

Insert Figure 11.5 about here.

You could have created everything in this file from what you learned in Chapters 2-5, but this program makes your task much easier. Because you understand the HTML, you also know how to adjust it to add another variable, change the format, or make some other modification. You can change the background color, fonts, formats, or add graphics as appropriate for your experiment.

Figure 11.5. Appearance of the Impression formation experiment in Netscape.
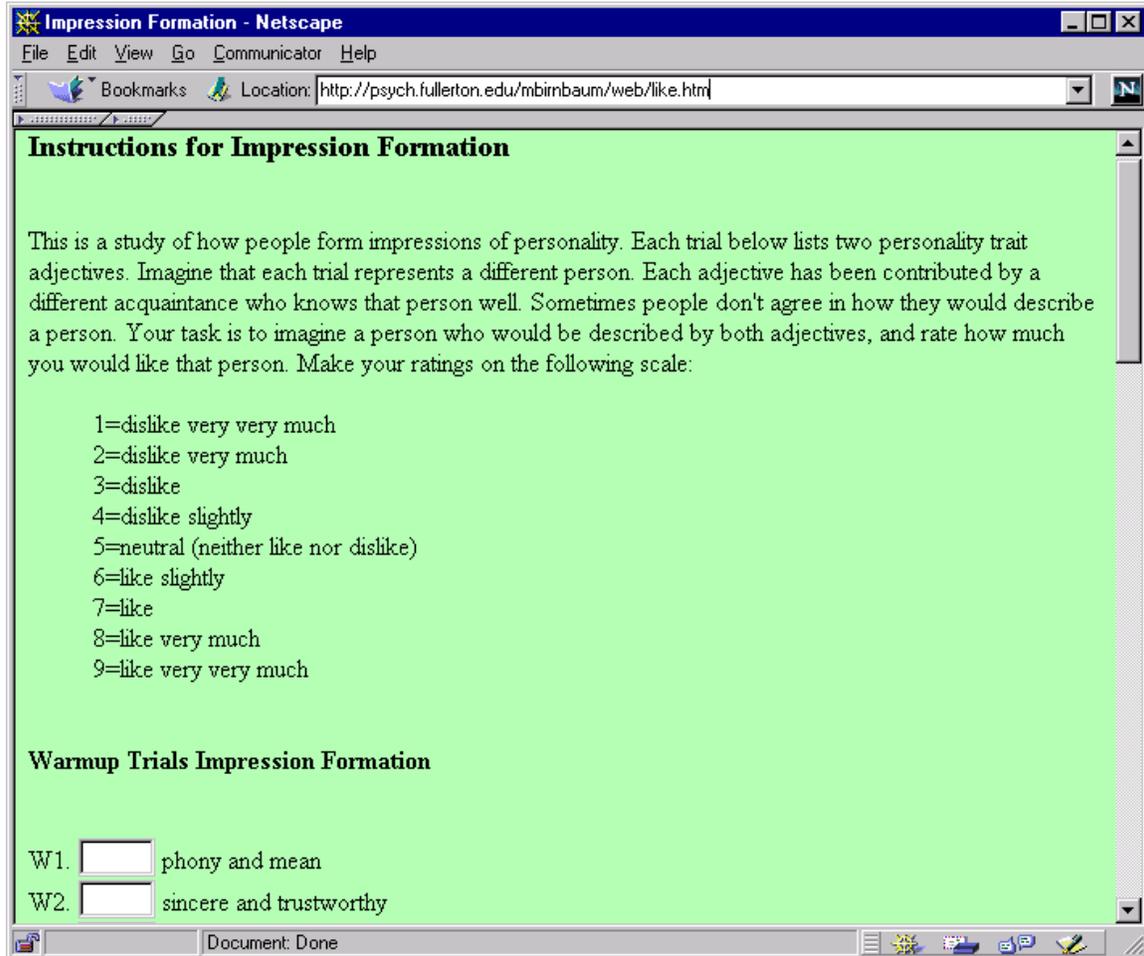
E. Check the Experiment and Data file Created.

Test the experiment in your browser to make sure it works properly. Download your

data. An FTP link to the data file is included in the examples for this chapter. You may

need to select Page Source from the **View** menu to see the file in your browser.

Be sure that you understand how the data are arranged in the data file. Note that

factorWiz randomized the trials, but the data will appear in the file in their proper factorial

order. The first variables sent by the script will be as follows:

Experiment short name,

Date,

Time,

Remote address (the IP Address identifies the computer network that sent the data. Two

successive entries from the same address probably mean that the same person pushed the

"submit" button twice. You can thus spot and delete multiple submissions.),

Age,

Gender (M or F for male or female),

Education, and

Nationality.

The next variables are the judgments, in the following order:

   (row 1, col 1), (row 1, col 2)...(row 1, col c)

   (row 2, col 1), (row 2, col 2)...(row 2, col c)

   ...

   (row r, col 1), (row r, col 2)...(row r, col c)

Finally, the last variable is for *Comments*.

To make sure that you know how the data are arranged, you should now "run"

yourself on the experiment by typing in the *stimuli* you see on each trial, i.e., the name of

each question instead of your judgment. For example, instead of judging how much you

would like someone who is *sincere and mean*, you type *sincere & mean*, or an abbreviation.

Type the word "*age*" when you are asked for age, and type "*Edu*" when asked for education.

You will then have a record in your data file of exactly how the experiment and the data are

organized. Figure 11.6 shows how the data file appears for the impression formation

experiment.

Insert Figure 11.6 about here.

Two records are shown in Figure 11.6. The first is the "reminder" created by the

experimenter who typed in the stimuli on each trial. It is a good idea to do this once for each

new experiment so that you will not be confused later when it is time to analyze your data.

The identifying line can also be imported with the data to Excel, where it can be cut and

pasted to the first line, to define the variables. In Figure 11.6, one should also replace

"like5x5", "1/3/99", "9:40:33" and "137.151.149.110" with the words, *Exp, date, time,* and

address. The second record shows a typical set of judgments.

Figure 11.6. Data produced by typing the stimuli into the response box to properly decode the experiment in the data file. In the first record below, the experimenter "took" the experiment by typing the stimuli; in the second record below, a subject took the same study, entering her judgments of liking.
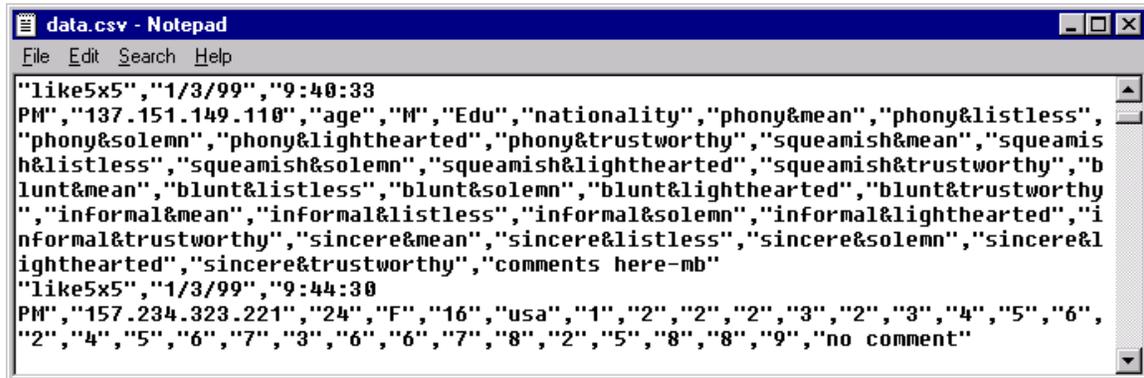
```
data.csv - Notepad                                                    _ □ ×
File  Edit  Search  Help
"like5x5","1/3/99","9:40:33
PM","137.151.149.110","age","M","Edu","nationality","phony&mean","phony&listless",
"phony&solemn","phony&lighthearted","phony&trustworthy","squeamish&mean","squeamis
h&listless","squeamish&solemn","squeamish&lighthearted","squeamish&trustworthy","b
lunt&mean","blunt&listless","blunt&solemn","blunt&lighthearted","blunt&trustworthy
","informal&mean","informal&listless","informal&solemn","informal&lighthearted","i
nformal&trustworthy","sincere&mean","sincere&listless","sincere&solemn","sincere&l
ighthearted","sincere&trustworthy","comments here-mb"
"like5x5","1/3/99","9:44:30
PM","157.234.323.221","24","F","16","usa","1","2","2","2","3","2","3","4","5","6",
"2","4","5","6","7","3","6","6","7","8","2","5","8","8","9","no comment"
```

F. Adding other Random Orders

It is easy to add other random orders. Once created, the trials could be cut and pasted within the form, and their trial numbers changed. The data will be returned by the script according to the numbers that precede the variable names, so they will return in the factorial order.

FactorWiz also allows you to make new orderings with the push of a button. After you have created one form and saved it to disk, just push *Make the Form* again, and you will have another random order of the same experiment (do not press *Reset* until you have all of the orders you want). You can put several of these orders on the web, and use a page in which the subject clicks on his or her birth month to be assigned to one of the random orders. You can then analyze the effects of trial order with Analysis of Variance, or you can just combine the data to average across different random orders.

You can insert graphics, sounds, or lengthy material for the Row and Column factors with search and replace. To do this, type an abbreviation for the Row and Column factor levels. For example, you can type rx1, rx2, rx3 for the Rows and cx1, cx2, … for the Columns. Then use *Search and Replace* in the text editor to replace these symbols with the appropriate HTML tags to insert the more complex or lengthy material. This procedure is illustrated in Chapter 14.

G. Summary

This chapter explained the use of factorWiz to make within-subjects factorial experiments. A variety of experiments created with this tool will be analyzed in Chapters 12 – 16. In Chapter 12, you will learn how to analyze data from a factorial experiment, using data for the impression formation study.

H. Exercises

1.   Use factorWiz to create the following 3 by 5 design in which the factors are (Rows) the length of acquaintance that the source has with the target person described and (columns) the adjective that the person has provided. You can use the same instructions, except add the following:

"In this study, your task is to rate how much you would like the person described if that person has been described by someone who has known the person for *one meeting*, for *one month*, or for *years*. A person who has only met the person once may not be as accurate as a person who has known the person for months or years."

Use the following levels for Row factor:

Acquaintance of 1 meeting says the person is

Acquaintance of 1 month says the person is

Acquaintance of years says the person is

Use the same adjectives for the Column adjectives as used in the example of this chapter.

2. Set up the following experiment, which is similar to one by Shanteau (1975b). The instructions are as follows:

"This is a study of the value of gambles. Suppose you will reach into a jar that contains 200 marbles, some of which are red and some of which are white. If you draw a red marble, you win the designated prize. If you draw a white marble, you receive nothing. A friend of yours has looked at the jar, and has estimated your chances of winning. Your friend has not actually counted the marbles, but has shaken the jar, viewed the marbles, and informally judged your chances."

The two factors are (Rows) the Prize, and (Columns) your friend's estimate of your chances. Set up a 6 by 6 factorial experiment with the following Prizes (Rows) and Chances (Columns). Prizes are a new toothpick, a six pack of your favorite drink, a scientific calculator, a CD player (with included tape deck, speakers, and radio), a bicycle, and a computer. Your friend's estimates of your chances: "No chance", "very unlikely to win", "probably won't win", "tossup-fifty fifty", "a good chance to win", "nearly sure thing."   A typical trial should read as follows: "a good chance to win a bicycle. Make the Chances the Row factor, since that factor is printed first. Use " to win " as the separator.

According to the model of Shanteau (1975b), the judged value of such a gamble can be represented as the product of the subjective weight of the probability phrase times the subjective value of the prize. Thus, Shanteau's model implies a multiplicative interaction between the chance to win and the subjective value of the prize. In this experiment, both the probability phrase and the prizes are described verbally.

3.   How large a tip would you leave if the service was slow and you did not get everything as ordered? Design a study to find out how large the tip would be if the bill was $5, $10, $15, $20, $25, or $30, and the service was "lousy", "mediocre", "acceptable," or "excellent." The two factors are (Rows) size of bill and (Columns) quality of service.

4.   A classic article by Cliff (1959) presented a model in which adverbs are multipliers.

For example, if "*very*" has the multiplicative value of 1.32, then "*very neat*" is 1.32 times as

neat as *neat*. A person who is "*very charming*" is also 1.32 times as likeable as a person

who is *charming*. You can use factorWiz to set up a partial replication of Cliff's research.

Use similar instructions as for the experiment on judgments of liking, as follows:

"This is a study of how people form impressions of personality. Each trial

below lists a description of a person. Assume that the description has been contributed by

an acquaintance who knows that person well. Your task is to imagine a person who would

be so described, and rate how much you would like that person. Make your ratings on the

following scale " (Insert the same scale as for impression formation).

        Set up a 4 by 6 design with the following adverbs: *slightly*, (*no adverb*), *very*, and

extremely. Let the six adjectives be *evil*, *bad*, *inferior*, *charming*, *pleasant*, and *good*. For

the *no adverb*, just leave the space blank. The separator between factors should be just a

space (to separate the adverb and adjective).   The CD contains two experiments for the

adverb*adjective experiment, *adjadv.htm* and *adjadv2.htm*, which were created by

factorWiz, as illustrated in Figure 11.7. The CD also contains data for one of these studies.

        Insert Figures 11.7-11.10 about here.

5.   A cab was involved in a hit-and-run accident at night. A witness said it was a blue cab.

     What is the probability that it was blue, as the witness testified? FactorWiz can be used

     to set up an experiment on this cab problem, as illustrated in Figure 11.8. Follow the

     figure and use factorWiz to make the same experiment, which is included and analyzed

     in Chapter 16.

6. How much do you think you will like John if you love Bill and Bill hates John? Set up a

    factorial experiment on social balance, following Figure 11.8. This experiment is

    analyzed in Chapter 13.

7. Study Figure 11.10. It illustrates how to use factorWiz to create a factorial design of

    graphic images. Each image was created in a graphics program and named F0L1.JPG to

    F5L5.JPG. This experiment is detailed in Chapter 14.

Figure 11.7. Using factorWiz to set up a replication of Cliff's (1959) experiment on adverbs as multipliers. The separator contains a single space. This experiment is named *AdjAdv2.htm* on the CD.

Figure 11.8. How to set up an experiment on the Cab Problem of Bayesian

inference. This experiment will be analyzed in Chapter 16.

Figure 11.9. This figure shows how to use factorWiz to set up a factorial design to test

Heider's Social Balance theory. This experiment is analyzed in Chapter 13.

Figure 11.10. This figure illustrates how to use factorWiz to set up a factorial design involving graphic stimuli. In this study, a series of stimuli have been created, named F0L1.JPG to F5L5.JPG. Each combination of Row and Column creates the image tag to present one image. Tags are also included to separate each trial with a horizontal rule.