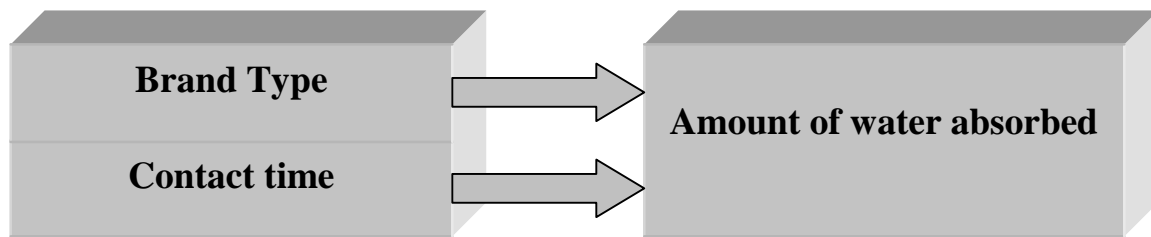


# ABSORBENCY OF PAPER TOWELS

## 5. Conducting the Experiment

In the first part of the experiment we have selected three rolls of paper towels, one from each brand. We have assumed the rolls to be representative of their corresponding populations. Then we selected randomly 15 sheets from each roll. Now in order to examine the effects of brand type and contact time on the amount of water absorbed, it is necessary to assign randomly the 15 sheets from each brand to the three treatment groups corresponding to the three time levels.



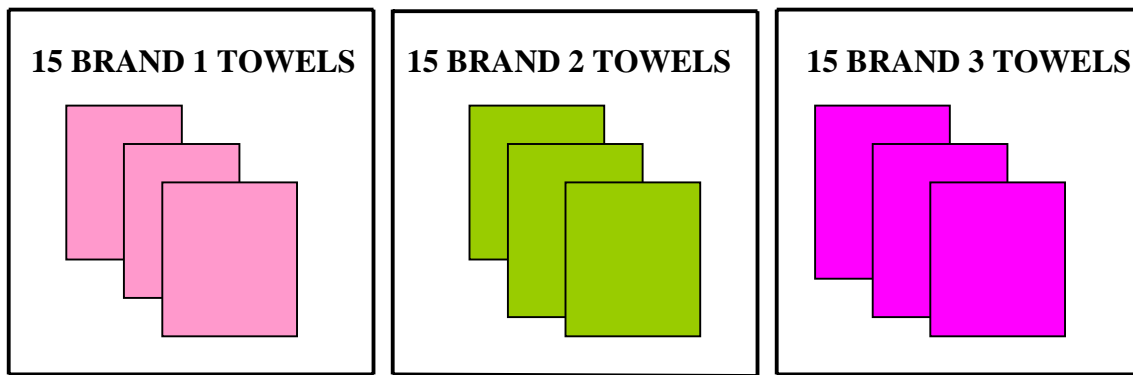
As this experiment has two factors: brand (with three levels) and the contact time (with three levels), this creates  $3 \times 3 = 9$  factor-level combinations, as represented by the cells in the following table.

Levels	General Description	Detailed Description
(1,1)		brand 1 and time level 1
(1,2)		brand 1 and time level 2
(1,3)		brand 1 and time level 3
(2,1)		brand 2 and time level 1
(2,2)		brand 2 and time level 2
(2,3)		brand 2 and time level 3
(3,1)		brand 3 and time level 1
(3,2)		brand 3 and time level 2
(3,3)		brand 3 and time level 3

This is an example of a two-factor experiment with replication.

To minimize the effect of uncontrollable factors, it is very important that the 15 sheets from each brand (experimental units) are assigned at random to the three treatment groups (three time levels). Randomization is a technique for assigning experimental units to treatment combinations. This technique gives each of the 15 sheets an equal chance to be chosen to each of the 3 time levels.

In the first step of randomization, it is necessary to assign labels to the selected 15 sheets. Two digits are needed to label each of the 15 sheets, so we use labels 01, 02, 03, ..., 15 for each of the three brands. As we assign 15 sheets from a particular brand to the three time levels, exactly five sheets will be assigned randomly to each treatment combination.



Now obtain a long sequence of random numbers between 1 and 15. The sequence can be obtained either from the table of random numbers (numbers different from the integers between 1 and 15 are disregarded) or by random number generation feature in the statistical software (integer uniform distribution with possible values between 1 and 15).

The first number in the sequence between 1 and 3 indicates the brand we will be selecting a towel sheet from. The next number between 1 and 15 indicates the number of sheet from the brand. Continue using the numbers until all the 15 sheets of each brand have been assigned one of the three time levels. Remember that each time level is to be used exactly five times for each of the three brands. That is, after five 1s have appeared for a particular brand, skip over the remaining 1s. Use the figure below to record the treatment-combination assignments as they are determined.

Test Number	Brand Number	Sheet Number	Time Level
1	2	6	2
2	3	5	3
3	1	11	1
4	1	4	2
5			1
...			
44			
45			

When you are finished, for each brand you should have 15 towel sheets labeled as five 1s, five 2s, and five 3s. The random assignment of the experimental units (towel sheets) to the treatment combinations is now complete.

Instead of using random number tables, you can use a fair die and a balanced coin. Roll a fair die before each test to randomly choose which brand to test. The number of dots facing up shows the brand selected for testing (4, 5 and 6 disregarded). Roll a die again, and flip a coin. If the coin lands tails, the number of dots facing up on the die indicates the sheet number. If the coin lands heads, roll a die again and find the total on both dice. Roll the die again and again as long as the coin lands heads and the total does not exceed 15. Of course, when all fifteen towels of each brand have been tested, you don't need to roll the die and flip a coin any more.

Now work in teams to carefully make the absorbency measurements described in Section 4. Use the following table to record the results of your experiment.

TEST	BRAND	TIME	DRY WEIGHT	WET WEIGHT
1	1			
2	1			
	1			
	1			
15	1			
16	2			
17	2			
	2			
	2			
30	2			
31	3			
32	3			
45	3			

In the *Dry Weight* column of the above table, record the measured weight of the dry sheet and bowl together. In the *Wet Weight* column, record the measured weight of the wet sheet and bowl together.

Launch SPSS. In the new worksheet, name the first four columns *Test*, *Brand*, *Drywt*, and *Wetwt*. Remember to use numbers (1, 2, and 3), not letters (A, B, and C) for the variable *Brand*. When you have finished typing the data and have double-checked it, save the data set onto your diskette.

We will now create a new variable, *Water*, to reflect the weight of the water absorbed by each paper towel. *Water* for each row (sheet) is the difference  $Wetwt - Drywt$ , and can be created as follows:

1. Click on the *Transform* menu, and then select *Compute...* from the submenu. A *Compute Variable* dialog box will appear.
2. In the *Target Variable* entry box, enter the name of the variable, *Water*.
3. In the *Numeric Expression* entry box type " $Wetwt - Drywt$ ".
4. Click OK.

In a moment, the new variable, *Water*, should appear in your worksheet. Now we are ready to carry the statistical analysis of the data.

The data from our experiment are available in the SPSS file *towel.sav* located on the FTP server in the Stat337 directory.

The following is a description of the variables in the data file:

<u>Column</u>	<u>Name of Variable</u>	<u>Description of Variable</u>
1	BRAND	Brand Type (1, 2, or 3)
2	TIME	The length of time a sheet has been kept in water (in seconds)
3	DRYWT	Measured weight of dry sheet and bowl together (in grams)
4	WETWT	Measured weight of wet sheet and bowl together (in grams)
5	WATER	The difference WETWT-DRYWT.

In our calculations only the variables BRAND, TIME, and WATER will be used. Once the variable WATER has been obtained, the variables DRYWT and WETWT are not needed any longer.