SOME COMMON EXPERIMENTAL DESIGNS AND THEIR ANALYSES

I. One-Factor Between-Subjects Design

In this simple design several (two or more) groups of different subjects are formed and a score on the dependent variable obtained for each subject. The groups are thought of as being the several levels of the one independent variable or "factor." It is essential that scores in one group be independent of scores in other groups. That is, there should be no sense in which scores in one group could be meaningfully paired with scores in any other group.

Structural layout:

Example: 4 groups, 5 subjects per group.

	Group 1	2	3	4
	S_1	S_6	S_{11}	S_{16}
	.	.	.	.
	.	.	.	.
	.	.	.	.
	S_5	S_{10}	S_{15}	S_{20}

Randomized experimental form: Subjects are randomly assigned to be in one of the experimental conditions. The experimenter manipulates the independent variable by determining the specific treatment each group receives.

Example: Subjects are randomly assigned to receive one of 4 levels of drug dosage: placebo, 50mg, 100mg, or 200mg. Scores on a cognitive performance test are obtained for each subject.

Quasi-experimental (correlational) form: Each group of subjects is treated as a random sample from a preexisting population. The experimenter does not manipulate which group the subject is in, but simply observes which group the subject is in.

Example: Reading ability scores are obtained along with a measure of socioeconomic status (SES) for a large sample of subjects. Subjects are divided into 4 levels of SES in order to compare average reading ability for different SES levels.

Analysis of Variance: a = # of groups;
s = # of subjects/group

Source	*df*	*Error Term for F-test*
Groups	a - 1	Within
Within	$a(s$ - 1)	None
Total	as - 1	

II. Two-Factor Between-Subjects Design

In this design several groups of different subjects are formed from a "factorial" arrangement of two independent variables. A score on the dependent variable is obtained for each subject. Each factor has two or more levels. It is again essential that scores in one group be independent of scores in other groups. That is, there should be no sense in which scores in one group could be meaningfully paired with scores in any other group.

***Structural layout**:* 3 subjects per group in a 2 × 3 factorial design

		FACTOR B		
	LEVEL	1	2	3
FACTOR A	1	S_1	S_7	S_{13}
		S_2	.	.
		S_3	.	.
	2	S_4	.	.
		S_5	.	.
		S_6	S_{12}	S_{18}

Randomized experimental form: Subjects are randomly assigned to be in one of the experimental cells. (There are 6 cells in the above example.) The experimenter manipulates the independent variables by determining the specific treatment combination each group receives.

Example: Subjects are randomly assigned to receive one of 2 sets of instructions (Factor A) and one of 3 levels of drug dosage: placebo, 50mg, or 100mg (Factor B). Scores on a cognitive performance test are obtained for each subject.

Quasi-experimental (correlational) form: Each group of subjects is treated as a random sample from a preexisting population. The experimenter does not manipulate which group the subject is in, but simply observes which group the subject is in.

Example: Reading ability scores are obtained along with a measure of socioeconomic status (SES) for a large sample of subjects. Subjects are divided into males and females (Factor A) and 3 levels of SES (Factor B) in order to compare average reading ability for different SES levels and sex groups.

Analysis of Variance: s = # of subjects per cell
a = # of levels of Factor A;
b = # of levels of Factor B

Source	*df*	*Error Term for F-test*
A	$a - 1$	Within
B	$b - 1$	Within
A × B	$(a - 1)(b - 1)$	Within
Within	$ab(s - 1)$	None
Total	$abs - 1$	

III. One-Factor Repeated Measures (Within-Subjects) Design

In this design each subject receives all levels of one independent variable. Scores on the dependent variable are obtained for each subject under all conditions in the experiment. Thus, the scores in the several conditions are not independent of one another, i.e., they can be meaningfully paired: A score in one condition "goes with" a score in another condition because they both belong to the same subject.

***Structural layout*:**

Example: 4 conditions, 6 subjects each receiving all 4 conditions. Y_{23} represents the score for the 2nd subject in the 3rd condition.

	Condition			
Subject	1	2	3	4
S_1	Y_{11}	Y_{12}	Y_{13}	Y_{14}
S_2	Y_{21}	Y_{22}	Y_{23}	Y_{24}
S_3	Y_{31}	Y_{32}	Y_{33}	Y_{34}
S_4	Y_{41}	Y_{42}	Y_{43}	Y_{44}
S_5	Y_{51}	Y_{52}	Y_{53}	Y_{54}
S_6	Y_{61}	Y_{62}	Y_{63}	Y_{64}

Since each subject receives all conditions, there is no random assignment of subjects to conditions here and no real distinction between randomized and quasi-experiments. Nonetheless, it is often important to institute experimental controls such as randomizing or counterbalancing the order in which subjects receive the conditions.

Example: Each subject is required to make a judgment about each of 4 stimulus stories. Scores are the judgments for each story.

Analysis of Variance: s = # of subjects (Factor S)
a = # of levels of Factor A (Conditions)

Source	*df*	*Error Term for F-test*
S	s - 1	None
A	a - 1	S × A
S × A	(s - 1)(a - 1)	None
Total	as - 1	

IV. Randomized Blocks (or Treatment × Blocks) Design

This design is closely related to Design II (Two-way factorial) described above. In fact, it may be thought of as a combination of the randomized and quasi-experimental forms of that design. In this design several groups of different subjects are first formed on the basis of their scores on a concomitant or "blocking" variable. Subjects within each level of this blocking factor are then randomly assigned to be in one of the levels of a second independent variable. A score on the dependent variable is obtained for each subject. Each factor has two or more levels.

Structural layout:

Example: 3 subjects per cell in a 2 × 3 factorial

		FACTOR B (BLOCKS)		
	LEVEL	1	2	3
FACTOR A (TREATMENT)	1 Control	S_1 S_2 S_3	S_7 . .	S_{13} . .
	2 Experimental	S_4 S_5 S_6	. . S_{12}	. . S_{18}

Example: Socioeconomic status (SES) scores are obtained for a large sample of subjects. Subjects are divided into 3 levels of SES (Factor B): High, Medium, and Low SES. In order to assess the effectiveness of a reading improvement program, half the subjects in each SES block are randomly assigned to receive the experimental program, the other half to receive a control program.

Analysis of Variance:
(Same as two-way factorial)

s = # of subjects per cell
a = # of levels of Factor A
b = # of levels of Factor B

Source	*df*	*Error Term for F-test*
A	$a - 1$	Within
B	$b - 1$	Within
A × B	$(a - 1)(b - 1)$	Within
Within	$ab(s - 1)$	None
Total	$abs - 1$	