

23-2 A study is to be conducted to see if there is any evidence of a difference in mean heart rate increase of subjects resulting from three different exercises labeled Q, R, and S. Twelve subjects are available for experimentation.

- (a) Is this an observational study or an experiment? Why?

- (b) Identify the response variable, the explanatory variable, and the sampling unit.

- (c) Describe how a completely randomized design would be utilized.

- (d) Describe how a randomized block design would be utilized.

- (e) Decide which of the two designs in parts (c) and (d) is preferable, and say why.

- (f) Would it be appropriate to make this experiment single-blind? Why or why not?

- (g) Would it be appropriate to make this experiment double-blind? Why or why not?

- (h) How might the Hawthorne effect influence the results in this study?

23-3 For each situation described, (i) identify the response variable, (ii) identify the explanatory variable, (iii) identify the sampling unit, and (iv) decide whether the data should be treated as one sample of paired observations or as two independent samples of observations.

- (a) A study is conducted to see if there is any evidence that the mean weekly nicotine intake for smokers is smaller three weeks after participation in a series of seminars. Weekly nicotine intake for each smoker who participated in the seminars is recorded before and three weeks after participation, with the following results:

Smoker	#01	#02	#03	#04	#05	#06	#07	#08	#09	#10	#11	#12
Before	1.6	1.9	2.4	3.2	2.7	1.7	2.8	1.6	2.0	3.0	2.6	2.3
After	1.3	2.0	2.2	2.4	3.0	1.9	1.8	0.9	2.0	2.5	3.1	1.7

- (i)
- (ii)
- (iii)
- (iv)
- (b) The variables "Weekly Radio Hours" and "Sex" in the SURVEY DATA, displayed as Data Set 1-1 at the end of Unit 1, are being used to see if there is any evidence of a difference between males and females in the mean time spent listening to the radio weekly.
- (i)
- (ii)
- (iii)
- (iv)
- (c) The variables "Sales" and "Location" in the CHAIN DATA, displayed as Data Set 23-1 at the end of Unit 23, are being used to see if there is any evidence of a difference in the mean sales between restaurants in the northern and southern parts of a chain known as McDoogles.
- (i)
- (ii)
- (iii)
- (iv)

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- (d) The variables "Weekly TV Hours" and "Weekly Study Hours" in the STUDENT DATA, displayed as Data Set 23-2 at the end of Unit 23, are being used to see if there is any evidence of a difference in the mean time spent watching television weekly and the mean time spent studying weekly.
- (i)
 - (ii)
 - (iii)
 - (iv)
- (e) The variables "High School GPA" and "Freshman Year College GPA" in the GPA DATA, displayed as Data Set 23-3 at the end of Unit 23, are being used to see if there is any evidence of a difference in the mean high school grade point average and the mean college grade point average among college bound high school graduates.
- (i)
 - (ii)
 - (iii)
 - (iv)
- (f) A study is conducted to see if there is any evidence that the mean lifetime is longer for Topline brand batteries than for Econo brand batteries. Lifetimes are recorded for each of 9 Topline batteries and 11 Econo batteries, with the following results:

Topline	441.5	428.0	426.5	444.5	434.0	422.0	419.0	438.5	425.0			
Econo	404.5	423.0	421.5	410.5	414.5	407.0	414.5	417.5	413.0	416.0	406.5	

- (i)
- (ii)
- (iii)
- (iv)

23-4 For each situation described, (i) identify the response variable, (ii) identify the explanatory variable, (iii) identify the sampling unit, and (iv) decide whether the data should be treated as one sample of paired observations or as two independent samples of observations.

(a) The variables "Expenses" and "Location" in the CHAIN DATA, displayed as Data Set 23-1 at the end of Unit 23, are being used to see if there is any evidence of a difference in the mean expenses between restaurants in the northern and southern parts of a chain known as McDoogles.

(i)

(ii)

(iii)

(iv)

(b) A study is conducted to see if there is any evidence that the mean reaction time of rats to a particular stimulus is faster when injected with a specific drug. The reaction time is measured in milliseconds for each available rat, once with the drug and once without the drug in random order, with the following results:

Rat	#01	#02	#03	#04	#05	#06	#07	#08	#09	#10	#11	#12
No Drug	62	87	52	60	71	69	67	70	69	78	75	73
Drug	65	78	54	56	68	70	67	72	74	73	68	67

(i)

(ii)

(iii)

(iv)

(c) A study is conducted to see if there is any evidence of a difference in mean yield, measured in bushels per acre, between two varieties of corn, labeled V and W. Yields are recorded for each of several plots where variety V corn was grown and each of several plots where variety W corn was grown, with the following results:

Variety V	65.0	81.0	73.5	83.5	77.0	73.0
Variety W	74.5	90.0	88.0	80.5	84.5	

(i)

(ii)

(iii)

(iv)

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- (d) A study is conducted to see if there is any evidence that the mean score on an exam is higher when a new method to teach French is used than when the standard method to teach French is used. Scores on the exam are recorded for each of 45 students in a French class where the standard method was used and for each of 50 students in a French class where the new method was used. The mean and standard deviation of the exam scores resulting from the standard method are respectively 85.2 and 5.6; the mean and standard deviation of the exam scores resulting from the new method are respectively 88.8 and 6.2.
 - (i)
 - (ii)
 - (iii)
 - (iv)

- (e) The variables "Expenses" and "Sales" in the CHAIN DATA, displayed as Data Set 23-1 at the end of Unit 23, are being used to see if there is any evidence that the mean sales exceeds the mean expenses among restaurants in a chain known as McDoogles.
 - (i)
 - (ii)
 - (iii)
 - (iv)

- (f) The variables "Verbal SAT" and "Math SAT" in the GPA DATA, displayed as Data Set 23-3 at the end of Unit 23, are being used to see if there is any evidence of a difference in mean between verbal SAT scores and math SAT scores among college bound high school graduates
 - (i)
 - (ii)
 - (iii)
 - (iv)

23-5 Each of parts (a), (b), (c), (d), (e), and (f) in Exercise 23-3 describes a hypothesis testing situation. For each, indicate whether the hypothesis test will be one-sided or two-sided. (Do not try to perform any of the steps of a hypothesis test.)

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|-----|-----|-----|
| (a) | (b) | (c) |
| (d) | (e) | (f) |

23-6 Each of parts (a), (b), (c), (d), (e), and (f) in Exercise 23-4 describes a hypothesis testing situation. For each, indicate whether the hypothesis test will be one-sided or two-sided. (Do not try to perform any of the steps of a hypothesis test.)

- (a) (b)
 (c) (d)
 (e) (f)

**Table 11-2
 Temperature and
 Strength Data**

Breaking strength (lbs. of force) of an alloy is recorded at various temperatures (degrees Fahrenheit).

Temperature (°F)	Breaking Strength (lbs.)
9	396
50	351
60	320
97	281
123	263
140	227
152	155
178	116
225	61
262	36
277	16

23-7 Why is it not appropriate to calculate the mean of the differences between the pairs of values displayed in the Temperature and Strength Data of Table 11-2, used in Exercise 11-4 and displayed here on the right for convenience?

Table 10-4

Age and Grip Strength Data

The age (years) and right-hand grip strength (pounds of force) are recorded for each of several right-handed males.

Age	15	17	19	11	16	22	17	25	12	14	25	23
Grip Strength	50	54	66	46	58	54	64	80	46	70	76	80

23-8 Why is it not appropriate to calculate the mean of the differences between the pairs of values displayed in the Age and Grip Strength Data of Table 10-4, used in Self-Test Problem 10-1 and displayed here above for convenience?

23-9 Circle the number of the response which correctly completes each statement.

- (a) The Hawthorne effect refers to
- (i) the effect of all extraneous variables on the results of a study.
 - (ii) bias resulting from subjects' behavior tending to be influenced by their awareness that they are part of a study.
 - (iii) the influence that the explanatory variable exerts on the response variable.
 - (iv) bias resulting from a researcher's knowledge about which treatment each subject receives.

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- (b) Data from a completely randomized design
 - (i) results in two or more independent samples.
 - (ii) results in repeated measures data.
 - (iii) results in paired data.
 - (iv) is possible only in double-blind experiments.

23-10 Circle the number of the response which correctly completes each statement.

- (a) The purpose of an institutional review board is to
 - (i) consider the design of a study.
 - (ii) consider the value of the knowledge to be gained from a study.
 - (iii) consider the manner by which data is to be collected from subjects, the information given to subjects about potential risks and benefits, and the manner by which a subject's consent is obtained.
 - (iv) verify that the conclusions drawn from a study are valid.
- (b) Informed consent refers to
 - (i) the permission that subjects in a study give in order to allow their individual data to be publicized.
 - (ii) the anonymity of subjects in a study.
 - (iii) the permission to use animals in a study.
 - (iv) the complete information about risks and benefits that subjects need to know concerning their participation in a study.