AP Statistics Summer Assignment 2019-2020

Welcome to Advanced Placement Statistics. This is a yearlong course that completes a semester and a half of college level statistics. Your performance in this course is evaluated on the AP exam, which is to be administered on **Friday May 15, 2020 at 12pm.** A score of 3 or higher out of 5 on this exam can lead to college credit at many colleges and universities.

For your first assignment, you will be learning about how to collect data and run an experiment. In order to do this, you will first need to log into our Google Classroom, the code is **iekvdu.**

Once you have logged into the Google classroom:

(1) Log into the google classroom by August 15, 2019.

(2) Read chapter 4 of our textbook (On Google Classroom) pages 207 – 229, 234 – 259, and 266 – 276. Be sure to read the green summary of each section.

(3) Complete the reading guide, **Designing Studies**, for chapter 4 (attached). **This is due Friday, September 6th, 2019. No late assignments accepted.**

(4) Watch all of the videos under Mr. G's Mathematics Emporium Chapter 4 and complete the fill – in class notes (attached). **Class notes are due on Friday, September 6h, 2019. No late assignments accepted.**

Videos are uploaded on the Google Classroom or can be found using the following link: https://sites.google.com/a/cusd.kahoks.org/mrg/ap-stats-lecture-videos/chapter-4

(5) Complete the attached take home test. **It is due Tuesday, September 10th, 2019. No late assignments will be accepted.** You may come for remedial to get assistance on September 4th, 5th, and 9th.

This summer assignment *(Reading guide, Fill- in class notes, and Take home)* will count as your first 3 grades for the 2019-2020 school year.

We look forward to a productive year!

CHAPTER 4 READING GUIDE
DESIGNING STUDIES

Name _____

Key Vocabulary:

- voluntary response sample
- confounded
- population
- sample
- design
- convenience sampling
- biased
- simple random sample
- table of random digits
- probability sample
- stratified random sample
- strata
- undercoverage
- nonresponse
- response bias
- sampling frame
- systematic random sample
- observational study
- experimental units
- subjects
- treatment
- factor
- level
- placebo effect
- control group
- randomization
- completely randomized experiment
- statistically significant
- replication
- hidden bias
- double-blind experiment
- block design
- matched pairs design

4.1 Sampling and Surveys

1. How does a population differ from a sample?

2. What are the steps to planning a sample survey?

3. Why are voluntary response samples unreliable?

4. Why might convenience sampling be unreliable?

5. What is a biased study?

6. Define simple random sample.

7. What two properties of a table of random digits make it a good choice for creating a simple random sample?

8. State the two steps in choosing an SRS?
   -
   -

9. How do you select a stratified random sample?

10. What is cluster sampling?

11. What is the difference between a strata and cluster? (see page 221)

12. Give an example of undercoverage in a sample.

13. Give an example of non-response bias in a sample.

14. What factors can cause response bias in a sample.

15. How can the wording of questions cause bias in a sample?

16. What is the difference between nonresponse and voluntary response?

4.2 Experiments

1. How does an experiment differ to an observational study?

2. What is a lurking variable?

3. What is confounding?

4. Explain the difference between experimental units and subjects.

5. Define treatment.

6. What is the difference between factor and level in an experiment? Example on page 235.

7. Explain how to perform a completely randomized design.

8. What is the significance of using a control group?

9. The basic principles of statistical design of experiments are:
   -
   -
   -

10. Describe the placebo effect.

11. Define randomization.

12. Define statistically significant.

13. Describe a block design.

14. When does randomization take place in a block design, and how does this differ to a completely randomized design?

15. What is the goal of a matched pairs design?

16. State the two most common ways in which matched pairs experiments are designed.

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-

17. What are the advantages of a double-blind study?

4.3 Using Studies Wisely

1. What are the criteria for establishing causation when we can't experiment?

2. What is meant by inference about cause and effect?

MR. G MATH EMPORIUM CHAPTER 4 VIDEO #1
4.1 – Sampling Designs

2 BAD Sampling Designs (from yesterday's reading):
1. _____ - People choose whether to respond.
2. _____ - Interviewer chooses whom to sample.

The Remedy:
Allow _____ to choose the sample because a sample selected by chance does not allow favoritism or self-selection, and reduces _____ by giving all individuals an equal chance to be chosen.

5 GOOD Sampling Designs!

3. **Simple Random Sample (SRS)** – **A SRS is chosen so that every _____ of individuals has an _____ chance of being selected.**

Δ 3 ways to take a Simple Random Sample (SRS):

1) Use an actual, physical routine like drawing names out of a hat.
- **Make sure everything is "equal" to ensure equal chance and randomness.**

2) Use a random number table (back of formula sheet) to select #'s tied to people.

1. It is a long string of the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9 with these two properties.
   a. Each entry in the table is **equally likely** to be any of the ten digits 0 through 9.
   b. The entries are **independent** of each other. That means that knowledge of one part of the table gives no information about any other part.
2. Q: Why are the numbers in groups of 5? A: To make it easier to read
3. Q: Why are the Lines numbered from 101 to 150? A: To make it easier to read

3) Use technology to randomly generate numbers that are tied to people.

Using the **randInt** function on your calculator → **[Math], PRB Menu, #5 randInt**

The inputs are: **randInt(min #, max #, number of numbers you want displayed at a time).**

Why might the AP Test and your Chapter 4 Test require that you use a random number table as opposed to the **randInt** function?

4. **Stratified Random Sample** – First divide the population into _____ (groups that have something in common to each other…you're making each group *homogenous*). Then, select a _____ from **EACH** strata and combine them to form the full sample.
    - Ex: *Randomly select x students from freshmen, sophomores, juniors, & seniors to account for difference amongst grade level.*

5. **Cluster Sample** – The population is already broken down into pre-formed clusters naturally. Each cluster is perceived to be similar to each other cluster and a *heterogeneous* mixture of the population. Randomly select however many clusters you decide and **EVERYONE** within those clusters are a part of your sample.
    - Ex*: Randomly select 10 study halls to question all the students in there. Each study hall is assumed to be a mixture of all grade levels. The individuals inside the cluster are assumed to be randomly picked since their "cluster" was randomly selected.*

6. **Systematic Random Sample** – Individuals are selected according to a random starting point and a fixed, periodic interval.
    - Ex: Out of 100 students, I want to randomly select 5. Student #42 is randomly selected (the starting point). Then a fixed, periodic interval is determined. Typically, you take your population size divided by your sample size. For this example that means 100/5 = 20, so that every 20th student is selected after student #42 until 5 are chosen. If you reach the end of the line of students before your total sample is chosen, just wrap back around to the beginning of the list and continue until done.

7. **Multistage Random Sample** – refers to sampling plans where the sampling is carried out in stages using smaller and smaller sampling units at each stage.
    - Ex: Imagine a cluster sample, but then individuals are randomly selected out of each cluster instead of just taking the whole cluster of individuals as your sample.

YOU TRY!!!: The manager of a sports arena wants to learn more about the financial status of people who are attending an NBA basketball game. He would like to give a survey to a representative sample of the more than 20,000 fans in attendance. Ticket prices for the game vary a great deal: seats near the court cost over $100 each, while seats in the top rows of the arena cost $25 each. The arena is divided into 30 numbered sections, from 101 to 130. Each section has rows of seats labeled with letters from A (nearest to the court) to ZZ (top row of the arena).

Would a stratified random sample using the lettered rows or a cluster sample using the numbered sections be the best option to guarantee a representative sample of the various financial statuses of

people attending the game? *Consider the worst case scenarios of each to decide which method is superior.*

MR. G MATH EMPORIUM CHAPTER 4 VIDEO #2

4.1 – How to choose a random sample!

Today, we practice on how to select a random sample using our 3 methods discussed in Video #1.

We will devise a "scheme" for how we will accomplish our random sample which has 3 parts:

1) ***Label the individuals in the population.*** With the "hat method", this step could just be writing everyone's name on equal sized piece of paper. For the technology or random number table method, this means assigning numbers to each individual. You must be ***specific*** about the range of numbers that will be used. You cannot just say "assign numbers to individuals".

2) ***How you will select the first individual.*** With the "hat method", this step is simply saying you would mix up the papers and blindly select a piece of paper. With technology, this means describing what function of you would use to select your random number. With the random number table, this means stating what line will you use and *how many digits will you select* at a time to represent the first individual.

3) ***Repeating the process and conditions to watch out for.*** With the "hat method", this step just means how many names will you select out of the hat, will you put a selected name back in the hat before you select the next, etc. With technology and the random number table, this means using the function or the table from part 2 however many times you need before your whole sample is selected and discussing what to do with repeated numbers.

Ex #1: Here are the names of 10 guys on a local HS baseball team. At practice, every 15 minutes the coach randomly selects 2 guys to run sprints up a steep hill. Practice is 2 hours long and starts at 3:00. Write a scheme using the random number table and use Line 120 to determine who runs.

Joe	Ron	Dave	Matt	Bryan
Mark	Pat	Jimmy	Adam	Gary

Line 120: **35476 55972 39421 65850 04266 35435**

MR. G MATH EMPORIUM CHAPTER 4 VIDEO #3
4-2 Completely Randomized Design (CRD)

There are 3 principles of experimental design:

1. **Control** the effects of the lurking variables on the response by comparing 2 or more treatments.
    a. Always use a control group when designing an experiment.
    b. ***What is a control group?***

    _____

    _____

    _

2. **Randomize** – use chance (the random number table) to assign experimental units to treatments.
    a. Decide how many treatments there are.
    b. Find out how many experimental units you have.
    c. Number them.
    d. Randomly allocate the experimental units to the groups.

    Why is this important?

    _____

3. **Replicate** each treatment on many units to reduce chance variation in the results.
    a. Larger sample sizes always yield more _____ results!
    b. Use enough experimental units to reduce chance variation because the effects of chance will average out when the sample size is large.

There are 3 types of experimental designs you will learn soon:

1. Completely Randomized Design (CRD)
2. Matched Pairs Design
3. Randomized Block Design (RBD)

A good experimental design should be **double blind**.

Double Blind -

Single Blind -

Placebo -

Placebo effect -

A food company assesses the nutritional quality of a new "instant breakfast" product by feeding it to 15 newly weaned male rats. The response variable is a rat's weight gain over a 28-day period. A control group of 15 rats eats a standard diet, but otherwise receives the exact same treatment as the experimental group.

a. How many factors are there? List it / them.

b. How many experimental units are there?

c. What are the experimental units?

d. How will they be labeled?

e. Use line 110 to randomly allocate the rats to the two groups.

f. The following is a diagram of this completely randomized design. Label the four essential parts.

When doing an experiment we hope to see a difference in the response so large that it is unlikely to happen just because of chance variation. If the difference is larger than we would expect to see strictly due to chance variation we call our result _____.

A manufacturer of food products uses package liners that are sealed at the top by applying heated jaws after the package is filled. The customer peels the sealed pieces apart to open the package. What effect does the temperature of the jaws have on the force required to peel the liner? To answer this question, the engineers prepare 20 pairs of pieces of package liner. They seal five pairs at each of 250°F, 275°F, 300°F, and 325°F. Then they measure the strength needed to peel each seal.

a. Use a diagram to describe a completely randomized experimental design.

b. Use Table B, starting at line 120, to do the randomization required by your design. ***YOU DO!***

TABLE B Random digits

LINE								
101	19223	95034	05756	28713	96409	12531	42544	82853
102	73676	47150	99400	01927	27754	42648	82425	36290
103	45467	71709	77558	00095	32863	29485	82226	90056
104	52711	38889	93074	60227	40011	85848	48767	52573
105	95592	94007	69971	91481	60779	53791	17297	59335
106	68417	35013	15529	72765	85089	57067	50211	47487
107	82739	57890	20807	47511	81676	55300	94383	14893
108	60940	72024	17868	24943	61790	90656	87964	18883
109	36009	19365	15412	39638	85453	46816	83485	41979
110	38448	48789	18338	24697	39364	42006	76688	08708
111	81486	69487	60513	09297	00412	71238	27649	39950
112	59636	88804	04634	71197	19352	73089	84898	45785
113	62568	70206	40325	03699	71080	22553	11486	11776
114	45149	32992	75730	66280	03819	56202	02938	70915
115	61041	77684	94322	24709	73698	14526	31893	32592
116	14459	26056	31424	80371	65103	62253	50490	61181
117	38167	98532	62183	70632	23417	26185	41448	75532
118	73190	32533	04470	29669	84407	90785	65956	86382
119	95857	07118	87664	92099	58806	66979	98624	84826
120	35476	55972	39421	65850	04266	35435	43742	11937
121	71487	09984	29077	14863	61683	47052	62224	51025
122	13873	81598	95052	90908	73592	75186	87136	95761
123	54580	81507	27102	56027	55892	33063	41842	81868
124	71035	09001	43367	49497	72719	96758	27611	91596
125	96746	12149	37823	71868	18442	35119	62103	39244
126	96927	19931	36809	74192	77567	88741	48409	41903
127	43909	99477	25330	64359	40085	16925	85117	36071
128	15689	14227	06565	14374	13352	49367	81982	87209
129	36759	58984	68288	22913	18638	54303	00795	08727
130	69051	64817	87174	09517	84534	06489	87201	97245
131	05007	16632	81194	14873	04197	85576	45195	96565
132	68732	55259	84292	08796	43165	93739	31685	97150
133	45740	41807	65561	33302	07051	93623	18132	09547
134	27816	78416	18329	21337	35213	37741	04312	68508
135	66925	55658	39100	78458	11206	19876	87151	31260
136	08421	44753	77377	28744	75592	08563	79140	92454
137	53645	66812	61421	47836	12609	15373	98481	14592
138	66831	68908	40772	21558	47781	33586	79177	06928
139	55588	99404	70708	41098	43563	56934	48394	51719
140	12975	13258	13048	45144	72321	81940	00360	02428
141	96767	35964	23822	96012	94591	65194	50842	53372
142	72829	50232	97892	63408	77919	44575	24870	04178
143	88565	42628	17797	49376	61762	16953	88604	12724
144	62964	88145	83083	69453	46109	59505	69680	00900
145	19687	12633	57857	95806	09931	02150	43163	58636
146	37609	59057	66967	83401	60705	02384	90597	93600
147	54973	86278	88737	74351	47500	84552	19909	67181
148	00694	05977	19664	65441	20903	62371	22725	53340
149	71546	05233	53946	68743	72460	27601	45403	88692
150	07511	88915	41267	16853	84569	79367	32337	03316

MR. G MATH EMPORIUM CHAPTER 4 VIDEO #3
4.2 - Matched Pairs Design

A Matched Pairs experimental design can take 2 forms:

1. The experimental units are matched to produce more precise results than simple randomization.
2. Each experimental unit receives both treatments and is compared to him or herself.

Ex 1. A manufacturer of boots plans to conduct an experiment to compare a new method of waterproofing to the current method. The appearance of the boots is not changed by either method. The company recruits 100 volunteers in Seattle, where it rains frequently, to wear the boots as they normally would for 6 months. At the end of the 6 months, the boots will be returned to the company to be evaluated for water damage.

a. Describe a design for this experiment that uses the 100 volunteers. Include a few sentences on how it will be implemented.

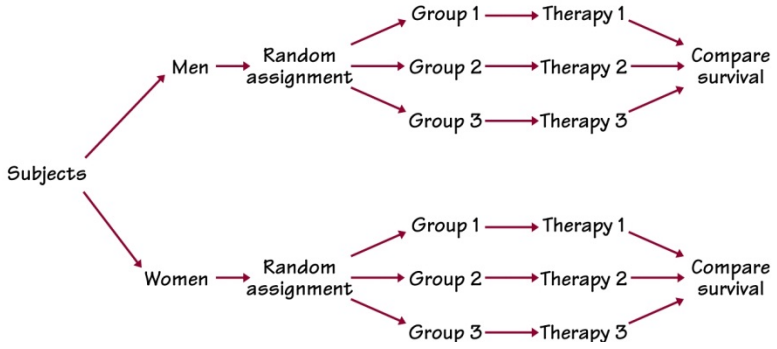
b. Could your design be double blind? Explain.

A **block** is a group of experimental units or subjects that are known before the experiment to be similar in some way that is expected to affect the response. In a **block design**, the random assignment of the units to the treatments is carried out separately within each block.

Ex 1. The progress of a type of cancer differs in men and women. A clinical experiment to compare three therapies for this cancer therefore treats sex as a blocking variable. Two separate randomizations are done, one assigning the female subjects to the treatments and the other assigning the male subjects. Note that there is no randomization in making up the blocks (the blocks are made by gender), the randomization comes into play when they split each gender up into the 3 treatment groups.

Label the main features of a Randomized Block Design.

List the group sizes there are 180 Subjects, 30% of whom are male.

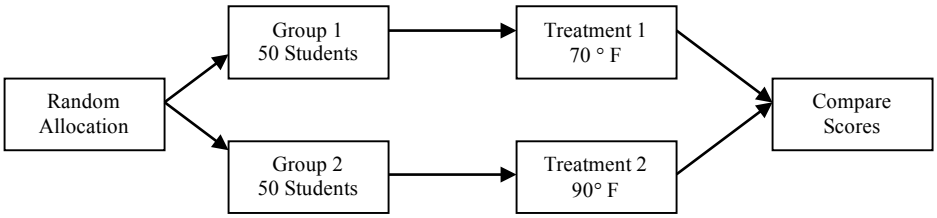


Experimental Designs Summarized

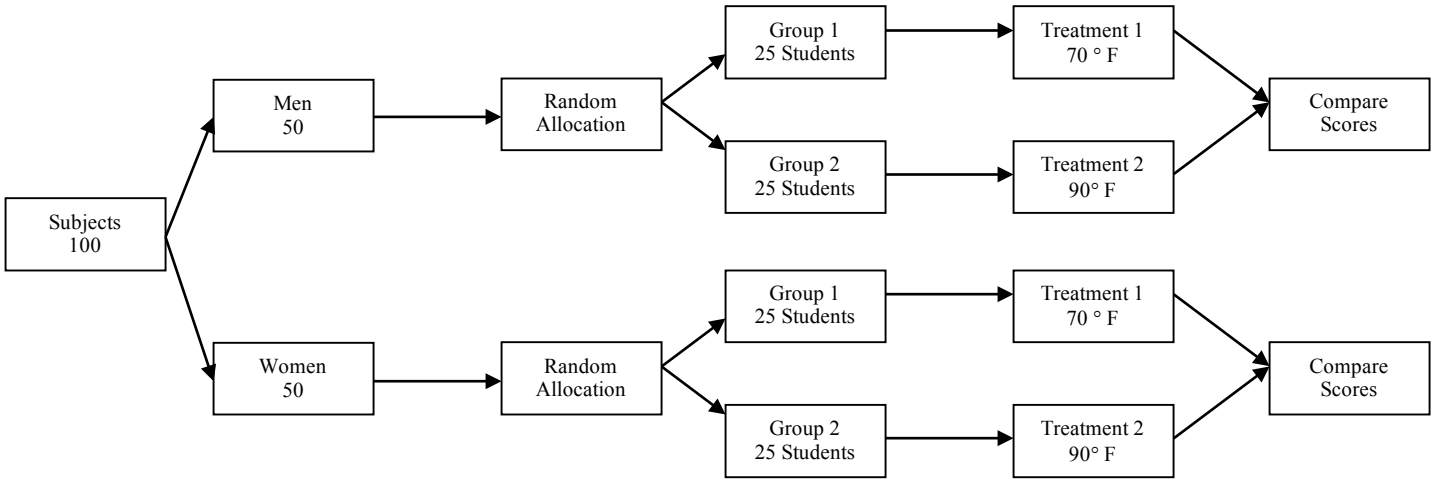
Situation: Mr. Gottschalk wants to compare the ability of a student to concentrate under two different room temperatures, 70° F and 90° F. He will administer the SAT's to a random sample of 100 seniors to draw a conclusion about this question.

One of the following experimental designs could be used:

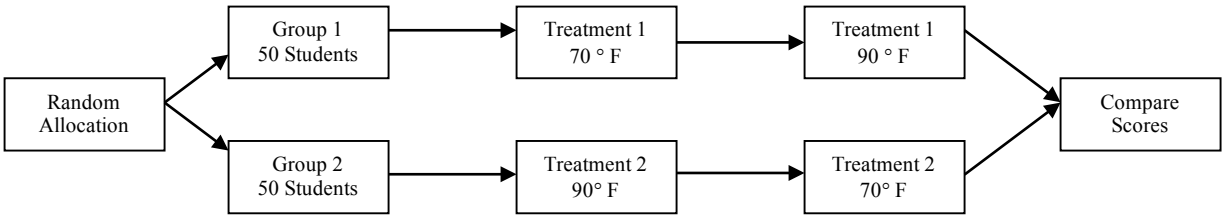
1. **Completely Randomized Design**: Considers the sample as a single group.



2. **Randomized Block Design**: This should be used if we believe that men and women will react differently to the different room temperatures



3. **Matched Pairs Design**: Each student takes the SAT in the 70° room and the 90° room. We must randomly determine which room they take the test in first.



Preparing for your Chapter 4 Test

You Should Know:

- How to identify the sample and the population
- How to identify sources of bias such as voluntary response, convenience sampling, undercoverage, nonresponse, response bias, lurking variables, confounding, wording of questions, etc.
- How to explain and describe the differences between SRS, convenience sampling, stratified random sampling, and cluster random sampling
- How to use the table of random numbers and the randInt function on the calculator to select random samples of various sizes.
- The difference between observational studies, surveys, and experiments.
- How to identify the factors (explanatory variables), treatments, response variables, experimental units or subjects in an experimental design.
- The purpose for using control groups in an experiment
- The three principles of an experimental design: control, randomization, replication
- How to outline the design of a completely randomized experiment and a randomized block design experiment
- The correct usage for a matched pairs experimental design
- That a larger sample size will provide more accurate results than a small sample size

Chapter 4 – Important Terms

- Voluntary Response Sample
- Experiment
- Confounding
- Population
- Sample
- Convenience Sampling
- Bias
- Simple Random Sample
- Stratified Random Sample
- Cluster Random Sample
- Systematic Random Sample
- Multistage Random Sample
- Sampling Error
- Nonsampling error
- Undercoverage
- Nonresponse
- Response Bias
- Observational Study
- Experimental Units
- Subject
- Treatment
- Factors
- Levels
- Placebo Effect
- Control Group
- Completely Randomized Design
- 3 Principles of Experimental Design
- Double Blind Experiment
- Block Design
- Matched Pairs Design

Name: _____ **Per:** _____ **Date:** _____

AP Statistics **Summer Assignment TAKE HOME**

DUE: Tuesday September 10th, 2019

Part 1: Multiple Choice. *Circle the letter corresponding to the best answer.*

1. A new headache remedy was given to a group of 25 subjects who had headaches. Four hours after taking the new remedy, 20 of the subjects reported that their headaches had disappeared. From this information you conclude
(a) that the remedy is effective for the treatment of headaches.
(b) nothing, because the sample size is too small.
(c) nothing, because there is no control group for comparison.
(d) that the new treatment is better than aspirin.
(e) that the remedy is not effective for the treatment of headaches.

2. We wish to draw a sample of 5 without replacement from a population of 50 households. Suppose the households are numbered 01, 02, . . . , 50, and suppose that the relevant line of the random number table is `11362 35692 96237 90842 46843 62719 64049 17823`.
Then the households selected are
(a) households 11 13 36 62 73
(b) households 11 36 23 08 42
(c) households 11 36 23 23 08
(d) households 11 36 23 56 92
(e) households 11 35 96 90 46

3. A maple sugar manufacturer wants to estimate the average trunk diameter of Sugar Maples trees in a large forest. There are too many trees to list them all and take a SRS, so he divides the forest into several hundred 10 meter by 10 meter plots, selects 25 plots at random, and measures the diameter of every Sugar Maple in each one. This is an example of a
(a) multistage sample.
(b) stratified sample.
(c) simple random sample.
(d) cluster sample.
(e) convenience sample.

4. A researcher for a consumer products company is field testing a new formula for laundry detergent. He has contracted with 60 families, each with two children, who have agreed to test the product. He randomly assigns 30 families to the group that will use the new formula and 30 to the group that will use the company's current detergent formula. The most important reason for this random assignment is that
(a) randomization makes the analysis easier since the data can be collected and entered into the computer in any order.
(b) randomization eliminates the impact of any confounding variables.
(c) randomization is a good way to create two groups of 30 families that are as similar as possible, so that comparisons can be made between the two groups.
(d) randomization ensures that the study is double-blind.
(e) randomization reduces the impact of outliers.

5. To test the effect of music on productivity, a group of assembly line workers are given portable mp3 players to play whatever music they choose while working for one month. For another month, they work without music. The order of the two treatments for each worker is determined randomly. This is
(a) an observational study.
(b) a matched pairs experiment.
(c) a completely randomized experiment.
(d) a block design, but not a matched pairs experiment.
(e) impossible to classify unless more details of the study are provided.

6. A survey was done in the town of Mechanicsville to estimate the proportion of cars that are red and made by companies based in Japan. A simple random sample of 25 cars from a parking lot at Lee-Davis High School was taken. Which of the following statements is correct?
(a) Since this is a simple random sample, it should be representative of all the cars in Mechanicsville.
(b) If a simple random sample of 15 cars were taken, we would expect the same amount of variability in the proportion of red cars as we would with a sample of 25 cars.
(c) An alternative method for getting a representative sample would be to select the 25 cars closest to a specified location, such as the entrance to the gymnasium.
(d) A different team doing the sampling independently would probably obtain a slightly different answer for their sample proportion.
(e) The results would be the same regardless of the time of day that the sample is taken.

7. A nutritionist wants to study the effect of storage time (6, 12, and 18 months) on the amount of vitamin C present in freeze dried fruit when stored for these lengths of time. Six fruit packs were randomly assigned to each of the three storage times. The treatment, experimental unit, and response are respectively:
(a) A specific storage time, amount of vitamin C, a fruit pack
(b) A fruit pack, amount of vitamin C, a specific storage time
(c) Random assignment, a fruit pack, amount of vitamin C
(d) A specific storage time, a fruit pack, amount of vitamin C
(e) A specific storage time, six fruit packs, amount of vitamin C

8. A researcher observes that, on average, the number of divorces in cities with Major League Baseball teams is larger than in cities without Major League Baseball teams. Which of the following is the most plausible explanation for this observed association?
(a) The presence of a Major League Baseball team causes the number of divorces to rise (perhaps husbands are spending too much time at the ballpark).
(b) The high number of divorces is responsible for the presence of Major League Baseball teams (more single men means potentially more fans at the ballpark, making it attractive for an owner to relocate to such cities).
(c) The association is due to confounding (Major League teams tend to be in large cities with more people, hence a greater number of divorces).
(d) The association makes no sense, since many married couples go to the ballpark together.
(e) The association is purely coincidental. It is implausible to believe the observed association could be anything other than accidental.

9. Control groups are used in experiments in order to accomplish which one of the following?
(a) Limit the effects of variables other than the explanatory variable on the outcome.
(b) Control the subjects of a study to ensure that all participate equally.
(c) Guarantee that someone other than the investigators, who have a vested interest in the outcome, controls how the experiment is conducted.
(d) Achieve a proper and uniform level of randomization.
(e) Reduce variability in results.

10. A survey is to be administered to recent graduates of a certain nursing school in order to compare the starting salaries of women and men. For a random sample of graduates, three variables are to be recorded: sex, starting salary, and area of specialization. Which of the following best describes a conclusion that can be drawn from this study?
(a) Whether being female causes graduates of this nursing school to have lower (or higher) starting salaries than males.
(b) Whether being female causes graduates in this sample to have lower (or higher) starting salaries than males.
(c) Whether choosing a certain area of specialization causes females graduates of this nursing school to have lower (or higher) starting salaries than males.
(d) Whether there is an association between sex and starting salary among graduates of this nursing school.
(e) Whether there is an association between sex and starting salary at all nursing schools.

Part 2: Free Response

Show all your work. Indicate clearly the methods you use, because you will be graded on the correctness of your methods as well as on the accuracy and completeness of your results and explanations.

11. Read the following brief article about aspirin and alcohol.

> **Aspirin may enhance impairment by alcohol**
>
> Aspirin, a long time antidote for the side effects of drinking, may actually enhance alcohol's effect, researchers at the Bronx Veterans' Affairs Medical Center say. In a report on a study published in the *Journal of the American Medical Association*, the researchers said they found that aspirin significantly lowered the body's ability to break down alcohol in the stomach. As a result, five volunteers who had a standard breakfast and two extra-strength aspirin tablets an hour before drinking had blood alcohol levels 30 percent higher than each had when they drank alcohol alone. Each volunteer consumed the equivalent of a glass and a half of wine.
>
> That 30 percent could make the difference between sobriety and impairment, said Dr. Charles S. Lieber, medical director of the Alcohol Research and Treatment Center at the Bronx center, who was co-author of the report with Dr. Risto Roine.

(a) Explain why this is an experiment and not an observational study.

(b) Identify the explanatory and response variables.

(c) Identify the experimental design used in this study. Justify your answer.

(d) In the second sentence above is the phrase, "…researchers said they found that aspirin significantly lowered the body's ability to break down alcohol…" What is the statistical meaning of the word "significantly" in the context of this study?

(e) This was a controlled experiment. Describe how it was controlled and explain the purpose of doing so.

12. High blood pressure adds to the workload of the heart and arteries and may increase the risk of heart attacks. If not treated, this condition can also lead to heart failure, kidney failure, or stroke. We wish to test the effectiveness of Angiotensin-converting enzyme (ACE) inhibitors as a treatment for high blood pressure.

(a) It is well known that men and women may react differently to common cardiovascular drug treatments. What sort of experimental design would you choose for this study, and why?

(b) Explain why an experiment involving 600 men and 500 women is preferable to one involving 60 men and 50 women.

(c) Assume that 600 men and 500 women suffering from high blood pressure are available for the study. Describe a design for this experiment. Be sure to include a description of how you assign individuals to the treatment groups.

13. Bias is present in each of the following sampling designs. In each case, identify the type of bias involved and state whether you think the sample result obtained is lower or higher than the actual