Name: Key

STATISTICS

PART 3 PRACTICE EXAM 2

Time – 1 hour and 30 minutes

Number of multiple choice questions – 20

Number of free response questions - 3

1. 40% of the staff in a local school district have a master's degree. One of the schools in the district has only 4 teachers out of 15 with a master's degree. You are asked to design a simulation to determine the probability of getting this few of teachers with master's degrees in a group of this size. Which of the following assignments of the digits 0 through 9 would be appropriate for modeling this situation?

(A) Assign "0, 1, 2" as having a master's degree and "4, 5, 6, 7, 8, 9" as not having a degree.
(B) Assign "1, 2, 3, 4, 5 " as having a master's degree and "0, 6, 7, 8, 9" as not having a degree.
(C) Assign "0, 1" as having a master's degree and "2, 3, 4, 5, 6, 7, 8, 9" as not having a degree.
(D) Assign "0, 1, 2, 3" as having a master's degree and "4, 5, 6, 7, 8, 9" as not having a degree.
(E) Assign "7, 8, 9" as having a master's degree and "0, 1, 2, 3, 4, 5, 6" as not having a degree.

2. A study showed that persns who ate two carrots a day have significantly better eyesight than those who eat less than one carrot a week. Which of the following statements is (are) correct?

I. This study provides evidence that eating carrots contributes to better eyesight.
II. The general health consciousness of people who eat carrots could be a confounding variable.
III. This is an observational study and not an experiment.

(A) I only
(B) III only
(C) I and II only
(D) II and III only
(E) I, II, and III

3. You are designing a study to determine which of three brands of golf ball will travel the greatest distance. You intend to use only adult mail golfers. There is evidence to indicate that the temperature at the time of the test affects the distance traveled. There is no evidence that the size of the golfer is related to the distance traveled (distance seems to have more to do with technique than bulk). This experiment would best be done

(A) by blocking on type of golf ball
(B) by blocking on size of golfer
(C) by blocking on size of the golfer and temperature
(D) without blocking
(E) by blocking on temperature

4.

In a certain community, 20% of cable subscribers also subscribe to the company's broadband service for their Internet connection. You would like to design a simulation to estimate the probability that one of six randomly selected subscribers has the broadband service. Using digits 0 through 9, which of the following assignments would be appropriate to model this situation?

(A) Assign even digits to broadband subscribers and odd digits to cable-only subscribers.

(B) Assign 0 and 1 to broadband subscribers and 2, 3, 4, 5, 6, 7, 8, and 9 to cable-only subscribers.

(C) Assign 0, 1, and 2 to broadband subscribers and 3, 4, 5, 6, 7, 8, and 9 to a cable-only subscribers.

(D) Assign 1, 2, 3, 4, 5, and 6 to broadband subscribers and 7, 8, 9, and 0 to cable-only subscribers.

(E) Assign 0, 1, and 2 to broadband subscribers; 3, 4, 5, and 6 to cable-only subscribers; and ignore digits 7, 8, and 9.

5.

A cause-and-effect relationship between two variables can best be determined from which of the following?

(A) A survey conducted using a simple random sample of individuals

(B) A survey conducted using a stratified random sample of individuals

(C) An association with a correlation coefficient near 1 or -1

(D) An observational study where the observational units are chosen randomly

(E) A controlled experiment where the observational units are assigned randomly

6.

Which of the following is a true statement about experimental design?

(A) Replication is a key component in experimental design. Thus, an experiment needs to be conducted on repeated *samples* before generalizing results.

(B) Control is a key component in experimental design. Thus, a control group that receives a placebo is a *requirement* for experimentation.

(C) Randomization is a key component in experimental design. Randomization is used to *reduce* bias.

(D) Blocking eliminates the effects of *all* lurking variables.

(E) The placebo effect is a concern for *all* experiments.

7.

An experimenter believes that two new exercise programs are more effective than any current exercise routines and wishes to compare the effectiveness of these two new exercise programs on physical fitness. The experimenter is trying to determine whether or not a control group, which follows neither of these new programs but continues with current exercise routines, would be beneficial. Which of the following can be said about the addition of a control group?

(A) A control group would eliminate the placebo effect.

(B) A control group would eliminate the need for blinding in the study.

(C) A control group would allow the experimenter to determine which of the two exercise programs improves physical fitness the most.

(D) A control group would allow the experimenter to determine if either of the exercise programs is more effective than current programs for physical fitness.

(E) There would be no added benefit to having a control group.

8.

Which of the following sample designs does *not* contain a source of bias?

(A) A politician would like to know how her constituents feel about a particular issue. As a result, her office mails questionnaires about the issue to a random sample of adults in her political district.

(B) A company uses the telephone directory to randomly select adults for a telephone survey to gauge their feelings toward items manufactured by the company.

(C) An interviewer selects a random sample of individuals to question about a particular issue. Since some of the individuals are not informed about the issue, the interviewer gives background and his personal view on the issue before recording their responses.

(D) A news show asks viewers to call a toll-free number to express their opinions about a recent high-publicity trial.

(E) One thousand numbered tickets are sold as a fund-raiser. Five numbers are chosen randomly, and the individuals with the winning ticket numbers each win $10.

9.

A university is proposing a new procedure for professors to gain tenure. To gauge sentiment about the proposal, the university intends to randomly sample five professors, five assistant professors, five associate professors, five adjunct professors, and five visiting professors. This is an example of what type of sampling design?

(A) Simple random sample

(B) Stratified random sample

(C) Systematic random sample

(D) Cluster sample

(E) Convenience sample

10.

A drug company wishes to test a new drug. A researcher assembles a group of volunteers and randomly assigns them to one of two groups—one to take the drug and one to take a placebo. In addition, the company wants the experiment to be double-blind. What is the meaning of double-blind in this situation?

(A) The volunteers in both groups are blindfolded when they take the drug or placebo.

(B) The volunteers in both groups do not know whether they are taking the drug or the placebo.

(C) Neither the volunteers nor the drug company executives know which volunteers are taking the drug and which are taking the placebo.

(D) Neither the volunteers nor the evaluator know which volunteers are taking the drug and which are taking the placebo.

(E) As long as the subjects are randomly assigned to the two groups, there is no need to make the experiment double-blind.

11.

Since many individuals walk around their homes in their socks, a manufacturer has created a material for socks that is believed to be more resistant to wear than cotton. The manufacturer wishes to test this belief over a period of a month. Given a group of volunteers, which of the following designs will *best* test this new material's resistance to wear?

(A) Have the volunteers wear the socks made from the new material for a month, and check the wear on the socks at the end of the month.

(B) Allow half of the volunteers to wear cotton socks, while the other half wear socks made of the new material. Compare the wear on the socks at the end of the month.

(C) Randomly assign half of the volunteers to wear cotton socks, while the other half wear socks made of the new material. Compare the wear on the socks at the end of the month.

(D) Randomly assign half of the volunteers to wear cotton socks, while the other half wear socks made of the new material. At the end of two weeks, the volunteers should change sock types. Compare the wear on the socks at the end of the month.

(E) For each volunteer, randomly choose which foot wears a cotton sock, while the other foot wears a sock made of the new material. Compare the wear on the socks at the end of the month.

12.

Having read about the positive effects of gingko biloba on memory, some precocious statistics students decide to conduct their own experiment to test the herb's effects. Close to 50 of their classmates, all in good health and representing a variety of ethnic groups, volunteer to take part in the experiment, and the students randomly assign half of the volunteers to take gingko. The other half take a placebo. The students perform a memory test on the volunteers at the beginning of the experiment and a second test eight weeks later. After analyzing their results, they find no memory improvement in the gingko group versus the placebo group. Assuming the students followed all aspects of good experimental design, which of the following can be concluded?

(A) Gingko biloba does not improve memory, and no one should take it to improve memory.

(B) Gingko biloba does not improve memory in healthy individuals and should only be taken by individuals exhibiting signs of dementia.

(C) Gingko biloba does not improve memory in healthy teenagers and should only be taken by adults.

(D) Gingko biloba does not improve memory in healthy teenagers and should only be taken by adults in poor health.

(E) Gingko biloba does not improve memory in healthy teenagers, and further studies should be conducted to determine its effectiveness in other groups.

13.

In order to ease parking problems in a community containing a university, university officials propose purchasing one acre of community parkland that is adjacent to the university to build a parking garage. The officials believe community members will overwhelmingly support this proposal, and they would like to conduct a survey of 100 community members to confirm their belief. Which of the following will produce a simple random sample?

(A) Recording the opinion of the first 100 people who call the university regarding this issue

(B) Randomly selecting 100 people from the local phone directory

(C) Surveying every third person who walks past the administrative offices until 100 people have responded

(D) Using the latest census data from the community, numbering the residents, and using a random-number table to choose 100 people

(E) Using the latest census data from the community and randomly choosing 25 residents ages 18–25, 25 residents ages 26–39, 25 residents ages 40–64, and 25 residents ages 65 and over

14.

Which of the following statements is true?

(A) A census is an experiment that involves the entire population.

(B) A parameter is a value used to describe a sample.

(C) A sample is the entire group of individuals we want information about.

(D) In stratified random sampling, every individual has the same probability of being chosen.

(E) Voluntary samples never introduce bias.

15.

A study was conducted to determine the benefit of an over-the-counter medication in reducing the development of disease. Subjects selected were chosen because they were known to be in a high-risk group for the disease. The results of the study are

(A) not replicable.

(B) applicable only to the subjects in the study.

(C) not readily generalizable.

(D) false and misleading.

(E) valid for all takers of this over-the-counter medication.

16.

Patients afflicted with a debilitating disease took part in a study to measure the effectiveness of a new drug in controlling the progress of the disease. The patients were divided into two groups: an experimental group who received the drug and a control group who received a placebo. The results of the experimental group were so positive that the study was stopped early. This was most likely because

(A) the researchers stopped getting useful information.

(B) the researchers realized that their subjects were poorly chosen.

(C) the researchers felt that it was too expensive to continue the study.

(D) the researchers felt it was unethical to use only patients who had the disease in the study.

(E) the researchers felt it was unethical to withhold an effective treatment from the placebo group.

17.

A study randomly assigned patients to treatment groups to determine the effect of taking aspirin in preventing the development of colon polyps. One group took an aspirin daily, and the other group took a placebo. Neither the patients nor the doctors knew who was getting which pill. This study is best described as a

(A) block design with random assignment.
(B) double-blind comparative experiment.
(C) blinded block design observational study.
(D) blind experiment with random assignment.
(E) randomly assigned observational study.

18.

If you wanted to find the average GPA for seniors at your school who have been accepted into college, what would be the most appropriate technique to use to gather the data?

(A) Census
(B) Simple random sample
(C) Stratified random sample
(D) Systematic random sample
(E) Controlled experiment

19.

Two students went to their local shopping mall to conduct a survey. They wanted to know how the local population felt about boys coloring their hair. Both students had neat haircuts but one had dyed hair and one did not. What type of bias could occur in their survey?

(A) Undercoverage
(B) Nonresponse bias
(C) Response bias
(D) None of the above
(E) A, B, and C may produce bias in this setting.

Part 3 Practice Exam 2

#1

AP® STATISTICS
2003 SCORING GUIDELINES

Question 4

Solution

Part (a):

For example, a deadline in the department where the group of volunteers works has been moved back, lowering the stress levels of those working in the department. If the volunteers from this department were all in the same treatment group, this change in stress level could mistakenly be attributed to the treatment.

Without random assignment of volunteers to the two programs, it is possible that the two treatment groups could differ in some way that affects the outcome of the experiment. Randomization "evens out" the possible effects of potentially confounding variables.

Part (b):

Without the control group, the company could compare the two treatments, but would not be able to say whether the observed reduction in stress was attributable to participation in the programs. For example, a change in the work environment during this period might have reduced the stress level of all employees. The addition of a control group would enable the company to assess the magnitude of the mean reduction attributable to each treatment, as opposed to just determining if the two programs differ.

Part (c):

It is not reasonable to generalize the findings of this study to all employees, because

the participants in this experiment were volunteers and volunteers may not be representative of the population
OR
the participants were not randomly selected from the company employees.

Question 4 (cont'd)

Scoring

Each component is scored as either essentially correct (E), partially correct (P), or incorrect (I).

Part (a) has two components: the example, and the randomization.

- The example is scored as essentially correct (E) if it contains each of the elements in the table below:

Elements	Sample statements
1. Identify a plausible example of a problem	"Because a deadline has been moved back..."
2. Relate the identified problem to the change in stress level (the response)	"...lowering the stress levels of those working in the department. This change in stress level..."
3. ...and state that the identified problem effects can not be distinguished from the difference in treatment effects	"...could mistakenly be attributed to the treatment." (Note: A construction such as "can't tell the difference" is OK here.)

The example is scored as partially correct (P) if the response contains 2 of the 3 components.

- The randomization is scored as essentially correct (E) if the student gives a reason for the necessity of random assignment. Possibilities include:

  clearly stating in context that randomization is relied upon to create comparable groups

  clearly stating in context that randomization controls for the effects of potentially confounding variables or reduces bias. (Both "Avoiding" bias and "Eliminating" bias are incorrect (I).)

The randomization is scored as partially correct (P) if the statement about randomization is not in context or is poorly communicated.

Note: Constructions such as "split up" and "divided into" can be interpreted to indicate randomization.

Question 4 (cont'd)

Part (b) is scored as essentially correct (E) if the student

1. indicates that a control group does provide additional information
   AND
2. explains that the control group allows the company to determine if either or both treatments are effective in reducing stress

   OR

   explains that the control group provides a baseline for comparison

Part (b) is scored as partially correct (P) if the student indicates there is additional information, even if the student's explanation is incorrect.

Note: Stating that the "passage of time" reduces stress is not sufficient; the student must specify that there is a confounding variable that operates through time.

Part (c) is scored as essentially correct (E) if it

1. indicates that it is not reasonable to generalize to all employees
   AND
2. gives an explanation that the participants were not randomly selected from the company employees

   OR

   gives an explanation tied to the use of volunteers

   Note: Simply using the word "volunteer" in the explanation is not sufficient.

Part (c) is scored as partially correct (P) if the student explicitly says that it is not reasonable to generalize to all employees, even if the student's explanation is incorrect.

Part (c) is scored as incorrect (I) if the student indicates that it is reasonable to generalize to all employees.

Question 4 (cont'd)

Scoring

4 Complete Response (4E)

All four "components" are essentially correct

3 Substantial Response (3E 0P or 3E 1P or 2E 2P)

Three components essentially correct and no components partially correct
OR
Three components essentially correct and 1 component partially correct
OR
Two components essentially correct and 2 components partially correct

2 Developing Response (2E 0P or 2E 1 P or 1E 2P or 1E 3P or 4P)

Two components essentially correct and no components partially correct
OR
Two components essentially correct and 1 component partially correct
OR
One component essentially correct and 2 components partially correct
OR
One component essentially correct and 3 components partially correct
OR
Four components partially correct

1 Minimal Response (1E 1P or 1E 0P or 0E 2P or 0E 3P)

One component essentially correct and 1 component partially correct
OR
One component essentially correct and no components partially correct
OR
No components essentially correct and 2 components partially correct
OR
No components essentially correct and 3 components partially correct

#2

AP® STATISTICS
2002 SCORING GUIDELINES (Form B)

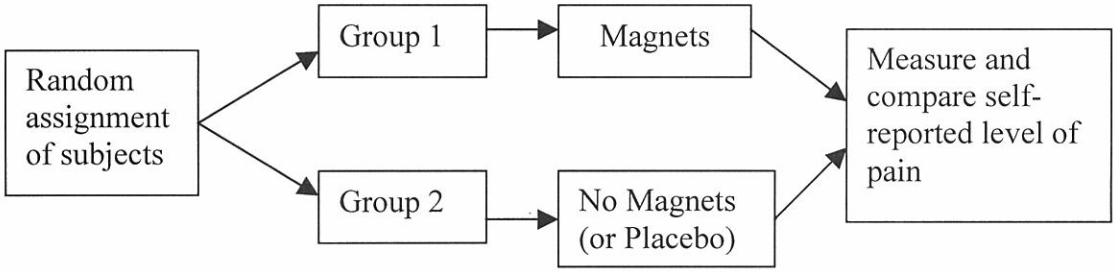
Question 3

Solution

Part (a):

1. Two treatments: magnets and no magnets (or magnets and placebo). Subjects in the no magnet group would be handled in the same way as the magnet group, but there would be no magnets embedded in the pads used.
2. There must be random assignment of subjects to treatments (or treatments to subjects). How the randomization would be carried out does not need to be specified, but it must be clear *what* is being randomized.
3. Variable measured: Self-reported level of pain or reduction in pain.

The design may be described by a diagram, but the treatments and the variable measured must be included and the randomization must be very clear.



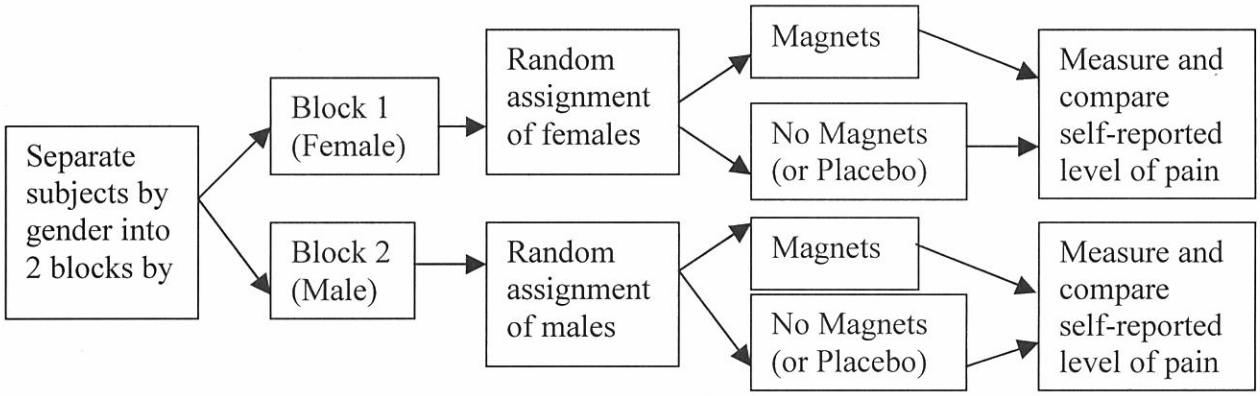
Part (b): Either one of the following approaches is acceptable.

1. Saying yes and indicating how they would alter the design: Separating the subjects into the two gender groups and then randomizing subjects to treatments within each group. This may also be described using a diagram, as shown below, but the blocking factor and randomization must be clearly indicated.

   OR

2. Saying no and describing why. For example, indicating that the randomization in (a) should equalize the effects of gender in the two groups or assuming gender does not have a strong effect and since the sample size is large
   OR
   providing a good explanation for *why* gender does not have a strong differential effect on the outcome.

Question 3 (cont'd.)



Scoring

Part (a) is

Essentially correct if all three of the following are adequately addressed: treatments, random assignment, and response variable.

It is acceptable for them to select the first group with an SRS, but only if it's clear that the remaining subjects are automatically assigned to the second treatment group as opposed to taking a separate SRS.

Note, if they describe a randomization scheme that results in an unequal number of subjects in each treatment group or does not involve randomization for each individual (such as flipping a coin to determine which group gets the placebo), this can be considered a minus.

The student may also describe the experimental protocol in more detail – double blind, placebo effect, etc. These are not necessary but can be considered a plus.

Partially correct if only one or two of the items listed above are adequately addressed. But, to receive the partial with only *one* item, the design must be described exceptionally well. For example, discussion of the placebo effect as reason for the control group, or a "before and after" measurement for the response, or a detailed discussion of randomization. (A well done "before and after" design in the new context can be considered partially correct.)

NOTE: Students do not get credit for discussing treatments if their design does not ever specify a control group or fails to define the treatment.

Question 3 (cont'd.)

Part (b) is

Essentially correct if either of the two acceptable approaches is taken (no and why OR yes and how) and the explanation/justification is clear and complete. For a yes, the response must clearly indicate and maintain the group separation and specify the separate randomization within each group.

Partially correct if either of the two acceptable approaches is taken, but the explanation/justification is weak. For example, the response states yes but it is not clear a separate randomization within each block is carried out, or the response states no but does not fully appeal to the randomization in part (a) or only states that gender does not matter and does not clearly state gender does not matter and why the groups will still be sufficiently balanced.

If done well, the response can appeal to the randomization in part (a) ("divide and proceed for each subgroup" vs. "divide and proceed"). A two factor design that includes randomization rather than a block is considered partially correct.

Note, using the term "stratified random sample" is considered extraneous and is not sufficient for an explanation of how randomization occurs in the new design.

Incorrect if all the response mentions is now having four groups of data to analyze. (No randomization, not even a reference to the randomization in (a), and no clear separation of the groups in the design.)

NOTE: If no randomization is specified anywhere, the highest possible score is a 2.

4 Complete Response

Both parts essentially correct.

3 Substantial Response

Part (a) is essentially correct and part (b) is partially correct.

OR

Part (a) is partially correct and part (b) is essentially correct.

Question 3 (cont'd.)

2 **Developing Response**

Both parts are partially correct.

OR

Part (a) is essentially correct and part (b) is correct.

1 **Minimal Response**

Part (a) is partially correct and part (b) is incorrect.

OR

Part (a) is incorrect and part (b) is essentially or partially correct.

NOTE: PP is between a 1 and a 2. If only the before and after design is present, it will be rounded down to a 1.

#3

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Question 2

Solution

Part (a):

A **paired design** is used in which each subject receives a pair of boots where one boot is treated with the new method and the other with the current method.

Subjects should be randomly assigned to one of two groups. Group 1 would have the new method applied to the right boot; group 2 would have the new method applied to the left boot.
OR
For each subject, whether the new method is applied to the right or left boot is determined at random.

OR

A **crossover design** is used in which each subject receives a pair of boots, both of which were treated with one treatment. The boots are used for three months and then exchanged for a second pair of boots, both of which were treated with the other treatment. These boots are then used for the next three months.

Subjects should be randomly assigned to one of two groups. One group receives boots with the new treatment first and the other group receives boots with the current method first.

NOTE: Additional appropriate blocking schemes are considered extraneous.

Part (b):

The design could be double blind, as long as both the *subjects* and the person *evaluating* the boots for water damage do not know which boots were treated with the new method and which were treated with the current method.

NOTE: If the student does something unexpected in part (a) and gives a design that actually cannot be double blind, then part (b) could be considered correct provided the response explains why the design could not be double blind.

Scoring

A student response is scored as **E** (essentially correct), **P** (partially correct), or **I** (incorrect) for each of the following key elements:

1. **Design**
   - **E** - paired design (may be described as blocking on individual) or crossover design
   - **P** - 2 or more groups (e.g., Completely Randomized Design)
   - **I** - no grouping or grouping with no treatments specified
2. **Implementation**: Randomization appropriate to the design
   - **E** - Written description of appropriate randomization
   - **P** - Incomplete or incorrect description of randomization
   - **I** - No description of randomization

   NOTE: (1) Diagram alone can be scored at most a **P**.
   (2) The randomization must apply to the allocation or assignment of subjects to the treatment groups or the allocation of treatments to the subjects.
   (3) Randomization to select the 100 volunteers without assignment to the treatment groups is scored an **I**.

Question 2 (cont'd.)

3. **Double blind**: Explanation in parts (a) and/or (b) that shows understanding of what it means for an experiment to be double blind.
   - **E** - response indicates that blinding applies to both the evaluator and subjects.
   - **P** - response recognizes that blinding applies to the subjects and at least one other party, whether or not they think that this can be accomplished; the other party may not be correctly identified.
   - **I** - response fails to recognize that both the subject and another party must be blinded or is missing or irrelevant.

Score as Design - Randomization - Double Blind

4 **Complete Response**

E E E

3 **Substantial Response**

Any one of the following combinations:

E E P	P E E	P E P *
E E I		
E P E		

2 **Developing Response**

Any one of the following combinations:

E P P	P E I	I E E	P E P *
E P I	P P E	I P E	
E I E	P P P		
E I P	P I E		

1 **Minimal Response**

Any one of the following combinations:

E I I	P P I	I E P
I E I	P I P	
I I E	I P P	

Question 2 (cont'd.)

0 **No Credit**

P I I I I I
I P I
I I P

* **P E P** may be scored as either a **2** or a **3**:
(1) If the description of the randomization *only* says, "Randomly allocate", then score P E P a 2.
(2) If the description of the randomization says, "Randomly allocate", but also contains greater detail about the randomization or the inclusion of blocking in the design or other statistical thinking, then score P E P a 3.