

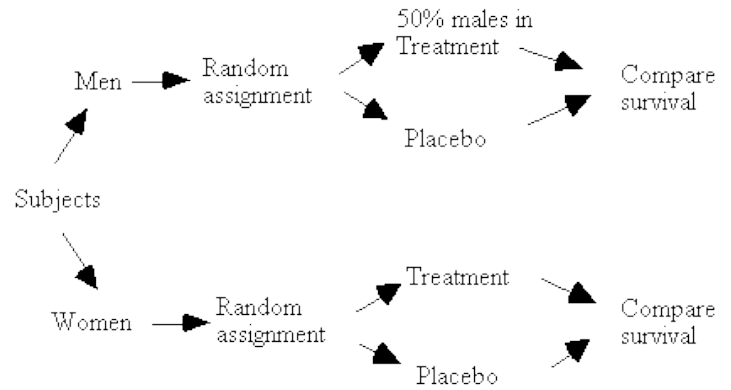
Instructions: Show work or attach R code used to perform calculations (or any other technology used). Be sure to answer all parts of each problem as completely as possible, and attach work to this cover sheet with a staple.

1. Give one possible sample of size 4 from each of the following populations:
 - a. All daily newspapers published in the United States
 - b. All companies listed on the New York Stock Exchange
 - c. All students at your college or university
 - d. All grade point averages of students at your college or university

2. Give three different examples of concrete populations and three different examples of hypothetical populations. For each of your examples, give an example of a probability question and an example of an inferential statistics question.

3. Determine the sampling method for each scenario below:
 - a. An auto analyst is conducting a satisfaction survey, sampling from a list of 10,000 new car buyers. The list includes 2,500 Ford buyers, 2,500 GM buyers, 2,500 Honda buyers, and 2,500 Toyota buyers. The analyst selects a sample of 400 car buyers, by randomly sampling 100 buyers of each brand.
 - b. A researcher wants to select a sample of 10 people from a population of 100. If he or she has a list of all 100 people, he would assign each person a number from 1 to 100. The researcher then picks a random number, 6, as the starting number. He or she would then select every tenth person for the sample (because the sampling interval = $100/10 = 10$). The final sample would contain those individuals who were assigned the following numbers: 6, 16, 26, 36, 46, 56, 66, 76, 86, 96.
 - c. Suppose a research team wants to determine the grade point averages of college students across the U.S. The research team has difficulty collecting data from all 21 million college students; it decides to take a random sample of the population by using 4,000 students. The team looks at the different attributes of the sample participants and wonders if there are any differences in grade point averages and students' majors. Suppose it finds that 560 are English majors, 1135 are science majors, 800 are computer science majors, 1090 are engineering majors and 415 are math majors. The team wants to use a proportional stratified random sample where the stratum of the sample is proportional to the random sample in the population.
 - d. A researcher is studying the academic performance of high school students in the United States and wanted to choose a cluster sample based on geography. First, the researcher would divide the entire population of the United States into clusters, or states. Then, the researcher would select either a simple random sample or a systematic random sample of those clusters/states. Let's say he or she chose a random sample of 15 states and he or she wanted a final sample of 5,000 students. The researcher would then select those 5,000 high school students from those 15 states.
 - e. A researcher asks survey questions of his neighbors and friends on Facebook.

4. An experimental design diagram is shown to the right. What kind of experiment is the diagram modeling?



5. Describe the properties that make a graph “good”. What are some things that can make a graph “bad” or misleading. Find two examples of good graph (or make them), and find two examples of bad graphs and explain what makes them bad.

6. A sample of $n=10$ cars was selected and each was subjected to a 5-mph crash test. Denoting a car with no visible damage by S (for success) and a car with visible damage by F (for failure), results were as follows: S S F S S S F F S S.

- What is the value of the sample proportion of successes $\frac{x}{n}$?
- Replace each S with 1 and each F with 0, then calculate \bar{x} for this numerically coded data. How does \bar{x} compare to $\frac{x}{n}$?
- Suppose it is decided to include 15 more cars in the experiment. How many of these would have to be S’s for $\frac{x}{n} = 0.80$ for the entire sample of 25 cars?

7. A sample of 20 glass bottles of a particular type was selected, and the internal pressure strength of each bottle was determined. Consider the following partial sample information.

Median	Lower fourth	Upper fourth	
202.2	196.0	216.8	
Three smallest observations	125.8	188.1	193.7
Three largest observations	221.3	230.5	250.2

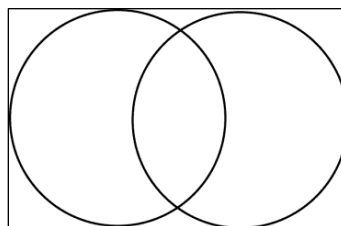
Are there any outliers in the sample? Any extreme outliers?

8. Let $A = \{1, 2, 3, 4, 5\}$, $B = \{0, 3, 6\}$. Find the following sets:

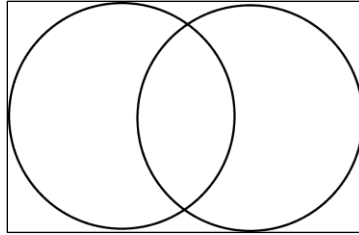
- $A \cup B$
- $A \cap B$

9. Use a Venn diagram to illustrate the relationship that $A \subset B$ and $B \subset C$.

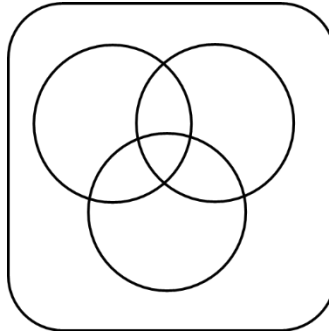
10. Use the Venn Diagrams below to draw the indicated sets.



- $A' \cap B$



b. $B - A$



c. $A \cap (C - B)$

11. Convert the two-way table to the right into a Venn diagram. Be sure to clearly indicate what each set represents.

	Plays Team Sport	Does Not Play Team Sport	Total
Plays Instrument	8	3	11
Does Not Play Instrument	2	7	9
Total	10	10	20

12. Give one example each of the following types of events and explain what the probability means in each case.

- Subjective (person) probability
- Theoretical (classical) probability
- Empirical (experimental) probability

13. An engineering construction firm is currently working on power plants at three different sites. Let A_i denote the event that the plant at site i is completed by the contract date. Use the operations of union, intersection and complementation to describe each of the following events of $A_1, A_2,$ and A_3 , draw a Venn diagram and shade the region corresponding to each one.

- At least one plant is completed by the contract date.
- All plants are completed by the contract date.
- Only the plant at site 1 is completed by the contract date.
- Exactly one plant is completed by the contract date.

14. Let A denote the event that the next request for assistance from a statistical software consultant relates to the SPSS package, and let B be the event that the next request is for help with SAS. Suppose that $P(A) = 0.30, P(B) = 0.50$.

- Why is it not the case that $P(A) + P(B) = 1$?
- Calculate $P(A')$.
- Calculate $P(A \cup B)$. (Assume A and B are independent.)
- Calculate $P(A' \cap B')$. [Hint: Use de Morgan's Law.]

15. A certain system can experience three different types of defects, Let A_i ($i = 1,2,3$) denote the event that the system has a defect of type i . Suppose that $P(A_1) = 0.12, P(A_2) = 0.07, P(A_3) = 0.05, P(A_1 \cup A_2) = 0.13, P(A_1 \cup A_3) = 0.14, P(A_2 \cup A_3) = 0.10, P(A_1 \cap A_2 \cap A_3) = 0.01$.
- What is the probability that the system does not have a Type 1 defect?
 - What is the probability that the system has both a Type 1 and Type 2 defect?
 - What is the probability that the system has both a Type 1 and Typ2 2 defect, but not a Type 3 defect?
 - What is the probability that the system has at most two of these defects?
16. A friend of mine is giving a dinner party. His current wine supply includes 8 bottles of zinfandel, 10 of merlot and 12 of cabernet (he only drinks red wine), all from different wineries.
- If he only wants to serve 3 bottles of zinfandel and serving order is important, how many ways are there to do this?
 - If 6 bottles of wine are to be randomly selected from the 30 for serving, how many ways are there to do this?
 - If 6 bottles are selected, how many ways are there to obtain two bottles from each variety?
 - If 6 bottles are randomly selected, what is the probability that this results in two bottles from each variety?
 - If 6 bottles are selected, what is the probability that all of them are the same variety?
17. A production facility employs 20 workers on the day shift, 15 workers on the swing shift, and 10 workers on the graveyard shift. A quality control consultant is to select 6 of these workers for in-depth interviews. Suppose the selection is made in such a way that any particular group of six workers has the same chance of being selected as does any other group (drawing 6 slips without replacement from among 45).
- How many selections result in all six workers will be from the same shift?
 - What is the probability that all six selected workers will be from the same shift?
 - What is the probability that at least two different shifts will be represented among the selected workers?
 - What is the probability that at least one of the shifts will be unrepresented in the sample of workers?
18. Seventy percent of the light aircraft that disappear while in flight in a certain country are subsequently discovered. Of the aircraft that are discovered, 60% have an emergency locator, whereas 90% of the aircraft not discovered do not have such a locator. Suppose a light aircraft has disappeared.
- Build a table (contingency table) to describe the data. Assume that the data was collected from 1000 aircraft.
 - If it has an emergency locator, what is the probability that it will not be discovered?
 - If it does not have emergency locator, what is the probability that it will be discovered?
 - Describe the scenarios in (b) and (c) using conditional probability notation. Be sure to say what your events are that are being described.