Introductory Statistics Project Help Guide

NSF Grant Project: R. Sinn & D. Spence
NGCSU Math/CS Department
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Introduction

The projects you will undertake in this statistics class will provide a real-world research experience using statistics as part of the ***Scientific Method***:

1. Hypothesis
2. Design an Experiment (Survey)
3. Collect Data
4. Analyze Data (Statistics)
5. Draw Conclusions

Every researcher knows the hardest work in survey studies is 90% done ***before anyone takes the survey***. The ***hypothesis*** and ***survey design*** are vital. Great survey studies happen when the research team possesses:

1. An Interesting Research Idea
2. Great Variables
3. Thoughtful Questions

Teams enjoy a project more when they're excited about the answer to their research question. Keep your projects fun. Be creative and throw out lots of ideas. Once you think of a topic or two, try to generate variables – not questions. Proper wording for questions and formats for answer choices come later.

Types of Studies

Statistics compares and contrasts variables or groups: **regression** studies compare a group on two numeric variables while **t-tests** and ANOVA contrast two or more groups using one variable. For example, a **regression** study might compare a person's "number of hours spent playing Guitar Hero" to "number of hours spent studying." Researchers would use a **t-test** to see which group, males or females, plays more hours of Guitar Hero each week.

The first part of the guide focuses on **regression** studies. The second part focuses on **group comparisons** (t-tests). You will complete two projects this semester, first using regression and then using t-tests.

Linear Regression Projects

Links to each topic are given in the outline below. Two vignettes follow teams through their project proposal process. The vignettes are written in story-form and show how ideas develop from their typically weak initial state into quality research designs.

1. Organizing your Team

2. Brainstorming a Topic
3. Developing Variables
    a. Drafting Survey Questions
    b. Making Closed-Response Answer Choices
    c. Developing Variable Constructs
4. Effective Survey Design
5. Quality Sampling

This guide will help you with your hypothesis (research idea) and designing an experiment (survey and sampling). Additional documents provide more detailed help with ideas for variables, how to construct and analyze your data set in Excel, and tips for the presentation and the written project report.

Organizing your Team

Take five minutes as your group first meets to introduce yourselves. Tell what your major is and your best guess about a career choice. Exchange email addresses and cell number with your group. Someone should go ahead and send an email with cell numbers in it to the group and have each team member "reply all." This will verify each person has each teammate's contact info. This simple step will save much pain and suffering later, when the team faces an important deadline and "life happens." Discuss what times the whole team is free, when would be good times to meet and which computer labs might be most convenient. Some groups manage to use email and cell phones to "teleconference." Some groups always meet in person. Some blend the two. Figure out early what works.

Professional teams share some qualities. They agree on team-decided deadlines, and they meet them. Remember that even high functioning teams often miss deadlines by a few hours or a day due to car trouble, illness or other emergencies. If you need to miss a deadline, alert everyone before the deadline and say when your work product will be available. As a team, set your team deadline earlier than class deadline. When emergencies do arise, the team can still turn in the work on time. Take some time to plan your work. Determine two times each week you can meet to work on the project outside of class. Start meeting at least once per week early on, even if the meeting is short.

FAQ's

What important tasks should have a designated person in charge?
What if my team sucks?
Will we all get the same grade?

Brainstorming a Topic

Teams that finish with interesting study topics often go through several different ideas initially before "hitting on" something. Keep talking. Keep tossing out ideas. Check the variables page for examples after your team has generated a few ideas. Keep refining and brainstorming.

Questions to Ask

1. What career interests do we share? Can we study something related to our majors?
2. What variables could we use?
3. What other variables might be related to the ones we've discussed?
4. Can these questions be "spiced up," made more edgy, practical, hard-hitting or fun?

Write down several project ideas. They don't have to be connected initially. Use your own experience about campus life to inform your study. What trends do you notice on campus? Recent groups have

investigated Facebook, Guitar Hero, and which majors and campus groups experience the most stress. Pick something relevant and interesting. If you're a business major, considering analyzing the financial side of Guitar Hero. How much money has the typical college student spent on Guitar Hero video games and controllers in the last year? Education majors could investigate if there is a relationship between hours spent playing Guitar Hero and how much a person studies. Sociology or psychology majors might investigate the social aspect of Guitar Hero. How often is the game played in groups rather than alone? None of these ideas will work for a project in their current form, but each is a seed that could grow into an interesting study about a fun topic. Projects are much less tedious if you actually care about the questions you're asking people.

Spend 15 – 20 minutes brainstorming, and another 10 minutes refining your ideas.

Assignment 1

Open the Hypothesis document. Fill in team members' names and organization tasks. Then type in three research ideas your team came up with during the brainstorming session. Remember, these are not finished products. Just three ideas to start you working. You may also benefit by reading the Regression Project Proposal. The next dozen pages of this help guide address the 8 items you will need to address for your formal project proposal.

Developing Variables

There are four types of variables you will use in your regression study:

1. Demographics Category Variables (gender)
2. Numeric Variables (GPA, age)
3. Likert scale opinion questions
4. Hierarchical Category Variables (year in school: freshman, sophomore, junior, senior)

Likert scale questions provide a range of numbers, say 1 – 7, corresponding to opinions ranging from "Strongly Disagree" to "Neutral/No Opinion" to "Strongly Agree." If seven responses are possible, we call it a 7-point Likert scale. A more in-depth discussion of variable types is available. For now, we will provide a few examples to get you thinking:

How many total hours have you studied in the last three days? (numeric)

What is your current cumulative GPA? (numeric)

Are you in a fraternity or sorority? (demographic category)

I would vote for a female presidential candidate if she represented my political views. (Likert scale opinion question)

I consume alcohol (circle one): Never // Sometimes // Often (hierarchical category)

On a scale of 1 – 10, 10 being "total hottie," I rank my physical appearance as ___ (Likert scale opinion question)

Now you've seen some types of questions to use, and you should have some research ideas like the examples below:

1. Hours spent playing video games vs. Hours spent studying
2. Cell phone minutes per month vs. Facebook hours per week
3. Reported stress levels vs. Hours spent studying

4. Fast food spending vs. Textbook costs

It's time to refine the actual variables you will study. Let's take "hours spent studying" as an example, for "hours spent studying," there are two basic ways to ask the question:

Example 1: How many hours, on average, do you spend studying per week?

Example 2: How many hours did you spend studying in the last week?

The first example asks for an **estimate**. The second asks for a **snapshot** of recent behavior.

We suggest you ask **snapshot** questions. Participants, even truthful ones, often are biased with estimates. For "study hours," they might feel guilty about recent procrastination and then overestimate. Ask explicitly about occurrences in the last few days or weeks. Participants tend to give rather accurate responses to these questions.

FAQ's

Why ask snapshot questions instead of "estimate the average" questions?

Questions to Ask

1. How can we make our variable precise?
2. How can we make our questions easier to understand?
3. What time period should we use?
4. What range of answers do we expect, including outliers?
5. What outside influences will affect different participants' response?
6. Will the participants be truthful?
7. Is the question sensitive? If so, how can protect the participants' confidentiality?
8. Is the question invasive, inappropriate or offensive to certain individuals?
9. What demographics questions should we ask?

Suppose your team has decided on the "hours spent studying" variable. What is a good time period to ask about? Most college students study different amounts on week nights than they do on weekends. One good solution is to ask about "study hours in the last week." On any day you collect data, this will include the same number of weekend days and week days. However, think about this: how accurate can you be with determining, in a few seconds, exactly how many hours you studied five or six days ago? Another solution might be to ask about "study hours in the last three days." But data collected on Monday will have two weekend days included while data collected on Friday will have none. And data collected in the afternoon might be affected by the confusion of exactly which three days are being asked about.

Your team might choose the following question:

"In the last three days (not including today), how many total hours have you studied?"

As long as you collected all your data on the same day of the week or only collected data on Thursdays and Fridays, this variable would generate high quality response. The time period is short and from the very recent past, and everyone will be answering based on the same type of academic work days.

Precision. The example question is precise: Each participant immediately knows which days are being asked about and how to configure their response. Without the word "total" in the question, some participants may give an average per day while some might give a three day total. A similar problem with

precision happens with the “hours of sleep per night” variable. College students often manage to get naps, even *outside* of class. A precise way to ask that question might be, “How many hours of sleep including naps have you gotten in the past 48 hours?” As with studying, care must be taken about when data is collected because sleep patterns are different for weekends than week nights.

Easily Understood. Ultra-precise questions can be hard to understand. Consider the following “alcohol consumed” question:

> In the last three days (not including today), how many total servings of alcohol have you consumed? A serving of alcohol is defined as a 12 oz. beer, an 8 oz. glass of wine, a shot of hard alcohol, or a 10 oz. mixed drink.

The question is very precise but long and involved. Try your best to shorten the question and retain the precision. Defining a “serving” of alcohol is vital since many different serving sizes and types exist, but maybe you can be more succinct.

> In the last week, how many total servings of alcohol have you consumed (glass of beer/wine, shot, or mixed drink)?

The parentheses nicely set off the definition, and the time-period change to “last week” alleviates the “which days are we talking about” problem and shortens the question. Remembering and calculating the answer is more difficult, so there’s a tradeoff here. But using “week” rather than “last three *nights*” also fixes the inaccuracy that might occur with weekend drinking, since college students often tailgate before games and drink alcohol earlier in the day. The definition has been shortened at the cost of precision, but “glass of beer or wine” connotes 8 – 12 oz. servings rather than Big Gulp portions. By offering a definition, you have planted the idea for participants to think about the 40 oz. Grande Margarita as more than one serving.

There is often no perfectly precise, concise, easily-understood way to phrase your questions. Balance is involved. Take care to be both precise and concise. Have several friends read over your survey questions before you finalize your survey draft. As few as 8 – 10 different people critiquing your questions will ferret out most problems with confusion. Ask them for suggestions about how to improve the way you ask your question.

Time Period. We suggest using snapshot questions with times of a week or less. When possible, asking about the last few days is best. Asking someone how many hours of sleep they got a month ago will lead to junk data. We simply don’t remember the minutia of our lives all that well. And time period can be heavily influenced by precision and conciseness issues (see above).

Range of Answers. We often suggest using closed response answer formats. When you ask an open-response questions, respondents can offer “junk” responses as a joke or (possibly) a misunderstanding. When you ask how many beers someone had last weekend, they might put “millions” in the blank. That survey is not useable, even if they answered the other questions truthfully. Here are two examples of closed-response questions:

> In the last three days (not including today), how many total hours have you studied?
>
> 0-2 3-5 6-8 9-11 12-14 15 or more

> In the last three days (not including today), how many total hours have you studied?
>
> 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21+

The first example has too few categories, and the extreme low category of “0-2” may not have many responses, especially during midterms. The second example is better. The person realizes every whole number up to 20 is available and simply tries to think of the right number. The first set of responses may

not have a high enough range (15). Expect outliers in your data set. Some people do study more than 20 hours in a given three-day period, even if none of your close friends do. A good plan is to include as many "outlier" categories as will fit easily on your survey page width. Be sure to avoid closed-response choices like this:

> In the last three days (not including today), how many total hours have you studied?
>
> 1-2 3-6 7-10 11-15 16-20 21-25 25 or more

Leaving out "0" is a very common mistake. Include it, even if it seems impossible. The categories all have different sizes, from 2 hours to 5 hours. Ensure that all categories have identical ranges (also called "bin width"). Outlier responses can also influence the time period you use. Consider the "hours of sleep per night" variable with the following responses:

> In the last three days, how many total hours have slept (including naps)?
>
> 9 or less 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30+

Some lucky individuals may have gotten more than 10 hours of sleep per day recently while some unfortunate souls may have gotten less than 3 hours per day. Here it might be better to ask about the last 48 hours so that you can make closed response answer choices that cover all the outlier possibilities.

Consider the type of data you are collecting. For example:

> What is your current, cumulative GPA (4.0 scale)?
>
> 1.4 or lower 1.6 1.8 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0

This would likely generate useable data, but this is an example where an "open response" question would be preferable. Most students know their GPA, say 3.12. They can provide more accurate responses much more quickly to an open response question. Be careful when using open response answer formats: you leave yourself open to "wacky" responses and junk data which will either decrease your sample size or force you to collect more data. You may get someone who claims to have a 7.2 GPA or to have gotten more than 24 hours of sleep per day. Those data cannot be used in your study. You will be surprised at the moronic things some participants put down on your survey. We generally prefer closed response formats to avoid this junk data.

Outside Influences. Consider a survey asking about sexual activity, binge drinking or weight. These are legitimate study topics (though we often ask our students not use the drinking and sexual activity variables, and your professor may decide certain topics are inappropriate for your class). Males often optimistically report sexual activity while females often underreport theirs. Cultural norms persist. The same is true for binge drinking, but there is another concern: underage participants. Your binge drinking survey asks them report an illegal activity. Males and females often feel differently about their weight due to cultural influences.

Confidentiality is vital for all three of these survey questions, and some people may refuse to complete your survey or answer untruthfully if they feel their privacy will be invaded (see below).

One way to combat outside influences is to limit your population to certain demographic group. For a drinking vs. GPA study, consider only asking those who are 21 or older to participate. When gender may bias estimates in opposite directions (weight), consider surveying only males or only females. Gender differences are also an important consideration if you study BMI (body mass index). Often, fit males have "high" BMI's and prefer their workouts to "bulk them up." Fit females often have the opposite desire, choosing exercise regimens that "slim them down." Males and females also have different "healthy" body fat percentages.

There is no easy way to combat outside influences with some variables. Criminologists still debate the most accurate measure of "unreported rapes" simply because not all participants who have experienced rape are willing to discuss it, even when their privacy is protected. Issues like drug abuse, date rape, underage drinking and the like are interesting and valuable topics for researchers to study. We suggest that our students avoid these issues. If you do decide to study something like sexual activity or underage drinking, consult your professor far in advance.

Participant Truthfulness. People often ask the question: "How accurate is self-reported data?" That depends largely on the question. Most people tend to be very truthful when answering questions about mundane topics like hours studied, amount of sleep, or the number of movies they've watched recently. Participants are also fairly accurate when responding to more sensitive questions like weight, alcohol consumption or GPA ***if their privacy is ensured***. With questions about GPA, it's true that most people likely "fudge" a bit, and report a higher GPA than they actually have. But it turns out that they don't often tell big lies, and many people fudge a similar amount. For regression studies, the self-reported GPA variable often works extremely well. While the average GPA reported may be a bit high due to "optimistic" responses, the data overall will be accurate enough to show differences between A, B and C students.

Two other concerns should be mentioned: **length of the survey** and **wording of the question**. Participants are more truthful if the survey they are taking is short. After several minutes of answering survey questions, participants get bored and start skimming through questions in an effort to finish quickly. Make your survey as short as possible, limiting your questions to only those that are essential and for which you will have time to analyze the data. Try to collect data in places where the students are not in a hurry: cafeterias, dorm lounges or break areas are best. Avoid hallways where students are rushing to class or parking lots where they are rushing to work. With question wording, be sure to ask each question in a neutral way. Here is an example of a badly-worded question:

> I believe racism is abhorrent (circle one)?
>
> Strongly Disagree Disagree Neutral/No Opinion Agree Strongly Disagree

This question asks about an explosive topic and uses a highly charged word: abhorrent. It is doubtful that this question would lead to useable data. It begs responses of "Strongly Agree," so there will be very little scattering of data. We often ask students to narrow their topic. Racism is certainly something of interest, but we can target other behaviors and attitudes regarding racism without resorting to poor questions. For example, one behavior related to race relations is interracial dating. Here is a question adapted from a nation-wide study:

> Select the most appropriate statement:
>
> ____ I am not open to dating interracially.
>
> ____ I am open to involvement in an interracial relationship.
>
> ____ I have dated someone of another race.
>
> ____ I have married someone of another race.

This is a hierarchical variable, with ratings of 1, 2, 3 or 4 assigned from top to bottom, which has proved worthwhile in regression studies our students have conducted. Notice that the wording of each response is stated in a neutral way that avoids inflammatory words. The students were able to respectfully gauge campus opinion about a racial issue with very little danger of upsetting or angering anyone. As long as privacy not compromised, most participants will answer truthfully. Even though there are only four response categories, the hierarchy is clear and yielded useable data. Similar care should be taken when issues such as homosexuality, obesity, or suicide are being studied. Try your best to word the questions in a neutral, inoffensive way, and try to think of related issues that might be better for your study and your participants. Always field test your questions with several friends, asking them if they see any problems with how you have stated things. Get help from your professor.

Confidentiality. This is Research 101. When participants are certain their privacy will be protected, they typically answer even hard-hitting questions truthfully. Never ask for a participant's name on the survey, and avoid using a small sample like a single sorority or other group where there is a danger of someone on the project team being to figure out which responses came from which individuals. Ask only 3 – 5 demographics questions (age, major, gender, etc.) so that there are several individuals in each subgroup.

Be sure that participants have plenty of privacy as they respond. Consider offering them a clip board with the survey on it and then stepping away three or four paces as they begin. This signals that you won't scan their responses as they're working or when they're done. When they hand in their surveys, allow them to place their survey in the middle of the stack and then even it up, so you can't find it later. Have several pens (blue or black ink) available so they don't have to be the one person who fills in the survey in purple.

Put a privacy statement at the top of your survey. Keep it simple: "Thank you for helping with this survey. Your privacy will be protected." Use boldface type. Tell participants as they begin that their privacy will be protected and that you will have them fold their survey in half so the responses are hidden when you take it. Have a large manila envelope for the completed surveys, and hold it open toward them as they put theirs inside (taking care that they cannot see anyone else's responses!). Avoid discussing the survey with anyone while participants are taking it. If a participant jokes about a response they are considering, smile (if it's funny) but don't respond. You can talk and joke with them about it after they have completed, if no one else is completing a survey nearby.

Be very aware that all participation is voluntary. If someone becomes agitated or upset while taking your survey, remind them that they don't have to participate. You can suggest that they could tear up the survey and put it in the trash themselves. While it is painful to collect extra surveys, that is far better than getting junk data from uncomfortable participants. If someone becomes aggressive or angry (thankfully, this happens ***very rarely***), thank them for helping and discuss options for destroying the survey and having them not participating. Refer any complaints to your professor.

Invasive Questions. In our experience, two variables are repeatedly suggested by college students when brainstorming research ideas: alcohol consumption and sexual activity. We often discourage teams from pursuing these variables or suggest alternatives. For alcohol questions, many college students are underage. We typically ask our students what it is they want to study. They often make it clear that they're trying to measure something like "partying." Here is an elegant workaround we often suggest:

> In the last week, how many social events have you attended where alcohol was served?
>
> 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15+

This question gently skirts the underage drinking issue. There is nothing necessarily illegal about a teenager being at a party where alcohol is present, and no one is asking if they drank any alcohol. What this question does very well is get at the main issue of how much time the person spends at bars, clubs and rowdy college-style events. And some students party very hard but don't drink. They enjoy dance clubs and other events where alcohol is routinely served. These types of parties often last late into the night and detract from sleeping, studying and other academic pursuits. The variable generated by the example above is related very closely to alcohol consumption and college-style partying but relieves most the privacy and illegality issues. It is typically related to other variables in consideration, like study hours or GPA. And remember the outliers – some folks attend multiple parties in one night, although perhaps 15 in a week is a bit much!

In our experience, college students are interested in sex. We have seen most every variation of the following questions during brainstorming sessions:

> How many times have you had sex in the last month?

Have your ever cheated on your girlfriend (cheating means sexual intercourse)? [From a study targeting males only.]

How many times have you had unprotected sex in the last three months?

How many sexual partners have you had in the last year?

These questions are indelicate, first of all, and can anger or embarrass your participants. Notice the girlfriend question is especially bad. Participants may be gay. Second, not every young adult is sexually active, even if they are in a committed dating relationship. For the cheating question, a young man could make out with another young women exactly as he does with his girlfriend. Most would consider that cheating, even if sexual intercourse didn't occur. And, inspired by a certain former President, some might even argue that very sexual behavior didn't count as sex at all.

We often refuse to let our students do "sex" studies. When students have solid research ideas that include measuring sexual activity, like a "cheating" study, we often suggest the following alternative: "passionate kissing." This variable applies more widely to more people and more situations. As for cheating, a guy who spends 15 minutes kissing some other girl before coming up for air is going to have trouble explaining his behavior to his girlfriend, even if he failed to get past "third base." Some groups have also switched to a "make out" question and left the definition intentionally vague. If the participant thinks of "making out" as including sex, fine. If they think of "making out" being possible without removing clothing, fine. Let the participants decide based on their own experience, values, culture and behavior. The "make out" variable often leads participants to ask the person giving the survey, "What do you mean by 'making out'?" We tell our students to have a response ready that each team member will give when asked, something like, "It means whatever you think it should mean." It's important that each team member say exactly the same thing, so that each participant is answering exactly the same question.

One of our most memorable projects was conducted by a team of three women who wanted to use the question, "How old were you when you had sex the first time?" We pointed out that, in a sample of 100 college students, some might be virgins (they had left out that option in their closed responses). Second, the study included males and females, so responses were likely to be biased differently for men and women. Third, it's an invasive question. They suggested asking "How old were you the first time you got a little sumpin' sumpin'?" and leaving the definition vague. After some discussion, they decided to ask, "How old were you when you had your first real kiss (at least two minutes)?" We're not sure this is best question ever, but it did lead to some fun results and a humorous class presentation. They made a joke about trying to word their question, and put up a PowerPoint slide with more than a dozen slang terms for making out. They asked the class which ones they liked best. And predictably, the boys in their data set claimed to have had their first real kiss (on average) by age eight, while girls waited until they were eleven. The presenters asked jokingly about just whom those eight-year-old boys were kissing. Cat calls from the class included: "Each other!" "Older girls!" and "One eight-year-old girl with really sore lips!" By the way, five females (but no males) reported not having had their first real kiss, yet. All were freshman.

The point is that you can have fun and be relevant without asking invasive questions. Your participants will have more fun filling out a lighthearted survey. You'll have an easier time presenting your results and writing them up for your professor. And you won't embarrass or anger the people who are taking time out of their day to help you with your project. Be creative and flexible. You can probably come up with an interesting variable that pretty much measures what you're interested in without the problems that come with asking about anything hard-hitting or deeply private. Don't lose sight of the goal here: have some fun and make a good grade.

Demographics. When you have a good idea of what research variables you would like to study, consider your demographics variables. You will use these results to demonstrate that you have a representative sample. You need to think about various groups on campus. Typical demographics variables include age, gender, commuter vs. resident status, year in school (freshman, sophomore, etc), ROTC/Corps of Cadets, and Greek affiliations (fraternity/sorority). Most university web sites include campus-wide demographic variables for recent years. Decide on 3 or 4 useful demographics questions. If you decide to

narrow your population (say, choosing an all-female sample), you won't need to include that as one of your questions. Remember that variables like BMI, weight, drinking, and working out yield very different responses for males and females, and often narrowing the population you are studying will produce much better data.

Variable Constructs

Many variables we wish to study require more than one question. We ask several questions and then sum them all to get a total. This approach is called a "construct." A typical example is a work inventory where total commuting time is added to the hours worked. Another is a dental hygiene inventory which accounts for brushing, flossing and mouth wash.

Our students often encounter a problem when they wish to compare "hours spent on Greek life" vs. GPA. This single question does not really measure enough to correlate with much of anything. Greek life are one aspect of campus involvement. Other aspects are student organizations (student government, student activities board, yearbook, newspaper, etc), sports (intramural, varsity, club), campus religious groups, marching band, and so forth. Here is an example of how one group attempted to measure this.

Campus Involvement. How many hours did you spend last week on these extracurricular and co-curricular activities?

Honor Societies	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15+
Greek Life	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15+
Student Org (SGA, etc)	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15+
Intramurals, Club sports	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15+
Religious (BCM, etc)	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15+
Military (ROTC)	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15+
Other	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15+

Each response was a different variable column in their data set. They left a blank column and summed all the hours for a Campus Involvement variable. Note how they used the same range of answer choices for ease of use, not because they expected someone to spend 15+ hours on honor societies. Asking one question with several parts is often a good way to allow your participants to quickly respond with a good deal of accuracy. Also watch your spacing and formatting to insure readability (the above example is probably too "bunched up").

Total Work-related Hours.

How many hours did you work in the past week? _____
How many minutes does it take you to commute to work one-way? ____
How many times did you commute to work in the past week? ____

Some arithmetic was required, which Excel performed. Their formula determined the total hours spent working and commuting to and from work.

Work Inventory = Hrs Worked + 2 * Times Commuted * (Commute Minutes / 60)

Note that their units were in hours, even though commute time was measured in minutes. It is important to think through your choice of units before you write your survey questions.

Dental Hygiene. How many times in the last 3 days have you…

Brushed your teeth	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15+
Used mouthwash	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15+
Flossed your teeth	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15+

This group noted that brushing and flossing are not equally hygiene-perfect. Because they felt the typical recommendation was to brush three times per day and floss once per day, that flossing should count more. The formula they used for their inventory:

Dental Hygiene Score = Brushings + Mouthwashes + 3 * Flossings

Their interpretation could be debated. With constructs, different questions often have different importance or weight, so some adjustment will have to be made. When you make a survey construct, you should be ready to defend your choice of units and your rationale for increasing or decreasing the value of any one component. This group chose "tooth brushings" as their base unit. They felt that flossing was three times more important. Could they have used 2 or 2.5 in their formula? Certainly. Discuss it. Compute different values for your inventory. For example, using their formula, a person who brushed and flossed once per day was equivalent to someone who brushed four times.

Survey Design

Effective surveys are short, easily understood, and have easy-to-mark closed responses. They have 3 – 5 demographics variables followed by just enough questions to get data for 3 good numeric research variables. Generally, your survey will fit on half a typed page, though if you use a construct (multi-question variable), it may be longer. Try to keep it to a maximum of a single page.

Care must be taken to ***ask the questions in the right order***. When studying binge drinking vs. GPA, consider asking GPA at the top of the survey in the midst of the demographics questions, and starting off the research question section with all the other questions. Separating the GPA and binge drinking questions (as much as it's possible in a half-page survey) will help remove bias due to participant guilt over drinking too much and letting it interfere with academics.

Take time to format your survey so that the questions and responses are easily scanned. Put similar types of questions together. For example, if you have several Likert scale questions, group them together with the same number of responses.

Make each question simple and easy to answer, with check-boxes and "circle one" answer choices. The following survey is typical for students in our classes. The team was studying Facebook usage, hours spent studying, and time spent playing video games. You may simply use blanks for numeric variables instead of closed-responses, but expect 5 – 10% "junk" surveys.

Demographics (check all that apply):

□ Male	□ Freshman	□ Campus Resident
□ Female	□ Sophomore	
	□ Junior	□ Corps of Cadets/ROTC
Age _____	□ Senior	
	□ Graduate/Post Bac	□ Greek

In the past 3 days, how many hours have you spent on Facebook or other personal blog (circle one)?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21+

In the past 3 days, how many total hours have you spent studying (circle one)?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21+

In the past 3 days, how many total hours have you spent playing video games (circle one)?

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21+

I often use Facebook (or another blog) as a "study break" (circle one).

Strongly Disagree	Disagree	Agree	Strongly Agree
1 2	3	4 5	6

The survey is easily completed in less than a minute. The three numeric variable questions are all structured a similar way, using the same language and the same response categories. Notice that all the response ranges were 0 – 21+, even though different ranges might be appropriate if each question were asked individually. This makes understanding the questions and responses very easy for participants which will lead to higher quality data.

The final question uses a 6-point Likert scale response. Opinion questions have to be positive assertions so that the participants can actually agree. Make your "question" a simple, declarative statement. Good examples are "I consider myself pro-life" and "Professors at this university are very helpful during office hours." Bad examples include "Are you pro-life?" and "Professors at this university are available to students via email and very helpful outside of class and during office hours." The first bad example is a question, not a statement. What is one agreeing with? The second bad example has far too many topics combined into one questions. If all these professor attributes are important to your study, make each its own separate Likert scale question.

Notice that the even number of Likert responses does not allow participants the option to select "Neutral/No Opinion." This is an often-used technique that forces participants to take a position on the issue. However, participants are wily. They often put a big circle around two numbers, in this case 3 and 4, to resist our efforts. They also are prone to doing so with the numeric questions, for example circling 19 and 20 even though it's highly unlikely they know that they studied exactly 19.5 hours. Is this a drawback? Certainly. A wise person once said that he who thinks he has designed a fool-proof method has seriously underestimated the creativity of fools. This is very true for survey data where participants rarely consider the poor researcher and often spend their valuable time submitting a survey that is effectively junk. In cases of "double circling," we usually suggest averaging the two numbers when entering the data.

Quality Sampling

Most statistics book go into great detail about random sampling. In real-world studies, however, only rare occasions allow researchers to utilize random sampling. More often, especially when doing survey research with people, we have to rely on volunteer participants or convenience samples. We tell our students that having a representative sample is the goal, regardless of how the data were collected. There are five basic ways to collect survey data.

Convenience Sampling — A sample of volunteers. Since participation in our projects is voluntary, your project sample will be a convenience sample.

Cluster Sampling — The researcher tries to get a 100% response from an entire group: everyone in your psychology class, everyone in your sorority, or everyone on your dorm hallway.

Index Sampling — The researcher chooses every n^{th} person to participate. For example, you stand outside the chemistry building and ask every 5^{th} person who walks through the door to take your survey.

Targeted Sampling — Identify the demographic characteristics you need in your sample, and then go to places where those types of participants are likely to hang out.

Stratified Sampling — You divide the population into groups, and attempt to sample a certain number from each group. Technically, stratified sampling includes randomly sampling from the strata or groups, but we won't do much random sampling in these projects. Instead, we often use stratified

sampling with targeted sampling to identify demographics groups we need more data from.

Most of our project groups use two or more of the above samplings together. First, they gather the easy data by sampling their dorm hallway, a French class and twenty friendly-looking people in the food court (**cluster**). They now have 70 of their needed 100 surveys, so they quickly tabulate how many males and females have responded, how many freshman, how many Greek-affiliated, how many commuters. They compare their partial sample to the overall campus demographics (**stratified**) and find out how they're doing. Oops. To many sophomore and not enough seniors. Too few commuters. And too few males. So they **target** senior commuters who are male to balance their sample demographics. Of course, everyone in their sample is a volunteer, so they also used **convenience sampling**. Is this completely representative? No, but it's the best we can do without the project taking 5 semesters.

Targeted sampling works best when you've intentionally chosen to study a subpopulation rather than the entire campus population. For example, if you're studying the subpopulation of females in sororities, you would target chapter meetings and other concentrations of Greeks. You might target female dorms if you're studying the female subpopulation.

We encourage all of our students to consider **stratified sampling**. This requires some knowledge of campus demographics before you start collecting data and usually is combined with targeted sampling techniques. Check the university web site for demographics data. Often, the undergraduate admissions office or student affairs has this information publicly available and linked on their web site.

Cluster sampling is a favorite but has some serious disadvantages. Of course, cluster sampling a class of 40 students quickly generates survey responses, especially if the professor is late to class or agrees to let you pass out your surveys at the end of class one day (always get permission!). But cluster sampling tends to get many participants who are very similar: all sophomores or all one major. Too much cluster sampling almost always leads to samples that are not very representative of the overall campus population. Use this technique wisely. Choose classes that have a wide range of freshman through seniors and all different majors. Have only every third member of your fraternity take the survey (cluster/index sampling). Or just grab the first dozen folks to four very different classes.

What is a "good" representative sample? Our campus is about 60% female. In a sample of 100 students, having anywhere between 55 and 65 females is pretty good. Having 50 or 70 females is okay, but not optimal. Our campus has about a third residents and two-thirds commuters. So a sample of 100 should have between 60 and 70 commuters. A general rule might be $\pm$5%. When a huge majority of campus is from one group, however, it's often better to err on the side of over-representing the minority. Our campus is roughly 15 – 17% Greek affiliated. If Greek affiliation is one of your demographics variables, consider targeting between 15 – 25% Greek so that you have enough data from Greeks to be meaningful.

Remember that it's hard to get a perfectly representative sample. The job gets tougher the more demographics variables you attempt to stratify. Choose two or three main demographics variables (male/female, freshman/sophomore/junior senior, etc) and get them as close as you can.

What happens to teams whose samples are imperfect? It's not the end of the world, especially if they realize what happened and admit the error in their presentations and written reports. Our campus is about a third residents, but some teams have ended up with nearly 90% residents in their sample. While it's not optimal, groups who find themselves in this situation need to do two things. First, identify where their sampling plan failed and state how they could do better next time. Second, change their study population. In this case, the team should simply admit that they studied campus residents and know very little about their commuting peers. Their findings are relevant for the subpopulation of residents but not for campus as a whole.

Think about your sampling methods before you begin and develop some way of checking on your progress part way. Teams get off track when all the team members go their separate ways without any planning or coordination and collect the most convenient data. When they realize (usually after most of

the data is entered) that they don't have anything like a representative sample of any reasonable population or subpopulation, it's too late.

Assignment 2

Open the Regression Project Proposal. Fill in each area of the form in complete sentences. The proposal guides you to consider all of the issues above: variables, possible correlations, questions, survey design, and sampling. Also, verify the IRB requirements with your instructor. Do not begin collecting data until your instructor has approved your project proposal.

Assignment 3

Collect your data now that your proposal has been accepted. You will need to work quickly to get all data entered and analyzed so that you may begin work on your in-call presentation and final project report.

Constructing a Data File

We expect our students to create a spreadsheet in Microsoft Excel and enter their survey data. We have made a very comprehensive Help File to assist you. Complete your data collection, then use the help guide insure that you set everything up correctly.

Always save your data file!! As often as possible, save your data. When you have a complete data and ***before*** you begin any analysis, save copies to flash drives and/or email copies to all team members. Having multiple uncorrupted copies of the original data is virtuous and will save you immense time and sanity if and when data are lost.

Presenting Your Regression Project in Class

You should verify exactly what your instructor's expectations are since grading methods and preferences will differ. The following general guidelines will help you determine appropriate ways to present scientific analysis to your peers. These project presentations relate specifically to regression studies. In general, our students do not make a class presentation for the group comparison (t-test) projects.

Your presentation…

- Should be 4 – 8 minutes in length.
- Include about 7 – 10 easy-to-read, uncluttered slides.
- Should introduce your entire team but be conducted (mostly) by a single presenter.
- Should not include the word "random."

Topics you should address include…

- What was your hypothesis? What were you studying?
- Survey design
    - Questions and Constructs
    - Confidentially
- Sampling design
    - Targeted, Cluster, Convenience, Stratified, etc.
    - Was you sample representative of the study population?
        - If not, what could you do better if you were to do the project over?
- **Regression results**
    - Scatter-Plot
    - Correlation (analyze r)

    - Line of Best Fit (analyze slope)
    - Coefficient of Determination (analyze R^2)
- What were your conclusions based on your research?
- What did you learn while doing the project?

Additional Hints

- Send a team member to visit your instructor during office hours. If you work in advance, your instructor will likely be willing to look over your PowerPoint file and/or help with a data analysis point that you would like to clarify.
- Do NOT wait until six minutes before your in-class presentations to ask your instructor detailed questions about your data analysis or your slides.
- **Presenters**
    - Dress nicely—it shows you care.
    - Practice giving the entire talk (out loud and with slides) at least twice.
    - Do not say "we proved x and y are correlated." Say instead, "we found evidence that x and y are correlated."
    - Practice your opening sentence several times. First impressions matter!!
    - Have a single presenter speak for the group. Without a lot of practice, multiple presenters typically confuse the audience by interrupting one another and talking over each other.
- Display slides for at least 30 seconds. Busier slides need 45 – 60 seconds.
- Choose a teammate to advance PPT slides so the presenter can focus on speaking.
- ***Do not just read the slides***. Slides are for displaying your main points along with charts, graphics, numbers and equations.
- Don't use silly graphics, weird sounds, hot pink backgrounds or whacky transitions. Keep the presentations professional. Color is fine but should be muted.
- Cute stories or funny anecdotes can be appropriate. Try to "lighten up" your audience at least once or twice, but remember that this is not a comedy routine. Good examples of humor are stories about silly things that happened during the project like surveys that got soggy in a rain storm or someone getting asked for date after while doing a "dating" survey.
- Address the entire class. Do not speak only to your instructor. In fact, the best presenters will make eye contact with everyone in the room except the instructor. You are the experts on your topic. Present with confidence about what you discovered.

FAQ

Why can't I use the word "random"?

Group Comparison t-test Project

Overview

Your group comparison project will be similar to the regression project in many helpful ways. Regression projects compare two variables. When we want to compare two demographics groups like males vs. females, we use a t-test. We still must use a numeric variable. We still require evidence that the variable comes from an approximately normal (bell-shaped) distribution. We still have a population we are studying although it typically is a sub-population of campus. Therefore, you will use the same guidelines for writing questions, for developing constructs, for sampling procedures and for analyzing whether your sample is representative.

As you've learned in class, there are three types of t-tests, but let's discuss two first:

1. One sample t-test
2. Two sample t-test (independent)

These t-tests help us compare a sub-population to an overall population or to compare two sub-populations to each other. What if we would like to compare three groups or sub-populations? What about four or more? Any time we have three or more independent samples, we use a generalization of the t-test called ANOVA. Like most statistics, the test statistic for ANOVA is denoted by a letter, in this case "F." ANOVA is more advanced procedure which requires a follow-up series of statistical tests called *post hoc* procedures. But the idea is exactly the same as for t-tests.

The third type of a t-test is a special case:

3. Two sample t-test (dependent)

The dependent samples t-test is also known as a "matched pairs" t-test and most often is used to analyze a pretest / posttest research design. One student compared stress levels on her dorm hallway, first asking her dorm mates prior to the Thanksgiving break to complete a stress inventory, then giving each of them the same inventory when they returned from break to face final exams. Having exactly the same participants fill out exactly the same survey is vital (and why we refer to the procedure as matched pairs), and therefore anonymity is not possible. This limits what variables we can comfortably utilize.

Project Tasks

Working in self-selected teams of two or three (or as individuals – ask your instructor for details), you will complete the following tasks:

1. Brainstorm a Topic
2. Select 1 Sub-population per Team Member
3. Design a Survey
4. Sample at Least 25 Participants from each Sub-population
5. Run the Appropriate t-tests
6. Write a Report

Teams and Topics

You must decide how many team members you will be working with prior to beginning the assignment. If you are working along (ask your instructor about this option), you will simply select a sub-population to compare to the overall population. If you are working with others, each person will need to select a sub-population. Choose groups you have easy access to for the data collection. For example, an international student might choose the members of the International Student Association for her sub-population. Our students who smoke often use smokers as their sub-population since they routinely hang out in designated smoking areas around campus.

The sub-populations cannot overlap. Consider a "nights out partying" study that contrast varsity athletes with Greek affiliates. The problem is that some athletes might be in fraternities or sororities. The easiest way to deal with this is sample athletes who are not Greek-affiliated and Greeks who are not athletes. When you are sure that no single member could even theoretically be in both groups, then you can use an independent samples t-test or ANOVA procedures.

Some group choices make this easier. For example, it is difficult (though not impossible) for the groups male and female to overlap. Groups like "varsity athletes" have well-defined members. Comparing athletes vs. non-athletes is pretty straightforward.

Three person teams have studied groups like "commuter females," "resident females," and "resident males." Three females might study three different sororities. You could also study residents from three different dorms, but you would need some hypothesis about how the residents might be different (perhaps they have reputations ranging from a "party dorm" to an "anti-social dorm").

Select your team. Select your sub-populations or study groups. Now develop a research variable or construct on which you think the two groups will be different. In the past, our students have found that upperclassmen have higher GPA's, drink more caffeine and study more than underclassmen. Develop a hypothesis based on what you know of the world.

The task for three-person teams studying sub-populations A, B and C is slightly more complex. They must compare and contrast all three pairs of groups, A vs. B, B vs. C and A vs. C. This requires more statistical tests, and each one must be treated separately. We need to make it clear, however, that multiple t-tests is not good research design. The appropriate test for three or more independent samples is ANOVA. Some instructors cover ANOVA designs. Some do not. Ask your instructor for details.

Some instructors allow individuals working alone to access or use data from the regression project. This requires that all the relevant demographics variables exist in the original data set to allow for a representative sample to be "drawn," or to argue that one exists. Again, preferences vary between instructors. Make sure you understand and follow your instructor's guidelines.

Survey Design

You still must be able to argue that you have representative samples for each sub-population. If you are studying athletes, are all sports represented? Are different ages represented? Both male and female athletes, or just one gender? You will typically ask only 1 or 2 demographics questions, but you need to choose wisely and make sure that you have the correct demographics for all the sub-populations. If you are studying your fraternity, you might ask if the brothers are freshman, sophomores, juniors or seniors.

Your sample size needs to be at least 25, so make sure your group is large enough that data collection will reasonably easy. If you were studying your sorority, you would probably want to insure you had at least 5 members from each class: freshman, sophomores, juniors and seniors (if that was your demographic variable).

For your survey, you only need one research variable. The same criteria apply for creating your questions, your variables and/or your constructs. The survey will be much shorter than the one you created for the regression project, possibly only two questions long. This makes data collection very quick.

Sampling

Even though the process is not complicated, you should still think carefully for a couple of minutes about your sampling design ***prior*** to handing out surveys. Should you **target** at least five from each class rank in your sorority? Should you use **cluster sampling** in organic chemistry lab to find pre-med majors? Determine your sampling design to insure the most representative sample possible.

If you need to collect more data than just 25 surveys to adequately gather a representative sample, you may do so. However, problems arise with the assumptions for t-tests if we have sharply unequal sample sizes. A good rule is to have your smallest group be at least two-thirds the size of your largest group. If your partner is collecting a sample of 25, your sample can be 1.5 * 25 = 37.5, which we would round down to 37.

Data Analysis & t-test Procedures

Because the surveys are short and the samples small, most of our students find the best way to analyze their data is to use their graphing calculator. However, you must provide your data to your instructor with

your final project report. This allows instructors to assign partial credit if you make an error. Our students generally provide a table as an appendix to the reports.

While the number of "steps" instructors require for in-class quizzes and tests may differ, a formal report of a t-test should include all the following information:

- Which statistical test(s) is (are) being used for analysis
- Null and alternative hypotheses, type-set using proper mathematical notation
- Discussion of Type I and Type II error
- Rationale for your chosen level of significance (α)
- The t-test results with both the test statistic and p-value reported
- Whether you "rejected" or "failed to reject" the null
- A statement in real-world terms describing the implications of your results

These are all topics that your instructor will cover in class. See your instructor's assignment sheet for details on how to prepare and present each one. You can find suggestions for writing your report in the section below.

Dependent Samples Studies

As noted above, you can complete a dependent sample project. This is most easily accomplished by an individual working alone, but it requires a double dose of data collection. Responses cannot be anonymous unless you number each survey (and the participant actually remembers their number!!).

Lots of interesting ideas can be developed here. What variables might change in the short time you have to complete this project? Stress? Resting heart-rate or blood pressure? Hours studied the night of a big game vs. a typical week night?

Some people dislike mathematics. An example of a dependent sample t-test would be to measure the participant's resting heart rate, then administer a math quiz. The quiz would need to be long enough (2 – 3 minutes) to actually affect one's heart rate. Then measure it again. You might measure heart rate before and after the participant walked up and down a flight of stares 5 times.

Get creative. There are lots of ideas. Not many of our students have tried these types of designs, but they always make for interesting reports.

Writing your Project Report

Technical writing must be precise. There is no page limit for these project write-ups, and shorter reports are often better than longer ones. Technical writing in mathematics is difficult for some because of the precision necessary.

Use simple, short declarative sentences. Use each term properly, referring to class notes and this document as needed. When making an analysis statement, include the statistical value. Example, "we found height and weight to have a strong, positive relationship (r = . 58)." Including the statistic in parenthesis is nice way to keep your analysis direct, concise and easy-to-understand. If you found a negative correlation, be sure to check that each time you report the correlation or the slope, that you include the negative sign – it's easily lost in regression.

Statistical conclusions are fuzzy. Do not say that you proved something. Say, "we found evidence for a weak, negative correlation between hours spent in bars each and GPA."

Refer to your class notes when writing about sampling, and use the proper term for what you did. Provide a rationale, even when it's weak. Be honest. "We ran out of time and grabbed just anyone we could from the hallway outside of class." While it's not ideal, it's true. And it's technically a tepid combination of convenience and cluster sampling.

Never try to "BS" your way through a technical paper, especially not in this case. The instructor knows the proper way to analyze these data. Take the time to make sure it's done correctly, and state exactly what you did.

Use the proper symbols. For R^2, use the "font" options to make the "2" a superscript. For your equations, we often use spaces to make them more readable. We also often use variable names or abbreviations, for example, you might type your Line of Best Fit equation:

GPA = -0.68 * DrinkNights + 3.16

We often reverse the terms on the right side of the equation to make the negative slop easier to see:

GPA = 3.16 – 0.68 * DrinkNights

Also, we typically use the asterisk (*) instead of "x" for multiplication to avoid confusion. When we type "x," we mean the independent variable or predictor in the regression model. Most word processors have an Equation Editor. You might consider using one, but it's not necessary.

For the group comparison projects, using proper symbols includes making the correct null and alternative hypothesis. Use the "font" options to make subscripts. Be sure to use colons, not an equality symbol. Use the "insert symbol" option to place the Greek letters alpha (α), mu (μ) and sigma (σ). Example:

$H_0 : \mu = 9$

Attach a copy of your survey exactly as it looked to your participants. You will likely need to paste in the questions you used for the numeric variables directly into portions of your report (see your instructor's guidelines). Place the entire instrument (same formatting, same font, same spacing, same everything) in an appendix. For demographics, you may simply note which variables were used, for example, "age, gender and Greek affiliation."

For the regression project, you MUST attach a copy of your Excel data set complete with your graphics, scatter plots and other analyses. This is for partial credit. Instructor's can readily determine when the statistical calculations are flawed without seeing them. Being able to open the data file and scan for the error allows your instructor to assign partial credit where warranted.

Double- and triple-check every statistical calculation and every mathematical or analytic statement. Your job is to complete a math problem and to get the exact correct numbers and symbols to appear on your computer screen. It is more difficult than most people imagine. Even if the work is correct, you can easily lose a letter grade with a simple transcription error between your by-hand work and your paper. The beauty of the written report is that you can proofread it. The downside is that you must proofread repeatedly to catch all the errors.

Consider having an author and a proofreader for each section, with a third person skimming and checking all mathematical or analytic statements. This requires that you get the paper done well in advance of the deadline so that everyone has a chance to proofread and fact check. Technical writing takes lots of time during the editing phase. Do not leave the report until the last minute, or the hurried drafting will cost you entire letter grades due to what, in non-technical writing, would be considered typos.

Frequently Asked Questions

What important tasks should have a designated person in charge?

Consider which teammate is most suitable for which tasks. Important tasks include the coordinator or leader who gathers all work from the team and is responsible for turning it into the professor, a tech savvy person who can be responsible for the MS Excel data set including making formulas and backing up all data, an assured public speaker to present for the group, a good graphic designer who can make an appealing and professional PowerPoint presentation file, and a person who knows campus well to suggest quality sampling designs and who can figure out where to go to get the right participants. Tasks that can be shared are the write-up/reports and the data collection.

What if my team sucks?

We expect all teams to work professionally and to meet agreed-upon team deadlines. Sometimes, one or more teammates are not as responsible and professional as they should be. But that is rare. Be prepared and organized. Exchange email, cell phone numbers – even become Facebook or MySpace friends. Well-organized teams that communicate effectively about work and deadlines rarely have problems. Different instructors have different penalties for persons who cause problems within their project teams. Generally, that includes doing significantly more work on a later project. Be considerate of your teammate's work schedules, commutes, and other responsibilities. Get to work early, and be willing to help each other out. If someone gets sick and can't do much data collection, allow them to take on a bigger part of the work later, making the presentation slides or doing extra sections of the write up.

Will we all get the same grade?

Yes, but ask your professor or check the syllabus for details. Most professors give the same project grade to all team members. Some professors give 80% of the grade for the "team" assignment and 20% for individual work. But the majority of the grade will be assigned for team effort, and each teammate will receive the same score.

Why ask snapshot questions instead of "estimate the average" questions?

There are several reasons we humans tend to estimate inaccurately. Here are three of them.

Other survey questions influence our estimates. Suppose you were comparing "servings of alcohol consumed per week vs. hours spent studying." The participants see from the questions on your survey that one behavior is considered "good" while the other is "bad." They often will estimate their alcohol consumption lower than it actually is or their study hours higher than they actually are, or both. The same thing happens when comparing weight or fitness to fast food consumption. Participants begin to feel guilty about their lack of exercise or their abundance of unhealthy meals. Guilt changes their estimates subconsciously, even when they attempt to be truthful.

Recent experiences influence our estimates. Consider how the time of data collection might influence the "hours spent studying" variable. The average number of hours changes from the first week of class to midterm time to finals week. These recent experiences will influence how the student estimates the average. Many students experience the "I should study more" guilt around midterm time as they find their scores on exams, papers and projects are lower than desired. They might overestimate their actual average, hoping to do better these next few weeks. They may also forget how little they study during "down times" of the semester if they pulled a couple all-nighters recently.

Cultural norms influence our estimates. With variables like weight and alcohol consumed, participants often shade their answers toward more socially acceptable numbers. Females are

often much more weight conscious than males, so estimates will differ between genders. Young adult males are often proud of how much they drink, so their estimates may be optimistic.

Questions requiring **estimates** are difficult questions to answer at the best of times, and our mental calculations can be muddied by many factors. We recommend you ask **snapshot** questions about actual behavior in the recent past. The **snapshot** question does have drawbacks. For the "hours spent studying" variables, one person may have had a light week while another may have had several exams and papers due recently. Different majors might be especially busy while you're collecting data. But in general, **snapshot** questions will lead to more accurate responses. The highs and lows from individual participants will even out in your final data set, especially if your team has a quality sample that is truly representative of your school: many different majors, both upper and lower classmen, both Greeks and unaffiliated, and a correct proportion of men and women based on your school's demographics.

Why can't I use the word "random"?

Random has become slang, a word we use a lot in every day speech. But in statistics, random means mathematically random. When you say we sampled by "randomly selecting people in the cafeteria," you are saying you took a mathematically random sample of everyone who was in the cafeteria at the time. That would mean identifying every single person there, assigning each one a number, and then using a computer-generated randomization procedure to select, say, 20. Next, you would have to approach each of the 20. Further, if only 19 of them agreed to participate, your sample is not random. No one we have ever seen has managed anything resembling a simple random sample on one of these projects. Most use a sample of convenience (volunteers). Saying the word random in your presentation will almost always be incorrect mathematically. So avoid it.