

Encouraging Participation

Discussions that generate questions and encourage active participation provide an effective way of student learning.

Some topics give rise to discussion very readily. Many statistics tutorials however are concerned with questions that if taken at face value may not promote discussions. You need to help coax students along. For example: by asking "How would you design and then analyze a study to compare the wear for 2 different shoe sole materials?" the students may not know where to begin. Perhaps start by describing such a study, writing down some simple data, and asking how to proceed to answer the experimenter's questions.

What can be done to get students involved in discussing questions like that?

Here are some suggestions:

1. Be gentle. It is essential to have an atmosphere in which students feel welcome to participate and are not afraid that they may be embarrassed or humiliated.

You will sometimes be surprised at how little students understand. Many things that came easily to you won't come at all easily to average and even above-average students, let alone below-average ones. Your expectations are especially likely to be unrealistic in the case of first and second year students, because many of them don't know how to learn statistics (or to be more accurate, and/or they have wrong ideas about how to do it). You can expect students to ask questions and say things that you will find surprisingly uninformed. When this happens it is important to respond in a positive way, so that neither the student who spoke nor the others who are listening will be intimidated into not asking "stupid" questions in the future. Quite often you will be able to respond to a question by saying in all sincerity that it is an important question to get sorted out—while resolutely hiding your surprise that anyone would need to ask it.

2. Obviously, be ready with questions designed to start discussion and questions designed to lead it further. With many problems the best

approach is to stand at the chalkboard and develop the result as the discussion proceeds. Perhaps start by writing down the names of 8 subjects for the study. Ask what type of experimental design would be appropriate. Ask why one type would be superior to the other type. Is it necessary to randomize? How would you do so? Then use a Random Number Table (or better yet run some off of your computer using R, matlab or Excel) to actually do so (in the back of most intro stats texts). Fabricate or use some data from the textbook, and write the data down on the board (or project to the screen from your computer). Ask how to proceed to analyze the data. Do you have to make any assumptions? How can you check them? What can/should you do if the assumptions are mildly or severely violated? After you ask a question, wait a few moments for the students to process the question and formulate a response. Give different people a chance to respond to questions. Ask if they follow or are lost. Ask if they have questions. Try not to explain something exactly the same way twice.

Often the most valuable approach is to ask the student who provided the solution how they thought of dealing with the problem the way they did. An amazing number of first and second year students only want to know the solutions to problems and don't realize that what they need to learn is how to approach a problem when they don't have any idea what the solution will turn out to be.

If the advice you got when you asked a question was wrong, it is important that you try to think of a way to respond that doesn't make the student who gave the advice feel cut down. Maybe you can convey the impression that the student's response was one that you more than half expected, because students often take that approach to that sort of problem, and then explain that there is a difficulty. Or you might say something like "Yes, it's very tempting to come at the problem that way, but it turns out that there is a difficulty."

3. Try to have one or two questions ready that would be valuable to raise after a problem has been dealt with; sometimes everything goes swiftly

and as a result your students haven't had much of a workout. If there is time left over these can be used to give them something to think about. For example, ask what constitutes a type I and type II error, and how these are controlled. Or about other possible designs or non-parametric approaches to analysis (what do we mean by "non-parametric?"). Perhaps, discuss how to use the course's computer package to analyze such data.

You might ask the students for some further examples of comparative (paired and independent samples) studies, or for hypothetical ones to investigate some question of interest to the student or to you. You can discuss how the procedure you are discussing now ties into/extends/differs from previous procedures (e.g. if discussing the one-way ANOVA F-test, you can ask how this ties in to the t-test and if the assumptions differ; or how this is similar/dissimilar from the chi-square test of association and from a simple regression or correlation analysis).

Don't get carried away though. Keep in mind the time you have and the necessity to discuss a good number of problems during the hour. You can come back to a particularly interesting discussion point at the end, if time permits, or you can just pose some of these questions briefly for students to think about. Or save your best tricks for last, after some important basic material has been covered.

The key point is: ask questions of your class, ask, ask, ask! This will encourage participation, and liven up the class considerably. Even if it is only, "Do you follow so far?" and "What should I do next?"

How Much Participation Is Enough?

Even when a tutorial works well and you have a comfortable atmosphere and active participation, there may be some students who never say anything. You can make a point of ensuring that they can catch your eye at moments when someone (possibly yourself) is just finishing speaking, so that it is clear that they can get a word in edgewise if they want. If they don't

want to say anything, and they appear to be listening and thinking, the importance of inveigling them into saying something is debatable. If the group is too large, as many of our groups are, you may be grateful to have a few quieter students.

When Is General Participation too Time-Consuming?

Not often. Even when an assignment appears to be too long, quite often it isn't because right answers are suggested promptly and few questions are asked or if you aren't very successful at generating discussion and have to fall back on dealing with some of the material by lecturing.

Sometimes, though, the discussion may be unusually time-consuming, or you may use up a lot of time reviewing something important that seems to be widely misunderstood—with the result that you then find yourself running out of time. An obvious solution is to abandon general discussion and "cover" the remaining material quickly yourself. But an alternative worth considering is just to continue the successful discussion and then say that you will distribute written notes on the left-over problems at the next tutorial. If you can do this easily, the advantage of doing it is obvious. But if you ever do get involved in anything like this, be clear about exactly what it is that you are undertaking to do. If you mention that you will bring written answers to the rest of the assignment next time, somebody will want to know how to get them sooner, somebody else will want to know how to get them if they are not at the next tutorial, and the more general question of why don't you provide written solutions to all the problems all the time may also come up!

Other Methods

Dyads and triads: A variation of this method was used successfully by a STA221 TA one year, who even gave colourful names (of birds) to each group. Students, in groups of two or three, discuss an assigned question or problem. All the groups can discuss the same problem or different questions can be given to each group. Students, who are reluctant to speak out in a larger group, will talk when with they are in groups of two or three. Groups are

given a stated amount time (5-15 minutes) to complete the task. You can circulate and monitor what is going on. Then, each group reports back to the rest of the class (or submits a written answer to the quiz question), after selecting a member as its reporter.