

12<sup>th</sup> Math Stats  
Main

Teacher: Okay, good. We have 10 people. We're going to sit in groups of 5 today. Can we do 5? No?

Student : [crosstalk 00:00:15]

Teacher: Ew. Okay. There's one open one. That's disgusting. Are you ready? As I throw things around. Good morning, everyone. Today, what we are going to do is we are going to review and practice significance testing, hypothesis testing, confidence intervals and all that fun stuff we've been working on.

Student : Are we going to need to know this?

Teacher: We're going to need to know this. Good question. We're always going to need to know this, right? Whenever you see things of confidence intervals, you have to relate it back to what does that mean, what is the the true proportion? We've been practicing means a lot, so I want to do one with a proportion instead. Okay? Also, AV test is coming up in 6 weeks. We need to get started.

[00:02:00] Today it's called, "Give me a kiss". You're each going to be dropping 5 kisses at a time. What you're going to do is get a cup, shake around 5 kisses and you're going to drop it from some specified distance. If you want to specify that distance for your entire group, you can. Else, that might be a bias. That might be some kind of flaw in your experimentation. We're going to see how many kisses land upright. How many kisses land straight upright? I think they say the known hypothesis for this is about .3. Okay?

Student : Should I write that?

Teacher: You can write that down. Known hypothesis is .3. We'll see if that .3, that known hypothesis, falls within our confidence interval that we're finding. Today we have cookies and cream Hershey's and we have the regular Easter colored Hershey's Kisses. Maybe there might be a difference ... In your group you're going to have one group work with the cookies and cream, one group worked with the regular chocolate, and we might be able to talk about how that changes things. Whether the uniformity of chocolate changes how things fall.

You're just going to basically go through this. Do you want me to give you the kisses now or are you going to be tempted to eat it while you work through the initial part?

Student : [crosstalk 00:02:54]

Teacher: You will be fine? If not Skittles. Yeah, Student.

Student : Yeah, it's not Skittles.

Teacher: Okay. Get started with this first of all. Read through it. Yeah, I'm going to give you 5 each in your cup. Whatever it is. What?

Student : Is is okay if I see cookies and cream?

Teacher: Okay. Got 5? Okay, move around the room as you need to. You can do groups of 5, you can do groups of 4, it doesn't matter. It's really fluid. You did 3? Okay. That's fine.

Student : We should do a combination.

Teacher: You could do a combination.

Student : 3 and 3. No, that would make things too difficult. Student, come with us.

Teacher: It doesn't really matter. You can do 3 and 3, that's fine. Just do 3 groups, fine.

Student : We can all pick our own?

[00:04:00]

Teacher: Huh? Yeah, because you're all going to do and you're going to be able to have more data.

Student : Oh.

Teacher: A few are the replicates, right?

Student : [crosstalk 00:04:11]

Teacher: I mean, we honestly have enough if you want both cookies and cream and the regular, we can do that.

Student : [crosstalk 00:04:55]

Teacher: Okay, I there's 5 in each. There you go. Go ahead. Yeah, drop it.

Student : I've got 3. You got 1. [crosstalk 00:05:38]

Teacher: You're just not good at this, Student.

Student : Wait, we have to do it 50 times?

Teacher: There's usually 50 kisses, so you're doing it 10 times.

Student : Oh, I ...

[00:06:00]

Teacher: You see how that's 50 kisses? Good. Did you do it 10 times?

Student : [crosstalk 00:06:02] We're doing it with the different ones?

Teacher: You can do it with different ones. Yeah, that's why I'm giving you ... Because I already know.

Student : Would that be separate from ...

Teacher: Yeah, that would be separate.

Student : These are consumable after?

Teacher: These are all consumable after. Yes.

Student : Oh no. [crosstalk 00:06:27]

Teacher: You can determine whether you think that that is a bias. If that is, then maybe you shouldn't use that thing.

Student : [crosstalk 00:06:49] Do we do ...

Teacher: Yeah, you're going to do the regulars. You can do it twice.

Student : Where?

Teacher: Just do it on the side. I didn't anticipate it, and then I thought about it later and I was like, "Oh, that might be good." We can all see the differences. Okay, there we go.

Student : [crosstalk 00:07:15] I got 3 then 2. What's wrong with this?

Student : My thing is exactly the same ... [crosstalk 00:07:25]. Never mind.

Student : I'm trying to put my cap on, but it's not sticking. I like the consistency of my data.

[00:08:00]

Teacher: Okay, Student , try it again.

Student : Try it again?

Teacher: Using these. Okay? Oh, you did 5 and 5?

Student : Yeah.

Teacher: Okay, you're going to do 5 more of each.

Student : [crosstalk 00:08:12]

Teacher: You're doing it right. Here, you got it.

Student : It makes a difference.

Teacher: It does make a difference?

Student : I got 18 on this one. [crosstalk 00:08:34]

Student : Zero.

Teacher: Yeah, but now you can continue on right? Where's this data?

Student : I didn't record this one yet.

Teacher: Okay.

Student : This data is getting way too consistent.

Teacher: It knows.

Student : It knows what it wants to be.

Teacher: Are you flipping it the same way?

[00:10:00]

Student : Yeah. [crosstalk 00:09:59]

Student : Must be, because it's so consistent.

Student : You just give it a down shake and it just goes straight over.

Teacher: Is it a bias that it's hitting your hand?

Student : Probably.

Teacher: Do you take that into consideration?

Student : Yeah. It's going to be noted in the ...

Teacher: Yeah.

Student : Is the sample the amount of kisses? Is the sample just ...

Teacher: The population of interest is number of kisses landing on the base.

Student : [crosstalk 00:10:32]

Teacher: Mm-hmm (affirmative). It's the sample.

Student : Cookies and cream? 10?

Teacher: Yep. We can say these 5. These specified that are given to me. I don't know. What you're going to say ... Hmm?

Student : Given kisses?

Teacher: Given kisses, yeah. Then you could say that for one study it would be just the plain chocolate. One other study would be cookies and cream.

Student : All 5 of them are random ones.

Teacher: You got all 5?

Student : Yeah.

Teacher: Oh wow.

Student : [crosstalk 00:11:24]

Teacher: Yeah.

Student : When they say a total, it's just the total that land upright, right?

Teacher: Mm-hmm (affirmative).

Student : Oh okay.

Teacher: Because the total would be 50.

Student : Okay.

Teacher: Which we don't need.

Student : Are we counting the 2 separate ones?

Teacher: Yeah, you're going to keep them separate.

Student : Oh, keep them separate.

Teacher: Yeah. Keep them separate.

Student : Oh.

Student : I got 4-1-1. Some great information. Don't you think?

Student : I got 3-3-4. [crosstalk 00:11:55]

Student : Maybe my kisses are defective.

[00:12:00]

Teacher: Okay. Cookies and cream is the one that is ...

Student : Dude, I got 4-1-1-0-0.

Teacher: You just slowly ruined your strategy.

Student : No. [crosstalk 00:12:10]

Student : That is not 6 inches.

Teacher: Do you feel like you're pouring it the same way every single time?

Student : No.

Student : [crosstalk 00:12:16]

Teacher: No, Student. Not... Shucks.

Student : Do you see this?

Student : We're going super slow. Maybe that's why.

Student : Yeah, it's not specified how you're supposed to ...

Teacher: Do you go super slow?

Student : Usually I pour them out one at a time.

Student : Do I put this in a table?

Teacher: No, because you're using 12.

Student : Oh, that's P?

Teacher: No, P is your proportion, right?

Student : [crosstalk 00:12:44] ... 12 out of 10?

Teacher: No. Every round we can go is 5 and we did 10 rounds. How many kisses was that?

Student : 24. Holy shit, that was so much more than last time.

Student : 50.

Teacher: Watch your language.

Student : Holy moly.

Student : 50?

Student : Can we edit that one out?

Teacher: Don't look at them.

Student : 50?

Student : He said he can edit it.

Teacher: Great. 50, yeah.

Student : 12 out of 50?

Teacher: It doesn't excuse it. Continue on. Let's go to 10, 12. Okay, I see it.

Student : 12 out of 50?

Teacher: 12 out of 50, yeah. Okay, population of interest and sample. What you going to do? What do you guys say is the population of interest?

Student : [crosstalk 00:13:30]

Teacher: How many what? Let's be specific, Amber.

Student : Kisses stand on it's base.

Teacher: Okay.

Student : Wouldn't our population of interest be [inaudible 00:13:42] because we did 2 different?

Teacher: Mm-hmm (affirmative). It would be, but there's 2 different studies going on. We're not com...

Student : They're independent?

Teacher: Yeah, they're going to be independent.

Student : Oh, okay.

Teacher: I'm sorry I only gave you one space for one, but I thinking this might be an interesting comparison just because I found 2 [duds 00:13:59] of kisses at the store .  
[00:14:00]

Student : [crosstalk 00:14:06]

Teacher: Is that the sample or the sample size?

Student : Sample size.

Teacher: Okay.

Student : I'm confused.

Teacher: Okay.

Student : For the ... when we were talking about which one ...

Teacher: Mm-hmm (affirmative).

Student : [inaudible 00:14:49]

Teacher: Is it an SRS? Okay, so it's from a certain bag? [inaudible 00:14:56]

Student : They were chosen at random.

Teacher: They were chosen at random? Okay. We can assume it's an SRS? They weren't actually chosen at random. We weren't didn't use a random digit table. We didn't use a random number generator. I know this is sounding [pedantic 00:15:12] when we talk about it, but this is the kind of stuff that you will have to state on the AP test. We're assuming SRS of kisses that are plain chocolate, and what else?

Student : [inaudible 00:15:25] ... Cookies and cream, that's what it's called. [inaudible 00:15:31]

Teacher: Yeah, because sample size would be the number.

Student : I got 13 for both.

Teacher: Really?

Student : Yeah.



Student : You got 30?

Student : 13.

Student : Oh, I got 14.

Student : 13 what?

[00:16:00]

Teacher: Why are you sitting back there, Student? Do your work.

Student : 13 what?

Student : Total.

Student : Are you showing off?

Student : No, I'm saying I got the same for both of them.

Student : Oh, I was like, "What's the significance of that?"

Teacher: Getting the same is a pretty significant thing. We'll find out, I guess.

Student : Yeah, I redid mine because it was outrageous. I had 9 and 22.

Teacher: 9 and 22? How did you get that?

Student : I had 9 with the regular chocolate and 22 with the other ones. I started off with 3-3-4. Then I had 2-2-2-0-2-2-2 again.

Teacher: What's wrong with that?

Student : It seems outrageous.

Teacher: If we're observers of a study, are we able to make comments about that? You erased everything? Why? Why are you erasing?

Student : No reason, I'm just [inaudible 00:16:48] my old data.

Teacher: Okay. You're putting in your own experimenter bias there? Okay. What are we doing? What is this?

Student : Isn't it the sample? It's like 5 of them.

Teacher: Oh okay. I see what you're doing. SRS, yeah.

Student : Oh that's what you meant.

Teacher: We're going to assume it's a SRS. We didn't do a random digit table. Okay, what does  $\hat{p}$  stand for? Now that we're refreshing our memory on a lot of things.

Student :  $\hat{p}$ -hat here...

Teacher: Student, do you need to sit over by Student and Student to focus?

Student : I guess so.

Teacher: Okay, go do it.

Student : [crosstalk 00:17:41]

Teacher: What's  $\hat{p}$ -hat stand for?

Student : [crosstalk 00:17:46] I don't know, because [Cherry 00:17:51] was asking us how to find  $\hat{p}$ -hat.

Teacher: What is brutal about this?

[00:18:00]

Student : I don't know. I have the hardest time trying to figure out.

Teacher: What could  $p$  be? What could it stand for?

Student : Is it not just 13/50?

Teacher: Yeah. It's your proportion. It's not this proportion. Or is it the sample? It's the sample proportion. Yes, you're right. It's your proportion.

Student : All right.

Teacher: Yeah.

Student : When I was trying to find  $\hat{p}$ -hat, I had the hardest time because I didn't think that was it. I thought it was something else entirely different. I was way off.

Student : Is it 13 out of 50? Yes.

Teacher: Yes it is.

Student : I didn't sleep last night.

Teacher: Student?

Student : Yes.

Teacher: What's new?

Student : That is. I normal get not a lot of sleep, but it's good sleep. This time I got a lot of sleep, but it was terrible sleep.

Teacher: Excellent. Okay.

Student : As for the population of interest, the Hershey kisses lands upright or just Hershey kisses in general?

Teacher: Yeah, we're going to say ... Yeah, we can say upright.

Student : Wait, but the whole ...Never mind.

Teacher: Yeah, because we're checking for normality. How's it going?

Student : Cole will get a set.

Student : Okay, I'll take that bet.

Teacher: What bet are we talking about?

Student : Dude, Student is good.

Teacher: Oh we're talking about tennis.

Student : Wait, I have a question.

Teacher: Guys, you're not even going to go to tennis until after this. Okay.

Student : [crosstalk 00:19:43] To find this, what did they do?

Teacher: What do you do to find a confidence interval?

Student : I forget.

Teacher: Do you have your notes?

Student : Not with me. No, I remember how, but what do we do? Take all this ...

[00:20:00]

Teacher: Remember that we're doing our inverse norms? We're doing inverse norms? Uh oh,

Student.

Student : Oh I got it. This is the one where we go ...

Teacher: The z-score.

Student : 100 minus 95, and then you get that and you add it to the ... Yeah. How do you get that? What do I do after that?

Teacher: 100 minus 95? What are you talking about?

Student : This equals 5, then ... Then 5 divided by 2, right?

Teacher: Look, you have all your stuff. Just go to your [com-pen-tu-ro 00:20:31].

Student : Is out p-hat our ...

Teacher: Yes.

Student : Decimal right?

Teacher: Yes.

Student : Oh yeah, right here. Is it z?

Teacher: Yeah, [you-see-a-total 00:20:46] we're going to assume normality.

Student : Statistics, yeah.

Student : When we record the other people in our group, we always record the decimals?

Teacher: Mm-hmm (affirmative). Decimals, yeah, that's our p-hat.

Student : Oh, does this apply to standard deviation?

Teacher: Yeah, how do you find the standard deviation?

Student : Mean ... No, N over ... I forget. It's the one divided by the square root of ...

Teacher: Divided by? No, it's something divided by 50, divided by N. Because it's a proportion, right?

Student : It's the mean over the ...

Teacher: Not the mean, the proportion.

Student : The proportion times 1 minus the proportion.

Teacher: Good.

Student : Okay, it's 12 over 50 times 1 minus ...

Teacher: 12 over 50.

Student : 12 over 50, over 50?

[00:22:00]

Teacher: Yep. Let's see. Is it in our books? Remember this?

Student : Mm-hmm (affirmative).

Teacher: They're going to give you this.

Student : I remember, I ...

Teacher: Don't forget your square roots y'all.

Student : The square root of 50?

Teacher: No, look, I'm showing it to you.

Student : Oh.

Teacher: This is what you found. Standard deviation of statistics. Don't forget that. I want you to be able to remember that though. Maybe I should give everyone their booklets. Know where you're looking. Reference.

Student : [inaudible 00:22:44]

Teacher: Mm-hmm (affirmative), yes.

Student : It's just all the "normalities" and stuff here.

Teacher: Yes.

Student : Okay.

Teacher: Well that's normality. What do we do to determine their independent? What do we say?

Student : That their [random 00:22:58]. That they're a random sample? Oh okay.

Student : Is x-bar the number? It's 12?

Teacher: Wait, can I see this? Yeah, point whatever.

Student : Hmm?

Teacher: It's not the mean. What did you find? What's your average of all your data sets?

Student : We need an average?

Teacher: Isn't that how you found your standard deviation?

Student : No, I just plugged in my data.

Teacher: You were only using yours. You have to use everybody's.

Student : Oh, so I add 12 plus 14 plus 20, and then find the mean?

Student : I might have messed up too.

Teacher: You find the mean, but you have to divide it by the ... Yeah.

Student : Average. Oh, this is where we're doing it all the same?

[00:24:00]

Teacher: Yes. Now that I've helped you with this, you're going to go back and do cookies and cream or the other one all by yourself. Yeah? Don't look at me like that. You're doing it. Uh oh, what's happening guys?

Student : This thing isn't normal. He got 9.

Teacher: Okay, wait, how did you figure out it's not normal? 50 times .8 equals 9. We'll see. We're going to assume normality because it's pretty close. No, sometimes you're just going to have to do that. You're going to say, "We're going to assume normality for the sake of this study."

Student : Okay.

Teacher: Even though we will make a note of it when we look p-values in the end. So close, yet so far away. How come?

Student : Wait a second.

Teacher: Is it because ...

Student : [crosstalk 00:24:55] It's all good.

Teacher: Granted, I'm sure he could combine your p's and got your average when you start ...

Student : Yeah, if I combine the p's, then I got my average [inaudible 00:25:11] ...

Teacher: Yeah.

Student : Is the p-hat that we find ...

Teacher: What?

Student : Yeah, I don't know what happened to that one.

Teacher: Wait, did you start eating it?

Student : No.

Student : I just opened it and it was like that.

Teacher: Don't eat it, Logan. Throw it away.

Student : It looks like somebody ate it.

Teacher: I know. Is that your trash? Okay. What's up?

Student : Is the p-hat that we ... This p-hat? This one?

Teacher: Mm-hmm (affirmative). Yeah.

Student : Is it just asking to write it again?

Teacher: Mm-hmm (affirmative), because then you're going to find their p-hats as well. You take that average and that's what you're going to use to move into your next ...

Student : This is all [crosstalk 00:25:45] right?

Teacher: Yep.

Student : Asking for?

Teacher: Yeah. Then all of these. Are these [fractions 00:25:52] or these the separate numbers?

Student : No, separate.

Student : Yeah, separate numbers.

Teacher: [00:26:00] Okay. Make sure that you know, because you're going to be going through this once with the regular , and then once with the cookies and cream. Keep the data separate.

Student : Is there 2 pages?

Teacher: No, there's no 2 pages. Just keep it separate.

Student : Okay.

Teacher: Okay?

Student : We still have to write this anyways so that it proves that it's not ...

Teacher: Yeah. Yes. Just in case, some people tend to forget where you can look at how you find the statistic. Yeah, when you're using that one, proportion.

Student : [crosstalk 00:26:27]

Teacher: What is that?

Student : Do you see my milk chocolate [visual 00:26:32]? My p-hat?

Teacher: Nice, .3. Okay, it works. Student, are we okay?

Student : Yeah.

Teacher: Okay, getting distracted?

Student : No, she had asked me a question. My brain exploded. [crosstalk 00:26:52]

Teacher: How to find the statistic? Okay, the first thing you're going to do is your going to find your standard deviation. How do you find standard deviation? Which one are you using? Okay. Hey, finish standard deviation. You haven't even got there yet. Mm-hmm (affirmative). You're finding the average of all your groups one and using that. Okay?

Student : Nailed it.

Teacher: Nailed it?

Student : Mm-hmm (affirmative).

Teacher: You have your ... Good. Okay, keep going. Yes.

Student : Don't we have to make a 95 [confidence rule 00:27:37]?

Teacher: Yes, you do. It's giving you all the steps right here, and eventually you'll get there.



Student : Oh.

Teacher: It's so silly. Why would you just put it in the calculator and not remember how to do it?  
We're going to go through it all over and over.

Student : [crosstalk 00:27:51]

Teacher: What?

Student : No.

Student : Yeah, the z ...

Student : Let's find the z-score now.

Teacher: Mm-hmm (affirmative).

Student : That's not what you were doing?

Student : No, this is just the standard deviation.

[00:28:00]

Student : Oh. You're being silly.

Student : How is that silly?

Student : You're being real silly.

Student : How do I find the z-score on this [thing 00:28:06]?

Teacher: Yeah, but you're doing interval right now, so no.

Student : How do you do that? Statistics?

Student : She said no.

Student : Or you cannot?

Teacher: No, I'm saying ... You're trying to find the z-score?

Student : Mm-hmm (affirmative).

Teacher: [Does that 00:28:25] count? There they go.

Student : What's happening? Wait, what am I doing?

Teacher: I don't know what you're doing. What are you doing? You know the critical value. What's the critical value of z if we're at 95%?

Student : 1 point ...

Teacher: Say the rest of it.

Student : Send a video of him smoking weed.

Teacher: Okay, let's turn that off now.

Student : Is that Student?

Teacher: 1 point?

Student : It's 1.2 or 1.3 something... 9.

Teacher: 1.9 what?

Student : 7, 3, 2, 4? 1.96?

Teacher: Mm-hmm (affirmative).

Student : How would you find that in the book though? I forget. Do you do the inverse norm of the ...

Teacher: Yeah because you could do ... Um.

Student : Inverse norm of 0 point ...

Teacher: No, you can do norm CDF. You can do norm CDF lower bound is 95, upper bound is infinity because 95 percentile with ... Right? .95, upper bound infinity, mean is 0, standard deviation 1. Check.

Student : Mean is 0, standard deviation is 1?

[00:30:00]

Teacher: Yeah, check this. Just check it out.

Student : [crosstalk 00:30:01]

Teacher: Why are you doing that? We're going to go .95. My upper bound, I guess, will be ...

Student : 9-E-9-9-9.

Teacher: Are we done? What are you doing?

Student : How do we have an autistic person in this Student?

Teacher: I don't know what you're talking about. Zero one. Nope. I did not do that right.

Student : Why don't you just type in norm CDF?

Teacher: You can do that.

Student : Snapchat shows what happens after [you-get-stats 00:30:38].

Student : Isn't it inverse norm of .975?

Teacher: Mm-hmm (affirmative).

Student : That's how you get that, right?

Teacher: Yeah. You're right.

Student : See I was right. When you have 100 minus 95, then divide the 5 by 2 and then you ...

Teacher: That's what you were talking about? I couldn't figure. I was like, "What are you talking about?" Yeah.

Student : Remember when we were talking about standard deviation, are we going to [inaudible 00:31:08]?

Teacher: Yeah.

Student : No I said I think [inaudible 00:31:14] ...

Teacher: Guys, every group I'm going to I'm hearing this word.

Student : It's all them.

Teacher: I do see you, Student.

Student : [crosstalk 00:31:33]

Teacher: I am, yeah. Are you having any questions?

Student : That was the only question.

Teacher: About Student's ability level?

Student : [inaudible 00:31:52] ... If we're supposed to use the average of all our p-hats?

[00:32:00]

Teacher: Yes, use the average. Yes. Good. You remember that number. Did you copy that number or did you remember that number?

Student : I remembered it, but I opened the book to double check.

Student : Then the other one was like 2.3 something, I can't remember.

Teacher: 99.

Student : Oh.

Teacher: Okay. Amber, do you have any questions going forward right now? No?

Student : [inaudible 00:32:31]

Teacher: Not yet. Student, are you okay?

Student : No.

Teacher: Okay.

Student : I understand how you got these [inaudible 00:32:46] I have no idea.

Teacher: Okay. The confidence interval is p-hat. What is p-hat?

Student : Oh, that the mean ...

Teacher: Your proportion, right? Did you find your proportion?

Student : Yes.

Teacher: What's your proportion here? Which one are we?

Student : Oh shit, I need to write down.

Teacher: We're going to find that first. Go find the p-hat.

Student : That's these right?

Teacher: Yeah, we're going to use it for all of them. You're going to take the average of 13, 10, 18, and 15. That's going to be your group p-hat. You guys should all be getting the same answer. Make sure you check, but working alone and figuring out on your own is really helpful. Mm-hmm (affirmative). What do you divide it by?

Student : 50, right?

Teacher: No, you're going to get the average first.

Student : Okay.

Teacher: Okay? Now what? No, now find your  $\hat{p}$ . Now what are you dividing by?

Student : [inaudible 00:33:47]

[00:34:00]

Teacher: Mm-hmm (affirmative). Okay, now you have that. Right? Okay, here we go. The  $\hat{p}$ , do we know what that is?

Student : Yeah.

Teacher: What is it?

Student : I wrote 9.

Teacher: Okay. Do plus or minus? Do we know the z-score?

Student : Yeah, right here.

Teacher: Okay, what is this? What is this sigma  $\hat{p}$ ?

Student : Standard deviation.

Teacher: Mm-hmm (affirmative). Do you know all those numbers?

Student : No, we don't have this one.

Teacher: You don't know that one? You didn't find it here?

Student : Oh, I did, never mind.

Teacher: Okay, so you can do it. Yes?

Student : Yep.

Teacher: Okay. What's up Student?

Student : Tired.

Teacher: You're tired.

Student : How do you draw [inaudible 00:34:35]?

Teacher: What is your p-hat?

Student : The average?

Teacher: Mm-hmm (affirmative), [inaudible 00:34:41] z. Let's finish your work first. Turn off the game. I know you're addicted. I got it.

Student : I just started today.

Teacher: No, you did not. Put your p-hat point.

Student : What is it? 15.3.

Teacher: What?

Student : It's .32, right? As a decimal it'd be .3 [crosstalk 00:35:04].

Teacher: Yeah, okay.

Student : You're right.

Student : What? How's that a decimal?

Student : Because you'd make it out of 100. You just double it and put a decimal in front of it, right? Is that not how you can get the decimal?

Student : You need a decimal for p-hat?

Teacher: Yeah, it's a decimal.

Student : 15.3 out of 50 would be .32, because the 15.3 is out of 50. She didn't put it as a decimal.

Student : Oh, I didn't put it as a decimal.

Teacher: That's true. You have to put is a decimal.

Student : Okay, let's do this again.

Teacher: What are you doing?

Student : The confidence interval.

Teacher: Oh you did 15.

Student : Yeah.

Teacher: Oh yeah, that standard deviation will be way wrong.

Student : Okay, because I was thinking, I was like, "How the heck do you graph this?"

Teacher: Mm-hmm (affirmative), because remember we're doing proportions. Yeah?

[00:36:00]

Student : I thought we were pretty close actually. 15.3 [inaudible 00:36:01] extended.

Teacher: No, we can't be looking at that number.

Student : Can we just double it and put a decimal in front?

Teacher: No, we can't do that. No you can't.

Student : Okay. [crosstalk 00:36:18]

Teacher: Tell me why.

Student : [crosstalk 00:36:23] It will be 3.06.

Teacher: Okay.

Student : Oh, this makes a lot more sense.

Teacher: Now you're on it. Now you can do your confidence. Okay, you're making your confidence interval. One for the regular Hershey kisses and one for the cookies and cream. We can see how that matches up. Okay?

Student : We just used .29 and .37.

Student : When are we having the astronomy people coming back?

Teacher: Astronomy people might be coming next week, Thursday, because I'm cancelling JTCU. They're definitely coming on the 15th.

Student : How come you're cancelling JTCU?

Teacher: Because we don't have enough time. You want to go to JTCU?

Student : No.

Teacher: If you want to go, we'll go.

Student : Don't we just sit there and listen to them talk.

Teacher: It's a career panel this year.

Student : It's boring.

[00:38:00]

Teacher: Can we finish this?

Student : Are we going to have 2 upper and lower bounds?

Teacher: Yes. What I want to do is, I want to do the third page as a group discussion. Just finish up second page right now.

Student : [inaudible 00:38:19] small one now.

Teacher: I want to do third page as a group discussion.

Student : [crosstalk 00:38:23]

Teacher: Okay?

Student : [crosstalk 00:38:27] ... Dart sticker thing?

Teacher: How did, what?

Student : The dock sticker? Your dot sticker?

Student : Is this right?

Teacher: Yeah, did you draw your line?

Student : Oh we have to draw one.

Student : Oh okay. It's like a range kind of thing.

Teacher: Yeah, what's your lower bound and upper bound? That's your 95%.

Student : Oh, okay.

Teacher: Yep.

Student : [crosstalk 00:38:43]

Teacher: Kind of.



Student : Where does the dot go?

Teacher: The dot goes at your  $\hat{p}$ .

Student : [crosstalk 00:38:50]

Teacher: You guys should all have the same  $\hat{p}$ . No?

Student : No.

Teacher: Okay. If you're using your individual  $\hat{p}$ 's, then you'll plot everyone else's. Right now I was hoping to just see the difference between the regular kisses and then the cookies and cream. Student, how are you doing? Is that how small it is, your confidence intervals?

Student : Yeah.

Student : I'm going to be famous.

Teacher: Or infamous.

Student : Either way that's famous [crosstalk 00:39:42].

Teacher: At the data? The data does lie in between the two.

Student : That?

Teacher: Be specific.

Student : The  $\hat{p}$ , the mean?

Teacher: The true...

Student : They're going to need to edit a lot.

Student : That the true data?

[00:40:00]

Teacher: The true proportion.

Student : [crosstalk 00:40:08]

Teacher: Okay. Once you're done with that, you can read through page 3, but I want to talk about it as a group. Okay?

Student : My range seems so much bigger than the other one.

Teacher: There's is much smaller, so you know variability happens.

Student : This is the same? Is 9,right? [crosstalk 00:40:41] Yes.

Teacher: Mm-hmm (affirmative).

Student : On this one, instead of doing it as a group, do you want us to do ...

Teacher: Yeah, why don't we compare cookies and cream and the regular. Can we compare them? Would you think that 95% of the time they'd be the same? Are they the same?

Student : Are we doing this between the two different ones or just one as a group? Like just the first chocolate as a group?

Teacher: Yeah.

Student : 0.16. How can I get ...

Student : Yeah, I don't know. That's what I was saying.

Teacher: Whoa, you're a negative. What happened?

Student : I don't know. 0.29 minus that.

Student : It's the same thing for the second one.

Teacher: Okay.

Student : For the cookies and cream.

Student : Then how about this? 0.16? Oh I did 0.64. Okay.

[00:42:00]

Teacher: Oh I see. Do you feel that the cookies and cream and the regular kisses are the same?

Student : Yes.

Teacher: Looking at your data and your picture, do you feel it's the same?

Student : No.

Teacher: That's what I want you to write below here.

Student : Yes, because we did it 2 times.

Teacher: That has nothing to do with it. Okay. What? Why?

Student : These are harder than these ones.

Teacher: Really?

Student : To me, I think. Try to squish them. Compare it to the other one. That one is easier to squish than [inaudible 00:43:51].

Student : I also think because the [inaudible 00:43:57] to the bottom of this.

[00:44:00]

Teacher: The cookies hold it together more and it gives it more structural integrity?

Student : No, I mean maybe the cookies are heavier.

Student : All the cookies are on the bottom.

Teacher: Oh, because it sinks.

Student : Yeah, it's a little weight on the bottom.

Teacher: That's an interesting hypothesis. Okay. What?

Student : Nothing.

Teacher: We okay? Almost there guys? Okay. Read over third page. Think of some thoughts that you would like to share out on ABC and D.

Student : I think we're ahead of you on the third page.

Teacher: You're way ahead of me? Student, I'll bring you Skittles next time. I know, okay, I'm sorry, but it's hard to figure out whether a Skittle is going to fall on it's head or on it's flat S.

Student : [crosstalk 00:44:56]

Teacher: Like the ink of the S would make it heavier so it goes down?

Student : I mean like original though.

Teacher: You're so picky. Oh my goodness. Are you good? On the second one I just want you to compare whether you think that the proportion of the chocolate versus the cookies and cream would fall in the same confidence interval ... For the proportion for each would be represented by the confidence interval for the other. You guys actually have it

overlapping. Okay.

Student : We're just reading this right?

[00:46:00]

Teacher: Yeah, and then we're going to talk about it. Okay, 2 minutes. 2 minutes more.

Student : Oh I think that would be perfect for Skittles. [crosstalk 00:46:26]

Teacher: Mm-hmm (affirmative). Well you could've just eaten a kiss.

Student : I don't want a kiss.

Student : Just one.

Student : No.

Teacher: Just one, Student.

Student : No.

Student : He says not even once.

Teacher: Not even once?

Student : Not even once.

Student : It's not meth.

Teacher: For Student it might be. That's why he wants to keep his svelte figure.

Student : Didn't you see him on the cookies?

Student : Yeah, Student's cookies. He was yelling at Student to run faster.

Student : Yeah.

Teacher: Too much sugar for you, Student?

Student : Probably.

Teacher: Okay.

Student : You're getting [fiber 00:47:00] now.

Student : You were just laughing [crosstalk 00:47:04].

Student : Yeah, I wasn't even hyper.

Teacher: Yeah, you were. Okay, ready? Student, are you guys ready? Okay. You've looked at A, B, C, and D? Do you think A, there is a 95% probability that the true proportion will fall into your interval? Is that true? Would you circle that if you saw that on a AP test?

Student : Yeah.

Teacher: Yeah, why?

Student : We proved it.

Teacher: Is that what you proved? Is the wording correct?

Student : [crosstalk 00:47:38]

Teacher: Why is the wording not correct?

Student : [inaudible 00:47:43] ...95% confidence, the true proportion falls into ...

Teacher: Okay, you're saying that ... Would you circle it or not?

Student : No.

[00:48:00]

Teacher: If you saw it? Being 95% confident, is that the same thing as 95% probability?

Student : No.

Teacher: Okay. We'll leave that there for now. Let's just leave that sitting. B, there is a 95% probability that your interval will include the true proportion. Does that feel better to you as a statement?

Student : Yeah.

Teacher: Tell me why.

Student : Because it ...

Student : Wait, no no no.

Teacher: That doesn't feel better to you? Why?

Student : It's the same ... I don't know.

Teacher: It's the same thing.

Student : [crosstalk 00:48:28]

Teacher: Different words, yeah. Is there a difference between A and B?

Student : The organization of the sentence. [crosstalk 00:48:41]

Teacher: Is it the same thing? Are they saying the exact same thing? Is it wrong?

Student : [crosstalk 00:48:48]

Teacher: Okay. What about C? Before we take the sample, there is a 95% probability that the confidence interval we will create will include the true proportion.

Student : It's all the same.

Teacher: Can we state something about before?

Student : No, because we don't know the ...

Student : We don't know what they've been through.

Teacher: We don't know what they've been through.

Student : They could be like that when we opened [inaudible 00:49:16] or something.

Teacher: We can't make any predictions before we do something. C is obviously out, versus A and B which are kind of still in?

Student : False.

Teacher: Okay. After we take the sample, there is a 95% probability that the confidence interval we created does include the true proportion?

Student : [crosstalk 00:49:36] Yeah.

Teacher: Yes? D, you feel the best about? A and B were iffy. If we saw that on a test, but there was no better answer, would we choose it?

Student : Yes.

Teacher: Okay.

Student : [inaudible 00:49:51]

Teacher: [00:50:00] No. That was just a conversation. In AP Student, haven't we been noticing that the A and B are very similar to each other, there's one word off? We don't know what to do sometimes? What?

Student : [crosstalk 00:50:05] Kind of like a trick question.

Teacher: It's kind of like a trick question, yeah. However, if you were to state that kind of stuff on the AP test showing that you're at least thinking about true proportion, they're going to give it to you. They're going to say that, "Okay, they're getting it. This wording may not be perfect, but they're understanding it."

Student : Wait, what if it's a multiple choice? What is the best answer?

Teacher: I would like D. Yeah. Now that you've read the second part of the paper, that is your homework tonight.

Student : We've got homework?

Teacher: Yes. You are going to create a study in which someone else in the Student will enact.

Student : [inaudible 00:50:51] [crosstalk 00:50:55]

Teacher: Mm-hmm (affirmative), you're going to take it home tonight. You're going to figure out a study in which it will be set up just like this, and we're going to trade papers, and then someone else is going to have to do it over the weekend.

Student : Someone's actually going to have to do this ...

Teacher: Don't be like, "Okay, let's look at 400 dogs," because, obviously, that would be impossible for someone.

Student : How about rocks?

Teacher: Rocks we can look at. [crosstalk 00:51:18] As long as you can think of something that is measurable. It always has to be measurable. Whether it's proportion or mean, it has to be measurable and doable in a financially sound and timely sound way. Because Logan's going to create something that's like ten hundred steps and then you're going to give it to Student, and Student's going to be pissed off. Right? Yes. I'm out right now.

Student : He's just going to come to house and be like, "What the heck is this?"

Teacher: Exactly, so don't do that. Be nice. Think about someone that you might want to give this to, but make it meaningful. Once you start writing these questions, you're going to feel more comfortable answering them. You like that Student? Okay. That's your homework tonight because we're being mindful of when Amber and Logan have to leave. Then the tennis people have to leave soon.

[00:52:00]

Student : You guys have to leave?

Student : To help Student with the rally stuff.

Student : I'm on the tennis team. [crosstalk 00:52:16]

Teacher: There's a rally? Oh a smoking one. Yeah, Student can't go to that.

Student : I can just [inaudible 00:52:25]?

Teacher: Yes, you can.

Student : I will. [crosstalk 00:52:28]

Teacher: If you would like to offer who you want to give this to, go ahead.

Student : I'll give it to Student.

Teacher: Okay. Take this home so you can write on the paper.

Student : What am I going to do? I don't know what I'm going to do.

Student : I can give you something to do.

Teacher: Why don't you do running? Something that interests you.

Student : [crosstalk 00:52:43]

Teacher: Yeah you should. You should make Student run.

Student : What's the probability he'll run in 4 seconds?

Student : 4 seconds?

Student : I don't know.

Teacher: Make him do like 50 100-meter dashes.

Student : [crosstalk 00:52:57] We could do a mile.

Teacher: You have to do it as a repetition too, right? It has to be repetition. I'm going to grade on the ability to do an observational study.

Student : How do I do this?



Teacher: Mm-hmm (affirmative). That's what you're going to be thinking about tonight. We can talk about it later during Student, while everyone else leaves and does what they need to do.

Student : [crosstalk 00:53:20][inaudible 00:53:20]

Teacher: Okay. You can do something with Skittle too. It doesn't have to be the same thing. Yeah, because you're just going to get someone else. You don't have to exchange.

Student : Good bye.

Student : I'll think about it.

Teacher: We're just going to rotate around. Okay? Are we good? We understand what the task is? Due Friday. Yes? Due Friday, I see you on Friday.

Student : Yes.

Teacher: Okay, Student? Do you understand what your task is? What is your task?

Student : Isn't odd you [crosstalk 00:53:48] ?

Teacher: No, it's even. Last week was odd.

Student : We didn't have odds Tuesday...

[00:54:00]

Teacher: So? Apparently no one cares. [crosstalk 00:53:57] We like to see even. Student, what's the task tonight?

Student : Do it at home?

Teacher: Do what at home?

Student : Create another experiment.

Teacher: Okay, thank you Student. Student, you heard that?

Student : Yeah, I'm going to make Student not smoke for a year.

Teacher: Okay, thank you. I appreciate it. Okay, good job guys. Trash in the trashcan. If you didn't drink out of your cup, I'll reuse it.

Student : Sorry.

Student : That was only him.

Teacher: If there's trash and weird stuff, like your saliva in there, I don't wan it back.