

Eric Gaze: hi everybody, my name is Eric is I direct the quantitative reasoning program at bowden college small liberal arts school. Eric Gaze: located in maine and today i'll be talking to you about how to use excel in your class or really any spreadsheet in your class to more effectively engage your students with. Eric Gaze: Real world data and teach them what I consider to be authentic Problem Solving so i'm going to first motivate with a PowerPoint presentation. Eric Gaze: Why quantitative reasoning is important and how spreadsheets help our students become better critical thinkers. Eric Gaze: and develop their algebraic reasoning skills and from there i'll actually switch to examples of excel that I use in my class and show you how you can build some for your class as well, so I will go ahead and share my screen at this point. Eric Gaze: and Eric Gaze: We can begin our presentation so again, I firmly believe that spreadsheets are a great way to engage your students in a mathematics classroom so first of all we'll talk a little bit about why quantitative reasoning is so important, how we can. Eric Gaze: embed spreadsheet into such a class and give you some example so consider this statistic 87% of US adults cannot read or write. Eric Gaze: With numbers they're quantitatively illiterate, but the fact that we finished that sentence with numbers. Eric Gaze: should not in any way diminish the impact of it to be quantitatively illiterate and today's data driven society is absolutely as debilitating as being illiterate was 50 or 100 years ago. Eric Gaze: And where does all that data live, when we talk about a data driven society today to live in a spreadsheet so as educators, I think it's incumbent upon us to teach our students, how to use this most basic, fundamental tool for dealing with data. Eric Gaze: And that statistic comes from the national assessment of adult literacy and effectively when we talk about quantitative literacy we're talking about proportions. Eric Gaze: In other words, the bar is not raised very high in terms of what we're asking our students to be able to do in terms of quantitative reasoning. Eric Gaze: Only 13% of US adults can actually calculate annual or monthly cost or determine flooring units per square foot. Eric Gaze: And so, one of the things that we want to think about what are we using spreadsheets is how do we develop our students proportional reasoning skills, alongside using spreadsheets or excel in our classroom. Eric Gaze: back here. Eric Gaze: Even the experts struggle, a little bit with quantitative reasoning, these two graphs look very similar The first one is one on the left is coming from the Economist. Eric Gaze: And it's ostensibly showing rushing Defense spending climate \$70 billion over this period while European data Defense spending has dropped to 265 like what in the world is going on here. Eric Gaze: sort of exactly the same thing is happening with this graphic from McKinsey company talking about energy consumption in the share of electricity. Eric Gaze: that's making up energy consumption, we can see down here that electricity is only making up 2019 23% and yet the blue line REP representing electricity is, at the end, more than double all the other fuels so exactly the same if you want to say trick is being used to create these crafts. Eric Gaze: But our students aren't equipped to actually read these crafts, and so I think if we want our students to be able to effectively communicate with numbers. Eric Gaze: To be able to take the data that was achieved and tell people a story from it. Eric Gaze: We need to teach them how to build a graph like this, in addition to showing them examples of craft of my students read articles in class where we encounter grass and then we use spreadsheets and I asked them to make line charts and bar charts like this, these are incredibly sophisticated. Eric Gaze: visuals of quantitative information, and I think all too many faculty think well, of course, our students can read, of course, they understand percentages, we can all of the proportional reasoning. Eric Gaze: That really is what's behind creating this crap so we'll come back to these in a little bit and talk about how they're made and i'll show you an example on making ourselves. Eric Gaze: That national assessment of adult literacy was conducted that last in 2003 the more recent assessment. Eric Gaze: Of numeracy or quantitative reasoning was conducted in 2013 and US millennials came and said laughed out of all these. Eric Gaze: countries from the OECD organization for economic cooperation element once again they're asking proportional reasoning questions. Eric Gaze: have more interest for us, they also measured Problem Solving and technology rich environments many math faculty will say that oh traditional math courses develop good problem solving skills. Eric Gaze: Especially using technology,

because our students, you know use graphing calculators or whatever. Eric Gaze: We be Poland this time I don't think it's anything to brag about but, more importantly, the question they were asking when they talked about Problem Solving using technology. Eric Gaze: were questions involving modeling with spreadsheets so this idea of modeling the world. Eric Gaze: Really, if you think about it, I mean that's what calculus was developed to do that's what Newton was trying to do. Eric Gaze: When you develop calculus was come up with some mathematics allowed him to model, the world around us and that's what spreadsheets allow us to do, and so we need again to just provide sort of a basic entry. Eric Gaze: into using spreadsheets so that students can do more sophisticated modeling so let's take an example. Eric Gaze: of using spreadsheets working with data data is just a bunch of numbers, so let me here we have mortality rates per 100,000 people from 19 6800 years ago in town in the road. Eric Gaze: By demographic group, starting with the over 85 cohort who of course highest mortality rates, all the way down to the below 25 units cohort much smaller mortality rates. Eric Gaze: We want our students to be able to take data take a bunch of numbers that look like this and tell a story with health course one of the dangers. Eric Gaze: That sells it's very easy to create a graphic highlight everything and you get this line chart well nothing really interesting. Eric Gaze: has been done here we can see that the over 85 cohort has a much higher mortality rate went down from 1968 on but we can't see anybody else down here right they're all washed out at the bottom So what can we do to our data so that we can more effectively tell a story. Eric Gaze: Well we're going to use this same trick as the economist and the McKinsey consulting group we're going to scale all of the values and the 1968 grow. Eric Gaze: To 100 and then proportionally scale the columns using that 100 as a starting point so every number for 1960 days in start at 100. Eric Gaze: create an equal starting point and then we'll be able to see all of them move together when we do this now what we're tracking is change over time, rather than the absolute numbers Okay, in order to do this. Eric Gaze: In order to transform our raw data into this transformed proportionally scaled data is very sophisticated. Eric Gaze: Three able to take the two numbers these first two numbers 19,018 thousand and say this is to this as 100 is back that's an arithmetic problem. Eric Gaze: Right and their students love setting up a portion and cross multiplying, but to be able to enter a formula and XL that we can. Eric Gaze: fill down and then across all of these numbers get transformed together that's an algebra problem Okay, and so here's the formula that we would enter. Eric Gaze: Before divided by three so in this case we're referring to the data set that's living and columns a PC etc. Eric Gaze: we're taking before, which is the value in 1969 dividing it by the value above it cross multiplying by the 100 memory of X over 100 so you get a sense of that arithmetic the setting up a proportion in this formula, but the cell references that we use the before and the be three. Eric Gaze: are essentially variables from algebra so when you're using spreadsheets you're teaching your students algebraic reasoning in addition. Eric Gaze: To teaching them how to work with data with \$1 sign is doing is locking the value in the 1968 row. Eric Gaze: That first value because we're always going to be comparing to that 100 in the first row we're setting up our proportion to the dollar sign locks us in row three at twice before the number three Okay, so what happens to our graphic is this turns into. Eric Gaze: A much more interesting story being told here exactly the same thing that. Eric Gaze: economist and McKinsey consulting group are doing with their graphs starting from the same point tracking change over time, we can see everybody's mortality rates have been going down since 1968. Eric Gaze: And we get this interesting blip for the 25 to 44 year old demographic what happened in this country in the late 1980s early 1990s that caused the mortality the 25 to 44. Eric Gaze: year old age group to spike. Eric Gaze: that's the AIDS epidemic, and this is a picture of the AIDS epidemic and the effect it had in this country okay. Eric Gaze: there's a nice book called the intelligence trap and David robson and he asked the question are smart people good at reasoning correctly and I have certain quotation marks here because. Eric Gaze: there actually are three different forms of intelligence, but we're used to this analytic intelligence with the sort of the IQ quotient what we typically. Eric Gaze: developer teach in schools, the SAP test is really about your analytic intelligence for mathematicians this would sort of be teaching our students, how to run the typical path. Eric Gaze: Well, the practical intelligence is

equally as important, knowing knowing when to actually. Eric Gaze: run that test and why you would want to do it is just as important, maybe more important than simply that rope procedural skill of knowing how to do something. Eric Gaze: Also, practical intelligence allows our students to communicate the results and again this goes back to their ability to create those graphics. Eric Gaze: Using spreadsheets so that they can effectively communicate that quantitative reasoning quantitative literacy. Eric Gaze: component it's so important when we're working with data and the third form of intelligence is creative intelligence, the ability to question assumptions. Eric Gaze: The ability to run a What if analysis, what if interest rates change what if the price of fuel comes up well when we model with spreadsheet that's exactly why businesses use spreadsheets right, so they can conduct this What if analysis. Eric Gaze: Last two forms of intelligence really are heavily emphasized in quantitative reasoning courses and I would argue that when you use spreadsheets in your own class you also will be developing those. Eric Gaze: forms of intelligence, essentially, we want to empower our students, give them the tools to think for themselves to ask intelligent questions and experts, so that they can confront authority content. Eric Gaze: So how do we do this, how do we teach you know, create a curriculum teacher student I think well in the course that i've developed for me it's really about infusing ratios and spreadsheets into the entire course okay. Eric Gaze: When I create spreadsheets for my class they look like this i'm creating a template for my students, so that they can. Eric Gaze: know where to type in values and the instructions are in these text boxes, so I would strongly encourage you to do this as well if you're starting off using. Eric Gaze: spreadsheets in your class can have a powerful effect on your students with student of mine actually enjoyed doing that and she wanted to continue to take more first time that makes sense to her, you know what's needed for our students is not that sort of formulaic procedural approach. Eric Gaze: But a greater understanding of where numbers come from and what to actually convey right, I mean we want our students to work with real world data and understand what those numbers mean. Eric Gaze: And then you have this nice quote about a perfectly correct description Microsoft excel is that it is a computer implementation. Eric Gaze: So when we teach our students, how to use spreadsheets we are actually developing. Eric Gaze: Their algebraic reasoning skills and the reality is that in the workplace people use spreadsheets they don't use graphing calculators changes the problems that people in the business world. Eric Gaze: can actually confront here's a quote from a student who has had an internship with IBM is like we constantly is finished and qr so thank you for doing, thank you for using spreadsheets in your class okay let's take a look at some of these examples that I promised you would see. Eric Gaze: So here we have just some data on on birth, the actual data table comes from the government, and I have this. Eric Gaze: blog thinking quantitatively at wordpress COM, if you want to see a lot of different examples. Eric Gaze: Of graphics and numerical tables from articles, and I use in my class, including quiz question. Eric Gaze: um but anyways you have some numbers Now this is i'm showing you this because this is a great way for you to use spreadsheets in your class. Eric Gaze: Just find an interesting article with data and then, if you can and usually you can download the data itself we're just in this case type it in and create a spreadsheet prompt, for your students. Eric Gaze: Like I have here so they've broken up the mother's age into the different cohorts 10 to 14 years old 15 to 19 years old we've got the total number of births appear and the number of birth, for each cohort. Eric Gaze: And so, one interesting question, we can ask more looking at the data table they give us the birth rate. Eric Gaze: Right, so how many births her so many women again that that how many birds are so many women, this is that proportional reasoning you're just talking about, so this is how you can develop proportional reasoning, at the same time you're actually developing. Eric Gaze: spreadsheet capabilities for your students, so what the first question, we could ask is okay using this birth rate, which again, this is what the data table is giving us giving us the raw number of birth and then the rate. Eric Gaze: We need to understand is the rate per 100 women per 100 people per 1000 women to students have to carefully read the data table, and we can see right here that it's rates per 1000 women, and you can ask them to work backwards now. Eric Gaze: From the number of birth in the rate and actually compute the total population, the number. Eric Gaze: of women in that subgroup so I know that this 2503 is equal to 0.2 birth per

1000 women aged 10 to 14 and so, if we want to actually compute the number. Eric Gaze: of women, this would be 2503 over the total number of women is equal to 0.2 over 1000 and again you're getting this sort of cross multiplication. Eric Gaze: In the solution, I will double click on the formula, and you can see that if if you write this down on paper, and I strongly encourage you to write a ton of paper. Eric Gaze: You get this formula equals before which is this value, right here times 1000 that was underneath nominated divided by F for the rate over here right. Eric Gaze: So, this would solve for the total number of women in that group, so this is a formula that we would enter i'll go back to the previous page and show you how to enter belts formula so going back to the first page. Eric Gaze: You go into this cell when you enter a formula and an excel you always struck equals, and so this would be equal. Eric Gaze: Before the actual number of birth and remember what we had to do is multiply by 1000 multiplication of this dark and then we're going to divide by. Eric Gaze: The rate to 0.2 over here. Eric Gaze: So notice I don't have to type in f4 I actually just clicked on the cell F four. Eric Gaze: And really once you know how to do this, you pretty dangerous with xml Okay, you can enter a formula. Eric Gaze: And compute the number of women in this age group, I would want to enter the same thing again, this would be be five. Eric Gaze: Times 1000 divided by five well the beauty of using excel is we don't have to do that repeated typing in the formula over and over I click on the salad in the lower right hand corner, this will handle I click on that fillion don't in fact down. Eric Gaze: And I get that sort of. Eric Gaze: same formula repeated over and over and went from before to be five all the way down to be 11 and 11 and what's happening here is my formula is doing this sort of. Eric Gaze: doing the same thing in terms of spatial references right i'm always taking the cell to the left, which is in blue, so this one to the left times and thousand divided by. Eric Gaze: This one to the right in the column that OK so i'm maintaining that spatial relationship, when I fell down and I get all of. Eric Gaze: Those now, if you want to make a chart for this the way that you can actually make a chart let's say we highlight the ages and the number of birth, for each of those so in order to make a chart you need to highlight the information you're interested in, and then you go to insert. Eric Gaze: And you have all of these charts over here let's just make a simple column chart Okay, so you can see. Eric Gaze: i'll make this a little smaller, to make sure that everybody can see it, so you can see, you get your basic called Daddy to to make a chart like this, we could have chosen the pie chart or something else. Eric Gaze: And again at this point, your students are okay that's really all they need to know how to do in order to use excel effectively, you can add titles and. Eric Gaze: Do all sorts of aesthetic things i'm going to go ahead and delete that chart and let's say we want to know the percentage of birth. Eric Gaze: For each of these cohorts out of the total number, because it just one more example of entering a formula and filling this one, though, when we enter the formula, I want to know this 25 of three what percentage is that. Eric Gaze: The total number 3.9 million, so the formula that was before divided by three I hit enter notice it's zero so one thing that you need to teach your students is how to format your. Eric Gaze: Numbers correctly, right now, you can see, this this numbers for this cell is formatted to display the results, as a number if I click on this drop down arrow I get all these different choices in terms of how you want to format number. Eric Gaze: I want to format it as a percentage there's a shortcut I could should could have just clicked on the percent symbol, so now, I can see that this. Eric Gaze: numbers for 10 to 14 year old zillion 0.06% of the total numbers, but if I feel down, I immediately can an error and again, this is a great problem solving I like what just happened. Eric Gaze: This algebraic reasoning that take place with a student at think Oh, I want to divide the 220 9000 888. Eric Gaze: Not by the cell before it, but by the 3.9 million if I Double Click on my formula both cell references fell down, but I did not want to be three to turn into before so going back into this original formula we need to lock. Eric Gaze: To be three so I always want to refer to be three so I put \$1 sign before the three if you want, you can also put \$1 sign up to be, because I can feel right, left also it's possible and then. Eric Gaze: Letters would change ABC etc, the column headers so I lock the be three hit enter and now I feel my formula down just go and sell and you can see, when I Double Click on it i'm now always dividing by the 3.9 million, because that be three so has been locked. Eric Gaze: I can then Double Click on

the phil handle and while I tell. Eric Gaze: Like that OK so again that's it that's all you really need to know about using excel how to enter a formula, how to fill it and how to use the dollar sites to make absolute cell references versus the relative ones that will move again, I would encourage you. Eric Gaze: Just find some data sets here the top 15 causes of death and then create these sort of templates where students know where they have to type their answers in. Eric Gaze: My instructions are always over here, I do a lot of financial literacy so here we're looking at creating a you know, a spreadsheet tracking the balance for buying a TV. Eric Gaze: here's real world government data in terms of their seats and outlays and current dollars. Eric Gaze: Constant fiscal year dollars \$2,005 and this percentage of GDP, your students are overwhelmed I guarantee it will be overwhelmed and they see a spreadsheet like this there's so many numbers. Eric Gaze: How can, how can we possibly expect them to be able to work with these numbers when no one has ever used them in a class right, I mean they can't know what they haven't been taught. Eric Gaze: And so you don't have to dig too deep to find data sets that all around us pick anything of interest to you, and you can quickly create a spreadsheet like this we're asking students to do some interesting things and. Eric Gaze: Just show you this one, the body mass index here on computing the body mass index, you know this is calc three right functions of two variables function of height and weight and you can create some really interesting graphics based on this to a table okay so i'm more than happy to. Eric Gaze: answer any emails that you want to contact me good luck using spreadsheets I hope you have fun and. Eric Gaze: You go up here my email address you gaze@bowden.edu so again, you gaze upon who you have any questions, and I hope you do have fun engaging your students with excel in their class, so thank you for listening, I will stop sharing right now and and the video.