[MUSIC PLAYING]

KAREN FOLEY: Hello, and welcome to the Student Hub Live. My name's Karen Foley and I'm a lecturer here at the Open University and I'm also a tutor. And we have developed a really fun session today, which is all about maths for non-math students.

Now, you should see some interactive widgets popping up on your screen very soon and we'd like to know a little bit about you. So we'd like to know where you are so there's a map. And if you're watching the Watch and Engage option, you'll be able to select that so you can tell us where in the country you are. You can also tell us how you're feeling right now, what level you're studying, which subjects you're studying, and whether or not you've been to a Student Hub Live event before.

Now, if you can't see those widgets, you're probably in the Watch Only option, which is good, as well, but you won't be able to enjoy the Chat, ask questions, and talk to other students. So if that's you, you can go back to the website, which is studenthublive.kmi.open.ac.uk and select the Watch and Engage.

And then just sign in using your student or your staff ID so your name and your password that you normally sign into your OU account with, and then you should be able to access the Chat and the widgets and see what's going on in that way. If you're not an OU student, that's absolutely fine. Everyone is welcome to these events and you can just get a free Open University computer username. So there's a Frequently Asked Questions section on the website where you can find out more about how to do that.

We've also just shown you a little video before the session, if you were an early bird, about how to use the interface. And from that, we showed you how you could adjust the size of the screen and the widgets with the different view options.

And also, we talked about the pen. Now, the Chat can move quite quickly so if you'd like to slow that down, just press the Pen icon, which is at the top of the Chat, and then you can pause it and have a scroll through to see what sorts of things people are saying.

I'll know very soon where you are and what you're doing and whether you're new to the Student Hub Live. But before we start looking at that, I'd like to introduce Evaghn and HJ.

Welcome to the studio, you two.

HJ: Ah, thank you.

EVAGHN: Thank you.

KAREN FOLEY: Evaghn and HJ are going to be on our Hot Desk. They're going to be feeding all your comments in and doing a range of stuff throughout the session. Now, Evaghn, you haven't been with us before and you're studying business, aren't you?

EVAGHN: Yes, I'm doing the postgrad with OU.

KAREN FOLEY: Brilliant. Excellent. Well, welcome to the Student Hub Live.

EVAGHN: Thank you.

KAREN FOLEY: And HJ, you've been a regular here, as well, for some time. What sorts of things are people talking about?

HJ: I think we're just saying, oh, hi to each other. I think a lot of people, like me, haven't done maths in a while so I may need some help. I think this is why, though, we don't have Sophie on so she can't help me today.

KAREN FOLEY: Yes.

HJ: Because she's a math student, isn't she? So yes but we're very excited. And if there are any questions or comments that anyone has, we're here just to chat to you and put them to the studio and we'll try and get some problems solved today, I think,

KAREN FOLEY: Excellent. No, indeed we will. We've got a lot of problems to solve. And so those widgets really are going to be quite useful. As we go through and solve some of them, we'll be asking you what you think about things.

But like I said before, this is about students who may be using maths but who aren't actually studying maths. Hence, Sophie is banned. She's off counting something somewhere, I think. But what we're going to do is we're going to be taking a look at some of the content that's available on Open Online and this is called Maths Help.

Now, there are a range of modules within Maths Help and what we thought we'd do is cover the first six of them, which are very useful to students who are not studying maths. Now, often

when you're studying, you can think about seeing figures or charts or tables or things that are mathematically related. And these can be a really valuable source of information that you can write about in your assignments.

But if you don't know how to interpret those tables or data or how to maybe put them in perspective, it can be a bit tricky to get the most out of them and that's one of the key things that we're hoping to do today. But what we're going to do is start very basically by taking a look at numbers and units and basic aspects of arithmetic.

I'm thinking about some real-life examples because of course, we do maths every day. And sometimes, it can really raise our confidence levels just to think about how much maths we are doing and that we are actually quite skilled in it. So Susanne Schwenzer going to be my first guest coming along from the science department and she's going to be talking about all of those aspects.

We then going to talk to Charlotte Webb about ratio, proportion, percentages, square roots, and powers, so some slightly more complex terms but again, things that are really going to apply if you're a non-math student. And then we're going to end with Sue Pawley, who's going to be taking a look at a variety of charts and diagrams. And we're going to talk about how to interpret those and how to get the most out of that data.

So that's the plan for the next two hours. As I said before, you've got the Watch and Engage and the Watch Only options. And welcome those of you who are just joining the session, also.

That's not the only way that you can connect with us. We also are collating all of the data from Twitter. So our hashtag is studenthublive17. You can email studio which is @student oh, sorry, our handle is @studenthublive and you can email studenthub@open.ac.uk.

And we may be asking for some selfies and pictures and things of you, which is always nice to see where you are and what you're doing. So if you've got anything you'd like to send us, take a picture on your phone. Upload it on the email studenthub@open.ac.uk.

Right. I think I've gone through pretty much everything but I'm a bit worried actually because my next guest isn't here yet. And we're nearly on to

SUSANNE SCHWENZER: Sorry.

KAREN FOLEY: Oh, Susanne, I was waiting. Susanne, this is a math session.

SUSANNE SCHWENZER: Oh. Then let's put this down. I don't think we need this today.

KAREN FOLEY: Where were you going?

SUSANNE SCHWENZER: Well, I'm going to the field looking at some rocks, as geologists do.

KAREN FOLEY: Ah. I see. So why have you got a hammer?

SUSANNE SCHWENZER: Well, because we need the hammer to break up rocks but we also use the hammer as a scale. So if you take a photo of some rocks and you're out in the field, the first thing you do is you put your hammer there because everyone knows, at least every geologist knows, how big these things are. And if we are doing maths today, I am sure we are talking about scales and units. And so that's a big, widely used scale in geology.

KAREN FOLEY: Yes. I was just going to say I knew it was wrong to involve the science department in all of this. But actually, you make a good point.

[LAUGHTER]

Excellent. Well, thank you for coming along, Susanne. You're actually very interesting because you're a planetary scientist. And so you do a lot of things with very, very small things and very, very big things, don't you.

SUSANNE SCHWENZER: Yes.

KAREN FOLEY: When you're not investigating life on Mars and various other aspects.

SUSANNE SCHWENZER: Right. But you count. You look at things. You look at scales. You look at numbers, categories, everything.

KAREN FOLEY: Absolutely. So what are we going to do today? We're going to take a look at some basic numbers first. And that we've got some various props here, some food-based props, to take a look at, as well.

And we've got a pizza. We've got various clementines. We've been sectioning up and counting

the segments. Do you know that they don't all have eight segments in them?

SUSANNE SCHWENZER: No, I didn't know that.

KAREN FOLEY: Yeah. Some have nine. I know. It's quite interesting and it wasn't necessarily the biggest one that had a different number of segments. We can eat some later. So we're going to take a look at some various things within Maths Help and this is quite a teaching-led, I guess, session.

So please do ask questions as we're going through and HJ and Evaghn will let us know when they'd like to find anything in. So if you want to ask Susanne anything about Mars, for example, or numbers, units, and arithmetic, then do put those questions in the Chat and we'll do our very, very best to answer those as we're going through. But we've got quite a lot to crack on with and I put some technical equipment here.

SUSANNE SCHWENZER: Yes.

KAREN FOLEY: Yes, I have.

SUSANNE SCHWENZER: You've got a very high-tech ear here.

KAREN FOLEY: I have, yes. There we go. So I brought a number line because I thought that would be quite useful to talk about where the decimal place goes because I often get a little bit confused with some of these things and how we divide things up. And I guess with maths, the whole idea with maths is that it's very structured. There's a way of doing things.

SUSANNE SCHWENZER: Yes. And there is a way to me, maths is about sitting down and just looking at it. And if you just look at this, which you nicely wrote down before, we've got the units. So if we have a one here, that's what we all know, one thumb, there we are.

And then you go along this line and you add a zero behind that. So you've got the tens. You add two zeros, you've got the hundreds, the thousands with another zero, and you just keep adding a zero along this line. So it's very structured. And once you get over your fear about all these numbers, you can see beautiful patterns there.

KAREN FOLEY: And this is quite good, as well, for decimal places and hopping along the decimal places as

you're converting. When would students be mainly using decimal place? When would a non-math student be taking a look at something and, say, wanting to round it to something else?

SUSANNE SCHWENZER: Well, if you go shopping, for example, you have prices that are round numbers. You might pay two pounds for it. But you might also pay two pounds for one item and you pay five pounds 50 for three. So here you go. You're doing everyday math just when you go shopping because you need to figure out whether this is really a good deal.

KAREN FOLEY: No, absolutely. And we're going to be talking about good deals in the supermarket a little bit later. So we can have one of these numbers but of course, once we've got our units of one, we can have smaller things other than units, can't we? We can have 0.5 of something.

SUSANNE SCHWENZER: Yes.

KAREN FOLEY: Do you think that that can be quite conceptually difficult for people, in particular if maybe they're not studying maths, to flit between the two, to think about things in terms of percentages or halves or aspects of things in decimal places as opposed to fractions, that they're two quite different things?

And I often think people can think either pictorially or visually. And so sometimes having a pizza or doing things very physically can really, really help people make sense of something. But the decimal places can sometimes be another concept entirely.

How do you deal with overlapping those sorts of aspects where you might think, oh, I'm a very logical, unit-based person, 0.5 is absolutely fine for me whereas I'd rather think of something in a half?

SUSANNE SCHWENZER: Well, first of all, these are the same things and it doesn't matter whether you think of 1/2, whether you think you've got half a litre of milk there or whether I think I've got 0.5 litres of milk there. We need to understand these are the same things. They are synonyms, if you want. And that makes it easier because there is no right or wrong way to think about these things. And then the 0.5 looks less scary if you know what it is.

KAREN FOLEY: Yeah. No, OK. This is all very good. My producers just let us know that we've got a few video streaming problems out there. So if you're having problems with the video, we are working on it and you can just refresh your screen at any one time. But bear with us if anything is going wrong. We are aware of it and we're trying to sort that out as soon as possible.

So how do you make sense of some of this? Are you a more linear person or a more pictorial person as a scientist?

SUSANNE SCHWENZER: I am actually an Earth scientist and Earth scientists are observational people. So if we are talking about fractions, I can still see a millimetre quite well. But 1/10 of a millimetre, how do I see 1/10 of a millimetre?

Well, we geologists, we carry items. This is a hand lens which actually magnifies things. So if I look through that hand lens, I can see 1/10 of a millimetre. So these things are visual for me, as well.

KAREN FOLEY: Yeah.

SUSANNE SCHWENZER: You need to just look at them in an everyday context.

KAREN FOLEY: Excellent. Could we talk a little bit about translating then some of the decimal units and things into fractions, for example? We know fractions, I don't know if you want to talk about the denominator and the numerator, I always get those two mixed up the wrong way. You've got one at the top and one at the bottom and how do broadly those fractions work then?

SUSANNE SCHWENZER: Well, if you think about a whole thing, you've got some nice little food items here.

KAREN FOLEY: Yes.

SUSANNE SCHWENZER: If you think about this pizza, so it's one. But you can divide it and you would naturally divide it to serve it to your guests. So you've divided it into 16 pieces, as I see here.

KAREN FOLEY: Yes. I think it's eight. It might be.

SUSANNE SCHWENZER: It's eight? No. Yeah, sorry. It's eight, yes, 1, 2, 3, 4, 5, 6, 7, 8. Sorry.

KAREN FOLEY: Yeah. We divided the cake into 16 because it was a lot bigger.

[LAUGHTER]

Sixteenths were just too tiny for children. But we could.

SUSANNE SCHWENZER: You could. So you just would have to fraction each piece once more and that's, again, the same logic that applies here. You can do it again and again and again. And in this case, you get smaller and smaller and smaller fractions. So what you do here is you have the one.

KAREN FOLEY: If you show it up a little bit, then people can see our fabulous, rather uncooked pizza.

SUSANNE SCHWENZER: Well, I hope it sticks to the plate. So what we do here is we've got the 1 and that's the number on the top and you've divided it by 8. And so now if you divide that, you divide it first once. You slice it once and you have it divided by 2. So that's 1/2.

KAREN FOLEY: Right.

SUSANNE SCHWENZER: And then you take another slice. Then you've got 1/4. And then so you just keep doing this and you basically put the whole on the top and the pieces you do on the bottom of your fraction.

KAREN FOLEY: It's an interesting way of doing things. I often remember the slash when you're doing sums in Excel now is quite nice because you're going 2/4 or something. And so I guess all it is is a principle of division, isn't it?

SUSANNE SCHWENZER: Yeah.

KAREN FOLEY: But sometimes, if you're stuck on things, it can be useful to think about them as parts of a whole and visually draw them out, et cetera. OK, brilliant. So we've got our top number of our numerator and the bottom number is the denominator, which is why I guess there's the phrase, "the lowest common denominator" within the section.

But if we're looking you'll see, by the way, there are some widgets coming up on the screen because we've got a couple of problems that we'd like you to solve. And also, if you are just joining the session and you haven't told us where you are, it would be great to keep those widgets up there so that we can see the map and whether you're new to the Student Hub Live and what you're studying and at what level, as well.

That'd be very, very useful to know. You just select the button, by the way, that applies to you and then you can put things in. So if you're studying science, for example, you can just press that button and then let us know.

And then that widget will feed in. And then you can also see what everyone else is doing. And the Word Cloud's where we say three words about something. If you can't think of three, just put a full stop and then it will allow you to send those responses, also.

So you'll see some diagrams we've got here. But Susanne, we've also got this tray bake here of these flapjacks which we cut into 16 pieces. And so how would this then work because whilst eight pieces is fairly OK, we're used to pizzas in working on things. But sometimes, working on things that seem uneasy to naturally divide can be challenging for people. And again, if you just lift it up a little bit, that's not going anywhere, that flapjack.

[LAUGHTER]

That's even with your hammer. So if, say, for example, we wanted to divide this in a different way other than we might normally do, you can see halves and quarters coming there. But if we were to look at 1/3, we might not get an equal number out of 16. So what might we do then?

SUSANNE SCHWENZER: Well, you do have to do the fracturing again. So if you think about a third or a quarter, in this case, because if you want to think about 1/3, we would have to divide at least one of these pieces even further, but if you think about a quarter since we have 16 pieces, then you can do this in different ways.

You could slice one strip but you could also take a square of four or any other shape that you wanted, as long as you have the four pieces which make the quarter. It's basically 4/16. And because you can divide them by the same number, you can just divide both by 4. It tells you if you divide the 4 and the 16 by 4, you again have 1/4. and that's what you need.

KAREN FOLEY: Perfect. Excellent. We're going to be dividing some sweets out a little bit later using ratio with Charlotte. I'm looking forward to that, as well. But now let's go to see what Evaghn and HJ are talking about.

HJ: Ah, well, we've had a few problems and Evaghn's kindly reminded me that I needed to put 50p in the metre, which we've done. But if you're having problems and you can't see the video, we've popped a link in the Chat Box. And if you click on that, it will go to the video for you.

And if you keep the Chat Room open, you can chat to us while you're watching that video and you can access the widgets, as well. But we are sorry that we're having problems and we are glad that you can get that video back up for you.

EVAGHN: Yeah.

HJ: Yes. But otherwise, we've still got some people. Beverly is looking forward to this but Paula thinks math is her nemesis but hopefully not after this.

EVAGHN: Yeah. It seems like nobody.

HJ: Hopefully, we can get through this together.

EVAGHN: Yeah.

HJ: This will be an experience for all of us.

EVAGHN: Everyone's in the same boat so we'll hopefully get there.

HJ: And Chantal used to love maths but lost confidence in the subject. So we'll do some confidence building with this one. I think we'll up-skill with this one. We'll definitely do that.

EVAGHN: And if she gets confident enough, she said she's going to take up a maths degree.

HJ: Oh, there we go.

EVAGHN: Yeah.

KAREN FOLEY: What does confidence look like? How confident do we need to feel?

EVAGHN: I don't know. She said she was pretty good at it before. So we try and get her back to where that is, whatever that looks like. But we'll see. We'll see what she says at the end.

HJ: We'll see after this.

EVAGHN: Yeah.

KAREN FOLEY: Is this a common theme then, this whole idea of confidence, you think, Evaghn and HJ, that people are experiencing because ultimately, none of this stuff I can do yet. We've got a lot to go. But how much of this is actually thinking about, conceptually, math seems really hard and then thinking, yeah, well, when you put it like that, I can do it?

EVAGHN: I think that's a good point. I think people are, like me, scared of numbers. And unless you actually engage with it and take it on, you'll never really get past that.

But once people actually get into it, I think that when confidence builds up, then they realise they can do this stuff. So I think you're right. Yeah, confidence is a really big thing here.

KAREN FOLEY: Brilliant. Yeah, and that's one thing we're going to tackle, as well. So I think we've resolved some of the technical things. Keep watching us on the live stream and you can still use the widgets and chat to each other using the Watch and Engage. But I think the video part of the stadium isn't feeling very well today.

So you can have the two on and that way, you can also have the live stream there and chat to each other and let us know where you are and what you're thinking and hopefully solve some of the problems that we've got, as well.

Lovely. All right. Well, let's move this. Now, we've also got a diagram, Susanne, of some interesting things that you look at in scale. So I wonder if we could look at these. And naturally, these are to do with work for you.

SUSANNE SCHWENZER: Yes. What we have here is a whole range of different scales. And you saw the rock hammer earlier as a scale because it's on that picture. But if we go through this from the top around here, what we have here is, first of all, a silicon atom, which is very, very tiny. You would never be able to see it.

So what we do is if we want to express it in metres, we have to use what's called a "prefix." We have to tell people that you have to measure this in a very, very, very, very tiny fraction of a metre, a picometer. It doesn't matter what this is for the minute but just to go through the concept, you can put a prefix in front of the word "metre," which is a length scale we all know, and then you tell people it's very, very tiny.

And then we go to maybe this quartz crystal, which you would measure in centimetres. We all know the centimetres from the ruler. And now you go to the decimeters. I had my hammer before. And so you see these rocks and all the structures and you have the hammer here as a scale.

But then you go to an even larger scale. That would now be the metre scale. You won't need any prefix for that. However, the moment you step back a little and see the whole mountain back there, then of course, you need kilometres.

You go the other way. You need to express that this is much, much bigger than a metre map scale and finally, the Earth, which has a diameter of about 6,370 kilometres. So you need

much bigger scales there and you use prefixes to do that.

KAREN FOLEY: Excellent. And we've got an example of some of them here. And I guess one of the things about these, Susanne, is sometimes it's important to know what things are and sometimes it's important to know that if ever you need to find it, you know it's there. So we're not expecting everyone to memorise this and testing them. And it's just important

SUSANNE SCHWENZER: These tables, they are actually out there. And the prefix symbols, they are all out there. And I mentioned the "kilo" in "kilometres", so one kilometre is 1,000 metres and we know this from driving around the country. And from everyday life is the centimetre, as well. If you use a ruler or I think, in this country, it's more about inches and feet but it's the same concept. You have a certain word for a certain quantity.

KAREN FOLEY: Excellent. And these are all outlined in the Maths Help first module, as well. So if you want to take a look through and work through that, it's really a great resource and it really does build your confidence because it's got loads of different examples that you can try out. It'll teach you things and then say, right, have a go yourself at doing it. And this is available on Open End so anybody can access any material on Open End, for that matter. So do have a go at this first module of Maths Help if you'd like to.

So this is important and it's also important, I guess, when we're returning back to this idea of ratios, as well. So we can then start to think about how these relate two things. So a centimetre, for example, could be 1/100 of a metre, although we wouldn't express it like that.

So it's about, I guess, understanding some of these conventions and also recognising that if, for example, you did need to look at metres in that context like if you were making all these triangles, for example, you might then need to adjust your scale so you were looking at something larger as part of the whole. And then you'd be flipping those back into fractions, wouldn't you?

SUSANNE SCHWENZER: Yes. Yes. And it's in a way like learning a language. And that might be a lot less scary for a lot of people because knowing that "centi" is 0.01 or 1/100 is like learning a language. You need to know these vocabulary of mathematics.

And once you know them, things become a lot easier. So don't get scared. Just learn the vocabulary and that will get you over that initial hurdle.

KAREN FOLEY: And it's very, very important. It's a language I think we're all very interested in. And as I keep saying to my daughter, you need to do your math so you don't get ripped off in the shop and you can count your change properly.

SUSANNE SCHWENZER: Yes. Yes.

KAREN FOLEY: No, absolutely. So we've been converting money in units, as well, as part of this and we've got pounds and pence and things. And we're going to talk a little bit later, as well, Susanne, with one of my future guests about how we can not get, I don't know whether we're doing that not getting ripped off on holiday because when I go on holiday, I can deal with the converting all of the stuff.

But as soon as I am then translating things into other currencies, especially multiple times, it can get a bit confusing. And sometimes, you think things are a real bargain and they're not.

SUSANNE SCHWENZER: Well, you need to do the math there again. And quite often, people get bogged down because if you look up a conversion rate, you've got a number that has usually a decimal point and lots and lots and lots of figures back there. But you can round them up and you can say, if some conversion rate is 0.47689 whatever, you can say it's roughly 0.5. And then you have a much easier math multiplication to do than if you really tried to do it with all these digits.

KAREN FOLEY: Absolutely. HJ and Evaghn, how is this making sense to everybody?

EVAGHN: I think everyone's trying to sort out the screen stuff at the moment but yeah, we've got a way forward. Some people are splitting the screens. Some people are just switching between the two.

KAREN FOLEY: Brilliant.

EVAGHN: So hopefully, everyone's tuning in now.

KAREN FOLEY: Excellent.

HJ: I think Adele, though, is interested in knowing if it matters about interchanging numbers. She wants to delve more into that point if we haven't hit it already.

SUSANNE SCHWENZER: OK.

HJ: Perhaps.

KAREN FOLEY: Excellent. Well, I'm glad you're all sorting out the problems because you'll need to be able to use the widgets in a minute. We're going to be asking about your feedback on that and well done sorting it out.

This is also available on catch-up. So if you do want to rewatch some of it later, you can do that. It'll be available immediately after the session's finished. So you can watch the video stream later but thanks for bearing with us.

Susanne, would you like to answer Adele's question?

SUSANNE SCHWENZER: Well, interchanging numbers is something that you need to think about very carefully because you need to think about which mathematical operation do you actually want to do. If I take these pens and I have two and I add one, it doesn't matter if I say I have one and I add two. It's three. If I have 2 and I add 1, it's 3 again. So for certain mathematical operations like adding numbers and for multiplication, it doesn't matter.

But for other mathematical operations, it does matter. For example, if you have a succession of subtractions and additions, it might matter whether you subtract first and then add. If you do more complex things, like subtracting or adding and then multiplying, it might matter, as well.

And again, mathematics is a language so there are rules for how you do it. And if you want to do it differently, then the normal basic rules say we have the brackets that you can put around and tell someone, you need to add first and then multiply while the normal rule would say, you first perform the multiplication and then the addition.

KAREN FOLEY: I wonder how many people use Excel and regularly do calculations. That would be interesting to know because often, when I'm doing things on Excel, it makes it very clear in a way that takes me back to my days of doing maths, where you need to put things in brackets to get those calculations to perform.

So for example, you'll need to bracket something when you're adding something before you're multiplying. But broadly speaking, how would you remember when those rules matter? When does it matter when you can do things like the brackets?

Is it just for division and multiplication that you need to be bracketing things in context? How do

you remember them or make sense of them?

SUSANNE SCHWENZER: Well, the easiest is if you have a simple calculation, you try it both ways. And if your result is different, then you better go and look up the rules.

KAREN FOLEY: A heuristic, I like it. That's what I often do. That's why I like mandarins and things because I often put things into Excel and think, does that make sense? If I can just translate that broadly and think 1/3 of 100 is around 33% or so, then I can just think about it logically.

But we've got various things. So we've got one widget about whether it matters if you interchange numbers. So we've got some examples here and these are all on Maths Help, like if you multiply 3 by 365, that will give you the number of days in three years. But then if you divide 366 by 3 to find out how many days in a term, then that could be slightly different, couldn't it?

SUSANNE SCHWENZER: Yes. And there is a good example of why things are not interchangeable because if you have the big number, the 366, and divide it by 3, then you get a number that's roughly 100-something. But if you turn them around and divide 3 by 366, you get a number that's a lot smaller than 1.

And so that tells you it does matter, just from thinking about it. You don't have to do this exactly. You can just think about the quantity of 666 days or whatever and 3 and how these numbers relate to each other.

KAREN FOLEY: Absolutely. So dividing 3 by 366 is not the same as dividing 366 by 3. So it depends which order you're putting things in in particular for division.

SUSANNE SCHWENZER: Yes.

KAREN FOLEY: But would it matter the same with multiplication? If you've got 365 times 3 or 3 times 365, that doesn't matter as much, does it?

SUSANNE SCHWENZER: That doesn't matter.

KAREN FOLEY: Because you're still increasing things but when you're dividing things, the order really matters, again, because we had the denominator and the numerator.

SUSANNE SCHWENZER: Right.

KAREN FOLEY: So because they're in such different places, that's why there's such a difference between the two.

SUSANNE SCHWENZER: Yes. And you can, again, think about our cake or pizza. The one thing that you have first is your thing that you are going to divide by the other number. And if you flip that around, it just doesn't work anymore.

KAREN FOLEY: Yeah. No, absolutely. And I think just going back to this idea about Excel, once you start putting those things in and you can look at these calculations quite quickly and get the answers, it can make you make sense of some of these numbers also, which I guess was one of the main things that non-math students use it for.

Kate and Libby and Andrea and HJ are all avid Excel users, I am told. So I hope that this make sense and it'd be interesting to see if this is how you do some of those calculations and even if refreshing some of these for Excel would help you do more calculations because it can be quite an interesting way to divide things.

I often have an Excel document open when I'm doing something completely unrelated just to divide things up. Or if I'm doing a budget, I'll be working things out and it can be a really quick and easy way of doing things, other than using a calculator.

SUSANNE SCHWENZER: And you can track what you are doing. If you have any table calculation programme, you can track what you are doing. You see the numbers still in front of you.

When you use a calculator, that's gone. You only see the result. But you can track back and you can actually see what you are doing.

KAREN FOLEY: Alvin wants to know about the order of things, like brackets, which is brilliant, actually, Alvin, because that's our next section that we want to cover. So I wanted to talk to you about brackets because these are things that we see.

And we've touched on some of these before, in particular when you're using Excel. So sometimes, you might say 5 plus 3 and you'd have the brackets around them. I don't know if you want to use my technical chart.

SUSANNE SCHWENZER: Yeah probably.

KAREN FOLEY: My technical chart. We can do some samples to explain this to Alvin. Voila.

SUSANNE SCHWENZER: That's actually a good idea. I love high tech.

KAREN FOLEY: It is. It's very good, isn't it?

SUSANNE SCHWENZER: So.

KAREN FOLEY: Yes?

SUSANNE SCHWENZER: What was the task?

KAREN FOLEY: So we can use calculations in brackets, which mean ultimately, do this first, don't they?

SUSANNE SCHWENZER: Yeah.

KAREN FOLEY: So sometimes, we want to make some calculations in a variety of succession. So if we wanted to add 12 and 7 and 13, that makes no difference because we're adding.

SUSANNE SCHWENZER: Let me write the numbers down.

KAREN FOLEY: So 12

SUSANNE SCHWENZER: 12

KAREN FOLEY: And 7

SUSANNE SCHWENZER: 13 And 7. So that's our number.

KAREN FOLEY: So that's fine. So if we added, well, you've put them in the wrong order. It's 12, ah ha! It doesn't matter, does it?

So if we're adding 12 and 7 and 13, we're always going to get 32. If we add 12 and 7 together first and then add 13 or add those two together, it doesn't matter. We're always going to end up at 32. So we can do it either which way.

But the brackets can mean, do things first. So if we bracketed something, then that may make a difference in some situations, not all, because if we're adding, we can ultimately bracket 12 and 13 or 12 and 7 and we'd get the same, wouldn't we, because as we've just done, it doesn't matter 12 and 13 plus 7.

SUSANNE SCHWENZER: And you said that.

KAREN FOLEY: That's still 32.

SUSANNE SCHWENZER: Yes.

KAREN FOLEY: And it doesn't matter if we bracket this or we bracket it that way because ultimately, we're adding all of the things together.

But if we were looking at division, sorry, not division. If we were looking at subtraction, it might matter which bracket we were doing because we're getting a whole and then ultimately, we would have two different halves of that. So if we're adding 12 and 13 together first and then take away 7, that would be different. So shall we try 12 and 13 take away 7 and we'll change the brackets?

SUSANNE SCHWENZER: So you want 12.

KAREN FOLEY: And 13.

SUSANNE SCHWENZER: Plus 13.

KAREN FOLEY: Minus 7.

SUSANNE SCHWENZER: 7. So that's 25 minus 7 is 18. Right?

KAREN FOLEY: And that's when the brackets are here, isn't it, because we're adding that first and then we're taking away 7. But then if we were changing that, it wouldn't be the same if we were having 7 minus the 12 plus 13.

SUSANNE SCHWENZER: 7 Minus 12 plus 13.

KAREN FOLEY: And we're having the brackets here, so 12 plus 13, which is 25.

SUSANNE SCHWENZER: That's 25 so we can work it like.

KAREN FOLEY: Is this the same, this one, 7 minus 25?

SUSANNE SCHWENZER: We are actually getting it to negative numbers here.

KAREN FOLEY: Yes.

SUSANNE SCHWENZER: We had minus 18 here.

KAREN FOLEY: Yes.

SUSANNE SCHWENZER: So yes, it does matter.

KAREN FOLEY: So we're transferring that number line almost, then, where we were looking at units very early on and we only had positive units from that. But we can get negative units. So with certain things, the brackets do matter. And broadly speaking, the brackets mean, do that first.

So in these equations, we would be looking at doing this one first or doing that one first and then taking the answer from that aspect and then doing the sum that we were looking at.

SUSANNE SCHWENZER: And that's basically what I did here.

KAREN FOLEY: Yes.

SUSANNE Let me get a blue pen. So that's what I did here. Do that first and then do the rest. And that's a

SCHWENZER: lot what you need to do when you do maths. You need to be very systematic and think about it and go step by step. Never try to do 15 things at once.

KAREN FOLEY: Yeah. OK, brilliant. So Alvin, does that answer your question then about the brackets and where to put those and where to do them first?

So basically, if, for example, we had more of these together, so we had three or four brackets we would do everything in the brackets first and then we would take the equation systematically and go through it like such.

SUSANNE SCHWENZER: Like I did it here, just with more of them.

KAREN FOLEY: But where it might matter if we were designing some of those equations is not necessarily with addition but with some of the other ways of doing things. If we were adding things in order, then the order, other than just a straightforward addition, would impact. And that's when we might need to consider putting brackets to think about exactly what we're trying to do and when.

SUSANNE SCHWENZER: Yes.

KAREN FOLEY: So it's almost like commas in sentences. They can massively impact on the meaning that we've got and they're our way of accenting stuff in maths, isn't it?

SUSANNE SCHWENZER: So we are, again, back to that mathematics is a language.

KAREN FOLEY: So Chantel says she uses the acronym "BODMAS." Does that make sense to you?

SUSANNE SCHWENZER: She uses the

KAREN FOLEY: BODMAS, Chantel, what does "BOD" I haven't heard of that one.

SUSANNE SCHWENZER: I haven't heard of that, either.

KAREN FOLEY: Evaghn, what is it?

EVAGHN: Well, I've got it here. This is Brackets Of, as in power of, Division, Multiplication, Addition, and then Subtraction.

KAREN FOLEY: Ah, brilliant.

EVAGHN: So that's the order. This is Chantal who I think is probably going to be taking up that degree.

KAREN FOLEY: Is this Chantal who has definitely said that if she gets more

EVAGHN: Yes.

KAREN FOLEY: OK.

EVAGHN: She's helping everyone out. And I think Andrea also said, yep, I was taught BODMAS in school and this is the order I remember it in.

SUSANNE SCHWENZER: OK. Maybe the reason I'm not remembering this is because I learned my school math in German.

[LAUGHTER]

KAREN FOLEY: It wouldn't make sense, would it? Excellent. Well, I'm looking forward to hearing how you're signing up for your degree goes, Chantal, and thanks for helping everyone.

Right. We're going to need to move on quickly because we're running out of time, as we always do. We talked briefly about negative numbers and I just wanted to mention briefly some of those types of things, again, to do with order effect.

So we've got some examples to do with values of washing machines and things and talking about how negative numbers can occur in financial matters. So we've got a few problems. Again, all of these are on the Maths Help section.

So we've got, if a value of a painting increases by 20 pounds a year and it's worth 20 pounds today, how much is it worth in a year's time and how much is it worth a year ago? What I've noticed with these is they all start fairly easily and you can get a false sense of confidence when you're going through them.

SUSANNE SCHWENZER: Yes. Yes, Yes.

KAREN FOLEY: So we would go 200 plus 20 equals 220. And if we were looking at reducing the value of the painting, we would go 200 minus 20, which is 180. So we can't argue with any of that sort of thing. But if we were going to start looking at these constant annual increases of things and the current value, then we would need to subtract an annual increase from a current value.

So we would say, well, OK, if this painting is worth so and so and then this is how much it increases each year, like the latter example, we would go 200. And if it's increasing a year ago, it would have been worth 180 pounds. So we can make sense of those ideas.

But often with maths, it can get a little bit more tricky because you've got various other things that are happening, as well, with those numbers, like how much that money's worth. When I was born, 20 pounds was worth a lot more than it is now, so to speak. So we've got all of those differences, as well.

Then we've also got things about negative increases. So if you regard a decrease as a negative increase, does your answer then apply to the washing machine? So if we've got this 20-pound decrease or increase, is that the same sort of thing? And I think just thinking through some of this, the answer is that it is if we're looking in real time, isn't it?

SUSANNE SCHWENZER: Yes because what you are doing here is if you say the washing machine is worth 200 pounds at this moment and you calculate a decrease, what you do is you basically subtract the 20 pounds. And you can do this in two ways. You can either say, OK, I'm just subtracting these 20 pounds or you can think about the decrease as a negative number.

So let me just say, we've got the 200 pounds here and we want to think about the decrease and the decrease is 20 pounds. So what we can do is we can simply say, we have the 200 pounds here and we subtract the 20 pounds. But we can also think about the decrease as a negative number and at that negative number.

So that is basically the same as saying, I've got the 200 pounds here and I am adding a decrease and now I'm putting a bracket around here to make it a bit more clear of this negative number of minus 20. So these two are equivalent.

They are the same and you are thinking about it as a decrease. I need to subtract something. But the decrease in itself is a negative number. And so these two are equivalent.

KAREN FOLEY: Excellent. Susanne, thank you so much. We're just out of time now. I just wanted to end by

asking your advice on something I know students get very stuck with, which is just about rounding. How many decimal places for non-math students do you think one should go into?

SUSANNE SCHWENZER: It depends on what your original number had. So if you say you measure a temperature and you measure 20.5 degrees and you do any mathematical operation, for example, to convert it into Fahrenheit, the 0.5, that significant figure, does not change.

Just because your calculator or Excel spits out these 20 things after the decimal point, your significant figures of the original measurement do not change. So if you go by the number of what we call "significant figures" on your original measurement, you can't go wrong.

KAREN FOLEY: So it's not less accurate. It's just more appropriate in terms of how you might round it to present it to somebody.

SUSANNE SCHWENZER: Yes.

KAREN FOLEY: Excellent. Susanne, thank you very much. I hope your rock hunting goes well today.

SUSANNE SCHWENZER: Thank you. I am going now.

KAREN FOLEY: Don't forget to take your hammer and thank you so much for explaining all those basics to us. That's been a really useful session. Thank you.

SUSANNE SCHWENZER: My pleasure.

KAREN FOLEY: All right. We'll see you very soon. Thank you, Susanne.

SUSANNE SCHWENZER: Thank you.

KAREN FOLEY: Evaghn and HJ, how's everyone getting on? How did we enjoy that first session?

HJ: I actually think it went well. Yes.

EVAGHN: Yeah.

HJ: We were just talking though about whether it's "BIDMAS" or "BODMAS." But Kate tells me that

it's basically the same thing and it's just like using a different dialect of the same language

EVAGHN: The same language, yeah.

HJ: Which is good. And we had a little chat about calculators, as well. I know you always thought that I relied on them too much, which is why I'm finding problems with maths now. But Carrie says she recently changed her calculator and it blew her mind the amount of stuff that it could do.

EVAGHN: Yes.

HJ: I thought that was quite cool. She'll have to tell us what calculator she's using.

EVAGHN: Yeah, definitely.

KAREN FOLEY: And tell me, what sort of students have we got out there? What sort of level and what are they studying?

HJ: It seems to be lots of people at level one, which is good. So are you starting in February or doing your module? That'd be good to know. A few people at level two I think the post-graduates are just us two on the desk here.

EVAGHN: Yeah.

HJ: But yeah, it'd be good to know what you are studying. So if you haven't filled in the widget, just click on the widgets on the left and let us know what you're doing, lots of STEM subjects, as to be expected, in the maths one.

I wonder if we do have any more geologists. Is anyone interested in geology? And I think Susanne shows that just maths students isn't just for, well, maths isn't just for maths students, is it?

EVAGHN: Mm.

KAREN FOLEY: Excellent. All right. Well, do let us know that and let us know if you're starting your studying journey in February, which is coming up very soon. And we've got a freshers fair which will be on the 31st of January and the 1st of February and that's going to be a full two days ram-packed full of loads and loads of stuff, as well. So that will be really useful if you're starting your journey and very interesting for those of you who're already working your way through.

Well, thank you very much, Charlotte, for coming to talk to me today. You're our next guest and unfortunately, you have the most complicated, in my opinion, sessions, where we're going to be looking at ratios and all sorts of difficult things square roots. But you've brought a bag of shopping in, which fills me with the sense that this might not be so difficult and you might have a really wonderful way of explaining this to our guests.

So what you'll see now if you're in the Watch and Engage, and even if you've got the live stream running concurrently, as well, you'll see that we're going to be showing a lot of questions. And I would like to be able to use these within the session so please do fill them out if you can.

And Charlotte has designed a lot of puzzles that we're going to be looking through but they're very, very simple if you just pay attention. And I think that's you'll hopefully guide us through the answers with all of those, as well. Now, Charlotte, you are interesting because you like teaching people who are teaching maths, don't you?

CHARLOTTE WEBB: Yes.

KAREN FOLEY: The students no good.

[LAUGHTER]

CHARLOTTE WEBB: I like teaching students, as well. No, I've been a secondary maths teacher so I saw lots of younger students. But now I'm working with people who would like to become teachers. So it's about breaking down topics and working out how to make them clear and understandable.

KAREN FOLEY: Excellent.

CHARLOTTE WEBB: Yeah.

KAREN FOLEY: Oh, brilliant. It's always so interesting. Whilst we've got so many lectures at the Open University, it's always very interesting to see what other work people are doing, which is often very exciting and this is one, as well. And you really love dachshunds, don't you, which I do, too. So normally, we have our study buddies, as well.

So if you've got a study buddy at home and you'd like to send us a picture of your animal who

is your loyal companion as you're working through all of your TMAs, then please do send us that. Studenthub@open.ac.uk is our email box and our hashtag we're picking up the feed on Twitter is studenthublive17.

So we're going to take a look at ratio, proportion, and percentages. Now, why is this interesting then for students who are not studying maths?

CHARLOTTE WEBB: Well, percentages, ratio, and proportion come into all kinds of parts of life. So for students who are doing any sort of social science or anything where they want to write a convincing argument or show some facts, there are really easy and simple ways to make complicated data very accessible to a reader.

So they're a really useful way to show something, for example, the proportion of students to a teacher. At the moment, the government recommends that there should be no more than 30 pupils for each teacher so the ratio would be 1 to 30. And it's just a really clear way of showing statistics in reports, so really useful to both interpret and also to be able to produce documents.

KAREN FOLEY: And also, just thinking in some of my maternal duties, sharing out things appropriately for children who are very, very diligent at noticing if you don't give them an equal proportion and ratio of sweets, for example.

CHARLOTTE WEBB: We're going to do that soon.

KAREN FOLEY: OK, excellent. So a ratios really are quantity comparisons, isn't it, so comparing two things. And also, you mentioned class number. So I guess that would relate to statistics and that's something that, in particular, social science students are using a lot of, isn't it?

CHARLOTTE WEBB: Yeah, of course. So obviously, science students are going to use a lot of these kind of proportions, as well, but it's just a very clear way to show a comparison of two things. So a comparison of boys to girls, for example, studying maths is often looked at because in previous and hopefully, now we're a bit more even. But previously, it has been a more male-dominated subject. So ratios of boys to girls studying maths at university, for example, is a really interesting thing to look at.

KAREN FOLEY: Yeah. I was talking to Susanne about comparing and transferring some of these things because often, the numbers are the same. If you've got 1 to 30, it's just under 1/3 or so. But it

would obviously be more appropriate at some points to talk about a ratio if you're looking at a student number. It wouldn't be right to say, oh, there's 1/3 of a teacher to every student.

That just wouldn't really make sense. So sometimes, a ratio will be more important. But it's also important to recognise when those can be translated into percentages.

CHARLOTTE WEBB: Yeah, of course.

KAREN FOLEY: So would, I guess, your advice be to students to think about what's most appropriate in terms of how you numerically show that data, even if it might mean the same thing?

CHARLOTTE WEBB: Yeah, certainly. It's totally contextual and you can often go between two different formats, ratio and proportion. But sometimes, it's just a little bit clearer to, for example, talk about the fraction, the proportion, of a particular ingredient, for example, in a drink than it is to try and think about parts that you would in a ratio.

KAREN FOLEY: Excellent. Well, let's take a look at some of these and as you say, they're commonly used in everyday things. I see you've brought your shopping with you to have a look through. And we've got a lot of our students out there who are studying STEM, so 58%, which I guess is just under 2/3. I'm into my fractions, aren't I, at the moment? I'm looking at pizza.

[LAUGHTER]

So what's the first challenge that we have to look at? Are we going to do some sweet sharing?

CHARLOTTE WEBB: Yeah. So we'll look at some ratios to start with. So as you said, children and adults alike get very cross if things aren't shared out fairly.

KAREN FOLEY: Yes. Well, don't do that to HJ. You should see how upset he can get if he doesn't get all of his sweets.

CHARLOTTE WEBB: Yeah, exactly. Well, that's fair enough, isn't it? So what I've got here is I've got, I counted these because I like counting, being someone who likes math. I've got 49 sweets here and what I want to do is share them out in a ratio of 4 to 3. So it might be because there's more children in that class than that class and I want to make sure they're evenly shared out.

And so what you could do is think about having two separate piles or two bowls of sweets. And all that means is for every four that this bowl gets, this bowl gets three. So what you could do,

if you had time and you wanted to do it in a simple way

KAREN FOLEY: I imagine you strike me as being quite thorough, Charlotte.

[LAUGHTER]

CHARLOTTE WEBB: You could put four in that bowl and you could put three in that bowl and you could keep going, keep going, keep going. But obviously, if I've got quite a lot of sweets in here, it's going to take me quite a long time. So instead, I'm going to try and work out how many should go in each bowl by looking at that ratio.

So the first thing I'm going to look at is, well, I've got four parts essentially here. So for every four here, I've got three here. So altogether, I'm looking at four and three. I'm looking at seven parts altogether.

And every time I put sweets in the bowls, I'm putting seven parts. So what I'm going to do is instead of doing that bit by bit, I'm going to look at the total, which is 49, and see how many sevens will go into that.

KAREN FOLEY: OK.

CHARLOTTE WEBB: So luckily, 49 is a rather nice number.

KAREN FOLEY: Yes. I was going to say, I wonder why you had 49, not 50 sweets.

[LAUGHTER]

CHARLOTTE WEBB: Yes. Well, if we had a number that wasn't divisible by 7, you'd have to make a decision as to whether you were going to split it into fractions or whether you were going to take one away, depending on the context of the situation. But for now, we've got a nice calculation, so 7 times 7, which incidentally is a square number but we might get time to talk about that later.

KAREN FOLEY: Order.

CHARLOTTE WEBB: We know that we've got 7 times 7, which goes into 49. So that means that we're going to put seven lots of these piles into each bowl.

KAREN FOLEY: OK.

CHARLOTTE WEBB: So this bowl has four for every time and this bowl has three for every time.

KAREN FOLEY: OK.

CHARLOTTE WEBB: So in the left-hand bowl, I am going to do 4 times 7 and in the right bowl, I'm going to do 3 times 7. So I'm going to have 28 in the left ball and I'm going to have 21 in the right bowl.

KAREN FOLEY: Lovely. And we can check that that makes 49.

CHARLOTTE WEBB: And that's exactly what you do, yes. You double check that it adds up.

KAREN FOLEY: Good before you start. And then I guess it would be easier to do the 21. So you would just count 21 and then chuck the rest in.

CHARLOTTE WEBB: Yes, of course. Yeah. So you could evenly spread them out in that ratio.

KAREN FOLEY: I see what you're doing there. That's made it very clear. And actually, that's quite useful because just knowing how to do something like that could actually save you a lot of time because I do end up doing things like that in my everyday life and thinking about how I can allocate things and that's a really nice, quick way of doing it. Evaghn and HJ, did everyone get that?

EVAGHN: Yeah, I think everyone got that. People are saying they're not too confident but they're happy to see that we're splitting food. So I think that will help in confidence. Davin says he gets 98% brain freeze after drinking a smoothie too fast and Stewart says that his TMA's only 75% done.

KAREN FOLEY: Ah.

EVAGHN: So I think everyone's just using the numbers to make sense of their lives.

KAREN FOLEY: Brilliant. So are people studying and doing TMAs at the moment? Are some people from the October presentations already working my way through?

HJ: I think so. We've got people doing criminology and psychology. That's what Janice is doing at the moment. Libby's doing psychology and we've got people starting natural sciences. And Adele's doing art. So we've got a really nice mix of different students.

Sorry. Carrie's doing level one sciences so this will be a nice kickoff for the maths side of that for her. But yeah, so a very nice mix.

KAREN FOLEY: Lovely. And it's really nice to see some familiar names coming up in the Chat. And those of you who do come to the Student Hub Live, thank you and thank you for welcoming the other students. It can be really nerve wracking when you're first joining something like this and I bet there are people out there who aren't sure what to type in the Chat. And so it's really nice that you're there.

And Charlotte, you're really helping people. Elizabeth says now that the penny has dropped and then Kate said that it sounded like a very loud clang. But this is making sense to a lot of people.

CHARLOTTE WEBB: Great.

KAREN FOLEY: So that's ratio that we've had to look at and we can simplify ratio, as well, can't we?

CHARLOTTE WEBB: Yeah. So what we've done first is sharing.

KAREN FOLEY: Even more.

CHARLOTTE WEBB: What we've done here is sharing in a ratio. And we can also take a ratio. For example, we could take this ratio 28 to 21 and we could go backwards and simplify it. So we're going to do an example of that.

KAREN FOLEY: Tanya says she also gets it now so thank you. This is going well.

CHARLOTTE WEBB: Oh, fabulous.

KAREN FOLEY: Going very well.

CHARLOTTE WEBB: Well, I've brought in some ingredients for a drink that I quite like, which is basically

KAREN FOLEY: Oh, I like that, too.

CHARLOTTE WEBB: Elderflower fizz.

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: So a bit of elderflower and a bit of fizzy water.

KAREN FOLEY: And a lot more economical than buying it ready mixed.

CHARLOTTE WEBB: Exactly. Exactly. So yeah. And that's one of the key things about understanding ratios and everything is to be able to get good bargains.

KAREN FOLEY: Yes.

CHARLOTTE WEBB: Yeah. So what we've got here is I know that this whole bottle of cordial will mix perfectly with this whole bottle of sparkling water at the right consistency, the right taste and everything. So what I want to know is if I just wanted to pour one glass, what the proportion and what the ratio is that I need to use.

So what I'm going to do is simplify the ratio. So this bottle here is 500 millilitres. And this bottle here is two litres. Now, there is a question on the widget which is similar to this so you might want to have a go after we've done this example.

So first thing I notice, I don't know if you can notice anything that's different about those two numbers.

KAREN FOLEY: Yeah, they're not the same. So millilitres is a different unit to litres.

CHARLOTTE WEBB: Exactly.

KAREN FOLEY: I was paying attention at the end.

CHARLOTTE WEBB: Exactly. So that's really important to notice because at the moment, we can't really simplify them because they're not in the same unit. Exactly. So what we're going to do is try and change them so that they're the same.

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: So because I don't want to go into decimals or anything, I'm going to keep it into millilitres. So I'm going to keep the left-hand side as it is.

KAREN FOLEY: So we always try and make things easy as possible, don't we?

CHARLOTTE WEBB: Exactly. And two litres, as well, I know that there's 1,000 millilitres in a litre. So two litres will be 2,000. So now, I've got something. And I don't have to write "millilitres" here because they're both the same now. So I just know that it's a ratio of 500 to 2,000. They're in the same unit so I can get rid of the units.

KAREN FOLEY: So ratios don't have units.

CHARLOTTE WEBB: Yes, exactly. You can start with looking at units but you want to try and get rid of them.

KAREN FOLEY: That's important because some students try and be so thorough with things and then they'll put things on. But actually, it can demonstrate you don't quite understand the principle.

CHARLOTTE WEBB: Yeah, exactly. And actually, getting them into the equivalent form can sometimes be a stumbling block. So just recognising that that's the first step is quite important.

And now what I want to do is simplify. Now, I might be able to know how many times 500 goes into 2,000 but if I can't spot that straightaway, I can do the simplifying in a couple of steps. So the first thing I notice is that this is 500. It's got the zeros here and this is 2,000. So I can definitely divide by 100.

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: So I'm going to do that first just because that's really obvious to me.

KAREN FOLEY: Kate wants some elderflower fizz. Kate, we can't pour it down the I think that was part of the problem with it earlier was soggy cables. So I'm afraid you'll have to get your own.

CHARLOTTE WEBB: Yeah. Well, at least you'll know how to make it now in the right proportions.

KAREN FOLEY: Because it never occurred to me, in all honesty, to do this, I always just think, oh, it's about that much. But clearly, I'm doing it wrong.

CHARLOTTE WEBB: Yeah, you don't want it too sweet and you do want to taste it.

So the first thing I did, I'm just going to write it at the side just so we keep track of it. So I divide it by 100. But I can see now I've got 5 to 20. That's still not simplified enough because I know that 5 and 20 have some common factors. 5 actually goes into 20 so I can divide by 5, as well. So 5 divided by 5 is 1 and 20 divided by 5 is 4.

Now, I can't simplify 1 any further because I don't want to end up with fractions of decimals. Ratios should be using whole numbers. So I have finished. So I know now that for every one measurement and this is quite useful because it can be however you can use bottle tops or you could use a particular glass.

It doesn't have to be any particular size measure. But for every one measure of cordial, I'm going to have four measures of sparkling water. And then I'm finished.

KAREN FOLEY: Perfect. So how would you pour that then in your glass? Would you just look at it?

CHARLOTTE WEBB: Well, as I said, because I don't necessarily want to be using a measuring jug every time I make a drink, a lot of people I know either use bottle tops or you can use a little jug that you've got or whatever you've got to just measure roughly that that's one lot and that's four lots.

KAREN FOLEY: Perfect. So you know the proportion and that's how you know, I guess, that obviously, that looks a quarter of the size.

CHARLOTTE WEBB: Yes.

KAREN FOLEY: Of that one. Excellent. So we asked people at home some questions on the widgets and if you haven't had a chance to look at those, then please do fill those in as we're going through. All you do is select the item that you think applies to the correct answer and then you can close the widget. And then you can also see what everyone else is saying, as well.

CHARLOTTE WEBB: Great. And with that widget, the one that relates quite greatly to this, just remember that idea about units. That's really helpful for that question.

KAREN FOLEY: Yes. No, exactly. So what we're doing is we're making the units more appropriate and we're not displaying the actual number or the indication of that unit because we're looking at a ratio.

So it's different to that. Excellent. But we'll see how people got on with that, as well.

We also wanted to look at this in terms of bargains because of course, size and things when we're in the supermarket is really important. Now, they started displaying there how much per mil things are. So when you're doing your shopping, you can start looking at things and saying, well, that's this much and that much and things.

But it's quite tricky to work some of those things out. And even though you can look at those numbers, if you can't do the basic maths, there's more to it than that, isn't there? It's an important skill to have to work out which is best to buy.

CHARLOTTE WEBB: Definitely. And often, there's offers on and they don't always change their per millilitre or per grammes because I'm often in the supermarket and thinking, actually, is that still the same deal because now they've changed the price? So it is worth actually knowing how to have a quick look.

KAREN FOLEY: Shall we see that ratio widget before we move on, Charlotte, and see what students said about that? So let's have a look and see if that's coming up on our screen in a second. So we'll see what the ratio of 1.5 to 10 centimetres is and 85% of them said it was 15 to 1.

CHARLOTTE WEBB: Going up.

KAREN FOLEY: 92 Even. So people are clicking on that as we're going. Was that right, Charlotte?

CHARLOTTE WEBB: Well, yeah, we can have a look at that. Do you want to go through the answer?

KAREN FOLEY: Yes, let's go through this one.

CHARLOTTE WEBB: So it was 1.5 metres to 10 centimetres, I believe, was the original question.

KAREN FOLEY: Yeah, 1.5 to 10 centimetres.

CHARLOTTE WEBB: Yes, perfect. So the first step is as here, we need to get rid of the units because on first glance, you might think 1.5 to 10, OK, that's 15 to 100. But actually, it's not because here, this is metres and this is centimetres.

KAREN FOLEY: So we need to do that.

CHARLOTTE WEBB: It's very important not to miss that detail. That's very important. So whenever there are units, you must look at them. So the first thing we're going to do is, again, we wanted to make it simple so we're not going to start going into decimals. We're going to get rid of the decimals on this side.

So 1.5 metres, 100 centimetres in 1 metre. So that's going to be 150 centimetres. And I'm not going to bother writing "centimetres" because this is already in centimetres.

KAREN FOLEY: OK. Perfect.

CHARLOTTE WEBB: So now, hopefully you can see and this is a little bit easier than this one. We can simplify in only one step.

KAREN FOLEY: Mm-hm.

CHARLOTTE WEBB: And I can see that 150 and 10 both divide by 10. So I end up with 15 to 1.

KAREN FOLEY: Perfect.

CHARLOTTE WEBB: All those people.

KAREN FOLEY: So everyone's got it. Well done.

CHARLOTTE WEBB: Yeah. Good.

KAREN FOLEY: Excellent. So that was good. So this is a very self-explanatory way of doing things and we've covered that. And this is really what happens in this Maths Help module is that you'll be explained something then get a few chances to do it. And that can really increase your confidence because then you can think, well, yeah, I can do it and I can apply those principles in a variety of different contexts.

Evaghn, how's it all going?

EVAGHN: Yeah. No, it's going well. When you asked the drinks question, Libby gave the answer quite a bit before the answer actually came up on the board.

CHARLOTTE WEBB: That's good.

EVAGHN: Carrie says she likes ratios but only because it makes them sound so simple. I think that's the key point here, just making sure that you simplify it. And also if you could use something that you relate to in real life, like food or drink, yeah, it makes it a lot easier to understand, I think.

HJ: I think Davin as well has told us that Khan Academy is a great resource for maths. I've been on it myself and it gives you lots of practical problems which you can run through and practise it type of thing, which is really great when you can see it all laid out in front of you and go through it, as well.

And Stewart recommends an app called Wolfram Alpha, so sharing lots of helpful tools, as well, to help us with maths, which is very good. So thank you, Stewart and Davin.

CHARLOTTE WEBB: Yeah, love it.

EVAGHN: I think confidence is rising, as well. Paula says she can't believe that she actually got your answer.

CHARLOTTE WEBB: Great.

EVAGHN: Making sense.

KAREN FOLEY: Oh, you're a good teacher, Charlotte. See? My old physics teacher said to me, well, he was actually old. But he said, anyone can understand anything. It's just how it's explained to you. And some people just vary in the length of time they take to get something and I quite agree with that. It certainly worked for me.

Right. Shall we move on to proportion now, Charlotte?

CHARLOTTE WEBB: Okie dokie. Yes. So proportion is basically very similar to ratio. It's just in terms of instead of writing it as a ratio, you write it like a fraction.

KAREN FOLEY: OK.

CHARLOTTE WEBB: So I know that you did a little bit of work on fractions earlier so that's quite nice. So for example, if I go back to the elderflower cordial, I had 1 to 4 as a ratio. If I wanted to say what proportion of elderflower cordial I was using, then I would look at, well, how much is it out of the total?

So again, like we did with the sharing problem, you've got one part of elderflower and you've got four parts of water. So that's altogether five parts. So I can say that the proportion of elderflower is 1/5 and the proportion of fizzy water is 4/5. So it's basically turning ratios into a standalone figure. So you don't need to know what the other value is. You just need to know how much out of the total have you got.

KAREN FOLEY: Perfect. And when might this be appropriate to use when portioning things around?

CHARLOTTE WEBB: Proportions are useful in a number of situations. Again, if you're only interested in one particular ingredient, you might want to know the proportion rather than the ratio. But they're quite interchangeable, to be honest. You can use both of them in lots and lots of situations, like to do with mixing cement, to do with baking scones to do with any sort of cookery or measuring anything which you need to have a relationship.

KAREN FOLEY: And often, I've often seen these in the social sciences used to describe statistics, mental health statistics, et cetera. So people will often have 1 in 5 because instead of saying, there's a ratio of 1 to 4, if you think, well, there are five people in a room and one of them might have a mental health problem, for example, it can make it a lot easier for people to conceptualise.

And also, it's a lot easier to conceptualise than saying, 20% of people. So I guess all numbers and just ways of expressing them, even if the number's the same, have their place and are more appropriate than others.

So would you say then for some students, if they are looking at things like statistics and, for example, doing social sciences or STEM and they want to actually add some gravity to the argument, they might want to think about whether they're using a ratio or a proportion or even a percentage and think about how that would be expressed in terms of something that has significance, not significant, statistically but significance in terms of the point they're trying to make?

CHARLOTTE WEBB: Certainly, I think that if you can get something into a proportion, into a simple fraction, like you say, it's much more understandable to the general public and anyone who's reading it. So

where you don't want to use proportion is possibly when you've got quite a fiddly number.

So 17.5% you might leave as a percentage. But if it turns out to be 1/3 pretty exactly, then that's much clearer to everybody reading it. So it depends on the context again but it's definitely a really clever way to show something. And like you say, with mental health charities and cancer and all these health data, it gets used quite a lot.

KAREN FOLEY: My husband sometimes says I get things right out of proportion. Actually, I don't think that's possible so I might take him through some of this.

So we've talked about proportions and direct proportions and how those can change. And I guess that's quite useful if you're using recipes, isn't it, or doubling up on things. If you need to make a lot of cakes for something, like a Student Hub Life event, for example, you can then use these proportions to multiply things by numbers of things so that you can get more, can't you? And I guess, is that a bit of an easier trick if you do need to change your quantities?

CHARLOTTE WEBB: Certainly. If you can spot a relationship that you can, like you say, double it or triple it or times it by even 2 and 1/2, then yeah, it makes everything much easier to calculate. So you mentioned direct proportion. That's basically when as one thing gets bigger, the other thing gets bigger. So there's a direct relationship. So for example.

KAREN FOLEY: As you eat more cake, for example.

CHARLOTTE WEBB: That's not necessarily exactly direct but yeah, there is a correlation, I'd say, in that case. But things like presuming that the price of an orange doesn't change, you don't get a multi-buy deal or anything, then the more oranges you buy, the price is going to go up at a steady rate, the price per orange.

It's similar with things like converting euros to pounds. And also, like you said, ingredients, if I've got two potatoes for three people, then if I need to have six people, I'm doubling it. Or if I'm having five people, I have to think about what proportion, what fraction I need to times it by to get the exact number of potatoes that I need.

KAREN FOLEY: Mash them. But we'd had direct proportion and there's also something called "indirect proportion," isn't there?

CHARLOTTE WEBB: So indirect proportion is the opposite. So it's when one thing increases and the other thing decreases. So for example, the hours of work needed the more people you have, in theory, if

everybody's working at the same rate, then at the same proportion, it should decrease the amount of hours that it takes to do the job.

KAREN FOLEY: More hands make light work, isn't it?

CHARLOTTE WEBB: Exactly.

KAREN FOLEY: So we can see that those proportions go up and down and that these ratios are a fundamentalist part of that. But these also, as I intimated before, can be the same thing as percentages, although percentages are something entirely different. So we can say 1/5 or 4/5 could be, for example, 80% of something. So percentage is quite a different way of doing things.

What did you want to talk about in terms of how non-math students might use these? I think percentages is perhaps one of the most interesting things for non-math students and something that comes up a lot.

CHARLOTTE WEBB: Percentages, like ratio and proportion, come up in everyday life. So if you're looking at some food packets, you get proportion you get percentages, sorry, of fat, fibre, protein, all those kinds of things, and it's worth understanding what that actually means.

KAREN FOLEY: Let me see one of them.

CHARLOTTE WEBB: Yeah, sure. So I've got some oats. I was going to look at best bargains for different types of oats.

KAREN FOLEY: Oh, yeah.

CHARLOTTE WEBB: We've got here some proportions. We've got some percentages of sugar, fat, and things.

KAREN FOLEY: Now, these are quite common, actually, and again, about food labelling, you've often got consistencies in terms of how we measure things. So we've got the energy, the fat, the sugars, and saturated fat, et cetera, all on here. And those are on the same and I assume that the quantities are the same in terms of the number of fat and calories, et cetera, even though the bag's bigger.

CHARLOTTE Yes, I would assume so, as well.

WEBB:

KAREN FOLEY: Well, you should check that because like I find with those clementines, they're not always the same.

CHARLOTTE WEBB: No. No. Well, we can have a look at an example, perhaps. So I've got here some Wine Gums, which, obviously, you'd expect to have some sugar in. So we can have a look at how much sugar they actually have in them.

KAREN FOLEY: Oh my goodness.

CHARLOTTE WEBB: So I've got here a bag of 250 grammes of sweets, Wine Gums. And it says on there and like you say, most of the time, they do list what they've got in them but we can work it out for ourselves 17 and 1/2% sugar.

So what we want to do is try and work out, well, what is that in terms of grammes in the whole packet of sweets? Usually, they give you sometimes the figures for 100 grammes. But if you've got a bag of crisps that's actually 200 grammes, sometimes you look at it and think, oh, it's got that much fat in it.

KAREN FOLEY: Yes. We're having to be a lot stricter with some of this because now often, you'll have the number of grammes per bar, for example, and per percentage but not always. Yeah, OK. So in these super things, we've got 17% sugar, which is a lot.

CHARLOTTE WEBB: So we can work out how many grammes that is per bag. So as you said, percentage is a bit like a proportion but it's a proportion out of 100. So percent, which anyone who has done French or anything might recognise that little bit meaning "100." So we know that out of every 100 parts or grammes or whatever, 17 are sugar. So we can calculate how much exactly is in 250 grammes.

KAREN FOLEY: OK.

CHARLOTTE WEBB: So there's a couple of ways of doing this. We can use this fraction to help us. So the simplest way to do it is to find out what 1% is and then multiply up to 17. So to find out what 1% of 250 grammes is, we just need to divide by 100 because this represents a whole. This represents 100%. So 250/100 is going to give you 2.5.

KAREN FOLEY: Yeah, or we could just move the decimal place, can't we, that clever little trick?

CHARLOTTE WEBB: It's all to do with place value, yeah. So I know you looked at some hundredths earlier so yeah, it's all to do with place value. Exactly. And hopefully, you can dividing by 100, which is quite a nice thing about percentages. It's quite straightforward and it's quite nice.

KAREN FOLEY: Libby's got an answer already but I won't tell you what is. She's probably got a calculator. Who's got a calculator out there? I suppose it's not cheating if you're doing maths.

CHARLOTTE WEBB: To be honest, when you're doing percentages, most of the time, it is sensible to use a calculator, especially because a lot of them 17 or it might be something like 19.5 or 19.52 or something it's fine to use a calculator in those situations. So maybe we can see what answer Libby's got.

But what we would do is the second step. So this is worth 1% so I'll label that. This is worth 1% and what we want is 17%. So we're going to take that 1%, 2.5, and we're going to multiply it by 17. And we're going to get our total answer.

So this might be something you might want to use a calculator for. We can break it down. 2 times 17.

KAREN FOLEY: 34.

CHARLOTTE WEBB: 34.

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: I can maybe do some little calculations over here. And 0.5 times 17 is half, which would be 8 and 1/2 because 1/2 of 16 is 8 and it's halfway between.

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: So then we've got our answer, which is 42.5.

KAREN FOLEY: Well done, Libby and Kate.

CHARLOTTE WEBB: Yay. So well done, you two.

KAREN FOLEY: Excellent, two ticks.

CHARLOTTE WEBB: Sorry, one each.

KAREN FOLEY: OK, excellent.

CHARLOTTE WEBB: So we can work out a percentage of an amount and we can also go the other way. So we can say, if we have an amount, we can work out what the percentage is.

KAREN FOLEY: Yeah. So are you saying, like, when they say, like, 25% off discount or something like that?

CHARLOTTE WEBB: Well, that's another thing. That would still be calculating a percentage but that would be a decrease or an increase.

KAREN FOLEY: A decrease of a percentage.

CHARLOTTE WEBB: Yeah.

KAREN FOLEY: OK, brilliant. I'd like to cover some of those because we're running out of time, as we always do. These things go so quickly and it's so complicated. But often, in shops when you do have those decreases, they're something that you want to work out because often, whilst these are marked clearly on food packaging because we have to, sometimes when they say, 25% off, it's quite difficult to get to grips with that, as well. Can you give us a quick way of doing that?

CHARLOTTE WEBB: Yeah, of course. So it depends on the number, for example. So if you took a Trix, every time it says 50%, which you will know, that's half-price. 25% off

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: Well, there's two ways you can do it. You can work out a quarter of the total price because that's what 25% is equal to and subtract it.

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: Or you could straightaway work out, well, if it's 25% off, then that means I'm paying 75%.

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: So there's a couple of different ways that you can approach it.

KAREN FOLEY: And it's good to be able to do that heuristically, I think, and something we can often work out, even if we're just guesstimating. But what I find harder is where they say, like on a bottle of dishwashing liquid or something, 25% extra free because that's increasing something but it's not quite the same, is it?

CHARLOTTE WEBB: No. Again, quite often with packages, they don't necessarily tell you how much it was originally. So you can go backwards but in terms of working out an increase, so let's take an example of, say, let's see. What should we use?

We can use the oats. So say we've got here 500 grammes of oats and it says, 25% extra free. Normally, it's 500 grammes. Then what you can do is work out what 25% of 500 is and add it on. So in the same way as before, you can do 500/100 and times that by your 25 and you can add it on.

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: There are other ways of doing it, which are

KAREN FOLEY: I was just about to say, it's interesting because I would have worked out what 25% of 500 was. So I would have gone 2,500/4 equals 125.

One of the things that my students used to really worry about in particular, science students started very early on, is there a right or wrong way of doing this? If we both get to the same answer, is there a better or worse way of thinking about these things?

CHARLOTTE WEBB: I think it all depends on the question. So 25% I showed you the longer way in this sense, just because then you can apply to any other percentage, 13% or something like that. But 25% we know is a quarter. So when you're trying to work things out quickly, obviously, it's a lot easier to do it by dividing it by 4. But if you find it easier to do it this way, that's perfectly fine.

KAREN FOLEY: But it's good, I guess, to know both ways because, like you say, if it gets more complicated, you might think actually working it out that way is not going to work so I need to actually do it the more sensible, long-winded way so that you can then convert things appropriately.

CHARLOTTE WEBB: And there are other ways. There are lots of other ways which are included in the Maths Help module. So you can also think about the fact that if you've got 25% extra, then what you've actually got is 125%.

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: So you could actually calculate, well, what's 125% of 500? And so you could do it in one step and that's a little bit quicker. It's maybe a little bit harder to understand to start with but if you can find 25%, you can find 125% exactly the same way. You would just take the 5 and times it by 125. So it'll give you the same answer.

KAREN FOLEY: So let's check whether everyone at home has got this because we've got a widget about the price of a handbag and it's called "What is the Percentage Discount?" And the question is, "If a handbag is priced at 200 pounds and it's sold at 160 pounds, what then is the percentage discount?" And your choices are 40%, 25%, 20%, and 22%.

So vote now using the widget. Select which you think is the correct answer and then you can close that and see what everyone else thinks. And let's see if you got it right. And if you can't do that or you don't want to, you can type it in the Chat, as well.

So let's see. This handbag then, how do we work this out?

CHARLOTTE WEBB: It would be good to go through this one because this one's slightly different to the other examples we've done because we're talking here about discount. And we're trying to work out, which we haven't done yet, actually what the percentage is from the amount, rather than calculating the percentage.

KAREN FOLEY: Of the amount. Yes.

CHARLOTTE WEBB: So what we need to do, first of all, well, it's a discount and it's asking, what's the percentage discount? So first of all, we just need to know what the discount is in pounds. So I can see that it was 200 pounds and it's now 160 pounds so the discount is 40 pounds.

KAREN FOLEY: Right.

CHARLOTTE WEBB: Fine.

KAREN FOLEY: 40 Pounds.

CHARLOTTE WEBB: So I know I've got a discount of 40 pounds. But I need to turn that into a percentage. So this links quite closely actually with proportion, in a way, because we're looking at fractions and it links to what you were doing earlier with Susanne.

We've got 40% off and we want to know what percentage of the original amount have I had as a discount. So I can turn that into a fraction. So I've got 40 pounds off divided by 200. So "divided by" is another way of saying "out of," which is how it links to proportion so 40 pounds out of the original 200 pounds that it was going to cost.

And then because I want to make it into a percentage, this is going to give me a decimal, I'm going to multiply by 100 because I want it out of percent. So I don't know if anybody's managed to have a go at working that out yet.

KAREN FOLEY: I don't know. Let's see. Evaghn, has anybody put an answer in?

EVAGHN: Yeah. Kate's got 20%.

CHARLOTTE WEBB: OK. Fabulous.

KAREN FOLEY: Anyone else?

[EVAGHN CLICKS TONGUE]

EVAGHN: Not currently, no.

KAREN FOLEY: No? OK.

EVAGHN: I think the widgets are displayed in there.

KAREN FOLEY: Well, so far, the widget is 86% of people saying 20%.

CHARLOTTE WEBB: Fab. Yeah. So obviously, I haven't finished it off but you've managed to do that, which is brilliant. What I would do to make things easier is start doing some cancelling. So I can see this is dividing by 100 and this is timesing by 100.

So I would just get rid of those. And then I've ended up with

KAREN FOLEY: 40 Out of

CHARLOTTE WEBB: 40/2, Which gives me my 20%.

KAREN FOLEY: Perfect.

CHARLOTTE WEBB: So to break down what I did, instead of dividing by 200, which would give me a decimal, and then multiplying by 100, I know that these will cancel out. This is a divide by 100 and this is times by 100. So I've got rid of them and made my life easier.

KAREN FOLEY: I'm clearly not a maths person. I would have lopped off those two and then gone 40 out to 20

CHARLOTTE WEBB: Well, that's fine, as well.

KAREN FOLEY: And then made that into a 1 out of 5 just transferred it.

CHARLOTTE WEBB: Perfectly.

KAREN FOLEY: But clearly, this is a problem with being a psychologist, I think.

CHARLOTTE WEBB: No, no, that's a perfectly good way to do it. To be honest, mathematicians are notoriously lazy and trying to find quick ways. So if I can see something that cancels quickly, I'll do it. But there's lots and lots of ways to do it. So your way's good, as well.

KAREN FOLEY: OK, brilliant. Now, Charlotte, we're running out of time, as we do with every single session, and I know that you prepared something for squares. Can we do it in one minute or do you think we should leave the students to do that at home? What would you prefer?

CHARLOTTE WEBB: I think we can just talk about what squares are, perhaps, because it's a big topic in a sense to try and squish into a few minutes.

KAREN FOLEY: We all know they're part of that flapjack, aren't they?

CHARLOTTE WEBB: Well, yeah, exactly. So a lot of people wonder what's the point of square numbers and cube numbers and powers in real life.

KAREN FOLEY: Yeah, what is the point.

CHARLOTTE And what we use them for. Well, there are lots of different answers to that question. We have

WEBB: lots of STEM students listening. If you're going to do any calculations with moles and things with chemistry, you're going to be using scientific notation. You're going to be using things like times 10 to the power of whatever. So that's a power.

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: And equally, if anyone does anything like microbiology, you're going to be looking at very, very small numbers. So you might look at something like times 10 to the minus something and that's going to help you with very, very, very small numbers. So the scientists will certainly use powers and this sort of notation.

In everyday life, we use squares in all sorts of things. So for example, I'm sure when this was constructed, we've got lots of different areas and we've got lots of different bits of materials that are going to be using squares in them.

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: If you're calculating anything to do with your carpet or your tiles.

KAREN FOLEY: Yeah, absolutely.

CHARLOTTE WEBB: Or anything.

KAREN FOLEY: It's really important when you go to the carpet shop and you think, well, how big is my actual lounge? And then it's one of those things where you need to work out a price quite quickly. I struggle with that.

CHARLOTTE WEBB: And it's all in square numbers. And then if you go into anything 3D, you're going to be looking at cubes, metres cubed and things like that.

KAREN FOLEY: So how might you work that out then if we were looking at carpets? What's the quick way of doing it? Is it literally a 4 by 3, 4 times 3 type deal?

CHARLOTTE WEBB: Yeah. That's looking more at area, I suppose, but essentially, squares are just numbers which are times by themselves. So if we just take some basic examples, 6 squared is just 6 times 6, which is 36. And some of you may know all of your square numbers from the whole numbers.

But you can also do things like 1/2 squared. I've put a bracket on there just to show that the whole fraction is squared. And again, that's just 1/2 times 1/2. And I'm not sure if you did multiplying fractions earlier but this is something you might want to work on at home. But with fractions, when you multiply them, you just multiply the numerators and the denominators. So you can do square numbers with fractions.

KAREN FOLEY: So it's actually smaller here when you're squaring it.

CHARLOTTE WEBB: That's an interesting comment that you've made. Yeah. So one of the questions that I posed for the widgets was whether square numbers always get bigger. And when you've got whole numbers, because you're multiplying, even if it's something like 5.2, you're always going to get a bigger number.

You're multiplying by 5.2, it's going to get 5.2 times bigger. Even with negative numbers, actually, if you multiply a negative number by itself.

KAREN FOLEY: So let's ask this then for the question with the negative numbers because the widget is, is it true or false? So with negative numbers, what's the question then?

CHARLOTTE WEBB: So the question is, when you square any number, is the answer always bigger? And if we're going in the comment books, it would be nice to have some examples. If it's not always true, when is it not true?

KAREN FOLEY: OK.

CHARLOTTE WEBB: When does squaring a number make it smaller?

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: Or what happens with negative numbers when you square them?

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: What happens with decimals?

KAREN FOLEY: Yeah.

CHARLOTTE WEBB: What happens with fractions?

KAREN FOLEY: OK.

CHARLOTTE WEBB: They would all be good things for us to.

KAREN FOLEY: Find out about.

CHARLOTTE WEBB: Yeah.

KAREN FOLEY: Well, the widget balance is swinging at the moment so let's hope it steadies up soon.

CHARLOTTE WEBB: I expected it to. I thought it's quite an interesting thing to talk about. So I'd quite like to hear some comments about why people have chosen either answer.

KAREN FOLEY: Would you like to see where we'll settle on it for now. Let's see what people said. Well, actually, it's in the middle. So we've got slightly more saying it's false and slightly less saying it's true. So what is right then?

CHARLOTTE WEBB: Right. Well, you gave a bit of an example there, which is that when you get a fraction, you're multiplying by something less than 1. Then you're making something smaller.

KAREN FOLEY: OK.

CHARLOTTE WEBB: If I halve something, I'm making it smaller. So if I times something by 1/2, that's the same as halving something. So if we take this example here, 1/3 times 1/3, well, what I'm doing to the original number, because that's the question is I'm multiplying it by 1/3. And 1/3 means basically the same as dividing by 3.

KAREN FOLEY: Libby and Laura both say that fractions get smaller when you multiply them.

CHARLOTTE WEBB: They are exactly right. That's exactly true. Well, it is true for fractions, although, actually, if you have a fraction that's bigger than 1, then it's not true. But they are right that it's anything that's smaller than 1.

KAREN FOLEY: Because we often think of fractions as being less than 1, don't we?

CHARLOTTE WEBB: Yeah.

KAREN FOLEY: But actually, that's a good point.

CHARLOTTE WEBB: Yeah. We have these improper fractions where you've got the numerator larger. And in that case, it is actually bigger than 1 so you're actually, for example, here, you're multiplying by 1 and 1/2. So you are still making it bigger. But they're very correct in saying that a fraction that's smaller than 1 will indeed get smaller.

What about negative numbers? What do you think might happen with negative numbers?

KAREN FOLEY: So minus 2 squared so you're going minus 2 times minus 2. And when you minus and minus, you're getting a positive, aren't you?

CHARLOTTE WEBB: Correct. So even negative numbers, if they're bigger than 1

KAREN FOLEY: There's a way around it. They can be positive, too.

CHARLOTTE WEBB: Yes. Yes. Even negative numbers, if you square them, then they will give you a positive, larger number, unless, of course, they're a negative, very small fraction.

KAREN FOLEY: Excellent. Well, Charlotte, thank you so much for covering all that. We've got through a lot and lot of content and I think it's fair to say you've made it a lot easier for people. And there have certainly been some pennies dropping so thank you so much for coming along today with your bag of groceries and showing us all of these various tricks.

The elderflower cordial, I do crave an elderflower cordial right now. But thank you very much, Charlotte, for coming on. HJ and Evaghn, before I introduce our next guest, how's everything going?

EVAGHN: Yeah. In general

KAREN FOLEY: Are they tired of doing the maths? Yes, it's a brain fatigue?

EVAGHN: Yeah.

KAREN FOLEY: What percent

EVAGHN: For me a little bit but I think it's nice to see that everyone's generally getting the correct answers. And if not, people are helping them out to understand it. I think it also helps if you add stories. So when you're talking about drinks or you're talking about food or you try and apply it to everyday life, that helps, as well.

HJ: I think when we were talking about proportions, Stuart was applying it to everyday life because he says as long as he gets the biggest proportion, he's happy when it comes to cake. So I agree with that one. And yes, and I see people gaining confidence. Kate was confident using proportions, as well.

And Paula said earlier that the penny was slowly dropping. So hopefully, it would have fully dropped now, less slow. Or if there's anything that you need help with, I'm going to be asking mathematicians later for some more help on this, perhaps some homework.

EVAGHN: Yeah. No, so it's going well. And Carrie says, she's eaten 100% of her month to munch. She's just been concentrating so hard. So yeah.

KAREN FOLEY: Oh, that's brilliant. And I'm glad everyone's doing well and eating because it's coming up to lunchtime soon so I expect that our attention will turn to food. But before it does, we've got a lot of charts to get through. Now, charts and diagrams and figures and all these things will come up in your module materials very, very often.

And they're such a great source of information, as well. If you're writing an essay, for example, some students will think, well, how can I include this figure? I can't chuck it in there because my teacher will literally have something to say about that. I certainly would because you can't include things like that but they do have a lot of information in them that you can then use.

So Sue is my next guest. Welcome, Sue. We're going to talk about diagrams, charts, and graphs, which are the next modules in our Maths Help section, and having a look at really how we can actually use some of this data and how we can make sense of it and how we can write about it confidently.

SUSAN PAWLEY: Oh, definitely, yes. What you find is that you find tables and charts and graphs and everything in everything you see. And I've brought you some biscuits.

KAREN FOLEY: Oh, lovely. I'm so glad you brought me some biscuits.

SUSAN PAWLEY: I know. It's good. It's getting near lunchtime, is it? It's getting a bit peckish.

KAREN FOLEY: Oh, and Jaffa Cakes!

SUSAN PAWLEY: Jaffa Cakes.

KAREN FOLEY: They're a Student Hub favourite. Oh, I didn't know we had a Student Hub Live brand of Jaffa Cakes now.

SUSAN PAWLEY: Student Hub Live brand of everything and what you find is on all foods, as

KAREN FOLEY: Charlotte was saying.

SUSAN PAWLEY: Charlotte's saying before, you will find tables of everything. And I'm really interesting.

KAREN FOLEY: Because Jaffa Cakes are one of the lowest-fat biscuits, I find.

SUSAN PAWLEY: They are, aren't they? They're a good general staple. You can eat them whenever you want.

KAREN FOLEY: Brilliant.

SUSAN PAWLEY: And there you go. And so what you find is you tend to find the information in different categories. So you need to actually be really careful when you read the tables as to what you want.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: So tables can give quite good sets of information. Looking at the table we've got here, right. Hold on.

KAREN FOLEY: Yeah. If you just forward up.

SUSAN PAWLEY: There we go.

KAREN FOLEY: Forward that way.

SUSAN PAWLEY: Fantastic. There we go. We've got a table here of the change of sizes in the households in Great Britain over a period of 30 years. So they're looking at the different number of peoples in the house every 10 years. So what we have the tables for is really just so we can look at the information and see what we can get from it. And then we can write something about it.

So what do you think, Karen? If you looked at this table of information, what do you see from it? What's the most important thing you see, first of all? What would you say?

KAREN FOLEY: Well, I always look at things and think about the title. And I first try and make sense of what it is trying to measure. So this is about change in households over a period of 30 years so I'd start looking at seeing how they've broken things down. They seem to have done it in pretty much 10-year age groups.

Looking at the number of people per house, that all seems to make sense. Number of houses surveyed. I guess that's just to do with the sample, isn't it? So I'd start looking at where the big numbers were here. This is what I'd do. But I'm aware that my maths isn't always the right way.

So I start looking at things and saying, well, most people, I guess, have two or more people in the house. It seems to be a bit bigger than that. So I'd look at how you could section it, I suppose.

SUSAN PAWLEY: Yeah, that's right. You can do it. If you look, for example, at the number of houses with only one person in. you can see actually between 1961 and 1991, there's a definite increase in the number of people, whereas the number of two people in the house has stayed fairly similar but has increased slightly. However, the number of larger households have decreased quite a lot.

KAREN FOLEY: Yes.

SUSAN PAWLEY: And see, the number of people with six or more in a household has actually gone from 7% down to 2%. And that's quite an interesting figure and that's a look at the social demographics of the range of the different time eras.

And if you think about it, how back in the 1960s, you would stay at home with mum and dad until you got married and then you'd move out at that point, so there were a lot of larger households and a lot of less certainly one-bedroom, one-person households, whereas nowadays, you get a lot higher now.

KAREN FOLEY: So if you were doing, say, social sciences, where it would be very common to look at this sort of demographic, would you recommend then that people are looking at trends, grouping things? We've been looking at how you can translate data into various sort of other concepts, like ratios or proportions as opposed to the percentages that we have here.

How would you suggest that people could make the most use of a graph like this? Is it looking at the trends and thinking about how that physically is represented in terms of the population?

SUSAN PAWLEY: Yeah, I think so. I think you need to look at the numbers and actually work out what information you can pull out of it. So it is really interesting looking at things like, you can say that well, actually, in general, most people are in households of two or one person. So there are still actually quite small households, whereas maybe from the 1960s, there was more likely to be two or three people in the household.

So you're looking at mum, dad, and one kid maybe, whereas nowadays, it's more likely just to be two people, flat sharers, husband and wife, maybe even someone on their own is a lot more likely. So you can pull out real bits of information like that and actually write something just from this data alone.

KAREN FOLEY: Actually, this is a very good point you make because you're making some assumptions there about who these people might be. And often on the graph, we'll see who was surveyed or maybe we don't know who was surveyed. So it might be that this is adults. It might be this is children. Do you know what I mean?

SUSAN PAWLEY: Yeah.

KAREN FOLEY: So this is number of people so one might assume then that it was adults and children or any sort of living person within that household. But sometimes, it can be adults. And it's always important to think about what units people are actually basing some of these on when you're describing them and not making assumptions but describing what data is actually in the chart, as opposed to what you think it might be when you're starting to visualise it. It's that balance, isn't it?

SUSAN PAWLEY: It is. You've got to be very careful that you don't draw out completely fake information, that you don't take an assumption that doesn't work out to be. true. Another thing, as well, you can look at, as well, is we look down here. That's the number of households surveyed. And so in 1961, they surveyed 16.3 million households.

Now, you can actually take that number and use your percentage and then you can actually work out how many people that actually means. So for example, if we look at 1991, they surveyed 22.4 million households. So if we look at, say, the number of, all right, so the number of people that, so the percentage that actually have four people in the house was 16%.

So if we want to work out exactly how many people that was, we multiply the number of

households surveyed by 16 and that will give us a number of actual households that have four people in them. What you can actually then actually do with a little bit of searching on the internet which is really good because you can actually use different bits of information.

You don't have to rely on just your table. As long as you reference the other information you can use, you can use it, you actually find that this isn't just the number of households surveyed. This is actually the number of households in Great Britain at the time.

So not only are you just looking at a proportion of the population. You can actually then say, not exactly because obviously, we've averaged the number of households but we can say approximately how many households actually had that number of people in them in Great Britain in that time.

KAREN FOLEY: Now, this is interesting, Sue, because we asked our audience how confident they are with reading data and how confident they are with interpreting data. So there's one small change there in the question. Now, most of them are saying that they feel quite confident with reading the data but it's the interpreting the data that they're less confident with.

However, I've noticed that they're very good at maths and they're very good at making these conversions and they've been getting everything right. So what is the difficulty then with making these interpretations? Why might some students, do you think, feel less confident about the actual interpreting side of things?

SUSAN PAWLEY: I think, to be honest, it's just very hard to see things. Things like these tables, they're very dry, aren't they? You look at them and actually, they're just a set of numbers and you're trying to work out the relationship between these numbers and actually what you're looking at.

So one of the things we can do actually with looking at numbers and tables is we can take the information from a table and we can actually put them into a form of a chart, a graph, something a lot more visual, something you can look at and actually get your hands on and see how it feels. So if we go through on to there, one of the things we can do with information is we could turn them into a pie chart. Yeah?

KAREN FOLEY: Yes.

SUSAN PAWLEY: We can use this when we want to look at a whole of something and see how it's split up.

KAREN FOLEY: Now, these are good because we've got quite a lot of students out there who are real Excel

wizards. Wizards, is that accurate or not? I'm not sure but they're using Excel a lot to do calculations. And one of the things I love about Excel is you can just hover over the chart and get all sorts of different charts. So you could type up a table like this and you could look at things in different ways, couldn't you?

SUSAN PAWLEY: You can do, yeah. What you need to make sure is that from the information you've collected, you're using the correct table. You're using the correct chart that actually helps you display that information in the most accurate way and the most visually helpful way.

KAREN FOLEY: You couldn't just cut and paste that into a pie chart, for example, but you can collate things and get them into proportions, can't you?

SUSAN PAWLEY: You can do, yeah. With pie charts, the easiest way to look at it is if you want to actually explain how you've split something up, so if you are looking at percentages, you could take one year of the households that we were looking at earlier and look how each of the different number of people in the households were split up for that one year.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: And that would be displayed really well in a pie chart. And then you could see which sample was the biggest so which different household has the most number of people in, or sorry, which had the largest proportion of people, whereas you couldn't necessarily explain the information if you were looking at the different years. You would have to use a different sort of chart for that, which we'll come on to later.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: So at the moment here, we're looking at some pie charts here and they're really good at showing how you can split things up. And if you look at this chart here, we can see that on an average weekly spent something, go on again. Karen, what would you draw from this?

KAREN FOLEY: Right. OK. I would draw from this the largest proportion of things is the groceries that people are spending on

SUSAN PAWLEY: Yeah.

KAREN FOLEY: And followed by the meat and fish.

SUSAN PAWLEY: Mm-hm.

KAREN FOLEY: And fruit and vegetables has been sectioned out so I imagine someone will be talking about that for some reason.

SUSAN PAWLEY: Mm-hm.

KAREN FOLEY: But it seems to me, as well, that if you're looking at things and gross alcohol, it's not clear whether that's out or in. But a lot of stuff seems to be, they seem to be spending a lot more in than out. So the meals out is only 12.4%, so 85% of stuff I would assume that was being spent at home or not out, not going out entertaining.

SUSAN PAWLEY: Mm. Yes. Yeah, that's some good things to draw out of that. You can go further than that, though, actually. You can start comparing the sizes. And because these are all drawn in proportion, then it means you can actually look at the size of your wedge.

KAREN FOLEY: Yes.

SUSAN PAWLEY: And you can actually think about it. And if you look at the size of maybe the fruit and veg wedge, then you can see it's actually about a third of the grocery budget. So you could fit three of these into your groceries.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: Can you see that? Is that good?

KAREN FOLEY: Yes.

SUSAN PAWLEY: And also, it's not quite but it's about half the size of the meat and fish. So it's a really good way of visually showing the different sizes of different things. So it's very easy now to say that you spend three times as much on groceries as you would do on fruit and veg.

KAREN FOLEY: You could also, I guess, start looking at those and thinking then about where you would cut them and which distinctions or which categories you might group together to show what people are mainly doing, couldn't you?

SUSAN PAWLEY: You would do, yeah, because if you look at it another way, actually, you can see that it's almost it's not quite but it's almost a straight line straight down the middle here.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: So you could almost say that actually, half of people's spending is on groceries and alcohol.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: And the other half is being on meals out, fruit and veg, and meat and fish.

KAREN FOLEY: What are they doing with the meat and fish, though? I don't know if it's not in the grocery section.

SUSAN PAWLEY: Yeah, I was trying to wok out that, you see. And that's another thing that you need to think about when you're drawing these charts is you need to actually think about how your information's conveyed because this is a chart we've picked up off of the Maths Help site. And so we only had the information that Maths Help site gave us.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: And I've been certainly trying to work out what is groceries if it's not fruit and veg or meat and fish.

KAREN FOLEY: And I would put alcohol in my groceries.

SUSAN PAWLEY: Oh, yeah. You definitely got to have that bottle of vodka in there, haven't you?

KAREN FOLEY: Yeah. I would always put it. My dad also put it in meals out.

[LAUGHTER]

SUSAN PAWLEY: You can have a quick coffee out while you're doing your shopping.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: That's in the groceries.

KAREN FOLEY: Yes, exactly. So these categories really matter in terms of how we're spending

SUSAN PAWLEY: They do

KAREN FOLEY: How we're doing things.

SUSAN PAWLEY: So you always need to look behind the figures, as well, just to see how it's all being made up.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: My assumption is things like the groceries are more things like your washing powder and your tinned food and things like that.

KAREN FOLEY: Yeah. But this, I guess, would be important and maybe this is one of the reasons that people can read all of this and they can guess it. But it's when you're interpreting it. It's being very objective with the information that you've got there and not trying to, as you say, make too many assumptions.

SUSAN PAWLEY: Oh, definitely. Yeah.

KAREN FOLEY: So we can't say that they spend more in or out because we don't know whether the alcohol, meat or fish, or fruit and vegetables is in or out.

SUSAN PAWLEY: Yeah.

KAREN FOLEY: We don't even know what's constituting groceries if it's not those two. So when we were maybe making discussions of text-based comments about some of these graphs, what might be some of the things that we could accurately say about this chart?

SUSAN PAWLEY: Yeah. It's one of those things, isn't it? They say, there's lies, lies, and statistics, don't they?

KAREN FOLEY: Yeah.

SUSAN PAWLEY: So you do have to be really careful what you say. So what could we say about this chart? Those are the very basic things, like we were looking at to start with you. But groceries is about a third of the average cost.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: And then again, we can look again, like we said, about how things are made up. But you can stick to very number-based discussions. So you can say that obviously, you need to spend more on groceries because that's how people spend it.

KAREN FOLEY: Yeah

SUSAN PAWLEY: And also meat and fish. If you have a look at the next chart, there's not the numbers that were involved here and then you can start actually looking at the sizes of things.

KAREN FOLEY: Yeah. HJ and Evaghn, are you getting to grips with this pie chart idea?

HJ: I think we are.

EVAGHN: Yeah, we're working on it. So if you look at this pie over here, the brown bit is, with reference to Libby, the pie that I have not eaten. And the smaller bit in the middle is the small bit that I have eaten.

KAREN FOLEY: All right.

EVAGHN: But I will be working on it the rest of the afternoon.

KAREN FOLEY: Working on it as in eating more of it?

EVAGHN: Yeah. Yeah, you can say that.

KAREN FOLEY: That's a very nice pie chart. OK. Well, that's another way of looking at things, I suppose. Thank you, Evaghn.

SUSAN PAWLEY: At least, yeah, we have pizza down here, which is a good way of looking at things here.

KAREN FOLEY: It is, yes.

SUSAN PAWLEY: And the pizza has each been divided into equal-sized segments. So you can look at studying about how the segments can combine to make up wholes. So what about this one here then. On the spot again.

KAREN FOLEY: Proportions are, I don't know. I'm frazzled after doing all of these. Proportions of people living in different kinds of accommodations in a particular town. Interpret what the pie chart indicates by estimating the percentage of people in each category.

SUSAN PAWLEY: Yeah.

KAREN FOLEY: So we're making inferences here, aren't we, because we're starting to look at who might live in one of these things and what might happen. We could say a detached house might have a family in it because they're really good if you like screaming at your children, whereas a terraced house may suit more urban people. It may suit couples.

But I don't know. I am very conscious that I'm making lots of assumptions. And actually, I don't really think many of them hold because some people live in a detached house on their own.

SUSAN PAWLEY: Yeah. So let's pare it back again and just look at the figures. So what can we say from this pie

chart? What we can say is about a third of people live in some detached housing.

KAREN FOLEY: Yeah, because if you section it like this, it's about a third, isn't it?

SUSAN PAWLEY: Yeah, because if you look, there's three main segments. There's the semi-detached housing, there's the terraced housing, and there's the other three.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: Yeah? And they're all about roughly split into thirds.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: So we can start making some rough assumptions. About a third of people live in some detached housing.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: And probably about a third of people live in terraced housing.

KAREN FOLEY: Yes.

SUSAN PAWLEY: Yeah. So obviously, there's a lot more semi-detached housing around than there are terraced housing.

KAREN FOLEY: Yes

SUSAN PAWLEY: Because there's a lot more people that live in them. And then we look at the other three and we try and work out. So going back to Charlotte's percentages.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: We've got about 33% that live in semi-detached housing, probably slightly less in terraced housing so maybe be about 30% but still roughly a third. And then we're looking at the other three and we want to think about how these wedges are split up. Any guesses? Which one looks bigger? Which one looks smallest?

KAREN FOLEY: Well, the smallest is the other to me.

SUSAN PAWLEY: Mm-hm. Yeah.

KAREN FOLEY: I was just thinking I completely misread that question, as well, by the way. So yeah, the smallest one seems to be, in order of appearance, it seems to be the other, then the purpose-built maisonette, then the detached house, then terraced, then semi-detached.

SUSAN PAWLEY: Yeah.

KAREN FOLEY: And also, split in half, you've got the detached and semi-detached. So houses could be one side, whereas more smaller accommodation could be half, as well.

SUSAN PAWLEY: Yeah, that's a very good interpretation. If we look at just the red, the yellow, and the green here, the three that we've left in our last third that we haven't really looked at yet, having a look, I'd say probably the detached housing takes up almost half of that proportion.

KAREN FOLEY: OK. Yeah, I'd go with that.

SUSAN PAWLEY: So yeah?

KAREN FOLEY: Maybe a bit under, but yeah.

SUSAN PAWLEY: Maybe a bit under, so we're looking at these two roughly take up about a third each. So maybe they take up roughly about 6% each.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: So if we're looking at this last section here, it takes up about 40%.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: This is more or less half the size of it. So that would be about 20%?

KAREN FOLEY: 20%, Yeah.

SUSAN PAWLEY: And then we got a split between the last two. And so maybe we're looking at we're going to split the last 20% between the last two. So what do you reckon? About 7% and 13%, maybe?

KAREN FOLEY: Yeah.

SUSAN PAWLEY: Something like that?

KAREN FOLEY: Yeah.

SUSAN PAWLEY: Yeah?

KAREN FOLEY: Yeah.

SUSAN PAWLEY: Yeah. So we're looking at definitely the largest, then this next, down, down, and then the smallest. And so we can then start building up a look at the sorts of houses people live in, that the other houses are very small and the most popular houses are semi-detached.

KAREN FOLEY: Mm-hm.

SUSAN PAWLEY: And that's one form of drawing a pie chart.

KAREN FOLEY: So if we were describing this discursively, we might then start to look at some of this data and make comparisons or groups between things. Where we've been looking is to try to attribute a numerical figure to each of these because there aren't the numbers indicated on there. How important would that be?

Or if you, for instance, met a graph like this in your studies, would you try to do that? Yes. Yeah, or a bungalow. In your bungalow, if you found a graph like this, what would you do? So would you need to necessarily think about that or could you just do it very heuristically and just say, most people are followed by this or about half? Or how would you start to work with that?

SUSAN PAWLEY: I think it depends very much on what you need to say, really. You can talk very descriptively about, like we said, most people live in semi-detached housing or terraced housing. But it's sometimes nicer just to start building in just a few numbers, a few figures, just so you can actually picture what that "most" means.

KAREN FOLEY: And if you weren't sure because we've been looking at different ways of saying the same thing. So if you weren't sure whether that was 7%, for example, you could start using maybe fractions or something that was a little bit more vague, couldn't you?

SUSAN PAWLEY: Yeah. Or you can just easily say "approximately."

KAREN FOLEY: Yeah.

SUSAN PAWLEY: Or this is the least. This is the smallest portion.

KAREN FOLEY: Just slightly half of the section or whatever.

SUSAN PAWLEY: Yeah. Just under half you use the language that you feel familiar with, that you feel happy

with. And if you're not happy using percentages and you're not happy using fractions, then you can talk about the biggest wedges, that the semi-detached housing is three times the size of the other housing. And you can talk about things like that a lot more. You can talk about, it's a great game of Trivial Pursuit, as well.

KAREN FOLEY: Yeah. Just thinking about the just under half, it brings me back to the whole Brexit thing, where just under half actually meant a huge thing.

SUSAN PAWLEY: Yes. Yeah, it can mean everything in terms of voting, when it's all or nothing.

KAREN FOLEY: Absolutely, but a nice way to describe part housing, nonetheless.

SUSAN PAWLEY: Yes, definitely.

KAREN FOLEY: OK, excellent. So we've had a various look at some of those things and we've also been asking people which age range they're in. So if you haven't had a chance to tell us which age bracket you're in, then do do that because we're going to take a look at some bar charts, aren't we, as well.

SUSAN PAWLEY: We are. Yeah. So as we were saying earlier, pie charts are brilliant when you want to show how things are split up, when you've got a whole and you want to split it up into different segments.

But if you actually want to look at something like comparing how far different planets are away from the Earth or something like that, well, you can't split that up in any way because at different certain sets of dates, you'll say that one planet is x miles away and another planet is further. And so you need to find a way of showing that graphically because it's so much easier to see in a chart than if you've just got the numbers written down.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: And if we do things like that, we can actually start using charts.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: And here's one I prepared earlier, LEGO.

KAREN FOLEY: Brilliant. Excellent. So we asked people which percentage age range they were and we've got a chart. So let's see what people at home said in terms of the age ranges. So we've got 18 to

24, we've got 13%.

25 To 34, we've got 20%. 35 to 45 is 27%, 45 to 55 is 27%, and 55 plus is 13%. I don't like that 55 plus because it seems very broad, doesn't it? Progressively closer.

SUSAN PAWLEY: Ladies never disclose their true age.

KAREN FOLEY: No, exactly.

SUSAN PAWLEY: We're all 25 really, aren't we?

KAREN FOLEY: Indeed. Indeed. So we've got this nice spread, nice bell-shaped curve, which is very nice and very representative.

SUSAN PAWLEY: It is. So from our charts, we can actually look at it. So we're going to have to approximate because obviously, we've only got bricks. And so we can only

KAREN FOLEY: And you've got a nice thing underneath. I see you've labelled clearly for each thing. So that's good.

SUSAN PAWLEY: So our 18 to 24 age group, you said that was about 13%.

KAREN FOLEY: That's about 13%. Yes.

SUSAN PAWLEY: So let's think. So if we use that to be

KAREN FOLEY: I've written them down, clever.

SUSAN PAWLEY: I thought it was your memory.

KAREN FOLEY: No.

[LAUGHTER]

I'm focused on pizza, I'm afraid.

SUSAN PAWLEY: Oh, yeah, I know. It's lingering there in the corner, isn't it? Oh my god, pizza. Right. And so we have a block that's 18 to 24%.

KAREN FOLEY: Yes.

SUSAN PAWLEY: So if we use just one block to indicate about every 10%

KAREN FOLEY: Perfect. I think that's a good idea.

SUSAN PAWLEY: So 13% is closest to 10.

KAREN FOLEY: We're rounding.

SUSAN PAWLEY: We're rounding. Yeah. You did that one earlier, didn't you?

KAREN FOLEY: Yeah, a little bit. Yeah.

SUSAN PAWLEY: So we're going round to 10%. So our 18 to 24s are in 10%. So we're at 25 to

KAREN FOLEY: Then we have 25 to 34, which is 20%.

SUSAN PAWLEY: 20%. Oh, that's easy. That will be two bricks.

KAREN FOLEY: Perfect. Then 35 to 45 is 27%. So that's three, I think.

SUSAN PAWLEY: Yeah, I'd go for three. About 27 is closer to 30, isn't it? Yeah.

KAREN FOLEY: And again, rounding up to three bricks for 45 to 55 - 27%.

SUSAN PAWLEY: Ah.

KAREN FOLEY: This is interesting, actually. Do you know that we've got so many.

SUSAN PAWLEY: We're missing an age range here.

KAREN FOLEY: Are we?

SUSAN PAWLEY: You are. Right.

KAREN FOLEY: Use a different colour, maybe.

SUSAN PAWLEY: We will have to use this colour.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: Right, because I'm not touching. Then we can use the same colour again.

KAREN FOLEY: Exactly. Yes, you can, can't you?

SUSAN PAWLEY: So what was that?

KAREN FOLEY: So that's 27% again 45 to 55. And then 55 is 13%, so maybe one block for that.

SUSAN PAWLEY: And then so we're back down to our 55, which is one block.

KAREN FOLEY: So a very nice distribution, do you know OU students are getting a lot younger and a lot more in a full-time mark at the moment, as well?

SUSAN PAWLEY: They are, yes.

KAREN FOLEY: So our demographics are shifting massively, which is, again, why it's important to look at these things.

SUSAN PAWLEY: Yeah, definitely. Over the years I've been teaching, when I started teaching, you'd definitely have a larger demographic in that 55-plus bracket.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: And now we're moving down a lot more and we're seeing a lot more people that are looking for changes of career.

KAREN FOLEY: Yeah, absolutely. So we've made a nice bar chart very easily.

SUSAN PAWLEY: We've made a nice bar chart, which means that now we've got our bar chart here, you can very easily see how they step up and then they drop off very suddenly at the end, whereas maybe from the figures, that wouldn't be quite so apparent how big a jump it is between the last two age ranges.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: So just by displaying it very physically, you can actually get a lot more information from it.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: And you can say, well, from the 18-year-olds, they tail up quite nicely and then there's this sudden drop.

KAREN FOLEY: Mm-hm.

SUSAN PAWLEY: Now, as you'll notice, I've squinched these tables together, all these bars together, and that's

because what we've got is we've got a set of continuous data because someone is always so old.

KAREN FOLEY: Yes.

SUSAN PAWLEY: You can't, as much as we'd like to miss a few, you can't. Get back of it. So what you mean is because the data follows on from the other, then if we push them all together, then this is an indication that this is then displaying everybody's age.

KAREN FOLEY: And of course, you've done this for your point of view and as we know, normally when we shift things around, they're the same. But in this case, because you've done it to your side and turned it around, they're on a slightly different way for the viewers, which is fine. We're used to transformations.

SUSAN PAWLEY: Oh, sorry, was I pushing the wrong buttons?

KAREN FOLEY: It's fine. It's just not consecutive but it is still continuous, just the wrong way.

SUSAN PAWLEY: It's still continuous. Yes.

KAREN FOLEY: That's fine. We're going that way, not that way. So the youngsters and the old ones are the wrong way. There we are. See?

SUSAN PAWLEY: There you go.

KAREN FOLEY: It's a lot easier to do when you're not in Excel, isn't it?

SUSAN PAWLEY: It is, yes.

[LAUGHTER]

I have a part where I cut the mere representation yet.

KAREN FOLEY: No, I know. Neither have I. Anyway, it's fine. Good.

SUSAN PAWLEY: All right.

KAREN FOLEY: So a nice way to be able to demonstrate things and again, bar graphs would be very common. Sometimes, there are gaps between them. Is that when it's not continuous data?

SUSAN PAWLEY: You tend to use the gaps in them when you're actually representing different things.

KAREN FOLEY: Right.

SUSAN PAWLEY: So for example, if you've got children at home and you want to use a reward chart, then a really good way, normally, a lot of people draw a nice little chart out and they give them the little stars. And every time a child has done something good, they can stick a star on that chart. And then each child can compare how long their line of stars are.

KAREN FOLEY: Right.

SUSAN PAWLEY: And do it with LEGO, as well each set of LEGO represents one child. And then you can look at how good the child's been. And every time they've done something good, they can add on another block of LEGO on to their table. And then you can get dear old John, again, I've been better than you have. My tower's higher. And because they represent one child here and one child there, then you leave a gap down the middle.

KAREN FOLEY: Right.

SUSAN PAWLEY: And this is what's called "discrete data." So you can still use the bar chart to compare sizes of things but because it's not straight across the board and there's not some continuous link between the two because they're separated, then you just put a separation between the bar and that indicates that.

KAREN FOLEY: And it's nice. When you're talking about representing things visually, I think in particular for children, when they get a sense of scale and being able to transfer those for maybe a reward or something, it can be a really nice way to do things. That's brilliant. Top idea, excellent.

So we've got those but we've also got other ways of looking at data. And we've only got about seven minutes left till the end so we need to plough on through. And I really want to cover scatter plots because these are another very interesting way of interpreting data and often another way of describing populations and trends, so a very common thing that students might see.

SUSAN PAWLEY: It is, yeah. Well, so so far, we've looked at the pie charts that we use that we can split things up with.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: Then we looked at bar charts we've used where we can describe different amounts of things.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: Scatter plots look at something completely different.

KAREN FOLEY: Right.

SUSAN PAWLEY: Imagine you've got some information on maybe sending something on eBay or something and you want to look at how much we've sold each week. And so on week one, you may have sold five handbags.

KAREN FOLEY: Yeah

SUSAN PAWLEY: And in week two, you may have sold six handbags.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: And in week three, you might have sold for.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: And you want to look at how that is. So week one is five. Week two is six. This is what we call "paired data." The only way they work is that the two bits go together. It's like Morecambe and Wise, Ant and Dec, one without the other doesn't mean anything. So you need to find a way of describing them so they can stay linked.

And that's when you use something like a scatter plot because that way, we can produce a linked plot. So over here, not a very nice thing to talk about but very topical for this time of year.

KAREN FOLEY: Yes, flu.

SUSAN PAWLEY: We're looking at the number of reported influenza cases. So we're looking at along the bottom, we have the number of weeks.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: And along the top along the side, we have the number of cases reported. So in week two, we've had what's that look like, I don't know, about 20 cases reported.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: And it gets slightly higher for week three so we've obviously had a few more cases reported.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: Week four, we got that. And if we look, these are all the numbers of the data. So these are the data that we've actually calculated and we've looked and said, in week two, we've had this number reported.

KAREN FOLEY: So we're looking at an a relationship, I guess, between the two. So something is happening as the weeks are going on.

SUSAN PAWLEY: Yeah. So what you find is as the weeks go on, the number of reported cases, what would you say?

KAREN FOLEY: So as the weeks go on, there are more influenza cases reported with the number of weeks. So yeah.

SUSAN PAWLEY: That sounds good.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: Yeah. So that's what we can say from looking at the dots and that's really all we can say looking at them. But you might go, OK, so we now know how many cases were reported in week six.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: But what happens if you want to know halfway through week six how many cases there were? Could we use this to report It? Would we use it to guess?

KAREN FOLEY: Hmm. I bet there's a statistical way of modelling some of this because I bet you can't just join the lines up because if you did, you're saying that there is definitely a relationship between the two and there may not be.

SUSAN PAWLEY: You can say that. There may not be a relationship but the likelihood is looking at the pattern that is formed, you can definitely say there is some sort of link. So what we can do is we can draw a rough line through them and say, this won't be exact and this one of the few times you'll get a mathematician to say, it won't be exact.

KAREN FOLEY: No, I know.

SUSAN PAWLEY: So this is only a rough idea as to how the number of influenza cases that are reported increases throughout the time period. So now we can say, well, on about the Wednesday of week seven, well, we've had about 150 cases reported. And because it's continually going up all the time because obviously, the number of cases will always increase, then it's just an averaging out really as to throughout each week.

KAREN FOLEY: And this is called the "line of best fit," is it?

SUSAN PAWLEY: It's called the "line of best fit," yes, or if you want to be really posh and cool, there are things like "regression lines" and things like that. But it's a line of best fit. You can't really draw a line from dot to dot because that wouldn't be very realistic. However, because we can look at trends which is quite a nice thing to look at, really if you look at trends, you can say there is this upward progression on the trend.

KAREN FOLEY: Now, we've got a widget here for people to fill in. So the question that Sue has for you is, could we predict the cases in week 30? So let us know what you think. The answer is either yes or no and we'll come to the answer for that in a second.

Before we do, I just wondered if you could touch on a couple of things because often, you've got your x and y-axes and there's a certain way that you can put dependent variables or things that are changing and things that are not changing. Just for the record, what is the correct way of doing it and which is which?

SUSAN PAWLEY: Right. You have things you mentioned it briefly, actually, so I know you've been studying math somewhere.

KAREN FOLEY: Well, not really but I've been told off about putting things on the wrong axis.

SUSAN PAWLEY: What you tend to have is you tend to have what you call a "dependent variable" and that's something you can't change.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: It's often time and that always goes on the x-axis. So that's the thing that steadily progresses no matter what. And the other thing is influenced by that.

KAREN FOLEY: So that's the independent variable.

SUSAN PAWLEY: Yeah. So for example, my weight would be influenced by the number of cakes I eat.

KAREN FOLEY: Yes.

SUSAN PAWLEY: So if that was the case, I'm tracking the number of cakes I've eaten against my weight, topic of January.

KAREN FOLEY: Yes.

SUSAN PAWLEY: The number of cakes I eat would go along the bottom and my weight would go along this, the y-axis.

KAREN FOLEY: Because the weight is varying.

SUSAN PAWLEY: Because that will increase.

KAREN FOLEY: So that's why we're looking at the trend whereas if we plotted these on the other axis, we might not get such a good shift over time.

SUSAN PAWLEY: You would see exactly the same shape because you're still plotting the same numbers. You're just plotting them the wrong way around. But you need to think about which goes on regardless and which is dependent on it.

So for example, if you're all walking through the fields, say you want to work out how far you've walked in a set period of time. Well, the time carries on regardless and how far you've walked depends on how long you've been walking.

KAREN FOLEY: Right.

SUSAN PAWLEY: So you'd write the time along the bottom and you'd write how far you've walked along the side.

KAREN FOLEY: Good. So you mentioned then that this is modelling or a way of regression, which is a statistical technique. And your question then is whether we could predict the cases double down the line. And I'm just beginning to suspect that because you're looking at trends, trends are trying to predict futures, aren't they?

SUSAN PAWLEY: Yeah. Yeah, that's what you're doing.

KAREN FOLEY: And it's going up really massive and dramatically almost around that point.

SUSAN PAWLEY: Yeah.

KAREN FOLEY: So could we predict the cases in week 30? Let's see what people said. So that's the question. 87% said yes, they do think we could. 13% said no.

SUSAN PAWLEY: Really? So like you said, if we thought about this graph here, here, it's very easy to predict what happened in between the points where we have it marked.

KAREN FOLEY: Right.

SUSAN PAWLEY: But do you remember going back to what we talked about and you said very much about how you can't draw inferences that we don't know about?

KAREN FOLEY: Yeah.

SUSAN PAWLEY: Well, this is week 12. So week 12 was the last time we recurred. Well, maybe this is March.

KAREN FOLEY: Yeah. Yeah.

SUSAN PAWLEY: And by week 30, we're into June and July and so there won't be as many cases recorded.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: So you don't know what external factors can relate past the time. So you've got the date through here. So what you can say is you can say with some certainty what occurs here. But after this point where we've stopped actually recording what happens, we don't know what's going to happen.

KAREN FOLEY: We don't know if it'll peak and drop down and

SUSAN PAWLEY: Yeah. So certainly with many things, so some things you can go a little bit further but week 30? Not a chance, you can't say with any certainty what's happened by then.

KAREN FOLEY: So we could predict it theoretically, in terms of we could follow this line, but it wouldn't be accurate.

SUSAN PAWLEY: No. You simply really cannot predict at all, really. It's a thing because there are so many external influences. We use a great one, actually, when we teach a lot. It talks about that I've produced a wonderful chart here that says, your mathematical ability depends on the size of your shoes, shoe size. And they worked out that the bigger your shoe size was, the better you

are at math.

KAREN FOLEY: Really?

SUSAN PAWLEY: So those people with small feet can't be any good at math.

KAREN FOLEY: Hmm.

SUSAN PAWLEY: Does that seem fair?

KAREN FOLEY: No. No, no, completely unfair.

SUSAN PAWLEY: However, what it was was they did this test on schoolchildren.

KAREN FOLEY: Right.

SUSAN PAWLEY: And so basically what happened was the smaller their feet were, the younger the child was.

KAREN FOLEY: Yes.

SUSAN PAWLEY: And that was the influence. That was the actual link between the two.

KAREN FOLEY: A confounding variable!

SUSAN PAWLEY: It was simply that the children were younger and so they couldn't do maths as well. And it had nothing to do with the size of your feet whatsoever. So you're fine.

KAREN FOLEY: Oh, good, good. Excellent. Well, I like my shoes so I'm very pleased about that. Well, Sue, that's all we've got time for in today's session. We're going to have to end it there and it means that we haven't been able to look at the coffee example that I know that we'd planned. But I hope that everyone at home is feeling a lot more confident with their maths.

Now, we've been working through these modules so we've pretty much given people a synopsis of modules one to six. You've been looking through these doing it. What's your experience of going through some of this stuff, which is on Open Learn, and this is the website that people can go to?

SUSAN PAWLEY: It's really interesting stuff. It's all of the information that we've got is linked to real-life problems. So you can look at it and you can take parts of your own study. So if you are doing psychology or sociology, then you can look at parts of these different sections and you can actually take it into your own individual study.

KAREN FOLEY: Yeah.

SUSAN PAWLEY: So it's really good to go through. And if we're just given you a little taste, a little interest, a little excitement, then go and have a look at my Maths Help pages and you can really get some really good stuff that you can use in your further studies.

KAREN FOLEY: And also, whoever had the calculator, there's also one on using a scientific calculator. So if that's you and you want to know what buttons you can press and how they all work, then that will be a good idea. Sue, thank you so much for coming and talking to us about this all today.

I would just like to end the show with a final few bits of information, which is again, just go and check out that Maths Help. The resources are available on the website. So you can just click on the link on the Student Hub Live web page at studenthublive.kmi.open.ac.uk. Click on those Maths Help. There's also a load of material on Open Learn and we've put lots and lots of resources on the Resources page of the website that you can have a look at.

But I hope that we've shown you that maths is very accessible, there are different ways of doing it, and that spending a little bit of time can really enhance your understanding of things and you can then use some of that data in your essays and making sense of some of those points that are in the module materials, as well.

Evaghn and HJ, just before we end, would you like to say anything to our students before we have a break?

EVAGHN: Yes. Just come back and join us after lunch. Everyone's really happy, saying, thank you very much. Elizabeth is starting her degree and she says. she can't wait to do it now.

KAREN FOLEY: Oh, she is now?

EVAGHN: No, that was Chantal before but this is another lady.

KAREN FOLEY: All right.

EVAGHN: But she said, yeah, she's starting her degree soon.

KAREN FOLEY: And what about Chantal?

EVAGHN: She's gone to do a shop.

KAREN FOLEY: She's gone to the shop?

EVAGHN: She's going to buy some shoes.

HJ: She said she's going to put everything she's learned into practise while she's at the shop so that's good to her.

KAREN FOLEY: Because she'll be buying bargain value things and looking at proportions and percentages. Good. Excellent.

HJ: And yeah, just quickly, Kate says she's a lot more confident, which is great to hear. And we posted the links in the Chat, as well, for the Maths Help website for who wants to visit.

KAREN FOLEY: Brilliant. Excellent. Well, thank you all so much. We've got a couple of widgets there which are just seeing how you found the experience. So if you just let us know what you've thought, that would be brilliant, just for us to know. We won't show those on screen. But do let us know what you've thought of the session.

If you want to put any comments in the Chat, that would be brilliant. If you've got anything you can email us, do that studenthub@open.ac.uk. There's a Count Me In button, as well, so you can add your name to our mailing list. And then we'll let you know when we've got future events on.

And as I said earlier for those of you who were here, we have a big event for our Freshers' Fair, which is on the 31st of January and the 1st of February. That's covering loads and loads of stuff, including lots more maths. So do join us for that.

But what we're going to do now is we're going to break the stream, which means the video will stop and then you just refresh it to start. And we're going to go and have some lunch here in the studio and eat a lot of proportions of things. And then we're going to come back in an hour, where we're going to be doing a boot camp on dealing with feedback from your TMAs.

But while we're doing that, we're going to leave the Chat open so you can talk to each other. And we're going to show you a couple of things and those are a session by some of our lovely colleagues, Katie and Sally from the math department, and they looked at some maths puzzles, which was a lot of fun. And then we're going to look at something on being a reflective learner, as well, which will lead into our session for this afternoon, which is between 1:00 and 3:00.

So I hope you can kick around but do make some time to get some lunch. This is available on the Catch-Up afterwards so if there's something that you've missed, you can pop back and view it a little bit later. But I will see you back here at 1:00 with Evaghn and HJ and a whole selection of new guests to talk about making the most from your TMA feedback.

So thank you for watching, thank you for engaging, and we will see you very soon.

[MUSIC PLAYING]