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SPEAKERS

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Hello and welcome, we're going to look at deviations from the mean. So this is kind of our first step towards having a sense of measuring outliers and extreme values, we're also going to look at something called the Weighted Mean, where we're going to weight observations in a particular way, so that all the weights will add up to one or 100%. And this is useful because in the social sciences, and in business, you're often looking at weights, for example, you're thinking of what percentage of your portfolio to invest in, say, ESG stocks, and sort of green environmentally friendly stocks. And rather than maybe say dollars, you're going to use weights. And so we'll introduce the concept of a weighted mean. Now, let's consider deviations from the mean. So when we calculated the mean, before, this was actually a specific type of mean, called the arithmetic mean. There are two other types of means there's the geometric mean and the harmonic mean, we're not going to worry about them for now. But I just wanted to let you know that we calculated what is called the arithmetic mean. Now, calculating deviations from the mean is going to be useful when we look at variance and dispersion, the variability of a series in a future video. So when we're measuring a deviation from the mean, all we're going to do is take the value that we see and subtract the mean from it. And we did this surprisingly, off a regular amount of time, we do this a lot in the social sciences, for various reasons, some of them statistical, and some of them for giving us a better sense of extreme values, and value generally. So to illustrate, here, we have some player salaries, and we want to calculate the mean. So quickly, we can see that if we have 4 million plus 5 million, plus 6 million divided by three, that's going to be equal to 5 million. And we can calculate the deviations from the mean. So player one is going to be four minus five, which equals negative 1 million player two, five minus five, which is just going to be equal to zero. And player three is going to be equal to 1 million. So calculating these little deviations from the mean, is relatively straightforward. And we can see that you know, player three compared to the mean is played quite a bit, and player one is compared to the main is paid, not so much. Again, we'll come back to deviations from the mean, this is going to be a useful concept, and one that we're going to use very frequently when we look at dispersion or variability. Let's consider how to calculate a weighted mean. On a table here, we have parking tickets issued by the city of Guelph. And there are five sides size tickets, or fines that are lovely. There are $30 tickets, $35 tickets, $40 tickets, 5160 and $91 tickets, and we can see the frequency at which these tickets have been levied in the second column right here. Now let's try to find the average find what's

the average ticket penalty? And to do that, we'll do it by finding the weighted mean. Now we've got kind of a recipe so why don't we work through this example together? So to find the Weighted Mean let's start by cat lading values. So what was the total revenue for the city of Guelph from issuing $30 tickets? Well, they issued 30 of them. Or I should say they had $30 fines, and they issued 2209 of them. And so the total revenue coming into the city of qual from their $30 tickets was 66,270. Now let's multiply the $35 Fine by how frequent they learn, they were 13,007. And so we get 455245. And I'll write out my steps. In case, you want to make sure you can tell what I'm doing. Next, we've got 40 times 5410216400. And following similar procedure got 64, 821; 89,280. And the revenue from the $91 tickets is 194,012. And just to make it clear, I also punch this type this out. And so here are the values. So you can see that the city of Guelph earn almost half a million dollars from the $35 tickets. Why because there were so many of them. And then, they also earned a lot from the $40 tickets and the $91 tickets the highest fine, they earned a fair bit of money from almost $200,000 Even though the frequency wasn't as high as the $35, and $40 tickets. Now our next instruction is to sum all the values and all the frequencies so we can see we've got our list of frequencies here, we want to add them all up. And so we're gonna have 2209 plus 13,007 plus 55,410 plus 1271, plus 1488, plus 2132. When we add these all together, the total frequency the total number of tickets issued is 25,516. So that's the total number of tickets issued in the city of Guelph, Ontario. Next, we want to add up this entire column here. We want to sum up all the value. So how much what was the total value of all the parking fines levied by the city of Guelph. And when we add up this entire column here, we get the answer to the total value, and I get 1,086,280. I also keyed this in and so we can see here on this table, that we've got all the frequencies we need, including the total, we've got all the values that we need, including including the total value. Our next instruction tells us to divide the values by the total frequency to find the weighted average and should be the total value, we want to get that total value and divided by the frequency and that's going to give us the Weighted Mean for these parking tickets. So let's divide the total value by the total frequency. That's going to give us the weighted mean. So we got 1,086,028 divided by the number of the total number of tickets issued 25,500 and 17 And the answer is $42.57 rounded to the cent. And that's how we can find the Weighted Mean, we need to have the frequency of which tickets are issued. And we need to calculate the total value of the tickets issued. And there we can see it again on this table where it's been completed, all the frequencies and values have been added in. And the answer this time has been rounded to one decimal place. Now, we might be interested in the weighting of each of the different parking tickets. So we might be interested in knowing what was the contribution of $30 ticket to the total revenue, or the total amount of all tickets issued by the city of Guelph. And we can find that weight by taking the total value here. Or the value there, the value of each of the tickets and dividing by the total value here. So we have 66,270 divided by this big number here. And that's going to give us 6.1%. And so the weight of $30 tickets on all total tickets issued by the city of Guelph is just 6.1%. So it's not a very large contributor. I just moved our calculation over here to give myself a little more room. Now let's look at the $35 tickets. What weight did they represent the total amount of tickets levied? Well, we've got a frequency of 13,007 divided by our total. And that's going to give us 41.9%. And now let's take a look at these $40 tickets. So we see that their value is 216 400, we're going to divide that by our $1 million number 1,086,028 to be exact. And this is going to give us 19.9%. Now we can go on to the $51 ticket 64,821 divided by 1,086,028. And that's going to be equal to 6%. So I can fill in our values on the table here, we're going to complete this table 6%. I hope you see how we're calculating these weights. And if I fill in the rest of this table, we're going to have 8.2% and 17.9%. And if we were to add up all these weights, you would see that they sum up to 100%. Now what can we get out of this table? Well, you can see pretty clearly that the $35 tickets, although they're not as large as the $91 tickets, they make up almost 42% That's nearly it's getting close to half the value of all the parking tickets issued by the city of Guelph

or if we're thinking of these fine tickets are also equal to the city of Guelph revenue. They're getting almost half their revenue from $35 tickets. Here it is typed up nicely on the table in front of you. And you can think of the weights as representing the relative contribution of each of the fine sizes to total revenue collected or to the total amount of dollars issued in fines. One last thing I'd like to bring to your attention is looking at the mean here are the mean frequency. If we looked at the average number of each ticket type, that would be equal to just the average of these numbers here, which is equal to 4,252.7. That would just be the regular mean, where we treat each frequency or we give it equal weight. But of course, what we've done in this example is we waited that frequency by the dollar value of the fine so that a $30 ticket gets half the weight that a $60 ticket would get. And that's why we found that our mean was equal to or the mean dollar value of a ticket was 42 point $6. And so I hope that explains to you the difference between the regular mean that we looked at in an earlier video and the Weighted Mean that we were looking at in this video