

Welcome to the series. My name is Victor. Well, I'm a professor of mathematics. Version of the latest on statistics delivered by the Doctor. And let us start with the. What do you like the notion called the measure of variability? Also notice. Quite a bit of variation. In this lecture we introduce a notion called. Going to stop. You have heard that. I love the reaction inside in a given data where designing certain units. The next part that means by the standard deviation all have the same needs like we have seen already. And no, I divide the coefficient of variation between let us write. Is defined by. What do they expect? There is a Sigma leading given data that is added deviation divided by the. Yes, but but. Like no, no. If you look at this quantity in the right side, this is a dimensionless quantity that is independent of the unit. So this is useful that let us see now. For instance, I'll be asking that, of course there is no expert is not equal to. What any given data we can compute this measure of this is the measure of query. Ohhh. The increase that waiting. That's that's what it is. Measuring, quitting sense that suppose we have a. This is very useful when we generally, when we want to compare the two given datasets. For example, let us say we have some data. We call that one and we have our data too. I was it. I think that I compute this main expert and here let me call it X. One part here let me. Called the two by the mean and the standard deviation, let me call it Sigma one and here it is 612. And once he has that now, I can compute the CV, I call it CV one which is equal to Sigma 1 by far into 100. Similarly here also. Which is equal to 612. I know this is a dimensionless quantity now. Now now I can talk about the CV one and the CV two in case the CV one. Let's see if the city one is bigger than the CB2. Do we say that this first the data set this data does that has? Variability. CB1 is greater than the CB2. The data one. This is more disposed. More dispersed than the data. Then the data set then there. Their data. That's the conclusion being we can make when we complete this one and the outside, this one at the same that the CV2CV2 is more consistent with. Then the first. Inequality we can say. Also we can say. 2. It's more consistent. Send it no. In case, for instance if  $\bar{X}_1$  is equal to  $\bar{X}_2$  then we can do. We can make this conclusion just with the Sigma one and one. What is equal to? In addition then, we can say you are one is greater than 012, then that will automatically imply this. OK, then we can see data in the data two or we can say data two is more consistent than the data. But it says. The stickers they support example to illustrate this. Let us suppose we have a record of heights and weights of the students in the class. We have that record. You know rights and rights. Some students in the class. Let us say that. Let's say that over these students in the. And you know, we can talk to Dustin. We assume that. The made up that mean, right? That's what we call it the. The meaning is equal to some particular some number. Let's say, let's say seven 6462.6 centimeter. And similarly I have a. This six. That made up. Let's say 52 points. 3/6 I know I also we have our Spears in the standard deviation for the height. Is equal to some level 5 three centimeter. Ideas for the weight? Also they understand education and say. One point. 81 Katie no, but if I do this CV. The vision for the heights. So this becomes the dimensionless because  $11.3 / 162.6$ . Please give 6595. Let us hear the CV 20% of Asian from the base. 4581 52 point. Three 610 news #9.18. So obviously here the CVW is clear that the CV. Save that. City. The previous and hence the conclusion is that leads to a more variable. We can make out of this. And let us see flight permits. Let us come back to this. Report problems and the people we do that that is now start with the overall. Statistics let us see some problems. The power of that one. So consider the following data. It's better is something like this. I have a there are there is a factory and there are a lot of employees. Let's say there are only two 220 employees. Morning in the morning. I know just that, Ricardo. So that means. The millions leaving how many millions are laid for each employee. So that we call it. Find the frequency, how many employees and other particles 0 minutes late So the people who are punctured. Number of people. Quality of life. That there are. Play Sunday. I don't manipulate. 4 minutes, 3 minutes. Like 617. Correspondingly, we have this. I'll be in place already played the number of employees 13. 6. What, what, what? Employees now for this data. Now you see this look at this data. This data is totally. There is an extreme number. You will see you can compare with the mean and the median in this case. You know the first fight? The meat. Set a deviation. Media. And finally, there is also complete compute the the mean deviation you studied in one of the earlier mixes. The mean deviation about the media. Let us see let us analyze the data and we know that

the X bar. Computer, but we need to be there. We have the formula. Sigma FX. The same way. No, and the symbol is. Spyro see my Facebook. Don't have missing my. By the six. No, that is

So we need to complete all these terms. Say square. Send me some built in this and get the value. Let us say. The next button called the FBI.

So obviously this is zero 13. I didn't hear that. 15 we also need. If I say square. 3648 26 What you like? OK, put the list. We know the process, then we can and then the media. Now what is the media here in this case now I can. Yes, but there's something be simply 80. I mean, it's part is the Sigma FI say that is. Which is equal to 0.377. Set a deviation. You know all the. Custom. Yeah. Minus the Xbox. What is equal to? I don't know. 15367 stands out to be 1.165, so. We can compute this. Just from the formula straight away and then now if we look at this median. You look at the median here. That it could be recorded. The place, yeah, and the median is the the middle of the data, which is equal to somewhere around 100 and. That we needed the average of the 100 and 100 and 1600 and seven.

So the third one is the meeting. Median is equal to the average of. 607 which is equal to. They say values are 0%,

So we have. This data is something only entry is very, very valuable consideration for that Decision 0,

So therefore they automatically the average is zero and the median is equal to. And therefore, no. Now we want to calculate the. The first one that is the main deviation about the media. Disable domain name. How about the party? Stainless. My formula, we know that it is the difference in the world by Sigma. And some of all the deviations from this, you know it's I minus. Yep. Go to the same name as the. And. In this case it is. The same what we have calculated in the previously there is 0.37.

So in this. Doing something, something this data, what we have in the medium and the. Maybe you should about the media. You have a character picture out there somewhere, whereas the the mean and standard deviation. What we have calculated that they are not. They are totally distracted by that. The extremely high. Value 181

So therefore. All they need to increase the observation is 0,

So therefore.

So the current is given by this mean and this median and the mean deviation about the media. We can make the from this. And then there is. Go to the next example. Yes, we have a group,

So I have a student that is taking. The master. Hello guys. A particular test. That is the. Take this letter. This is a. The class that is the students. Frequency. 48 percent 24 months. \$60.00 78 19 they didn't. Yes. Was. Bob said in this class. If you wanna. For you. In but. Now let us watch this. Let us say calculate the standard deviation of Sigma. But

So for that, what we have to do is. We have to calculate that. The midpoint of the class. You know that this is the lower load than this. Quietly. This case say. Sword is. Divided by the 5460 fifty, four and 60 is 57. 69 75 87 something like. Somewhere what we need? Sigmai we know that popular community formula expired, we know. Play. Sigma. Wasting money. Using my advice. The house. Now let us calculate the. 102 171 so. Right? 817

So if by some of all that like. So therefore, no, I can immediately come to this that made up the data. Which is equal to 75. Nobody has that that we're losing this level of butter. Said it we know that the Sigma squared variance. Is equal to Sigma. It's a - 6 five. Doing it. And then by the standard deviation I can take sqrt 3. No, what we need is a - 6 one. To sum it up, and then I take them. Multiplied with the computer X - X. The deviation.

So you say minus 65 you have both the.

So minus 24. Six 4075

So therefore, you say. Minus the X1. Minus 24 - 18 - 12 - 6. 0658 I know. What we need is we have to take the square of this 8 - 6 plus. They were the same. Then I can do that. So it is equal to 576 inspiring these numbers. 24 36 zero six 144. That portal and now I have the right one. I have to multiply that day of my. Minus six points. On the last. Using the following. Multiply this 576 divided by. Seven, 2288. Steel. 4.0 three 24. Sum of all that.

So I get the 5348.

So nobody gets us to these values. 5328 the value is. Hello. Just right. Get better. Space. Next time we take one large sample. Look at this. There's nothing that they have

lots of these students. The entries. No, but this data. And for this. Square, I want to compute the variance. The various. Straight away. That is, the formula says you sum up all that,

So I'm not going to sum up all this,  
So that formula is square is equal to.

So all my time I just apply the Formula One.  $\Sigma XI^2$  square. Minus. See what you're saying. Formula for variance. We have to take this fight and then we have to do all that. So let me know. All the values.

So one way to beat the Sigma XI spider says that big numbers are correct.  $168 \text{ minus } 3796$  square divided by. Could be.

So this does. Yeah yeah no. Play. And here's the standard deviation. We want to say is 14.1. What is said? No. Instead of that time we can now the better ways we can. Probably status. How do we improve that data now we have the options for example. In this case what happens is if we look at this data, it is the starting from the lowest review. See the smallest one is 44 and the. Closest increased 98,

So the difference if you look at it is  $98 - 44$  it is 54.

So now I can prove that.

So in this case that we can improve the data like this so.  $88$  minus what do you call it? So that way we can group like this

So the other flexibility of grouping the data.

So we can. Assist, the problem is over, but what we are doing is by grouping by we are going to compute the same variance by. Like looking at it

So we can group our classify as follows. What I can do is we can we can form 11 classes. Either I can even classes. Of my unit. Thought I can also look 14 classes. How did that for you? Or I can call you keep classes after.

So it's up to us. And that's the first one that is from the level classes of with my unit. Let us take that class. You know what is on the table for the given data. Whether you like your time, just calling, you can press the data. Correct? That's in trouble. The other classic that is. From you know system 44. 23.5 48.5 is that? That's right then the next class. Game play. 3.5. White. 58.52 63 points like. 63.5 to 68.5. This is 2651. 96 it's saying. The evening hello, what are they in this? Right? Just need one. OK. As I said, there are.

So please.

So what we need? Sigma squared is the idea that right this formula, Sigma squared is equal to.  $\Sigma X^2$ . Famous.

So what we need is. Can't say. We need to play. And then then. Finally. These are the things we need. That's all.

So ex I square the square of 46. 26 601 336 776 65617396. They don't. They say it's like. No need to go. What you want? 639 810

So it's better that way. We got a number. There's some.

So something like this. 780 because we need that. 6:00 AM. Say something. Already in this work with this order.

So there's no. The value stored by 15 times. 1630 thirty 790 195967 and finally the Sigma value will be. And where is the by the? The variance. Device 14 by 4-5 now here it is. 13-5 eight so. The result is that the difference will appear. Value. The given data is taken as a midpoint. This point for these data and you know it is. That could definitely be. Difference. That's what we have seen in this. Itself. But an example of studying in the last lecture. By approximating the. When are you going to celebrate that? Said it division of the various, we use the approximate the ones that are commuting the main. We give some approximate value. It's called the assumed and then we can move with them. OK, so. Yes, we need the data. Some data. Let's say it's like. 38

So 1st 3817. This is a. 1748 3444 Fifty five. 63 What does 6?

So these are the data I have selections. No, that window is the. I said no, I I want to calculate finally this Sigma square by that time just going offline and approximate value for that. What I'm doing is I'm going to calculate that DIE.

So the. For this case that is. What's that mean to me? Look at this data. But between the. 48 and that is the main.

So let me choose the convenient number. Would be. Here. No, I would calculate this deviation. You say my. He's already. Then I'm calculating the deviation. Minus one because the number is now reduced a small number

So easy. Minus 12 - 2 - 16 - 8. By good. Just. Now this. Have followed up. The various.

Sigma da squared minus Sigma di divided by.

So what I mean is. Aspiring that.

So if I substitute all the values. There is forever. Let's 6. Something big. 1.3. Formal. 36 by simply. Problems. Find their variance. For example, let's take a. Meditate with the applications. It is, I think, that radiant system. Play. No, it's observation. This might be played by. By some numbers for some concept. My advice and then I say here. Then what will be the effect in the various? That's what we want to see here.

So what will be the change in the variance suddenly? What your own observation is multiplied by each observation here is multiplied by two.

So everything now will be shipped

So that we know the formula for Sigma squared. How to find the? Fight. You know?

So that is the problem we have.

So let us calculate the Sigma Sigma squared which one is employed by. USA minus 6 plus.

So I have to calculate the export. Still waiting. The number of entries. This summation now will be equal to. Six months.

So this is. Information we have learned from this is equal to 1. 3 - 6 plus. Is equal to.

No, that is. Look at the resulting observation of each entry. TSA is multiplied by 4 and they call that number as four. OK, that is a. It's

So easy.

So what happens?

So now let us compute the mean for this for these. Which is equal to Sigma of four.

Productions, which is equal to.

So what? See what? That and finally, it turns out to be two things. Please.

So that way by the meet up. The place that you know that takes place

So that would expire is equal to. What you bought? That relation? And the. No, it's a student there, even English.

So that one becomes. Morning. By 2 - 20 power by two.

So I can make that go outside

So so.

So important to the right. So.

So therefore what we have is. Meetings. Sigma squared is equal to. Brave. Look at the 20. Fire into the the Old Dominion.

So so that all the variance is the variance. Initially it was the original data, it was five. Now it is changed as 20 which is  $4 * 424$  is nothing but the the multiplication the constant we are multiplying by the number 2.

So that the two square times why it has become so? Therefore, we can generalize this result also. That is, if I multiply by any constant K,

So the new variants will be K squared times the whole,

So that is what you put that point. We have to observe from the. And also there is another important this multiplication. If I add or subtract each observation. You can

prove this. In fact, if instead. These observations. Added a contract. My positive number, let's say. They're not gonna be the. The media. Let us look at some

multiplication. We have seen that is there. But here in the case of addition and subtraction. It would not. The various remains sightings. The new aliens also remain the same. Take it as an exercise. Alright, everything is.

So let us take. Second example. There are hundreds of 1,000,000. Let's say exposure equal to. 40 and the Sigma is. Education is 5.1. Suppose Sir, in that. What an observation.

What about the observations? Is the request. Let's say 100 is. That may be specific one such as services. Let's say I think this is a request. Wait for the decision. Resolution. Replaced. Is any place like? No, what would be the new mean? What would be the question?

You're mean. Instead of. Then you started.

So I just said.

So what we do is now you, do you have an expert here,

So there are therefore, the Sigma XI will be equal to equal to Sigma XI by 100. Therefore Sigma XI equal to 100 will be. Or both. The new song. 70S and it was by 40. Therefore,

the new song. The old stuff is for 4000 in the new server 3990. Button here. And you said. Like this new me. 190 people similarly, I can calculate the variance the old

various by. Which is equal to 1 by height. See, my ex is squared. Minus  $4000^2 / 100$ .

This is the formula. You can see that the Sigma XI squared from this. To see why excite spider, be equal to. Played out that. 16260 on the new. This is the oldest Sigma XI

squared. Now New Sigma XI square. Like what film is the replacement, please replace that

one. Is that OK? Therefore  $164601 \text{ minus } 3^2 + 40 \text{ squared}$ .

So therefore there is some new some New Sigma XI square, meaning 161701 and then with this. With the new symbols. Sigma Square will be equal to 1 by. 61701 nine 100 minus. 39.9 while you can. Deviation.

So let's say we'll see. How would you? OK, finally we shall see one more example. Where we shall find the mean and standard deviation for a group data group. Data involving. We will assume that the data represent the age distribution for a group of people.

So for example, let us consider the class and the distributions in the following pattern. The class starts with. Let's say 20 to 30. 30 to 40, 40 to 50, and

So on. With the corresponding frequency.

So the 30 to 40, 40 to 50, 50 to 60, 60 to 70. 80 to 90 and the corresponding frequencies, let us, say, say, in the age group between 20 and 30 there are three people. OK, and in the age group 30 to 40 there are 51 people and here 122 people. And here again, 141 thirty I think I have done some mistake.

So it's between from 70 to 80 and 80 to 90 the corresponding frequencies are. 51 and two So totally the total number of people is north equal to 500.

So now for this data. Now we have to find the mean and standard deviation.

So you will see the distributions with the large numbers,

So to. Let us find the mid values 25, 35, 45, 55, 65, 75, 85. And. Now we have to choose the mid value here,

So this is what the transformation we are giving. We will sell. Choose  $x$  is equal to 55 the mid value. And of course, here the Class  $H$  is equal to. 10 The class the length of the class interval. Now for this now we complete. Let us compute. The  $U_i$ , which is defined as  $X_i \text{ minus } a \text{ divided by } H$  OK, here  $A$  is equal to 55 and  $H$  is equal to 10.

So it turns out to be minus 3 - 2 - 1 zero one and 2/3. And for this, let us compute this  $\sum f_i U_i$ . Turns out to be minus 9. Minus One 2 - 122 zero one thirty 126 and the sum is easy to find which is equal to 5 here. Next time we shall find the  $\sum f_i U_i^2$ . This is equal to 9410149 now  $\sum f_i U_i^2$  into  $\sum f_i U_i^2$  which is equal to 27204. One twenty 201-3204. 18

So the sum is equal to 700. 5. OK, now let us find the mean. We know the formula the  $\bar{X}$  is equal to the  $A$  plus the transformation. What we have given.  $A + H \sum f_i U_i / \sum f_i$  plus, sorry. One by north into Sigma  $f_i U_i$ . Now if it's Sigma Square is equal to  $H^2 \sum f_i U_i^2 / \sum f_i$  into one by North Sigma  $f_i U_i^2$  whole square. Now we have computed all the values. We can substitute all the values here and find the values of this  $\bar{X}$  and Sigma square here. In this case  $\bar{X}$  is equal to. 55.1

So that is the average. And Sigma Square will turn out to be. We substitute all the values we get.  $140 \text{ Double } 9 / 100$ . Which is equal to. 11.8739

So this is how. We the compute the mean and the standard deviation, and with this we are done.

So in this lecture we started with the coefficient of variation. You have some problems. Thank you.