Transcript for Chelsea Andrews' Lecture Video
"When Continuous Measurements Become Discrete"

[click]: Have you ever heard the following:

[click]: "You must be this tall to ride this ride."

[click]: "You must be 18 years old to vote."

[click]: "You must be 21 years old to purchase and consume alcohol."

[click]: "You must turn in your assignment by 11:59 p.m. on Sunday for it to not be considered late."

You might have encountered similar rules before. Perhaps you've even found yourself

[click]: questioning why you couldn't be

[click]: A little bit taller.

[click]: A little bit older.

[click]: Or why you couldn't have gotten your assignment in before the deadline.

[click]: You may have also found yourself asking for the rules to be

[click]: broken. [PAUSE]

[click]: Maybe you pleaded with the ride operator that you really wanted to go on the ride because you are ONLY 1 inch away from the height requirement.

[click]: Maybe you begged the bouncer to let you into the bar because your 21st birthday is just 1 day away and you really wanted to start celebrating now.

[click]: Maybe you emailed your Instructor just before the deadline asking for a one-hour extension because you are just one hour away from finishing your assignment.

[click]: [PAUSE] What does any of this have to do with statistical thinking?

Well, each of these examples illustrates what happens when we convert a continuous measurement into a discrete scale.

Let's break this down a bit further.

[click]: A measurement is continuous if it can fall anywhere in an infinite range of values.

[click]: Therefore, scales composed of continuous measures can have an infinite number of values between any two values!

[click]: For example, height is a continuous measurement.

[click]: We might refer to our height as 5 foot 7 inches.

But we can be even more precise with this continuous measurement.

[click]: We can refer to our height as 5 foot 7.3 inches.

[click]: We can even refer to our height as 5 foot 7.3682 inches.

[click]: And there are an infinite number of values in between 5 foot 7.368**2** inches and 5 foot 7.368**3** inches.

[click]: That's why height is a continuous measurement. There are an infinite number of values between any two values.

[click]: In contrast, a measurement is discrete if it can take on ONLY a specific set of values.

[click]: Therefore, scales composed of discrete measures can only have a limited set of values.

[click]: For example, the number of cats I have in my home is a discrete measurement. I can have 1 cat or I can have 3 cats, but I can't have 2.678 cats.

Telephone area codes are another example of a discrete measurement

[click]: For instance, in Iowa you can have a telephone area code of 712, 515, 641, 319 or 563.

But you can't have a telephone area code of 712.567 or 712.568. That's because telephone numbers are discrete variables, so they can only be whole numbers.

[click]: Now, let's look back at an example I gave at the beginning of this lecture.
"You must be 21 years old to purchase and consume alcohol."

[click]: Although we often state our age as a whole number, for example, we say "I'm 20 years old," age is actually a continuous measurement.

[click]: We can be 20 years, 11 months, 3 weeks, six days, and **22** hours old.

[click]: Or we can be 20 years, 11 months, 3 weeks, six days, and **23** hours old. And infinite possibilities exist in between! That's because time is also a continuous measurement.

When we make a rule, actually a law, that states that a person must be 21 years old to purchase and consume alcohol, we have taken a continuous measurement, age, that has infinite values, and converted it into a discrete measurement, that has only 2 values:

[click]: under 21 and therefore not old enough to legally purchase and consume alcohol,

or 21 and older and therefore old enough to legally purchase and consume alcohol.

Similarly, when there's a rule that states that a person

[click]: must be 48 inches tall to go on an amusement park ride, the rule has taken a continuous measurement, height, and converted it into a discrete measurement.

[click]: At least 48 inches tall and therefore tall enough to be allowed on the ride

Or under 48 inches and therefore not tall enough to be allowed on the ride

[click]: Similarly, speed, such as car speed, which is often measured in miles per hour is a continuous measurement.

When there are laws that state traveling a certain number of miles per hour over the speed limit result in penalties, the law has changed a continuous variable, speed,

[click]: and converted it into a discrete measurement that has multiple categories.

In Wisconsin, there are 3 categories.

[click]: Speeding 1-10 miles per hour over the speed limit results in 3 demerit points;

Speeding 11-19 miles per hour over the speed limit results in 4 demerit points;

and Speeding 20 miles per hour or more over the speed limit results in 6 demerit points.

[click]: Changing the measurement of age, height, speed, or any other continuous measurement into a discrete measurement means that a measurement that used to vary in an infinite number of ways will now fall into only discrete categories.

[click]: OK, let's go back to that amusement park ride where you must be 48 inches tall to be allowed on the ride.

Let's say you beg the ride operator to let you on the ride, even though you're only 47 inches tall, and therefore you're an inch short of the cutoff.

And let's say that, to your surprise, the amusement park operator says "Hey, kid, you're right. From now on, the rule will be

[click]: you must be 47 inches tall to go on this ride."

[click]: But then another kid comes up to get onto the ride. This kid is 46 inches tall.

He also begs the ride operator to go on the ride, saying that he's only one inch short of the cut off. If the amusement park operator changes the cut off again, so that now

[click]: you must be 46 inches tall, you can only imagine what size kid will come up next?

[click]: [PAUSE] Yep, a kid who's 45 inches tall!

[click]: The point is that whenever a continuous measurement becomes discrete there will always be people or things – depending on who or what you're measuring -- that fall just above or just below the categories of discrete variable.

No matter how many times the amusement park operator lowers the height requirement, there will always be another kid who is just one inch short of the cutoff.

[click]: Let's look at one final example. "You must turn in your assignment by 11:59 p.m. on Sunday for it to not be considered late."

[click]: It's Sunday 11:55 pm and the deadline to turn in your assignment is just a few minutes away.

[click]: "If I only had one more hour, I could get this assignment finished" you think to yourself. So, you email your instructor

[click]: asking for a one-hour extension. In that email, you thought you were just asking for a one-hour extension. But in reality, you were asking your instructor

[click]: to change the values of the discrete variable. If your instructor grants you a one-hour extension, to be fair,

[click]: the instructor would need to grant everyone in the class a one-hour extension. And at the end of that one-hour extension,

[click]: there would undoubtably be another student who wants "just one more hour," and so on.

Just as in the drinking age example and the amusement ride height example,

[click]: we could continue to change the due date for the assignment. However, there will always be students who could use just one more hour or even one more minute to turn their assignment in on time, regardless of how many times the discrete categories are changed.

People or things that fall on opposite sides of discrete categories may not even differ all that much from one another.

[click]: Someone who is one day away from turning 21 years old may be no less mature than someone who turned 21 one day ago.

But there will always be someone or something

[click]: one something away from the boundary. Altering the discrete categories will never fully fix the issue – usually it will only create a new issue.

[click]: So, the next time you lament your inability to drink one day before you turn 21,

[click]: you bemoan your denial to ride an amusement park ride because you are just one inch below the requirement;

[click]: or you think about asking your instructor for a one-hour extension, remember that even if those discrete measurements were changed, there will always be people on the other side of a division who are now

[click]: one day,

[click]: one inch,

[click]: or one hour away. That's what always happens

[click]: when continuous measurements become discrete.