Noise Reduction and Hearing Conservation 170

MEASURES OF CENTRAL TENDENCY

In this lesson, OSHA standards require an eight-hour time weighted average. The background information you should know is how do you find an average (the mean)? Related to this is mode (the most frequent) and median (the middle value).

To find an average (the mean), you add the values and divide by the number of values present. For example:

Suppose we measure 7 items as 10, 40, 24, 31, 17, 22, 38; the sum of the values is 182 which when divided by 7 is 26. The **mean** of our sequence of measurement is 26.

Try these sequences, find the mean

1. 18,24,55,11,23,25,18,22,41

2. 18,25,11,55,43,42,11,25,11,52,11

In our second sequence, we notice that the number 11 appears more often than the others. This is the **mode**, or the most frequent number.

Lastly, we have another measure, the **median** (middle) value. To find the median, you have to arrange the numbers in order. If there is an odd number of values as in my first example, it's simple:

10,17,22,24,31,38,40 ... 24 is the middle one.

But what if we have an even number of values like 10,17,22,22,24,31,38,40? Well we average the middle 2 like we did above. We add the 22 + 24 = 46 and divide by 2. The median is 23.

Try these sequences, find the mode and median:

1. 18,24,55,11,23,25,18,22,41

2. 18,25,11,55,43,42,11,25,11,52,11

Why do we need both mean and median? The closer the two values are, the closer the number sequence is. The further apart the mean and the median, the more spread out the numbers. This tells us something about our measurements. Here is a great example. Your boss claims he pays an average salary of $40,000 to his workers, but you know you make a lot less and so do the others, so you check. He pays Jill, $24,000; Sam, $28,000; you, $28,000; Bob, $26,000 and himself, $94,000. So is he right? What is the median salary at your workplace? Notice how far apart the median and mean are in this example. What does it tell you about the salaries? Yup, they are spread out.

What is a **decibel**? The decibel is a **logarithmic** unit used to express the ratio between two values' power and intensity. A logarithmic scale is often used to display a physical quantity such as the level of sound.

Table 5 Maximum Noise Levels

Sound Level (decibels)	Maximum Hours of Continuous Exposure per Day	Examples
90	8	Power lawn mower
92	6	Belt sander
95	4	Tractor
97	3	Hand drill
100	2	Chain saw
102	1.5	Impact wrench
105	1	Spray painter
110	0.5	Power shovel
115	0.25 or less	Hammer drill

You are familiar with a linear scale, like 1,2,3,4,5, etc., which is a line of numbers. But what if we need to express much larger ranges of values? This is where a logarithmic scale comes into use as it grows by powers of 10,100,1000,10000, etc.

Decibel	Power
0	1
10	10
20	100
30	1000
40	10,000
50	100,000

Note. Table 5 OSHA Certification student training manual

Lastly, what is a **weighted average**? When I calculate a mean, I give every number in the sequence an even weight.

Are these the same?

$$\frac{10, 40, 24, 31, 17, 22, 38}{7} \text{ and } \begin{array}{l} 1/7\ (10) + 1/7\ (40) + 1/7\ (24) + 1/7\ (31) \\ + 1/7\ (17) + 1/7\ (22) + 1/7\ (38) \end{array}$$

They are the same. Each number was given the same weight (1/7th). In a weighted average, I give more weight to one number than other.

But what if using Table 5 above, you spend most of your day with a chain saw and only a brief period with a power mower. Does that get you out of wearing hearing protection? The difference between 90 decibels and 100 decibels is not just 10 but a power of 10. The chain saw is 10x louder in decibels!

Average decibels over my 7 hour day where I spent 4 hours with a chain saw, 2 hours mowing and 1 hour at the computer my look like this, adding my chain saw time + my mowing time + my computer time as:

4/7 (100) + 2/7 (90) + 1/7 (30) = 87 average decibels. See how the time spent with the chain saw was weighted 4/7 while time at the computer 1/7. The chain saw had 4 times the impact on my hearing.

My time with the chain saw was much less but the impact on my future hearing was much greater. Wear the protection!