



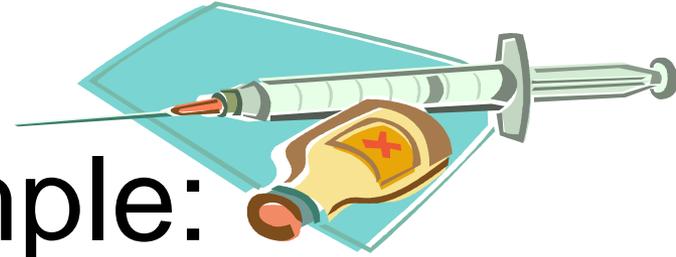
# Variability of Drug Weights

What do our reports mean to you?

# What's Variability?

- We weigh drug evidence using electronic scales. They are very precise and very accurate, and are checked monthly (or more often) to make sure they are working correctly. But, no lab environment or scale is perfect, and so each weight has a bit of *variability*, or *uncertainty of measurement*, associated with it.
- This means that the weight has a little “wiggle room”, or plus-or-minus, that we can't pin down. It is typically a very small amount.



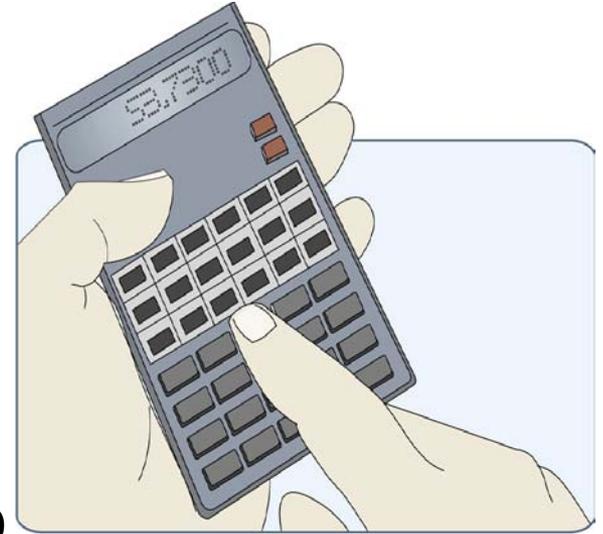


For example:

- If I have a sample of heroin that I know weighs exactly 10.00 grams, when I set it on my scale, most of the time the scale will read exactly 10.00 grams. But a portion of the time, it might read 9.99 grams, or 10.01 grams. Depending on the accuracy of the scale, it might even read 9.98 grams or 10.02 grams. Once in a while, the scale might even read higher or lower than that.

# We calculate our Variability

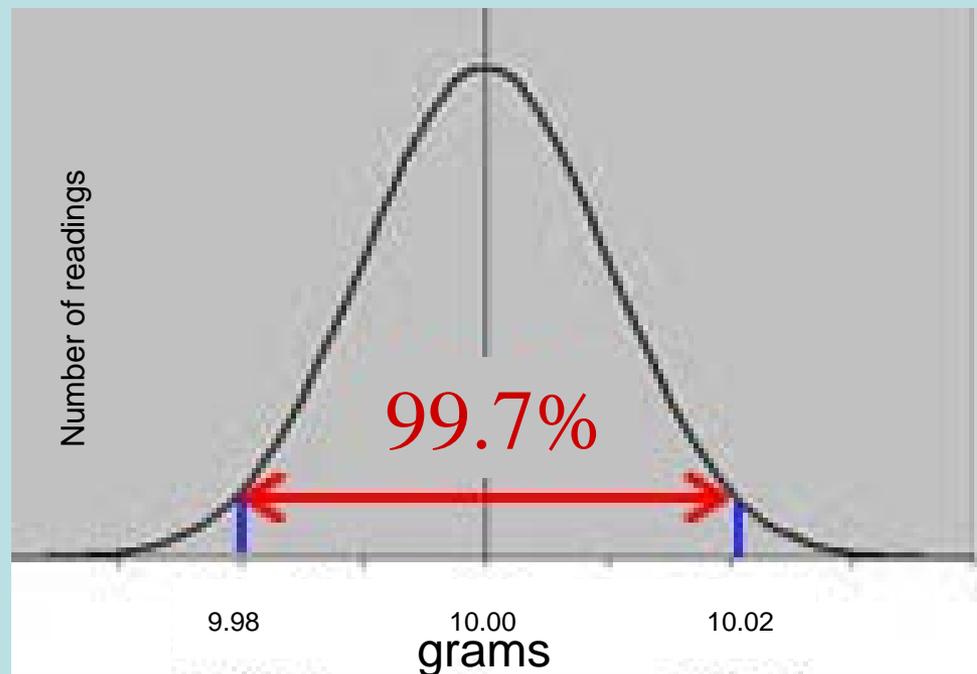
- We use statistics to assess the precision and accuracy of our scales.
- Then, we apply that variability to the measured drug weights to determine a *weight range of +/- 3 standard deviations*.
- The range means that we have 99.7% confidence that the drug's weight falls within the calculated weight range.



We use a reasonable range of 99.7% confidence for our weight ranges. (Statistically speaking, this is 3 standard deviations from the mean.)

For the graph below, let's say we are weighing our 10.00 grams of heroin 100 times. Most of the time, the scale reads 10.00 grams, so that is the highest point of the graph.

Less often, the scale reading is slightly higher or slightly lower. 99.7% of the time, the reading will fall within our weight range calculated from the scale's variation.

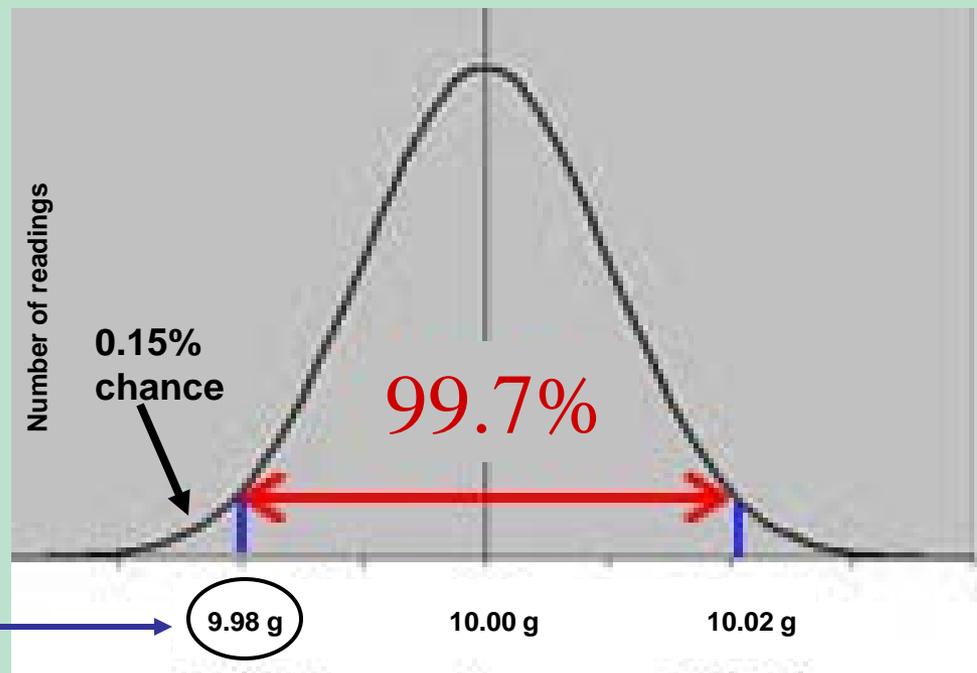


*Rarely*, the weight on the scale is predicted to be outside our calculated range limit. 0.3% of the time, the weight will be higher than the upper limit of the range or lower than the lower limit.

That means there is about a 0.15% chance that a drug weight could be lower than the weight listed on our drug reports.

We believe we have made a *reasonable effort* to assess and report the uncertainty related to the drug's reported weight.

**We report the low end of this weight range.**





# So, how much does it really weigh?

- With the heroin example, if the scale's reading is 10.00 grams, then the drug's *most likely true weight* is 10.00 grams.
- However, to be conservative, our reports give the low end of the statistical range, instead of the scale reading. (Weight minus uncertainty)
- This means that the chances that the drug's weight could be lower than our reported weight is only 0.15%. This is a 1 in 667 chance.



# 1 chance in 667



This is the possibility that the reported weight is slightly higher than the actual drug weight. (over-reporting)

- Roughly equivalent to your chances of being struck and killed by a car while you are a pedestrian.
- It is six times more likely that you will die in a motor vehicle accident than that the reported drug weight is too high.

These are considered activities with acceptable or reasonable levels of risk.

There are 666 chances out of 667 that the actual drug weight is the same or higher than the reported weight. (under-reporting)

- Until now, we have “done the math” in the lab to calculate the *lowest weight* of that weight range, and then the weight was sometimes rounded down even further. In the heroin example, the reported weight would be 9.98 grams, or rounded down to 9.9 grams.
- However, our accrediting body (ASCLD-LAB) would now like our reports to inform the reader that the variability has been factored into the reported weight, so we have added an explanatory footnote.
- New reports started January 2010.



# Our new reports:

- White crystalline substance from a plastic bag
  - Net weight 12.83 grams<sup>1</sup> (not rounded down)
  - Footnote: <sup>1</sup> *Reported weights have been adjusted to the lowest weight in the statistically-calculated range of values based on the accuracy and precision of the scale.*



If the scale reading was 12.86 grams, and the scale's variability was 0.03grams, that means that the true weight of the substance is 99.7% likely to be within the range of 12.83 and 12.89 grams. There is only a 0.15% chance that the weight is less than 12.83 grams

In other words... it is 99.85% likely that the weight of the substance is **at least 12.83 grams.**

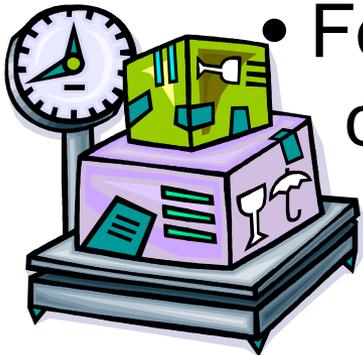
# When does it matter?

- In most cases, a few hundredths of a gram, give or take, won't affect the outcome of a case.
- But, if a weight-related sentencing enhancement is involved, the courts typically will use the lowest weight in the statistical range. This is why this lowest weight is the weight we report. This gives the defendant the benefit of the doubt.
- Example: if we had a sample of methamphetamine that weighed 10.00 grams, +/- 0.03 grams, we would report it as: 9.97 grams.



# What kind of uncertainty values are we talking about here?

- For most scales in the forensic labs, the uncertainty has been calculated to be less than 5/100 of a gram (0.05).

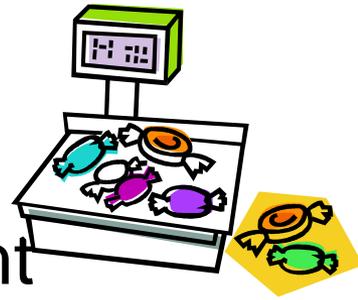


- For balances that are used to weigh large quantities of drugs (MJ, bricks), the uncertainty may be up to 20 grams.

- If an exhibit is made up of multiple parts that are weighed separately (like individual bindles), the uncertainty is cumulative, so there will be larger uncertainty values (wider ranges).

Example:

An analyst separately net weighs 35 bindles of cocaine. Each individual weight has an uncertainty of 0.01 gram. When all 35 net weights are added together, the total (cumulative) uncertainty is calculated. In this case, the total uncertainty would be 0.06 grams.



The combined net weight of the 35 bindles would be reported after accounting for the uncertainty by subtracting 0.06 grams.

**The more individual weights that are added together, the greater the total uncertainty will be. The uncertainty is subtracted to get the reported weight.**

# What can we explain on the stand?

- How our scales are checked and calibrated.
- How our scale's variability/uncertainty value is calculated.
- How that value is applied to the scale reading for the drug to determine the weight that is reported.
- Our statistical confidence that the drug's actual weight is at least as much as the reported weight (99.85%)



# Variability is NOT Error

It is important to keep in mind that the variability or uncertainty associated with a weight measurement does NOT mean

that the weight is wrong or that the analyst has made an error.

Variability/Uncertainty is simply a statistical way of describing a range of weights such that we can say with a high degree of confidence that the true weight falls within that range.



## Questions? - Contact:

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