

Retell a story of TYPE I error

When making a decision about an experimental outcome, we should minimize two types of error:

TYPE I : reporting something is true when it really is false. This is often referred to as the alpha (α) risk.

TYPE II : not discovering that something really happens (i.e. failure to discover the truth). This is often referred to as the beta (β) risk.

The following chart shows how we can go wrong but it also allows for the possibility that we may be correct:

Decision-making outcomes		What we conclude based on experiment	
		Yes	No
The truth	Yes	Correct	Type II error
	No	Type I error	Correct

In analytical chemistry, setting the method detection limit (MDL) of a trace analysis, such as a pesticide residue in food or a heavy metal in drinking water, is a good example of involving Types I and II errors that can potentially get us wrong. When we report a pesticide residue level above the MDL with a statement of $\alpha = 0.95$, we are effectively saying that we have 95% confidence that the reported figure is true, thus minimizing the TYPE I error.

In fact, all rapid qualitative tests leading to test outcomes such as “Present/Absent”, “Positive/Negative”, “Detected/Not Detected” also carry the Types I and II risks.

The following story illustrates a TYPE I error. Just hope it does not happen to you:

A sleepy driver pulled over to the side of the highway for a nap. A patrolman stopped and searched the vehicle. He found a powdery substance, which was thought to be an illegal drug, so he arrested the driver. The driver protested that this was a terrible mistake – that the bag contained the ashes from his cremated grandmother.

Initial screening tests gave a positive outcome for a specific drug. The driver spent a month in jail before subsequent tests confirmed that the substance really was ashes and not a drug. To make matter worse, most of the grandmother's ashes were consumed by the testing. The driver filed a lawsuit seeking unspecified damages.

(An excerpt from a copyrighted story in 1998 by the *San Antonio Express-News*, cited in the book *DOE Simplified - Practical Tools for Effective Experimentation* (second edition) by Mark Anderson & Patrick Whitcomb (Productivity Press NY)