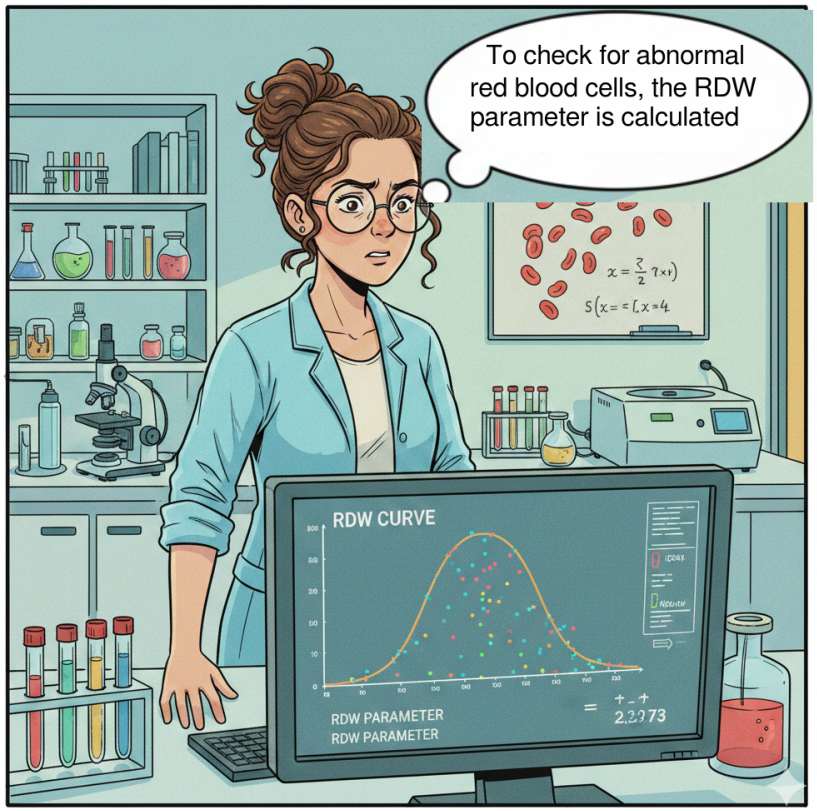
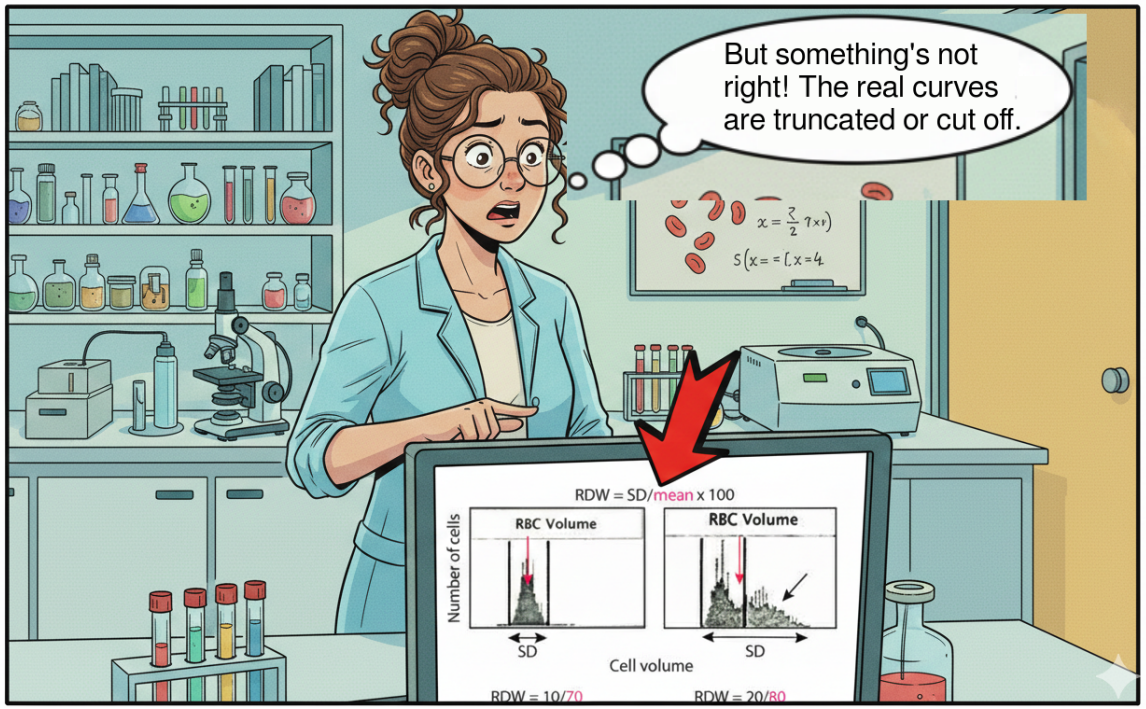
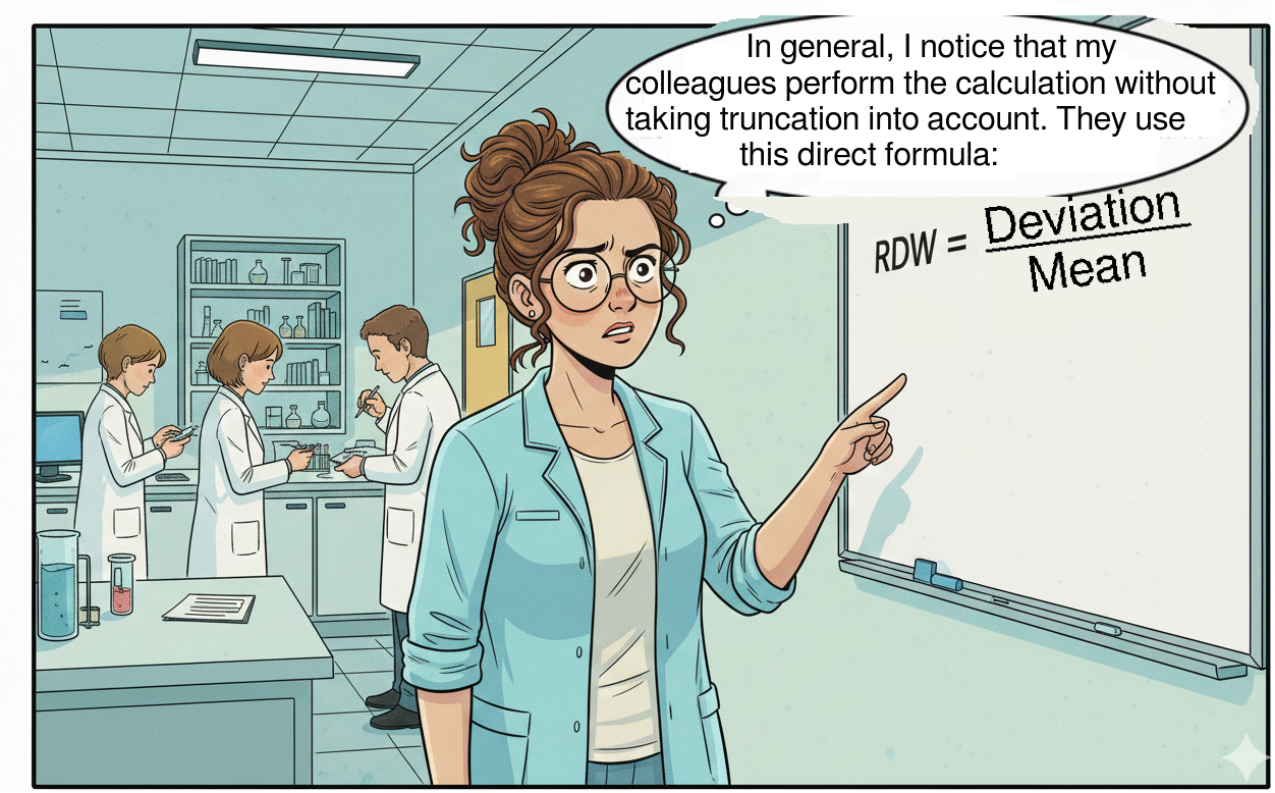
Case 4 - Illustrative Example of Application to Biology

A biologist is working in her lab:






In general, I notice that my colleagues perform the calculation without taking truncation into account. They use this direct formula:
RDW = Deviation / Mean

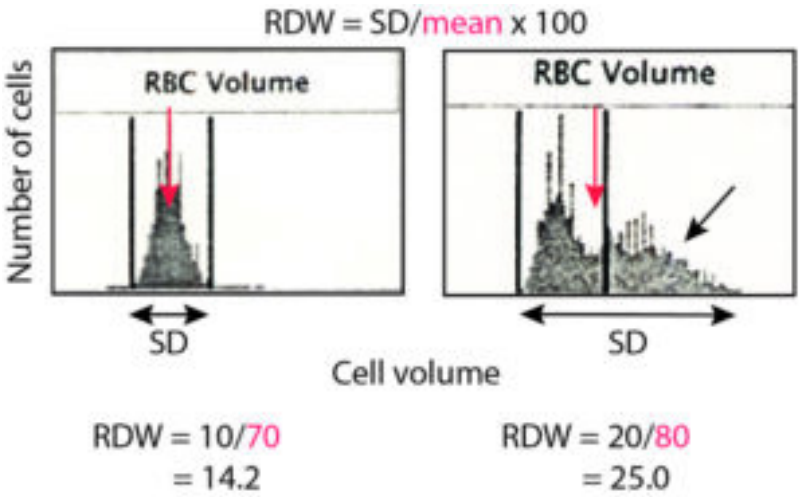

I found a book on truncated curves at https://liberotecno.com I'm going to write an email and call the expert !
liberotecno.com

Good afternoon, Mr. Expert from LiberoTecno,

I am in the lab analyzing red blood cell sizes. There is a standard indicator called
RDW = Red Cell Distribution Width

The RDW is a coefficient of variation = (standard deviation) / mean

But I've noticed something: there is a minimum and a maximum size for red blood cells. The lower limit exists because there is a minimum physical volume below which a red blood cell cannot function. It cannot hold enough hemoglobin, it cannot deform to pass through capillaries, and in fact, the spleen actively destroys cells that are too small. So it's a lower limit not only due to biology but also because of an active elimination mechanism. The upper limit also exists because red blood cells that are too large cannot circulate normally either. The spleen also captures and destroys them if they are excessively large. Furthermore, there is a limit to the size that the bone marrow can produce viably. I have realized that the actual curves are cut off or truncated by these limits:



These are histograms (x-axis: red blood cell size; y-axis: frequency)

Source: https://eclinpath.com/hematology/tests/red-blood-cell-distribution-width/rdw/

My colleagues are calculating the simple equation without taking truncation into account; I suspect the error might be significant.

Please, I'd appreciate your advice.

Best regards,

Dulfina, the biologist.


Hello, Mr. Expert,
I sent you an email with
a question.....


Thank you for
your call. I'll send
you my advice
soon.

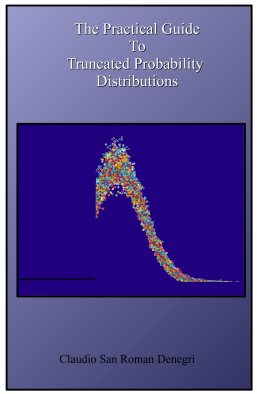
Good afternoon, Ms. Dulfina,

Thank you for your email. You are right; ignoring truncation can lead to significant errors.

This is a case of double truncation; the variable has limits on both sides.

I recommend my e-book; there is a section on double truncation:

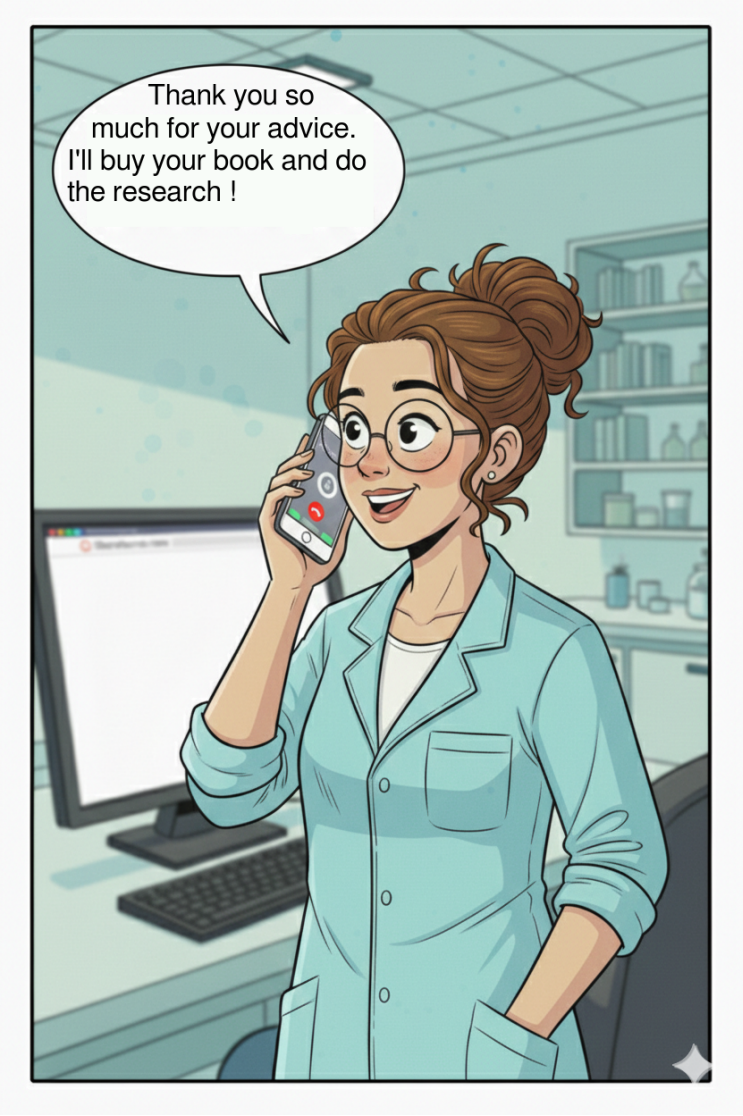
” The Practical Guide To Truncated Probability Distributions “



The best approach is to collect at least 30 real-world curves and try writing code in Octave or Python using the knowledge from the book to estimate the parameters of the truncated curves. In the end, you’ll be able to calculate the RDW with and without the truncation, and you’ll know the magnitude of the error. It will be useful for your lab; it’s an investment in the future. These methods aren’t perfect, but they are more accurate than ignoring the truncation.

Try modeling using Gaussian or Generalized Gaussian (Subbotin) curves, or any other distribution that comes to mind.

Best regards,
The Expert at Liberotecno.com



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References

[1] C. San Roman. The Practical Guide To Truncated Probability Distributions. https://liberotecno.com/PracGuideTrunc.php

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