*Have you heard of the "**Theory of Sampling**"?*

I bet you haven't (at least not this one!)

It sounds like standard stats theory...

BUT IT'S NOT!

The "Theory of Sampling" (ToS) - have statisticians missed the boat?

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Motivation - sampling compost

A researcher was interested in sampling compost for biological and chemical contaminants. He pointed us to the "Theory of Sampling" as a framework.

Compost Piles

Theory of Sampling (ToS)

ToS arose from work by chemical engineer **Pierre Gy** over 50 years ago.

Pierre Gy

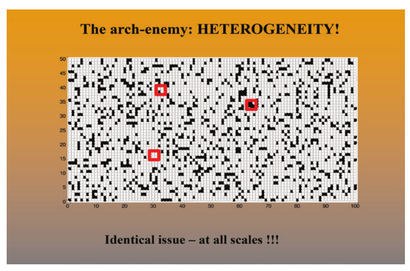
It concerns sampling of **bulk materials** such as soils, composts and ore deposits.

It now enjoys a strong advocacy network particularly amongst chemical engineers and geologists. As well as a formidable body of literature. Even a regular "ToS forum" journal. It is used to justify the recent review of composts and mulches in Australia ([1]).

ToS - sampling recommendations

ToS encourages practitioners to stop and think about the sampling process. ✔

ToS recognises heterogeneity in the sampling target and identify sources of variation in the sampling process. ✔



Heterogeneity *(from [2]*

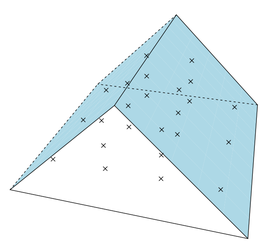
To deal with heterogeneity, rather than just taking a convenient "grab sample" from the surface...

"Grab sampling"

(from [2]

...take subsamples all across the entire sampling target - for instance, a compost pile. ✔

And combine these subsamples into one composite sample for analysis. ?



"Representative sampling"

of a compost pile

A "correct" sample for analysis

ToS encourages the analysis of a single composite sample. In [2], Esbensen concludes

"Applied properly, the TOS allows us to forward only one aliquot to the laboratory for analytical determination. Only one is needed because the entire from-lot-to-analysis process honours the TOS's principles for representativity."

One "correct" representative sample?

Of course, one sample for analysis means ***neither*** sampling ***nor*** analytical error can be estimated (let alone separated).

It's almost like this sample is considered a "population in miniature" as in the Kruskal-Mostellor papers on representative sampling [3].

Model train set - a "population in miniature" *(from [3])*

Have statisticians missed the boat?

Despite the obvious intrinsic statistical nature of the ToS, the theory has developed almost entirely independently of statisticians. Some related literature might be [4], [5] and [6].

Consequently, some statistical ideas appear confused or misconstrued in the ToS literature, as in [2].

This poster hopefully increases your awareness of the inherent problems in ToS. It is a reminder to always critically assess so-called "statistical theories". And it demonstrates the dangers of not involving statisticians in the application of statistics.

Acknowledgments

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References

<- Use the QR code to download

[1] K. Wilkinson, J. Jasonsmith, J. Biala, C. Lee-Steere, and A. Borshall. Review of AS4454 - Composts, Soil Conditioners and Mulches. Online, 2023.

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[5] AMCTB, Analytical Methods Committee, et al. Sampling theory and sampling uncertainty. *Analytical Methods*, 7(24):10085–10087, 2015.

[6] Charles H Proctor. Statistical considerations in bulk sampling. Technical report, North Carolina State University. Dept. of Statistics, 1990.