Which Gundersen CE value should I use, m=0 or m=1?

**Question**

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**Answer**

The stereological sampling process has two considerations. The first is the estimate of interest, be it cell counts or any other geometric quantity. The second is to get an idea of how good the estimate is. The latter is done by estimating the CE.

All CE estimates are model based and the CE method published by Gundersen is no exception. The $m=0$ and $m=1$ results differ in some arcane mathematical descriptions that relate the collected samples to a model of the object from which the samples were obtained. The authors decided that most biological tissue has characteristics that are described by the $m=1$ results. However, if there are any sharp cutoffs in the data, then the $m=0$ results are the appropriate results to use. Notice that the decision to use $m=0$ or $m=1$ is made outside of the obtained samples.

The easiest way to understand the difference is to consider an example of sampling in which the $m=0$ result is appropriate. Suppose that the samples come from something that has a triangular graph. A triangular graph is 0 until it ramps up in a straight-line segment and suddenly plummets back to 0. The volume of the chambers of a heart can approximate a triangular graph when the heart is sectioned perpendicular to its long axis. Near the tip of the heart the chambers are small and so is the cross sectional area. Sections closer to the top of the heart show increasing area until the end of the chambers is reached. Suddenly the area drops to 0. Sudden cutoffs are uncommon in biological tissues. That is why $m=1$ is recommended and usually used today.

For a case in which the $m=0$ CE seems to be more appropriate, please reference Slomianka L, West MJ. 2005 Estimators of the precision of stereological estimates: an example based on the CA1 pyramidal cell layer of rats. Neuroscience. 136, volume 3, 757-67.

In 1999, Gundersen et. al. published a new paper referenced below, which reconsiders the CE issue and recommended estimating the CE with the $m=1$ smoothness class. The authors determined that biological tissues are best described by the $m=1$ class. For a full explanation, please refer to The efficiency of systematic sampling in stereology – reconsidered” by H.J.G. Gundersen, E.B.V. Jensen, K. Kieu & J. Nielsen, Journal of Microscopy Vol. 193, Pt 3, March 1999, pp. 199-211.

In summary, the $m=0$ Gundersen CE equation was the original CE estimate developed for use with the optical fractionator (see Gundersen HJ and Jensen EB The efficiency of systematic sampling in stereology and its prediction. Journal of Microscopy 1987 Sep;147 (Pt 3):229-63). If you want to compare your results with older papers published using the pre-1999 CE estimate, you may want to use the $m=0$ smoothness class for a more direct comparison. Stereo Investigator calculates the CE estimates with both smoothness class equations: $m=0$ and $m=1$ because it is not possible to know from the samples which method is appropriate. The $m=1$ Gundersen CE value is the newer method, and is recommended.