1990: The Brain-Drug Problem

Researchers on brain disorders test the effects of the new medical drugs—for example, dopamine against Parkinson's disease—with intracerebral injections. To this end, they must estimate the size and the shape of the spatial distribution of the drug after the injection, in order to estimate accurately the region of the brain that the drug has affected.

The research data consist of the measurements of the amounts of drug in each of 50 cylindrical tissue samples (see **Figure 1** and **Table 1**). Each cylinder has length 0.76 mm and diameter 0.66 mm. The centers of the parallel cylinders lie on a grid with mesh 1 mm $\times$ 0.76 mm $\times$ 1 mm, so that the cylinders touch one another on their circular bases but not along their sides, as shown in the accompanying figure. The injection was made near the center of the cylinder with the highest scintillation count. Naturally, one expects that there is drug also between the cylinders and outside the region covered by the samples.

Estimate the distribution in the region affected by the drug.

One unit represents a scintillation count, or 4.753 $\times 10^{-13}$ mole of dopamine. For example, the table shows that the middle rear cylinder contains 28,353 units.

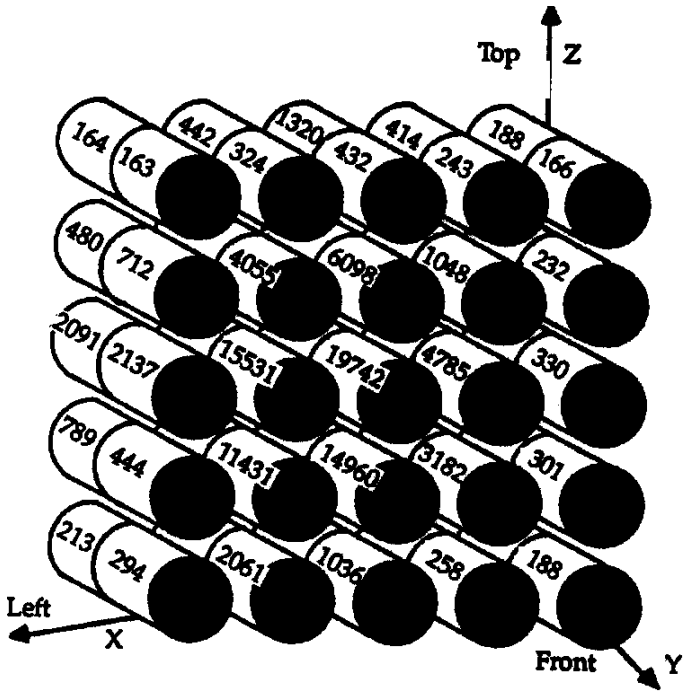

Figure 1. Orientation of the cylinders of tissue.

Table 1.

Amounts of drug in each of 50 cylindrical tissue samples.

Rear vertical section

164	442	1320	414	188
480	7022	14411	5158	352
2091	23027	28353	13138	681
789	21260	20921	11731	727
213	1303	3765	1715	453

Front vertical section

163	324	432	243	166
712	4055	6098	1048	232
2137	15531	19742	4785	330
444	11431	14960	3182	301
294	2061	1036	258	188