

On the landing phase of the cube method

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SUMMARY

The landing phase of the cube method rounds the fractional inclusion probabilities left by the flight phase, independently and one unit at a time. We prove that no reordering of such a landing can alter the sampling design: every landing that rounds the fractional units independently, with their fractional values as probabilities, induces the same design whatever its processing order, however informed. The landing can therefore only be improved by dependent rounding, and we show that the optimal dependent rounding — the enumerative landing of Deville & Tillé (2004), a small linear programme — is practical on modern hardware for moderate numbers of balancing constraints. In a factorial study it reduces the median standardised imbalance by 29% overall and 45% for ten balancing variables, returns a sample of exactly the target size, and does not degrade the Horvitz–Thompson estimator.

Some key words: Balanced sampling; Cube method; Dependent rounding; Landing phase; Linear programming.