

The Application of Uniform Design to Multi-Objective Sampling

Survey

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1.Introduction

A census about over 10000 enterprises of Shaanxi province was carried out in 1996, in which 26 quantitative indicators were designed. What we should now solve is how to use the census' data to construct a multi-objective sampling design for the enterprises. In this paper, we will make use of the method of uniform design to scheme a multi-objective sampling project, which will improve such aspects as manageability, multi-objective comprehension and sample capacity.

2.Design of Multi-objective Sampling Project.

We make correlation analysis of the 26 quantitative indicators and choose 4 indicators with low correlation to draw multi-objective sample. The 4 indicators are : the gross industrial products (GIP) ,taxes and additional taxes for sales of products (TAT), total assets(TA) and total wages of all staff (TW). To facilitate sampling, we classify the above 4 indicators into 3 different levels according to the method of 3-stage method, so, all the cases will be divided into 3^4 sorts.

Multi-objective sampling is to draw samples from these 3^4 sorts according to uniform principles. The samples drawn in this way will correspond with the experimental design of 4 factors and 3 levels of uniform design. By the uniform design table $U_{12}(3^4)$ [1]. We can obtain the following table (Table 1)

Table 1. Selecting Table of Multi-objective Sampling

sort level factor	1	2	3	4	5	6	7	8	9	10	11	12
GIP	1	3	2	1	2	3	2	3	1	3	2	1
TAT	1	3	3	2	3	1	2	2	3	2	1	1
TA	3	2	1	1	2	2	3	3	2	1	1	2
TW	2	2	1	3	3	3	3	1	2	1	2	1

Multi-objective sampling draws the above 12 sorts as samples, on the basis of this, we can make the population information inference.

The percentage of the sort of sampling is $12/3^4$ and if indicators are distributed uniformly, then the percentage of sampling cases is $12/3^4$, too. Apparently the multi-objective sampling scheme has the following advantages: 1), a small sampling capacity 2), different kinds of samples are drawn uniformly 3), good multi-objective comprehension 4). high manageability.

3. Sampling Results

Sampling results like table 2 are obtained from the above-mentioned sampling scheme (Table 2).

Table 2. The Comparative table between sampling results and population

item factor	Sample mean	Population mean
GIP	808.11	1012.36
TAT	19.38	19.23
TA	1130.19	1262.52
TW	150.21	134.05

References

- [1] Fang, K. T. and C. X. Ma. (2000) Orthogonality and Uniformity Experimental Design, Hong Kong Baptist University Press.
- [2] Fang, K. T. (1994) Uniform Design and Uniform Design Table, Science Publication.
- [3] Shaanxi Industrial survey Groups (1996) Census' data about industrial enterprises in Shaanxi.