Iterative Proportional Fitting For A Four-Dimensional Table

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What Is IPF?: 4-D

This set of slides follows 'Iterative Proportional Fitting For A Two-Dimensional Table' and 'Iterative Proportional Fitting For A Three-Dimensional Table.'

If you understand the information in those slides, you should be prepared for the information in these slides.

What Is IPF?: 4-D

First: What is a four-dimensional table?

A tabulation such as 'Age by Sex by Race by Borough' would be a four-dimensional table.

Just as there are two one-dimensional marginals for a two-dimensional table, and three two-dimensional marginals for a three-dimensional table, there are four three-dimensional marginals for a four-dimensional table (as in a row of cubes).

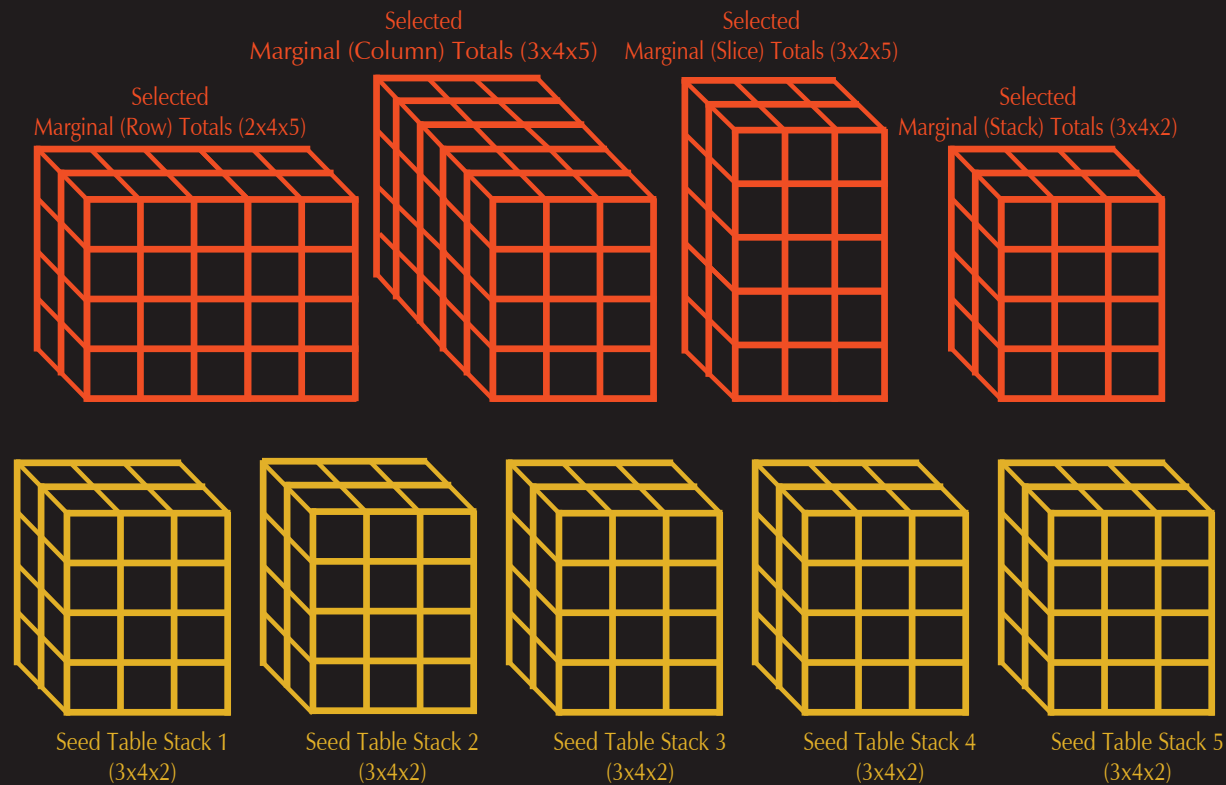We can describe the four marginals as rows, columns, slices and stacks.

What Is IPF?: 4-D

For an Age by Sex by Race by Borough table, the marginals include (order doesn't matter here):

Age by Sex by Race
Age by Race by Borough
Sex by Race by Borough
Sex by Borough by Age

The next slide will show what the cells of a four-dimensional table and its marginals look like in three-dimensions...

What Is IPF?: 4-D

Selected Marginal (Row) Totals (2x4x5)

Selected Marginal (Column) Totals (3x4x5)

Selected Marginal (Slice) Totals (3x2x5)

Selected Marginal (Stack) Totals (3x4x2)

Seed Table Stack 1 (3x4x2)

Seed Table Stack 2 (3x4x2)

Seed Table Stack 3 (3x4x2)

Seed Table Stack 4 (3x4x2)

Seed Table Stack 5 (3x4x2)

As in the three-dimensional case, these cells could all be layed out in two-dimensions.

How To Do IPF?: 4-D

So how to do four-dimensional IPF?

First you will need all of the pre-determined marginals (e.g. Age by Sex by Race, Age by Race by Borough, Sex by Race by Borough, and Sex by Borough by Age). You must also be sure that the dimensions of the marginals are consistent (e.g. that the values of the total age groups in the different marginals are consistent with one another).

Second, you will need a four-dimensional (e.g. Age by Sex by Race by Borough) seed.

You will then perform steps that are very similar to the cases shown earlier...

How To Do IPF?: 4-D

Step 1: Proportionally adjust each (three-dimensional) row of cells to equal the pre-determined totals of Marginal 1.

Step 2: Proportionally adjust each column of cells to equal the pre-determined totals of Marginal 2.

Step 3: Proportionally adjust each slice of cells to equal the pre-determined totals of Marginal 3.

Step 4: Proportionally adjust each stack of cells to equal the pre-determined totals of Marginal 4. This is the end of the first 'Iteration'.

Steps 5 and higher: Repeat the above steps until the desired level of convergence is reached.

Make Sense? If Not:

Here is a link to four-dimensional IPF done step-by-step in a simple Excel spreadsheet (just follow the 'Iteration' numbers).

And here, again, is that link and reference to Deming and Stephan's paper describing the procedure (see pp 439-442). Deming, W. and Stephan, F. (1940) 'On least square adjustment of sampled frequency tables when the expected marginal totals are known.' *Ann. Math. Statist.*, 6, 427–444.

The same 'important points' described in 'Iterative Proportional Fitting For A Two-Dimensional Table' apply for the four-dimensional case.

The End

So that's all I have to tell about IPF for a four-dimensional table.

Here is a link to my web page with more IPF information.