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## THE TABLE PRODUCING LANGUAGE OF THE BUREAU OF LABOR STATISTICS

BY RUDOLPH C. MENDELSSOHN

The Table Producing Language (TPL) is a computer system that selects and restructures data, cross tabulates and summarizes, uses the results for arithmetic calculations, and organizes their display in statistical tables. Except for hardware restrictions, the system is free of ordinary constraints. There is no practical limit on the number of variables it can access, and it can process up to 32,000 for a single table, should that unlikely amount be required. The numerical value of a variable may be as high as  $10^{75}$ , and the value of a result is correct to approximately 16 significant decimal positions.

Data can be cross tabulated, and the results displayed as tables without restriction. There is no limit on the number of tables processed in a single run, a feature that affords important economies at run time. Any fixed or variable length format and all commonly used sequential file structures are allowed. Hierarchical data files can be processed; the system can do interrecord analysis, and more than one record format can occur on any level. All data on all levels of the hierarchy are available for classifying, selecting, and computing. Aggregation or counting can take place at any level of the hierarchy.

The system translates user statements into procedures it must follow to get the product. From the user's viewpoint, TPL is problem-oriented, rather than procedure- or process-oriented as are most computer languages. In other words, TPL already knows what a table is and how to generate one; it needs only to be told the particulars about the one wanted. As a result, once the data file is organized according to TPL requirements, the Language may be used by nonprogrammers.

The user of TPL has optional control over the appearance of the table. If this option is not exercised the system will automatically format stubs, columns, and headings using the names of variables given in the data file. These may not be acceptable as published titles. If the user wishes to control the table, he can specify column and stub widths, as well as the desired alphabetic labels for each variable included in a table. Facilities for footnoting, hyphenation, and centering table titles and column headings are available. Taken together, these and other related features—e.g., decimal points and dollar, cent, and percent signs—can create tables that may be acceptable for direct photo-offset printing.

No single table could fully illustrate TPL's flexibility; the variety of tabular output is limited only by the user's imagination and the physical attributes of the line printer. With this caveat, the dummy table shown in Figure 1 may help to illustrate some options relating mainly to table appearance. (The table is devoid of substantive meaning and contains nonsense data.) The features illustrated include:

- (1) Capital and small letters in the same table.
- (2) Numbers centered in column and also flush-right.

Table 8. Family expenditures for food, by number of purchases made, amount spent, and type of area where located

Item	Family Units Surveyed (unweighted)				Number of Purchases Made				Amount Spent			
	TOTAL	Sex of Head of Family Unit2/		TOTAL	Sex of Head of Family Unit2/		TOTAL	Sex of Head of Family Unit2/				
		Male	Female		Male	Female		Male	Female			
TOTAL	117	82	35	1,724	1,381	343	\$2,228	\$1,833	\$396			
PERCENT	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00			
Type of Area in Which Located:												
Urban	87	61	26	1,277	1,039	238	\$1,633	\$1,326	\$307			
PERCENT	74.36	74.39	74.29	74.07	75.24	69.39	73.28	72.37	77.49			
Rural	30	21	9	447	342	105	\$596	\$506	\$89			
PERCENT	25.64	25.61	25.71	25.93	24.76	30.61	26.72	27.63	22.51			
Broad Types of Expenditures:												
Meats	76	57	19	153	119	34	\$352	\$299	\$53			
TOTAL	64.96	69.51	54.29	8.87	8.62	9.91	15.77	16.30	13.32			
Type of Area in Which Located:												
Urban	56	41	15	105	82	23	\$254	\$219	\$35			
PERCENT	47.86	50.00	42.86	6.09	5.94	6.71	11.38	11.93	8.80			
Rural	20	16	4	48	37	11	\$98	\$80	\$18			
PERCENT	17.09	19.51	11.43	2.78	2.68	3.21	4.40	4.37	4.51			
Dairy	97	68	29	258	189	69	\$262	\$209	\$53			
TOTAL	82.91	82.93	82.86	14.97	13.69	20.12	11.77	11.40	13.48			
Type of Area in Which Located:												
Urban	71	50	21	160	136	44	\$193	\$158	\$35			
PERCENT	60.68	60.98	60.00	10.44	9.85	12.83	8.64	8.60	8.85			
Rural	26	18	8	78	53	25	\$70	\$51	\$18			
PERCENT	22.22	21.95	22.86	4.52	3.84	7.29	3.13	2.80	4.63			
Produce	56	42	14	101	82	19	\$64	\$52	\$11			
TOTAL	47.86	51.22	40.00	5.86	5.94	5.54	2.86	2.86	2.87			

<b>Type of Area in Which Located:</b>												
Urban	42	31	11	73	58	15	\$46	\$38	\$8			
PERCENT	35.90	37.80	31.43	4.23	4.20	4.37	2.05	2.08	1.92			
Rural	14	11	3	28	24	4	\$18	\$14	(3)			
PERCENT	11.97	13.41	8.57	1.62	1.74	1.17	.81	.78	(3)			
<b>Other Foods<sup>4</sup>/</b>												
TOTAL	106	75	31	609	502	107	\$402	\$324	\$78			
PERCENT	90.60	91.46	88.57	35.32	36.35	31.20	18.05	17.70	19.70			
<b>Type of Area in Which Located:</b>												
Urban	76	54	22	489	374	75	\$291	\$235	\$56			
PERCENT	64.96	65.85	62.86	26.04	27.08	21.87	13.06	12.84	14.05			
Rural	30	21	9	160	128	32	\$111	\$89	\$22			
PERCENT	25.64	25.61	25.71	9.28	9.27	9.33	4.99	4.85	5.65			
<b>Alcohol</b>												
TOTAL	41	33	8	66	57	9	\$188	\$162	\$22			
PERCENT	35.04	40.24	22.86	3.83	4.13	2.62	8.26	8.86	5.51			
<b>Type of Area in Which Located:</b>												
Urban	29	21	8	44	35	9	\$120	\$98	\$22			
PERCENT	24.79	25.61	22.86	2.55	2.53	2.62	5.37	5.34	5.51			
Rural	12	12	-	22	22	-	\$65	\$65	-			
PERCENT	10.26	14.63	-	1.28	1.59	-	2.90	3.52	-			
<b>Food Away From Home</b>												
TOTAL	85	63	22	537	432	105	\$965	\$786	\$179			
PERCENT	72.65	76.83	62.86	31.15	31.28	30.61	43.28	42.89	45.11			
<b>Type of Area in Which Located:</b>												
Urban	61	45	16	426	354	72	\$731	\$579	\$152			
PERCENT	52.14	54.88	45.71	24.71	25.63	20.99	32.78	31.58	38.35			
Rural	24	18	6	111	78	33	\$234	\$207	\$27			
PERCENT	20.51	21.95	17.14	6.44	5.65	9.62	10.50	11.31	6.76			

1 Includes 2 apartment buildings with 4 families in each.

2 Preliminary

3 Rounds to less than .005 percent.

4 Includes cooking sherry.

- DATA NOT AVAILABLE.

NOTE: For additional detail, see table 2 in Consumer Expenditure Survey, 1960-1961.

- (3) Variable column width.
- (4) Percentage calculations using top row as base. Other choices as base are left-hand column and the cell in the upper left-hand corner.
- (5) Automatic positioning of title according to choice.
- (6) Automatic proportioning of text within column heading.
- (7) Footnote numbers in table matrix; text automatically sequenced below table by number.

The basic TPL arithmetic calculations do not permit many of the complex, scientific analyses required by statisticians, economists, demographers, and other analysts. An option enables the research user to shunt tabulated results into the statistical analysis package called SOUPAC. This is a collection of statistical routines put together by the University of Illinois in an operational form that interfaces well with TPL.

In addition to tables, TPL can produce a binary data-file output for input to another system. This makes possible the linkage between TPL and SOUPAC, and it would be possible to use this file to link TPL with other statistical systems such as BMD or SPSS. The binary file is constructed in the sequence and structure established by user written TPL instructions and can be processed by a PL/1 or FORTRAN program. If the target system cannot accept binary data as input or if it requires a special format, a small program would have to be written in PL/1 or FORTRAN to provide the required transformations. Once this is done, the linkage would be transparent to the user.

The Bureau of Labor Statistics operates the TPL system under OS/MVT (Release 21.6) on the IBM 360/65, 370/165, and 370/168. A region size of at least 150 K is used. Temporary storage requirements are extremely dependent upon the individual job; 4126 tracks on 2314 disk drives (or equivalent) is the default space allocation in our catalogued procedures. Permanent storage (on-line or private space) of about 100 tracks is needed. The print train should have the full 64-character set; i.e., the system expects to print the full character set required for PL/1 plus the "@" (at) sign. Lower case letters, if available, will be correctly handled. TPL also uses the "print advance suppress feature" for overprinting (i.e., the ANSI carriage control character "+").

Users outside the Bureau of Labor Statistics have installed TPL and report that it runs successfully under OS/VS2, Release 1, on the IBM 370/158 and under OS/MVT on the 360/50, 370/155, and 370/158.

TPL is written in XPL, a dialect of PL/1, and is distributed in object code only because a special compiler is needed. The System Transmittal Tape volume is recorded as an IBM standard-labelled, 9-track, 1600-BPI, phase-encoded tape, unless the requestor specifically requires otherwise. The tape which is furnished by BLS, contains all data sets necessary to install and test TPL. Complete installation and user documentation accompanies the tape. There is a charge of \$200 to recover the administrative costs of transcribing the system and providing the associated documentation and instructions. The documentation includes an introductory pamphlet describing the principles on which the language and system are based, and a guide for those who want to learn how to use the language. The latter is typically used in classroom training.

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*U.S. Department of Labor*