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Cc:	Dandekar, Ramesh
Subject:	About Your Research Paper on Holistic Solution to Contingency Table Release ..
Attachments:	BarakEtPODS07Conting.pdf

Hi Friends

I am with U. S. Department of Energy and have been actively doing research on Synthetic Tabular Data. My Research papers are on

http://mysite.verizon.net/vze7w8vk/

I do have a proprietary procedure to process a high dimensional tabular data (count and magnitude) using LP setup. I think, we need to join our forces to test your new procedure against what I have proposed using a real life CPS counts data

"Maximum Utility-Minimum Information Loss Table Server Design for Statistical Disclosure Control of Tabular Data", Ramesh A. Dandekar, June 9-11, 2004, Barcelona, Spain. Related LOG-LINEAR analysis and 3-D sectional data from Eight Dimensional CPS Counts Data.

Please let me know if there is any interest in collaborative work.

- sincerely

Ramesh A Dandekar

Maximum Utility-Minimum Information Loss Table Server Design for Statistical Disclosure Control of Tabular Data

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Abstract. Statistical agencies typically serve a diverse group of end users with varying information needs. Accommodating the conflicting needs for information in combination with stringent rules for statistical disclosure limitation (SDL) of statistical information creates a special challenge. We provide a generic table server design for SDL of tabular data to meet this challenge. Our table server design works equally well with counts data and magnitude data, and is compatible with commonly used cell perturbation methods and cell suppression methods used for the statistical disclosure control of sensitive tabular data. We demonstrate the scope and the effectiveness of our table server design on counts and magnitude data by using a simplified controlled tabular adjustment procedure proposed by Dandekar (2003). In addition to ad hoc queries, the information compiled using our table server design could be used to capture multi-way interactions of counts data and magnitude data either in a static environment or in dynamic mode.

1 Introduction

Procedures to protect sensitive cells in tabular data have evolved over the last few decades. In recent years there has been an increased realization that "one table at a time" tabular data protection procedures, though easy to implement, could be error prone and pose serious disclosure risks. As a result, system designers are increasingly tasked to develop a unified strategy to simultaneously protect multiple different tables resulting from the same survey data collection form. The complexity of the data collection form and resulting tabular data structures in related publications varies from survey to survey. This makes it difficult to develop a unified design strategy that will accommodate multiple variations in table structures as well as inter-table relations.

In the first part of the paper, we propose a unified method to simultaneously capture and process multiple different tables containing complex hierarchies and linked structures resulting from the same data collection efforts. As an integral part of our proposed method, we introduce the concept of a "guidance matrix" to capture complex interaction effects present within and across table structures.

J. Domingo-Ferrer and V. Torra (Eds.): PSD 2004, LNCS 3050, pp. 121–135, 2004.

We first explain the role of the guidance matrix concept in capturing complexities of seven different test cases of magnitude data. These test cases are currently available in the public domain to all researchers of tabular data protection from the website: http://webpages.ull.es/users/casc/ficheros.csp.htm. We also demonstrate the effectiveness of the guidance matrix concept in capturing multi-way interaction terms by illustrating its use on real life eight-dimensional counts data.

In the second part of the paper, we demonstrate the unique characteristics associated with simplified Controlled Tabular Adjustment (CTA) procedure by Dandekar (2003). This technique when applied to any generic N dimensional counts data structure in its entirety, offers complete protection from statistical disclosure. We utilize the guidance matrix concept, developed in the first part of the paper, to demonstrate the statistical validity of the CTA-adjusted counts table structure by performing cross section by cross section analysis of the SDL protected eight-dimensional counts data. We conclude by providing basic details on how to design a generic web-based table server to function in a dynamic mode by using the simplified CTA procedure. Our proposed web-based table server design, after some fine tuning, is capable of serving diverse user groups with conflicting information needs.

2 Concept of Guidance Matrix

A typical survey data collection form consists of multiple fields containing various categorical variables and related quantitative information. Categorical variables are mainly used to define table structures for the publication of cumulative statistics related to the quantitative information. Often, various intervals of quantitative information fields are used to create additional categories in the table structure.

For our discussion, we assume that the N dimensional space defined by the N different categorical variables has already been identified a priori by the statistical office. In our proposed implementation method, we first construct an N columns by M rows boolean guidance matrix as follows:

- J= 1 to M rows of the guidance matrix define M different tables to be created by the publication system.
- Within the Jth row of the guidance matrix, the column position assumes the value of zero if the related categorical variable details are not included in the Jth table. The column value of one indicates that the related categorical variable details are available in the Jth table.

We use the contents of the guidance matrix as a tool to connect, on a consistent basis, all different cross sections the statistical agency intends to display to the general public either through a conventional table publication system or through web access. The contents of the guidance matrix serve as a filter to extract only the relevant aggregates for publication purposes from a generic N dimensional table structure. Tables generated by using the guidance matrix concept could be protected by either cell perturbation or cell suppression methods.

3 Guidance Matrices for Seven Test Cases

Currently, seven complex test cases of magnitude data are available to all SDL researchers of tabular data. Three of the seven test cases (HIER13, HIER16, and BTS4) consist of single tables with complex hierarchical structures. For these three test cases, the guidance matrix consists of only a single row. Due to the fact that all the column details are included in the table structure, all column values are assigned the value of one in the guidance matrix. The remaining four test cases each consist of multiple different multi-dimensional tables with complex linked structures. By following the guideline above, the guidance matrix for these test cases, namely NINENEW, NINE5D, TWO5IN6 and NINE12, can be displayed by using a consistent procedure. The guidance matrices for the seven test cases are in Table 1.

Table 1. Guidance Matrices for Seven Test Cases

HIER13		
1	1	1

HIER16		
1	1	1

BTS4			
1	1	1	1

NINE5D								
1	0	1	1	1	0	0	0	1
1	1	0	0	1	1	1	0	0
1	0	1	0	1	0	0	1	1
1	1	0	1	0	0	1	0	1

TWO5IN6					
1	1	1	1	0	1
1	1	1	1	1	0

NINENEW								
1	1	1	1	0	0	0	0	0
1	0	1	1	1	0	0	0	0
1	0	0	1	1	1	0	0	0
1	0	0	0	1	1	1	0	0
1	0	0	0	0	1	1	1	0
1	0	0	0	0	0	1	1	1

NINE12								
0	0	0	0	1	1	0	1	1
0	0	0	0	1	1	1	1	0
0	0	0	1	1	0	1	0	1
0	0	0	1	1	1	0	0	1
0	0	1	1	1	0	0	0	1
0	1	0	1	0	0	0	1	1
0	1	0	1	0	0	1	1	0
0	1	0	1	0	1	0	1	0
0	1	0	1	0	1	1	0	0
1	1	0	0	1	0	0	1	0
1	1	0	0	1	0	1	0	0
1	1	0	0	1	1	0	0	0

Two of the three 9-D test cases, namely NINENEW and NINE12, are created from the same micro data file. In these two test cases, only a limited number of distinct 4-D linked tables are captured in 9-D variable space. In a real data situation, the statistical office would have decided on the substructure, including a dimensionality, for each table by taking into account user needs for published information.

In an extreme situation, the statistical office could have decided on capturing all the possible 4-D linked tables resulting from the 9 variables and making them available to the general public after statistical disclosure control of the tabular data. Under such a scenario, the guidance matrix will consist of 126 rows derived by using a combination of nine items, taken 4 items at-a-time combinatorial logic. Similarly, in the event that there is a need to publish all possible 5-D or 6-D tables resulting from the nine variables for public use, the guidance matrix consisting respectively of 126 and 84 rows could be constructed to satisfy user needs.

4 Complex Interactions in Hierarchical Structures

The guidance matrix concept offers considerable flexibility in capturing multi-way complex interactions in table publication systems consisting of multiple hierarchical structures. This is easy to demonstrate by using a hypothetical example. We assume that the statistical agency collects manufacturing industry data at the state level and three different Standard Industry Classification (SIC) levels, namely 2 digits, 3 digits and 4 digits SIC codes. We further assume that the individual states are further grouped into various regions. Complex requirements, such as the statistical agency deciding to publish (a) 2 digits SIC level data at the state level (b) 2 digits and 3 digits SIC level data at the regional level and (c) 2 digits, 3 digits, and 4 digits SIC level data at the national level, are easy to implement by using the guidance matrix concept. In the following guidance matrix implementation we assume that the first five columns of the guidance matrix represent state code, region code, 2 digits SIC code, 3 digits SIC code and 4 digits SIC code respectively. The rest of the column positions in the guidance matrix are assumed to relate to other categorical variables. To capture the complex data publication requirement above, the guidance matrix is implemented as shown in Table 2:

Table 2. Complex Hierarchies Using Guidance Matrix

```
10100......  2 digits SIC level state data
01110......  2 and 3 digits SIC level regional data
00111......  2, 3, and 4 digits SIC level national data
```

5 Eight Dimensional Counts Data Using CPS File from UC Irvine

Multi-way interaction terms are of importance in an analysis of counts and magnitude data. In this section, we demonstrate the versatility of the use of a guidance matrix to capture multi-way interactions on eight dimensional counts data. The file contains information on 48,842 individuals. The file was obtained from Dr. Alan Karr of the National Institute of Statistical Sciences (NISS) in August 2001 [1]. Dr. Karr believes this to be real data created by using a public use file with the original source of Current Population Survey (CPS) file from UC Irvine.

[1] In the SDL literature, the 8-D Counts data has been used by NISS to justify partial release of a select few summary tables as a statistical disclosure control strategy.

As stated by Dr. Karr, there were originally more variables and more categories for some of the variables and that NISS staff did some collapsing of the variables. After collapsing, the test data has the characteristics shown in Table 3.

Table 3. Characteristics of Eight Dimensional Counts Data

Variable	# of Categories	Category Label
Age	3	<25,25-55, >55
Employer Type	4	Govt, Priv, SE, Other
Education Completed	5	<HS, HS, Bach, Bach^{+}, Coll^{+}
Marital Status	2	Married, Unmarried
Race	2	White, Non White
Sex	2	Male, Female
Hours Worked	3	<40, 40, >40
Annual Salary	2	<$50K, >=$50K

There are multiple ways this data could be processed for statistical disclosure control and released for general public use. As an option, based on the data users' needs the statistical office could decide a priori on the total number of cross sections and dimensionalities of each cross section for public release by using the concept of a guidance matrix; and thereafter simultaneously apply an appropriate SDL method to those cross sections prior to the release of the information for general public use. Both cell suppression methods and cell perturbation methods could be used for statistical disclosure control of related tables.

Alternatively, the statistical office could decide on public release of table structures by using all the possible combinations of eight variables. Table 4 shows eight such options available to the statistical agency. In the first option, the statistical office could decide to release one cross section containing the entire 8-D structure. Such a structure will contain 33,860 non-zero cells, of which 3,874 cells could be considered as sensitive cells because those cells contain 2 or fewer respondents. To protect such a table from statistical disclosure by using linear programming based techniques, a total of 113,538 equality constraints will need to be evaluated for a feasible solution. Similarly, the statistical agency could decide on publishing eight 7-D structures or twenty-eight 6-D structures and so on. The total number of cross sections for release for each option is determined by using combinatorial logic.

From Table 4, it is obvious that in the option to release all possible 3-D sections, there are no sensitive cells involved. As a result, the statistical office could safely release those 56 cross sections to the general public without any concern for statistical disclosure. The last two options in the table, namely 28 2-D sections and eight 1-D sections, are subsets of fifty-six 3-D sections.

It is possible that some of the 70 4-D sections might not contain any sensitive cells. The 4-D sections without any sensitive cells could also be released to the general public without any concern for statistical disclosure. The drawback of such a data release strategy is that only a small fraction of the total data collection effort is published. In addition, cross sections released using such a strategy might not be what the majority of data users need. Considering the

Table 4. Characteristics of Multidimensional Cross Sections of 8-D Counts Data

Dimension of the Cross Section	Total Number of Cross Sections	Total Number of Non-Zero Cells	Total Number of Sensitive Cells	Total Number of Equality Constraints
8	1	33,860	3,874	113,538
7	8	32,165	3,327	105,045
6	28	25,367	1,832	76,731
5	56	14,609	498	39,411
4	70	5,755	56	13,561
3	56	1,506	0	N/A
2	28	251	0	N/A
1	8	24	0	N/A

Table 5. Characteristics of Eight 7-D Cross Sections from 8-D Counts Data

Section #	# of Non-Zero Cells	# of Sensitive Cells	# of Equality Constraints
1	12,200	830	35,777
2	8,961	685	27,229
3	11,748	1,063	34,911
4	11,921	915	35,232
5	11,829	970	35,076
6	6,179	305	19,119
7	7,446	437	22,755
8	9,394	508	28,139

cost involved in conducting surveys, the statistical office needs to concentrate on developing a strategy that will publish as much of the information as possible after adequately protecting data from statistical disclosure. We tackle that issue in later sections.

The classical literature related to SDL of tabular data often relies on a sequential processing of related cross sections followed by a backtracking procedure to ensure consistent protection across all cross sections. Apart from the ease of software implementation, such a strategy reduces the technical problem to a manageable size. Such a practice was desired and was considered acceptable in the past due to the practical resource constraints dictated by limited computational power. We believe that such an approach, in some instances, could be error prone and is not justified in an era where computational resources are of minor concern. However, as a matter of general research interest, in Table 5 we summarize the characteristics of one such option namely, generating and processing eight 7-D structures sequentially - option 2 from Table 4. The overall summary statistics of these eight sections are shown using a format similar to the one used in Table 4.

The contents of Table 5 are based on the eight 7-D cross sections derived by excluding one variable at a time in 7-D cross sections, starting with section number 1 which excludes the 8th variable, followed by section number 2 which excludes the 7th variable and so on. The guidance matrix associated with these eight sections is in Table 6.

Table 6. Guidance Matrix for Eight 7-D Cross Sections

1	1	1	1	1	1	1	0
1	1	1	1	1	1	0	1
1	1	1	1	1	0	1	1
1	1	1	1	0	1	1	1
1	1	1	0	1	1	1	1
1	1	0	1	1	1	1	1
1	0	1	1	1	1	1	1
0	1	1	1	1	1	1	1

As can be seen collectively from Tables 4, 5, and 6, when processed as a single table consisting of eight 7-D sections, there are 32,165 non-zero cells in a table and over 105K equality constraints to work with. However, when these eight sections are identified and processed separately, the non-zero cell count and the sensitive cell count varies widely from section to section. The total number of equality constraints in each section reduces significantly, reducing the computational complexity and computation time by an order of magnitude for LP-based data protection methods. The sum of the cell count over all the sections does not add up to 32,165 when each section is processed separately. This is due to complex 7-way interaction effects captured through the guidance matrix.

6 Statistical Disclosure Control by Controlled Tabular Adjustments

To minimize the information loss, as an option, the statistical office could use controlled tabular adjustments (CTA) on counts data and magnitude data[2]. Dandekar/Cox (2002) have proposed using a LP- based CTA implementation procedure. Dandekar (2003) has proposed using a simplified CTA procedure, which attempts to minimize percentage deviation from the true cell value for non-sensitive cells without using any special purpose software. In Table 7, we summarize the outcome from both the CTA procedures when used on NINE12 magnitude test data. The LP-based procedure uses the reciprocal of cell values as a cost function to minimize the overall deviation of non-sensitive cells from the true cell value. The reciprocal of the cell value-based cost function closely captures the minimum percent deviation criteria used in the simplified CTA procedure.

[2] Some iterative refinement of the CTA protected counts data might be required to eliminate fractional adjustments.

Table 7. Comparison of LP-Based CTA and Simplified CTA Method

LP-Based CTA 12 x 4-D Cross sections

Cell Size		Absolute Change in Cell Value								
From	To	0 To 0	1 To 10	11 To 25	26 To 50	51 To 100	101 To 150	151 To 200	201 To 300	301 To 600
1 -	32	34	1	2	0	1	0	0	0	0
33 -	64	61	6	0	0	0	0	0	0	0
65 -	128	36	63	18	0	2	0	0	0	0
129 -	250	99	31	51	0	0	4	0	0	0
251 -	500	124	1	86	95	1	0	0	0	0
501 -	1000	366	43	29	250	230	7	0	0	0
1001 -	2000	514	277	99	101	447	25	3	1	0
2001 -	4000	583	880	326	299	258	56	19	0	0
4001 -	8000	200	881	382	455	513	98	30	4	0
8001 -	16000	30	391	262	312	331	97	17	7	0
16001 -	32000	2	55	67	92	138	83	40	13	3
32001 -	64000	0	39	38	44	84	71	25	13	2
64001 -	820000	1	1	4	3	6	7	10	14	5
T O T A L		2051	2669	1364	1651	2011	448	144	52	10

Simplified CTA 12 x 4-D Cross sections

Cell Size		Absolute Change in Cell Value								
From	To	0 To 0	1 To 10	11 To 25	26 To 50	51 To 100	101 To 150	151 To 200	201 To 300	301 To 600
1 -	32	38	0	0	0	0	0	0	0	0
33 -	64	61	6	0	0	0	0	0	0	0
65 -	128	36	73	10	0	0	0	0	0	0
129 -	250	101	30	54	0	0	0	0	0	0
251 -	500	125	4	86	92	0	0	0	0	0
501 -	1000	429	9	37	227	223	0	0	0	0
1001 -	2000	936	25	38	45	413	10	0	0	0
2001 -	4000	1936	49	94	128	169	28	16	1	0
4001 -	8000	1695	76	109	220	385	61	15	2	0
8001 -	16000	821	34	89	166	284	35	15	3	0
16001 -	32000	77	35	48	77	135	64	31	23	3
32001 -	64000	20	13	36	59	85	56	22	24	1
64001 -	820000	0	1	2	7	8	8	1	9	15
T O T A L		6275	355	603	1021	1702	262	100	62	19

In Table 7, we use a two-dimensional histogram of a non-zero cell count to show how the cell value changes are distributed by the cell size. The rows in the table are classified into various cell size categories. The table columns are used to classify the changes in the cell value in various categories after the CTA procedure is used on the NINE12 test case. The comparative analysis of the outcome from the two CTA methods reveals that the simplified CTA procedure makes overall small changes to the magnitude data relative to the LP-based procedure proposed by Dandekar/Cox (2002). Approximately 62% of cells (6,275 out of 10,399 cells) in the simplified CTA method are unchanged, but only 20% of cells (2,051 out of 10,399 cells) in the LP-based CTA procedure are unchanged. Based on the percentage change in cell value criteria, 73% of cells in the LP-based CTA procedure and 79% of cells in the simplified CTA procedure are within 1% of the true cell value. Based on these statistics, it is clear that the simplified CTA procedure offers a low cost, computationally efficient, practical alternative to the LP-based CTA procedure.

As mentioned earlier, in the NINE12 test case only 12 out of the possible 126 4-D cross sections were included to generate 4-D linked tables. In Appendix A, we provide similar two-dimensional histograms based summary statistics for all possible 4-D, 5-D and 6-D sections protected by CTA procedure. Databases created using these three test cases result in (a) 126 4-D sections containing 60,588 non-zero cells (b) 126 5-D sections containing 120,161 non-zero cells and (c) 84 6-D sections containing 161,783 non-zero cells. In all three test runs, 68% of total cell values are consistently within 1% of the true cell value.

7 Simplified CTA Procedure for Counts Data

We have used the simplified CTA procedure on the entire 8-D cross section of the counts data[3]. In our CTA implementation, the cell values of less than three are selected for an adjustment at random. The values for these cells are changed either to zero or to three in such a way that the net adjustment to the table total always stays close to zero after each adjustment. The CTA procedure changes the table total from 48,842 to 48,844. Table 8 summarizes the outcome from the simplified CTA procedure by using the two-dimensional histogram constructed in a format similar to Table 7. Approximately 10% of 8-D cross section data (3,874 out of 33,860) contain sensitive cells. Yet, approximately one third of the total cells (10,986 out of 33,860) are unchanged. Another third of the cells (10,266 out of 33,860) are changed by only a single unit. The remaining one third of the cells undergo varying amounts of change[4]. Overall, only 18 percent of the cells are altered by more than 2 count.

By using the strategy proposed by Dandekar/Cox (2002) to convey the overall cell value accuracy to the general public, the CTA protected 8-D section of the counts data could be released for public use in its entirety. As a part of the recommended strategy, the statistical agency could make the Table 8 format summary statistics publicly available to all data users. In Table 8, some collapsing of small cell categories might be required to avoid an indirect disclosure of the data protection strategy.

[3] The CTA protected data and related log-linear model analysis is available by contacting the author. We look forward to comparative evaluation of CTA protected data with other sensitive tabular data protection methods.

[4] The preliminary analysis reveals that for a large population, relatively small changes in the actual cell count does not hinder the statistical inference based on log-linear models. Uncertainty bounds of log-linear model based statistical inferences resulting from the small changes in actual cell counts are easy to establish by using Latin Hypercube Sampling technique.

Table 8. Histogram By Cell Size and Change in Cell Value

8-D CROSS SECTIONS - CELL COUNT: 33860

Cell Size From	Cell Size To	Absolute Change in Cell Value: 0 To 0	1 To 1	2 To 2	3 To 4	5 To 6	7 To 10	11 To 20	21 To 30	31 To 40
1 -	1	0	1589	798	0	0	0	0	0	0
2 -	2	0	835	563	89	0	0	0	0	0
3 -	5	1351	752	422	362	65	3	0	0	0
6 -	10	1147	884	530	320	50	16	0	0	0
11 -	25	1752	1339	896	509	125	32	2	0	0
26 -	50	1456	1032	629	468	139	39	3	0	0
51 -	100	1426	976	651	518	167	78	9	0	0
101 -	500	2480	1744	1214	1028	391	189	34	2	0
501 -	1000	630	491	317	301	144	75	25	3	0
1001 -	5000	670	548	359	382	201	130	48	10	3
5001 -	10000	58	60	51	55	35	26	8	4	1
10001 -	25000	16	15	13	27	13	14	9	2	0
25001 -	50000	0	1	3	4	0	2	2	0	0
T O T A L		10986	10266	6446	4063	1330	604	140	21	4

To convey cell level data quality, the statistical agency could use the quality indicator field in connection with cell values to reflect "poor" or "good" data quality. The other option could be to simply not publish the cell values which are beyond previously accepted threshold accuracy criteria. In the later option, if a user decides to estimate the missing cell value by making use of related equality constraints, that will be the choice for those who need the "ball park" estimate.

Statistical agencies typically serve a diverse group of end users with varying information needs. Once CTA-adjusted data is in the public domain, different users are interested in different cross sections of these data. For example, for individuals interested in developing log-linear models on these data, the first few orders of interaction terms captured by all combinations of 3-D cross sections is all that might be required. As mentioned earlier, there are no sensitive cells in any of the 3-D sections of the database. However, the challenge for the statistical agency is to balance the need for the data for log-linear model developers with potential other users with different information needs.

In Table 9 we explain how CTA attempts to balance data utility and information loss. Table 9 is in 3 parts. Part A of the table shows cell size distribution for different cross section dimensions[5]. As illustrated in the table, the lower dimensional cross sections are typically larger in cell size. In our example, the upper limit for the cell size is 48,842, which is the total number of individuals in the database. At the bottom of the first part of the table, we provide a cumulative cell count for various cross sections. If log-linear modelers were the only users

[5] In multi-variate data analysis, the cell values from a 1-D cross section are used to develop a main effects model. The cell values from a 2-D cross section are used to capture two-way interaction terms, and so on for the higher dimensional cross sections.

Table 9. Cross Sectional Details of Simplified CTA Protected Counts Data

Part(A) CELL COUNT BY CELL SIZE

CELL SIZE From	To	1-D	2-D	3-D	4-D	5-D	6-D	7-D	8-D
1. -	1.	0.	0.	0.	27.	282.	1073.	2026.	2387.
2. -	2.	0.	0.	0.	29.	216.	759.	1301.	1487.
3. -	5.	0.	0.	3.	60.	542.	1646.	2647.	2955.
6. -	10.	0.	0.	2.	113.	673.	1793.	2702.	2947.
11. -	25.	0.	0.	18.	261.	1353.	3189.	4400.	4655.
26. -	50.	0.	1.	25.	319.	1409.	2872.	3632.	3766.
51. -	100.	0.	1.	50.	523.	1792.	3124.	3721.	3825.
101. -	500.	0.	10.	319.	1826.	4413.	6337.	6994.	7082.
501. -	1000.	0.	16.	254.	860.	1485.	1852.	1973.	1986.
1001. -	5000.	2.	113.	574.	1356.	2027.	2303.	2350.	2351.
5001. -	10000.	6.	50.	157.	260.	296.	298.	298.	298.
10001. -	25000.	9.	48.	92.	109.	109.	109.	109.	109.
25001. -	50000.	7.	12.	12.	12.	12.	12.	12.	12.
Total # of Cell		24.	251.	1506.	5755.	14609.	25367.	32165.	33860.

Part(B) AVERAGE CELL VALUE CHANGE BY CELL SIZE

CELL SIZE From	To	1-D	2-D	3-D	4-D	5-D	6-D	7-D	8-D
1. -	1.	.00	.00	.00	1.30	1.30	1.32	1.33	1.33
2. -	2.	.00	.00	.00	1.48	1.65	1.64	1.59	1.56
3. -	5.	.00	.00	.67	1.68	1.64	1.43	1.18	1.06
6. -	10.	.00	.00	.50	2.19	1.85	1.50	1.25	1.15
11. -	25.	.00	.00	2.28	2.20	1.93	1.57	1.31	1.24
26. -	50.	.00	.00	2.68	2.57	2.07	1.63	1.36	1.31
51. -	100.	.00	4.00	3.68	2.90	2.26	1.76	1.51	1.47
101. -	500.	.00	4.80	3.62	2.99	2.30	1.84	1.68	1.66
501. -	1000.	.00	2.56	3.91	3.17	2.49	2.09	1.97	1.95
1001. -	5000.	2.50	5.19	4.41	3.42	2.71	2.42	2.37	2.37
5001. -	10000.	1.33	4.42	4.03	3.52	3.19	3.17	3.17	3.17
10001. -	25000.	5.44	4.75	4.78	4.26	4.26	4.26	4.26	4.26
25001. -	50000.	3.14	5.08	5.08	5.08	5.08	5.08	5.08	5.08

Part(C) AVERAGE PERCENT CELL VALUE CHANGE BY CELL SIZE

CELL SIZE From	To	1-D	2-D	3-D	4-D	5-D	6-D	7-D	8-D
1. -	1.	.00	.00	.00	129.63	130.50	132.06	133.27	133.43
2. -	2.	.00	.00	.00	74.14	82.41	82.21	79.40	77.91
3. -	5.	.00	.00	16.67	42.08	41.10	35.66	29.46	26.39
6. -	10.	.00	.00	6.25	27.32	23.07	18.70	15.62	14.32
11. -	25.	.00	.00	12.65	12.24	10.73	8.71	7.28	6.88
26. -	50.	.00	.00	7.05	6.76	5.46	4.29	3.59	3.46
51. -	100.	.00	5.30	4.87	3.85	3.00	2.33	2.01	1.95
101. -	500.	.00	1.60	1.20	1.00	.76	.61	.56	.55
501. -	1000.	.00	.34	.52	.42	.33	.28	.26	.26
1001. -	5000.	.08	.17	.15	.11	.09	.08	.08	.08
5001. -	10000.	.02	.06	.05	.05	.04	.04	.04	.04
10001. -	25000.	.03	.03	.03	.02	.02	.02	.02	.02
25001. -	50000.	.01	.01	.01	.01	.01	.01	.01	.01

of this database, the statistical agency could release the information for a total of 1,506 cells associated with all the 3-D cross sections in the database (without confidentiality concern) and choose not to publish the rest of the cells in the database. By adopting such a policy, however, the statistical agency would have published only 4% (1,506 out of 33,860 cells) of data collected by the survey operation. The challenge facing the statistical agency is how to balance the data needs for diverse user groups.

Part B of Table 9 shows the average change in the cell value within various cross sections of CTA adjusted 8-D data by using the same size categories as in the first part of the table. Part C of the Table 9 shows the corresponding percentage changes in cell values in different cross sections by related size categories. Due to the fact that the majority of the lower dimensional cross sections are relatively large in cell size, the resulting percentage adjustments from the CTA procedure are generally smaller than one percentage point. Such a small percentage change in cell values is therefore likely to be statistically insignificant for hypothesis testing using log-linear model analysis. At the same time, a diverse group of other data users have access to all other relevant information from various cells of different dimensionalities resulting from the 8-D database. To demonstrate the suitability of the CTA protected data for log-linear analysis, in Appendix B, we provide a comparative evaluation of the actual and CTA protected data on the 3-D section of age, education and annual salary from the 8-D data.

8 Static vs. Dynamic Table Server Design

In recent years, there has been some discussion on operating SDL protected table servers in dynamic mode through interactive web access. The guidance matrix concept, in combination with commonly used cell suppression and/or cell perturbation methods, offers wide flexibility to statistical agencies in generating a wide variety of table structures for public use. Except for one, all tabular data protection methods require (a) a number of categorical variables for publication, (b) a number of table structures, and (c) dimensionality of the table structure for public release to be defined a priori to ensure adequate statistical disclosure control.

For the simplified CTA procedure, however, there is no need to know the total number of table structures and table dimensionalities for public release a priori in the system design. This allows the table server to function more or less in a dynamic mode without concern for statistical disclosure. Whenever dynamic table server capability is required through interactive web access, the statistical agency has two separate options. In the first option, the statistical agency could store in a database only the internal tabular cell values after adjusting internal sensitive table cells by plus or minus adjustment factors. The statistical agency could then provide user specific table generation capability in real time. In the second option, the statistical agency could store in the database management system all SDL protected internal cell values along with all possible marginal cell values. Users will be allowed to retrieve necessary information by accessing the database through a query system.

9 Conclusion

The concept of a guidance matrix allows statistical agencies a flexible option to simultaneously capture and process multiple multi-dimensional cross sections containing complex hierarchies in tabular data release. The guidance matrix tool is equally effective on counts data and on magnitude data and is compatible with all cell suppression and cell perturbation methods used to protect sensitive tabular data. Table servers, based on the CTA procedure for SDL control, in combination with flexibility of data release offered by the guidance matrix concept, further enhances table server capabilities.

Log-linear models are association models. Inferences based on any model are subject to some uncertainty. The uncertainty bounds for model-based inferences are easy to estimate and quantify by performing sensitivity/uncertainty analysis. Latin hypercube sampling based experimental design studies are routinely conducted to simultaneously capture the effects of uncertainties in multiple model input parameters on the model inference(s). We look forward to such evaluations of log-linear and other relevant models by using CTA protected tabular data.

Appendix A

Simplified CTA on 9-D Magnitude Data

126 x 4-D Cross sections - CELL COUNT: 60,588

Cell Size		Absolute Change in Cell Value								
From	To	0 To 0	1 To 10	11 To 25	26 To 50	51 To 100	101 To 150	151 To 200	201 To 300	301 To 600
1	32	502	0	0	0	0	0	0	0	0
33	64	606	97	0	0	0	0	0	0	0
65	128	363	713	86	0	0	0	0	0	0
129	250	941	331	575	0	0	0	0	0	0
251	500	1074	49	809	906	0	0	0	0	0
501	1000	3689	79	239	2267	2242	0	0	0	0
1001	2000	7045	239	326	629	4143	110	11	0	0
2001	4000	12819	405	765	1096	1849	278	108	6	0
4001	8000	5962	358	634	1155	2302	345	99	23	1
8001	16000	959	202	307	488	905	241	79	32	2
16001	32000	34	41	73	95	193	98	66	54	11
32001	64000	0	20	32	47	120	66	43	39	14
64001	820000	0	3	2	3	8	5	6	11	12
T O T A L		33994	2537	3848	6686	11762	1143	412	165	40

126 x 5-D Cross sections - CELL COUNT:120,161

Cell Size		Absolute Change in Cell Value								
From	To	0 To 0	1 To 10	11 To 25	26 To 50	51 To 100	101 To 150	151 To 200	201 To 300	301 To 600
1	32	1289	0	0	0	0	0	0	0	0
33	64	1527	278	0	0	0	0	0	0	0
65	128	936	1822	202	0	0	0	0	0	0
129	250	2402	802	1555	0	0	0	0	0	0
251	500	2666	61	2036	2339	0	0	0	0	0
501	1000	9094	98	496	5338	5523	0	0	0	0
1001	2000	17062	283	388	777	9451	131	12	0	0
2001	4000	29464	489	933	1251	2149	311	116	6	0
4001	8000	9248	379	676	1226	2521	350	99	23	1
8001	16000	995	202	307	489	907	241	79	32	2
16001	32000	34	41	73	95	193	98	66	54	11
32001	64000	0	20	32	47	120	66	43	39	14
64001	820000	0	3	2	3	8	5	6	11	12
T O T A L		74717	4478	6700	11565	20872	1202	421	165	40

84 x 6-D Cross sections - CELL COUNT:161,783

Cell Size From	Cell Size To	Absolute Change in Cell Value: 0 To 0	1 To 10	11 To 25	26 To 50	51 To 100	101 To 150	151 To 200	201 To 300	301 To 600
1 -	32	1868	0	0	0	0	0	0	0	0
33 -	64	2194	428	0	0	0	0	0	0	0
65 -	128	1353	2643	285	0	0	0	0	0	0
129 -	250	3474	1135	2292	0	0	0	0	0	0
251 -	500	3827	62	2940	3403	0	0	0	0	0
501 -	1000	13038	100	666	7507	7913	0	0	0	0
1001 -	2000	24276	287	394	802	13196	133	12	0	0
2001 -	4000	41315	508	964	1268	2173	314	116	6	0
4001 -	8000	11224	381	679	1233	2546	350	99	23	1
8001 -	16000	999	202	307	489	907	241	79	32	2
16001 -	32000	34	41	73	95	193	98	66	54	11
32001 -	64000	0	20	32	47	120	66	43	39	14
64001 -	820000	0	3	2	3	8	5	6	11	12
T O T A L		103602	5810	8634	14847	27056	1207	421	165	40

Appendix B1

ACTUAL DATA - LOG LINEAR ANALYSIS

PARTIAL ASSOCIATION STATISTICS USING IMSL ROUTINE "CTASC"
3-D SECTION X (A=AGE, B=EDUCATION, C=ANNUAL SALARY)

Table 1: C = 1
A (row) by B (column)

	1	2	3	4	5
1	1738.0	2444.0	1088.0	33.0	3036.0
2	3051.0	8930.0	5676.0	1245.0	5010.0
3	1253.0	1907.0	675.0	300.0	769.0

Table 2: C = 2
A (row) by B (column)

	1	2	3	4	5
1	11.0	20.0	28.0	4.0	30.0
2	221.0	2020.0	3657.0	2037.0	1694.0
3	134.0	463.0	563.0	466.0	339.0

Partial Association Statistics

Omitted Effect	Chi-Square	Degrees of Freedom	P-value	Marginal Zeros
A	25535.30	2.0	.0000	.0
B	9153.81	4.0	.0000	.0
C	13958.71	1.0	.0000	.0
A*B	2584.77	8.0	.0000	.0
A*C	3089.65	2.0	.0000	.0
B*C	4606.03	4.0	.0000	.0
A*B*C	26.51	8.0	.0009	.0

Chi-square statistics for testing that all k and higher interactions are zero.

k	Likelihood Ratio	P-Value	Degrees of Freedom	Pearson	P-Value
1	61349.58	.0000	29.0	73429.19	.0000
2	12701.76	.0000	22.0	12810.05	.0000
3	26.51	.0009	8.0	28.43	.0004

Chi-square statistics for testing that all k-factor interactions are simultaneously zero.

k	Likelihood Ratio	P-Value	Degrees of Freedom	Pearson	P-Value
1	48647.82	.0000	7.0	60619.14	.0000
2	12675.24	.0000	14.0	12781.62	.0000
3	26.51	.0009	8.0	28.43	.0004

Appendix B2

CTA PROTECTED DATA - LOG LINEAR ANALYSIS

PARTIAL ASSOCIATION STATISTICS USING IMSL ROUTINE "CTASC"
3-D SECTION X (A=AGE, B=EDUCATION, C=ANNUAL SALARY)

Table 1: C = 1
A (row) by B (column)

	1	2	3	4	5
1	1745.0	2453.0	1082.0	31.0	3034.0
2	3048.0	8933.0	5681.0	1240.0	5012.0
3	1255.0	1901.0	680.0	298.0	763.0

Table 2: C = 2
A (row) by B (column)

	1	2	3	4	5
1	6.0	17.0	31.0	6.0	29.0
2	226.0	2016.0	3653.0	2043.0	1691.0
3	127.0	467.0	562.0	471.0	343.0

Partial Association Statistics

Omitted Effect	Chi-Square	Degrees of Freedom	P-value	Marginal Zeros
A	25539.01	2.0	.0000	.0
B	9150.00	4.0	.0000	.0
C	13958.07	1.0	.0000	.0
A*B	2572.01	8.0	.0000	.0
A*C	3110.17	2.0	.0000	.0
B*C	4655.57	4.0	.0000	.0
A*B*C	24.14	8.0	.0022	.0

Chi-square statistics for testing that all k and higher interactions are zero.

k	Likelihood Ratio	P-Value	Degrees of Freedom	Pearson	P-Value
1	61423.50	.0000	29.0	73484.04	.0000
2	12776.41	.0000	22.0	12879.93	.0000
3	24.14	.0022	8.0	27.01	.0007

Chi-square statistics for testing that all k-factor interactions are simultaneously zero.

k	Likelihood Ratio	P-Value	Degrees of Freedom	Pearson	P-Value
1	48647.08	.0000	7.0	60604.11	.0000
2	12752.27	.0000	14.0	12852.92	.0000
3	24.14	.0022	8.0	27.01	.0007

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Privacy, Accuracy, and Consistency Too: A Holistic Solution to Contingency Table Release

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ABSTRACT

The contingency table is a work horse of official statistics, the format of reported data for the US Census, Bureau of Labor Statistics, and the Internal Revenue Service. In many settings such as these privacy is not only ethically mandated, but frequently legally as well. Consequently there is an extensive and diverse literature dedicated to the problems of statistical disclosure control in contingency table release. However, all current techniques for reporting contingency tables fall short on at least one of privacy, accuracy, and consistency (among multiple released tables). We propose a solution that provides strong guarantees for all three desiderata simultaneously.

Our approach can be viewed as a special case of a more general approach for producing synthetic data: Any privacy-preserving mechanism for contingency table release begins with raw data and produces a (possibly inconsistent) privacy-preserving set of marginals. From these tables alone – and hence without weakening privacy – we will find and output the "nearest" consistent set of marginals. Interestingly, this set is no farther than the tables of the raw data, and consequently the additional error introduced by the imposition of consistency is no more than the error introduced by the privacy mechanism itself.

The privacy mechanism of [20] gives the strongest known privacy guarantees, with very little error. Combined with the techniques of the current paper, we therefore obtain excellent privacy, accuracy, and consistency among the tables. Moreover, our techniques are surprisingly efficient.

Our techniques apply equally well to the logical cousin of the contingency table, the OLAP cube.

[*]Research conducted while visiting Microsoft Research.

[†]Supported by NSF grants CNS-0627526 and CCF-0426582 and US-Israel BSF grant 2004288.

PODS'07, June 11–14, 2007, Beijing, China.

Categories and Subject Descriptors

G.3 [**PROBABILITY AND STATISTICS**]: [Contingency table analysis]

General Terms

Algorithms, Theory

Keywords

Privacy, OLAP, Contingency table release

1. INTRODUCTION

Privacy-preserving data-mining, also known as statistical disclosure control, has historically been the purview of statisticians, both in practice, for example, at the Census Bureau, the Internal Revenue Service, and the Bureau of Labor Statistics, and in the research community. (see, for example, [12, 24, 17, 34, 1] and the references in Section 1.1 below). In recent years the topic has experienced a resurgence in the computer science community (see, for example, [2, 3, 4, 23, 14, 9, 10, 6, 20, 18, 37, 35]). In this work we focus on contingency tables, also known as frequency tables, and their logical cousins, On-Line Analytical Processing (OLAP) cubes.

1.1 Contingency Table Release

Informally, a contingency table is a table of counts. From a database consisting of n rows, each comprising values for a fixed set of, say, binary attributes $a_1, \ldots, a_k$, the contingency table is the histogram of counts for each of the 2^k possible settings of these attributes. Contingency tables are essentially equivalent to OLAP cubes, which cast traditional relational databases as a high-dimensional cube with dimensions corresponding to the attributes. While we stay with the notation of statisticians, we stress that this is simply notational, and the results can be directly mapped to privacy-preserving OLAP.[1]

What is commonly released is not a contingency table itself, but the projection of the cube onto a subset of the at-

[1]Typically, attributes are non-binary. While our exposition uses binary attributes, any attribute with m possible values can be decomposed into $\log(m)$ binary attributes. This is even natural in many OLAP settings, where the attributes are hierarchically organized.

tributes: the counts for each of the possible settings of the restricted set of attributes. These counts are called marginals, each marginal associated with a subset of the attributes, and called and j-way marginals when at most $j \leq k$ attributes are used. The data curator will typically release many sets of low-order marginals for a single contingency table, with the goal of revealing correlations between many different, and possibly overlapping sets of attributes.

At first glance, it might seem that low-order marginals are "naturally" privacy-preserving: after all, they are aggregations over many of database rows. This, however, is not the case. For example, small counts are considered disclosive: if a given pair of attribute values corresponds to a unique individual, then these fields can be used as a key in other databases to reveal further information about an individual. Empty cells are also potentially disclosive: while they do not point to a specific individual, they can permit the rejection of claims, eg: that student X received all 'A's by virtue of the fact that no student received such marks. Access to large counts over time can permit "differencing attacks", where the changes to the data set can serve as the basis for inference and privacy violation. Several papers examine the degree to which individual cell entries are revealed by marginals; see, eg, [15]. Finally, recent results of de Loera and Onn [30, 29, 31] are particularly discouraging.

The disclosure risks inherent in contingency tables have given rise to an extensive and diverse literature on techniques for altering the true tables. There are two broad classes of techniques: non-perturbative (specifically, cell suppression) and perturbative (eg, controlled rounding and controlled tabular adjustment). In cell suppression, so-called "sensitive" cells are identified (the *primary cells*; see [16, 33] for a discussion of sensitivity rules). These are suppressed, together with a set of complementary *secondary* cells (to avoid the disclosure of the primary cells). The typical goal is to suppress as few secondary cells as possible, leading to difficult combinatorial problems with impractical execution times on large instances. Controlled rounding, initially introduced in [5], also suffers from combinatorial explosion, and is NP-hard even for the case of three-dimensional tables [27]. Controlled Tabular Adjustment, due to Dandekar and Cox [13], and the use of quadratic interior-point methods, due to Castro [7], were introduced to address these difficulties. This is an active area of research; see for example, the discussion in [8].

Over the last 5 years or so, the database and cryptography communities have provided rigorous definitions of privacy and introduced techniques that provably satisfy the given definitions [23, 9, 4, 14, 22, 20].

The most general and robust of these, and the notion used in this work, captures the following intuition: the adversary learns nothing *more* about an individual when her data are included in the database than the adversary can learn about the individual when her data are not included in the database (see Section 1.2 for the formal definition and its motivation) [20, 18]. Combined with the algorithmic techniques developed in a series of papers ([14, 22, 6] and particularly [20]), these yield a simple approach to contingency table release, with excellent accuracy and strong privacy guarantees, independent of any auxiliary information available to the adversary and regardless of the adversary's computational power. At a high level, this approach involves adding a small amount of independently and identically distributed noise to each cell in the released marginals. However, the small errors introduced to ensure privacy will cause distinct breakdowns of the data to yield slightly different counts (not to mention possibly negative and non-integer cell counts). The current work addresses this, adding consistency (and positivity and integrality) to privacy and accuracy.

1.2 A Formal Statement of Our Contribution

Our contribution, as suggested by the paper's title, comes in the parts of privacy, accuracy, and consistency, each of which are critical components of any data analysis system. At an intuitive level, which we soon formalize, we are concerned with

- **Privacy**: The presence or absence of any one data element should not substantially influence the distribution over outcomes of the computation.
- **Accuracy**: The difference between the reported marginals and true marginals should be bounded, preferably independent of the size of the data set.
- **Consistency**: There should exist a contingency table whose marginals equal the reported marginals.

We now formally discuss each, in the context of prior work.

1.2.1 Privacy

Since a rigorous claim about privacy is integral to our result we begin by recalling the definition of differential privacy [18, 20], which our algorithms will ensure.

Definition 1. *[18, 20]. A randomized function $\mathcal{K}$ gives* ϵ-differential privacy *if for all databases D_1 and D_2 differing on at most one element, and all measurable $S \subseteq Range(\mathcal{K})$,*

$$\Pr[\mathcal{K}(D_1) \in S] \quad \leq \quad \exp(\epsilon) \times \Pr[\mathcal{K}(D_2) \in S] \tag{1}$$

A randomized function satisfying this definition addresses *any* concern that a participant might have about the use of his or her data. In a formal sense, the distribution over outcomes is almost as if the participant had opted out of the data set; no event is made substantially more or less likely by the use of her data. These "events" can be viewed mathematically, perhaps as outputs leading to a substantial shift between prior and posterior probabilities, or pragmatically, as actual objectionable events, eg: outputs leading to telemarketing calls or denial of credit.

Remark: Differential privacy has several consequences that follow from the definition but may not be immediately apparent. Notably, the definition is agnostic to auxiliary information an adversary may possess, and provides guarantees against arbitrary attacks. Moreover, any function with ϵ-differential privacy also ensures (ϵt)-differential privacy for groups of size up to t, and the composition of s functions with ϵ-differential privacy ensures (ϵs)-differential privacy. See [20] for further discussion.

Comparison with Other Definitions.

Differential Privacy provides much stronger guarantees than other privacy definitions of which we are aware. For example, k-anonymity[35, 37, 36] and its extension l-diversity[32] impose syntactic constraints on the outputs, requiring that many groups of tuples appear indistinguishable, or uninformative about specific values. Nonetheless, neither of these definitions protects against even simple background knowledge of the form "My colleague Mr. R., who works in zip code 2770*, is in the database". For example, if, cumulatively, the people in the database suffer from a small set of ailments, then the adversary learns that Mr. R suffers from one of these ailments. This may be worse than embarassing; it may result in Mr. R. being dropped from consideration for promotion, say. In addition, even two k-anonymous or even ℓ-diverse tables taken together may be completely disclosive.

Similarly, [23] promotes the concept of the (ρ_1, ρ_2)-privacy breach. Very roughly, such a breach represents a substantial change in the adversary's belief that an individual data item satisfies some particular property P. By definition, this notion is entangled with the adversary's prior knowledge about the data and seems to have forced some awkward assumptions (eg, independence among data items, adversary's knowledge of true prior). Comparable definitional awkwardness appears in [22, 9, 10, 6] (eg, the "informed adversary"). Interestingly, in hindsight we find that the *algorithmic* techniques in [23, 22, 6] yield stronger privacy than is proved in the papers themselves. This occurs because all three papers provide *statistical* guarantees regarding the outputs of the privacy mechanism, yielding, to differing extents, approximations to differential privacy.

Protection against (ρ_1, ρ_2)-privacy breaches in [23] comes as a *consequence* of the γ-amplification statistical guarantees. Other algorithmic approaches, such as in [4], prevent different sets of (ρ_1, ρ_2) privacy breaches than does ensuring at most γ-amplification, and are less satisfactory. For example, the guarantees in [4] may fail to protect Mr. R.'s recent purchase of "herbal supplements" – a not uncommon event for the population in general but again, embarassing to Mr. R.

One might – erroneously – conclude that no technique can protect individuals against adversaries with arbitrary background knowledge. After all, it is formally proven in [18] that, for essentially any non-trivial mechanism and definition of privacy compromise, there exists auxiliary information for which the output of the mechanism enables a privacy compromise that would not otherwise be possible[2].

This result, and its underlying intuition, led to Differential Privacy, which *does* provide guarantees against arbitrary auxiliary information. It succeeds because it makes the only fair comparison: the probabilities of disclosure (or any event at all, for that matter) with, versus without, the sensitive data. If a disclosure will happen even without a participant's data, perhaps because it is known beforehand that the participant is in the majority, say, then it is unfair to cast blame on the privacy mechanism: any mechanism that reports the majority would lead to the breach. This is a key distinction: comparing with and without *a participant's data*, rather than with and without *the output of the mechanism*, and it is what allows Differential Privacy to give such strong bounds. Since the definition talks about the statistical distribution of the outcome, it obviates any discussion of the adversary's auxiliary information.

1.2.2 Accuracy

Privacy guarantees are of course meaningless without accompanying accuracy guarantees. We could easily erase the data if the former were all we cared about. We now detail guarantees that our algorithm makes about the accuracy of the counts in the released marginals, while ensuring ϵ-differential privacy.

Our theorem statement is necessarily loose at the moment, for notational reasons. The full version appears as Theorem 7, and is tighter than what is presented now:

THEOREM 1. *(Rough Version): Let C be a set of marginals of the contingency table, each on at most j attributes. We compute marginals C' of a positive, integral contingency table, preserving ϵ-differential privacy, such that with probability $1-\delta$ for any marginal $c \in C$,*

$$\|c - c'\|_1 \quad \leq \quad 2^{j+3}|C| \log(|C|/\delta)/\epsilon + |C| \, . \qquad (2)$$

This result does not depend on the total number of attributes in the data set, nor on the total number of elements in the data set, but rather only on the "complexity" of the query, in terms of the number and order of the marginals. Our result is the first we are aware of where the error in the marginals falls below statistical error due to sampling. Note also that while one might be concerned that 2^j is a large number, it is the number of elements that are reported by each marginal, and a natural scale for the L1 norm.

The most natural comparison to make is with the recent work of [4], on privacy preserving OLAP. In this work, which provides a limited form of (ρ_1, ρ_2)-privacy, the data are randomized with a constant probability, resulting in each count being reconstructible to within roughly $\sqrt{|dataset|}$. Our approach improves the error by exploiting the property that it is the number of marginals requested, $|C|$, that determines a sufficient amount of noise.

Remark: Randomized response, or any other mechanism that allows the user to learn answers to too many counting queries of the form "How many of the subset S of tuples satisfy property P?" must necessarily introduce large amounts of noise. This follows from results of [14], originally obtained for the interactive case, but applying here as well. For example, given any mechanism for which the magnitude of the error on all 2^n counting queries is bounded by E, the adversary can produce a candidate vector that agrees with $(P(tuple_1), \ldots, P(tuple_n))$ on all but $4E$ entries. So for $E \in o(n)$, say, $E = n^{1-\epsilon}$, the adversary learns more than 99.99% of the P values. An efficient version of this requires only that the adversary obtain responses to $n \log^2 n$ randomly chosen subset counting queries with $o(\sqrt{n})$ error (in fact, an efficient attack may be carried out even if more than 20% of $O(n)$ queries have wild error, while the remaining suffer from at most $o(\sqrt{n})$ error [21]). In some sense the problem is that the randomized response mechanism reveals the (very roughly approximate) answers to many more queries than the user may actually want to pose. By focusing on interactive mechanisms we can add just enough noise to ensure privacy for a given number of queries. Whenever the curator knows the questions in advance, a "transcript" can be prepared with the desired queries and responses, so for the case of contingency tables, or OLAP cubes, we are not restricting ourselves by focusing on the interactive model.

[2] Intuitively, the *utility* of the database provides a cryptographic one-time pad which can be combined with auxiliary information to yield a devastating privacy compromise. The user of the system learns the utility and can therefore subtract out the one-time pad, revealing the privacy compromise. Anyone not having access to the system's utility cannot "decode" the auxiliary information.

1.2.3 Consistency

The matter of consistency among the released marginals might appear trivial; indeed most previous approaches, which produced actual randomized data sets, it is a non-issue, as their tables are produced from these specific data sets. However, there is previous work, namely [20], that assures differential privacy and strong accuracy simply by adding noise to relased cell values. It is unlikely that there exists a single data set that yields all of the released marginals, and this potential inconsistency in the released data can be the source of many technical frustrations.

As we will base our privacy and accuracy around the techniques in [20], we take this section to introduce their results and approaches, while also distinguishing our current work from theirs.

Definition 2. *[20]. For $f : \mathcal{D} \to R^d$, the* $L1$-sensitivity *of f is*

$$\Delta f \quad = \quad \max_{D_1, D_2} \|f(D_1) - f(D_2)\|_1 \tag{3}$$

for all D_1, D_2 differing in at most one element.

Note that sensitivity is a property of the function alone, and is independent of the database. In the particular case of marginals of contingency tables, which integrate counts over disjoint regions of attribute space, the $L1$-sensitivity is always two: changing a single participant's data can alter at most two counts, one old and one new.

Our interest in sensitivity is summarized by Theorem 2 below, connecting sensitivity to the amount of noise that suffices to ensure ϵ-differential privacy.

Theorem 2. *[20]. For any $f : \mathcal{D} \to R^d$, the addition of Laplace noise[3] with variance $2\sigma^2$ preserves $(\Delta f/\sigma)$-differential privacy.*

Proof. Using the definition of the Laplace density, the density at any a is

$$\mu[a|D] \quad \propto \quad \exp(\|f(D) - a\|_1/\sigma) \tag{4}$$

Applying the triangle inequality, we bound the ratio

$$\frac{\mu[a|D_1]}{\mu[a|D_2]} \quad = \quad \frac{\exp(\|f(D_1) - a\|_1/\sigma)}{\exp(\|f(D_2) - a\|_1/\sigma)} \tag{5}$$

$$\leq \quad \exp(\|f(D_1) - f(D_2)\|_1/\sigma)\ . \tag{6}$$

The last term is bounded by $\exp(\Delta f/\sigma)$, by the definition of Δf. Thus (1) holds for singleton sets $S = \{a\}$, and the theorem follows by integrating over S. □

Remark: To ensure ϵ-differential privacy for a query of sensitivity Δ we take $\sigma = \Delta/\epsilon$.

This perturbation approach directly leads to a mechanism for releasing approximations to the marginals of the contingency table: Assume the curator wishes to release the set of marginals C. One privacy-preserving approach applies Theorem 2 to the $|C|$ marginals (adding noise to each cell in the collection of tables independently), with sensitivity $\Delta f = |C|$. This yields ϵ-differential privacy, which is a very strong guarantee. When n (the number of rows in the database) is large compared to $|C|$ this also yields excellent accuracy. Thus we would be done, and there would be no need for the current paper, if the small table-to-table inconsistencies caused by independent randomization of each (cell in each) table are not of concern, and if the user is comfortable with occasionally negative and typically non-integer cell counts.

We have no philosophical or mathematical objection to these artifacts of the privacy-enhancing technology, but in practice they can be problematic. For example, the cell counts may be used as input to other, possibly off-the-shelf, programs that anticipate positive integers, giving rise to type mismatch. We know of one real-life test case in which poor communication with the system prototypers caused users who experienced inconsistencies among OLAP cubes to question the validity of the data.[19] And while such a problem can be solved with better communication and education, it may be difficult to arrange, say, when users are ordinary citizens accessing the United States Census public interface.

[3]The Laplace distribution is centered at zero, with exponential tails in each direction.

1.3 Key Steps in Our Solution

Apply Theorem 2 and Never Look Back.

In this paper we *always* obtain privacy by applying Theorem 2 to the raw data or a possibly reversible transformation of the raw data. This gives us an intermediate object, on which we operate further, but we never again access the raw data. Since anything obtained via Theorem 2 is privacy-preserving, any quantity computed from the intermediate object is still safe: the curator could equally well release the privacy-protective intermediate object and the user can carry out the rest of the compuatations. The results would be the same.

Move to the Fourier Domain.

When adding noise, two natural approaches present themselves: add noise to entries of the source table and compromise on accuracy, or add noise to the reported marginals and violate consistency. A third approach transforms the data into the Fourier domain, which serves as a non-redundant encoding of the information in the marginals. Adding noise in this domain will not violate consistency, because any set of Fourier coefficients corresponds to a (fractional and possibly negative) contingency table. Morever, as we will show, very few Fourier coefficients are required to compute low-order marginals, and consequently the magnitude of the noise we must add to them is small.

Use Linear Programming.

We employ linear programming to obtain a non-negative, but likely non-integer, contingency table with (almost) the given Fourier coefficients, and then round the results to obtain integrality. Interestingly, the marginals obtained from the linear program are no "farther" (made precise below) from those of the noisy measurements than are the marginals of the raw data. Consequently, the additional error introduced to impose consistency is no more than the error introduced by the privacy mechanism itself.

Strictly speaking, we don't really need to move to the Fourier domain: we can perturb the marginals directly and then use linear programming to find a positive fractional data set, which can then be rounded as above. The accuracy in this case suffers slightly.

When k is Large.

The linear program requires time polynomial in 2^k, which is the size of the contingency table (because that is what the linear program is solving for). When k is large this is not satisfactory. However we show, somewhat surprisingly, that non-negativity (but not integrality) can be achieved by adding a relatively small amount to the first Fourier coefficient before moving back to the data domain. No linear program is required, and the error introduced is pleasantly small. Thus if 2^k is an unbearable cost and one can live with non-integrality then this approach serves well. We note that non-integrality was a non-issue in the prototyped system mentioned above, since answers were anyway converted to percentages.

2. NOTATION AND PRELIMINARIES

Our formal treatment of contingency table release begins by casting our data set as a vector x in a high-dimensional space, indexed by attribute tuples. Formally, imagine k binary attributes, and for each $\alpha \in \{0,1\}^k$ there is a count x_α of the number of data elements with this setting of attributes. We let $n = \|x\|_1$ be the total number of tuples in our data set. As it is likely that x will be sparse, with $n \ll 2^k$, we will be mindful of n and 2^k independently.

For any $\alpha \in \{0,1\}^k$, we use $\|\alpha\|_1$ for the *weight* of α, the number of non-zero locations. We write $\alpha \preceq \beta$ for $\alpha, \beta \in \{0,1\}^k$ if every non-zero location in α is also non-zero in β.

2.1 The Marginal Operator

Central to our discussion are the operators $C^\alpha : \mathbb{R}^{2^k} \to \mathbb{R}^{2^{\|\alpha\|_1}}$ for $\alpha \in \{0,1\}^k$ mapping contingency tables to the marginals of the attributes that are positively set in α. For any $\beta \preceq \alpha$, the outcome of $C^\alpha x$ at position β is the sum over those coordinates of x that agree with β on the coordinates described by α:

$$(C^\alpha(x))_\beta \quad = \sum_{\gamma : \gamma \wedge \alpha = \beta} x_\gamma \tag{7}$$

Notice that we are abusing notation, and only defining $C^\alpha x$ at those locations β for which $\beta \preceq \alpha$.

Theorem 3. *The operator C^α is linear for all α.*

Proof. As each output coordinate of C_i is a sum over predetermined input coordinates, scaling and addition of its inputs translate to equivalent scaling and addition of outputs. □

It is common to consider the ensemble of marginals C^α for all α with a fixed value of $\|\alpha\|_1 = i$, referred to as the i-way marginals.

2.2 The Fourier Basis

We will find it helpful to view our contingency table x in an alternate basis; rather than a value for each position α, we will project onto a set of 2^k so-called *Fourier basis* vectors that each aggregate across the table in various ways. Our motivation lies in the observation, made formally soon, that while a low-order marginal needs access to all coordinates of the contingency table, it will need only a few of the new coordinates in the Fourier basis.

The Fourier basis for real vectors defined over the Boolean hypercube is the set of vectors f^α for each $\alpha \in \{0,1\}^k$, defined coordinate-wise as

$$f^\alpha_\beta \quad = \quad (-1)^{\langle \alpha, \beta \rangle} / 2^{k/2} \ . \tag{8}$$

That is, each Fourier basis vector is comprised of coordinates of the form $\pm 1/2^{k/2}$, with the sign alternating based on the parity of the intersection between α and β. In fact, it will occosionally be helpful to view the vectors f^α as contingency tables themselves, as we will want to apply the marginal operators C^β to them.

Theorem 4. *The f^α form an orthonormal basis for $\mathbb{R}^{2^k}$.*

Proof. This is a standard result from the theory of Fourier analysis. See for example, [28] □

A change of basis allows us to rewrite a vector x as a sum of its projections onto the basis vectors, each of which is referred to as a Fourier coefficient. For our purposes, we will want to rewrite x in this basis just before it is supplied as input to a marginal computation C^β, which by linearity is

$$C^\beta x \quad = \quad C^\beta \sum_\alpha \langle f^\alpha, x \rangle f^\alpha \quad = \quad \sum_\alpha \langle f^\alpha, x \rangle C^\beta f^\alpha \ . \tag{9}$$

As promised, the motivation for this transformation comes from the following theorem, that any marginal over few attributes requires only a few Fourier coefficients.

Theorem 5. *$C^\beta f^\alpha \neq \mathbf{0}$ if and only if $\alpha \preceq \beta$.*

Proof. For any coordinate $\gamma \preceq \beta$ of the output

$$(C^\beta(f^\alpha))_\gamma \quad = \sum_{\eta : \eta \wedge \beta = \gamma} f^\alpha_\eta \quad = \sum_{\eta : \eta \wedge \beta = \gamma} (-1)^{\langle \alpha, \eta \rangle} / 2^{k/2} \ . \tag{10}$$

If $\alpha \not\preceq \beta$, then there is a coordinate for which α is one and β zero. For every η in the sum above, the same string with this bit flipped is also in the sum, as $\eta \wedge \beta$ is ignorant of this bit. However, their coordinates in f^α have opposite sign, and their contributions to the sum cancel exactly. This holds for all η, making the total sum zero.

If $\alpha \preceq \beta$, then $(C^\beta(f^\alpha))_\alpha$ is non-zero, as the sum is taken over η with $\eta \wedge \beta = \alpha$, causing $\langle \eta, \alpha \rangle = \langle \alpha, \alpha \rangle$. Thus all terms contributing to the summation are positive. □

Consequently, we are able to write any marginal as the small summation over relevant Fourier coefficients:

$$C^\beta x \quad = \sum_{\alpha \preceq \beta} \langle f^\alpha, x \rangle C^\beta f^\alpha \ . \tag{11}$$

The coefficients $\langle f^\alpha, x \rangle$ are necessary and sufficient data from x for the computation of $C^\beta x$.

3. ALGORITHMS AND THEOREMS

We now delve into the details of our algorithm, which comes in two parts. We first show how to create consistent marginals by applying a privacy-preserving mechanism to the Fourier coefficients rather than directly to the marginals. The resulting Fourier coefficients may correspond to a contingency table whose entries are negative and fractional, and we then give a linear program which, after rounding, returns a positive integral contingency table, from which we compute marginals.

3.1 Consistency

Rather than perturb the marginals, a naive, but effective, manner of ensuring privacy and consistency is to simply perturb and release each coordinate of the contingency table. As low-order marginals are sums over many entries in the contingency table, their entries will have noise that is Binomially distributed with variance $\Theta(2^k)$.

Instead, we will isolate and perturb those features of the data set relevant to the marginal computation, the Fourier coefficients. Because we are taking substantially fewer measurements, as compared with 2^k above, we can add substantially less noise to each measurement. For example, we need only 2^i coefficients for a i-way marginal, and only $\sum_{j \le i} \binom{k}{j}$ coefficients for the full set of i-way marginals. While these numbers may seem large, recall that a i-way marginal releases 2^i counts, making this the natural scale.

We use the privacy mechanism of [20], based on the addition of additive noise, to ensure ϵ-differential privacy. Formally, we let $Lap(\sigma)$ be a random variable with density at y proportional to $\exp(-|y|/\sigma)$. The following theorem describes the amount of noise we must add to each Fourier coefficient, as a function of the number of coefficients we require.

THEOREM 6. *Let $A \subseteq \{0,1\}^k$ describe a set of Fourier basis vectors, and let x be the contingency table that results from a data set D. Releasing the set $\phi_\alpha = \langle f^\alpha, x\rangle + Lap(2|A|/\epsilon 2^{k/2})$ for $\alpha \in A$ preserves ϵ-differential privacy of D.*

PROOF. Each tuple of the data set D contributes exactly $\pm 1/2^{k/2}$ to each output coordinate, and consequently the $L1$ sensitivity of the set of $|A|$ outputs is at most $2|A|/2^{k/2}$. By Theorem 2, the addition of Laplace noise with parameter $2|A|/\epsilon 2^{k/2}$ gives ϵ-differential privacy. □

Remark: Note that $n = |D|$ does not appear in Theorem 6. To get a sense of scale for the error, we could achieve a similar perturbation to each coordinate by randomly relocating $4|A|^2/\epsilon$ individuals in the data set, which can be much smaller than n.

3.2 Non-Negative Integrality

While there is certainly a real valued contingency table whose Fourier coefficients equal the perturbed values, e.g.: by returning the perturbed values to the original space, it is unlikely that there is a non-negative, integral contingency table with these coefficients. We now use linear programming to find a non-negative, but likely fractional, contingency table with nearly the correct Fourier coefficients, which we round to an integral contingency table with little additional error.

Letting $B \subset \{0,1\}^k$, suppose that we observed Fourier coefficients ϕ_β for $\beta \in B$. The following linear program minimizes, over all contingency tables w, the largest error b error between its Fourier coefficients $\langle f^\beta, w\rangle$ and the observed ϕ_β:

$$\begin{aligned} &\text{minimize} \quad b \\ &\text{subject to:} \\ &\qquad w_\alpha \ \ge\ 0 \quad \forall \alpha \\ &\phi_\beta - \sum_\alpha w_\alpha f_\alpha^\beta \ \le\ b \quad \forall \beta \in B \\ &\phi_\beta - \sum_\alpha w_\alpha f_\alpha^\beta \ \ge -b \quad \forall \beta \in B \end{aligned}$$

This optimization occurs in a 2^k+1 dimensional space, and any vertex of the feasible polytope must intersect 2^k+1 constraints. At most $|B|$ of these can relate to Fourier coefficients (since for each β, only one of the two constraints corresponding to β can be satisfied by any point). Thus at least $2^k - |B| + 1$ must be non-negativity constraints. This means that at any vertex of the polytope, all but at most $|B|$ weights are zero. Without loss of generality, the linear program will return a vertex solution[25], and rounding to the nearest integral point will result in at most an $L1$ change of $|B|$.

3.3 Algorithmic Recap

To bring things together, we now collect the various steps we have taken into a single algorithm.

Marginals$(A \subseteq \{0,1\}^k, x)$:

1. Let B be the downward closure of A under $\preceq$.
2. For $\beta \in B$, compute $\phi_\beta = \langle f^\beta, x\rangle + Lap(2|B|/\epsilon 2^{k/2})$.
3. Solve for w_α in the following linear program, and round to the nearest integral weights, w'_α.

$$\begin{aligned} &\text{minimize} \quad b \\ &\text{subject to:} \\ &\qquad w_\alpha \ \ge\ 0 \quad \forall \alpha \\ &\phi_\beta - \sum_\alpha w_\alpha f_\alpha^\beta \ \le\ b \quad \forall \beta \in B \\ &\phi_\beta - \sum_\alpha w_\alpha f_\alpha^\beta \ \ge -b \quad \forall \beta \in B \end{aligned}$$

4. Using the contingency table w'_α, compute and return the marginals for A.

THEOREM 7. *Using the notation of **Marginals**(A), for all $\delta \in [0,1]$ with probability $1-\delta$, for all $\alpha \in A$,*

$$\|C^\alpha x - C^\alpha w'\|_1 \ \le\ 2^{\|\alpha\|_1} 8|B|\log(|B|/\delta)/\epsilon + |B| \ . \quad (12)$$

PROOF. Each Fourier coefficient has Laplace noise with parameter $2|B|/\epsilon 2^{k/2}$ added to it, and with probability $1-\delta$ none of these exceeds $4|B|\log(|B|/\delta)/\epsilon 2^{k/2}$. In solving the linear program, the error associated with each Fourier coefficient is at most this bound as well, as the original contingency table x is at least as close. Mapping the perturbation of a single Fourier coefficient back to the contingency table domain increases the L1 norm of the perturbation by at most $2^{k/2}$, up to at most $8|B|\log(|B|/\delta)/\epsilon$.

Consequently, for any marginal C^α, the error $C^\alpha x - C^\alpha w'$ is a result of noise in the $2^{\|\alpha\|_1}$ Fourier coefficients that contribute to the table, as well as the rounding that occurs. Multiplying the number of coefficients, $2^{\|\alpha\|_1}$ by the bound above, and adding the $|B|$ error due to rounding, gives the stated bound. □

Even tighter bounds can be placed on sub-marginals of a marginal C^α, by noting that the bounds hold for the marginals C^β for $\beta \preceq \alpha$ at no additional cost. No more Fourier coefficients are used, so $|B|$ is not increased, but $\|\beta\|_1 \leq \|\alpha\|_1$.

4. ALTERNATE APPROACHES

We now describe a few variants on the previous approaches that trade some of the accuracy of the previous approach for some conceptual or computational simplicity.

4.1 Alternate Linear Programs

The linear program we chose to use minimizes the largest error in any Fourier coefficient. There are other linear programs that one could write, for example minimizing the total error in Fourier coefficients, the largest error in reported marginals, the total error in the reported marginals, or several hybrids thereof.

This flexibility allows the data analyst with more specific accuracy concerns (eg: per cell accuracy) to address them. The perturbed Fourier coefficients can be released, and the specific linear program can be run to arrive at an integral, non-negative solution. Bounds similar to Theorem 7 can be proven, using the same methodology: the noise added perturbs the measurements by some distance in the norm of choice, and the linear program finds a non-negative solution at no greater distance from the perturbed measurements.

4.2 Non-Fourier Linear Programming

Our conversion to the Fourier domain is done because the Fourier coefficients exactly describe the information required by the marinals. By measuring exactly what we need, we add the least amount of noise possible using the techniques of [20].

Instead, we could apply the techniques of [20] directly to the true marginals, producing a set of noisy marginals that preserve privacy but not consistency. To these noisy marginals we apply a linear program to find a non-negative contingency table with nearest marginals. Imagining we have observed the noisy marginals c^β, the linear program is

$$\begin{aligned} &\text{minimize} && b \\ &\text{subject to:} && \\ & w_\alpha && \geq 0 \quad \forall \alpha \in \{0,1\}^k \\ & (c^\beta - C^\beta w)_\gamma && \leq b \quad \forall \beta \in A, \gamma \preceq \beta \\ & (c^\beta - C^\beta w)_\gamma && \geq -b \quad \forall \beta \in A, \gamma \preceq \beta \end{aligned}$$

As before, we are likely to discover a fractional contingency table w. However, the number of cell constraints is at most $2\sum_{\beta \in A} 2^{\|\beta\|_1}$, and at most $\sum_{\beta \in A} 2^{\|\beta\|_1}$ of the w_α variables are non-zero. By the reasoning above, any rounding to integers introduces error at most this much in the contingency table.

THEOREM 8. *Using the above approach, with probability at least $1 - \delta$, for all $\beta \in A$, then $\|C^\beta x - C^\beta w'\|_1$ is at most*

$$2^{\|\beta\|_1} 8|A| \log(\textstyle\sum_{\beta \in A} 2^{\|\beta\|_1}/\delta)/\epsilon + \sum_{\beta \in A} 2^{\|\beta\|_1} \ . \quad (13)$$

PROOF. The reasoning is the same as before: the difference in the marginals is no more than twice the difference caused by the additive noise, which is a Laplacian with parameter $2|A|/\epsilon$. We introduce the $\log(\sum_{\beta \in A} 2^{\|\beta\|_1}/\delta)$ term to give the high probability guarantee, and the additive term to account for rounding error. □

Remark: This theorem mirrors Theorem 7, using $|A|$ and $\sum_{\beta \in A} 2^{\|\beta\|_1}$ in place of $|B|$. Depending on the situation, these bounds can actually be tighter than in Theorem 7, though only when a single multi-attribute marginal is desired. The tighter bounds given by Theorem 7 through subtables also would not apply here.

4.3 Simple Non-Negativity

The solution of the linear programs we have described is an expensive process, taking time polynomial in 2^k. In many settings, but not all, this is an excessive amount that must be avoided. We now describe a very simple technique for arriving at Fourier coefficients corresponding to a non-negative, but fractional, contingency table with high probability, without the solution of a linear program. We construct the output marginals directly from the Fourier coefficients, rather than reconstructing the contingency table, which could take time 2^k.

To ensure the existence of a non-negative contingency table with the observed Fourier coefficients turns out to be a simple task, we simply add a small amount to the first Fourier coefficient. Intuitively, any negativity due to the small perturbation we have made to the Fourier coefficients is spread uniformly across all elements of the contingency table. Consequently, very little needs to be added to make the elements non-negative.

THEOREM 9. *Let $B \subset \{0,1\}^k$, and let x be a non-negative contingency table with Fourier coefficients ϕ_β for $\beta \in B$. If the Fourier coefficients are perturbed to ϕ'_β, then the contingency table*

$$x' = x + \sum_\beta (\phi'_\beta - \phi_\beta) f^\beta + \|\phi' - \phi\|_1 f^{\overline{0}} \quad (14)$$

is non-negative, and has $\langle f^\beta, x' \rangle = \phi'_\beta$ for $\beta \neq \overline{0}$.

PROOF. Each of the coordinates of f^β are $\pm 1/2^{k/2}$, and the most negative an entry could become due to the perturbation is $-\|\phi' - \phi\|_1/2^{k/2}$. By increasing the Fourier coefficient of the zero vector by $\|\phi' - \phi\|_1$, we increase every entry in the contingency table by this much, making them all non-negative. □

Our perturbation to the Fourier coefficients has $L1$ norm distributed exponentially with standard deviation $2^{3/2}|B|^2/\epsilon$. It is *critical* that we not disclose the actual $L1$ norm of the perturbation, but we can add a value for which the negativity probability is arbitrarily low:

COROLLARY 1. *By adding $t \times 4|B|^2/\epsilon 2^{k/2}$ to the first Fourier coefficient, the resulting contingency table is non-negative with probability at least $1 - \exp(-t)$.*

The addition of $4t|B|^2/\epsilon 2^{k/2}$ to the first Fourier coefficient corresponds to the introduction of $4t|B|^2/\epsilon$ individuals at random locations in the table; a relatively minor accuracy compromise.

5. CONCLUSIONS

We have shown a holistic solution to the problem of contingency table release, that outputs an accurate and consistent set of tables while guaranteeing in a very strong sense that privacy of individuals is preserved. We also show how to construct a positive and integral synthetic database that corresponds to these tables—thus, e.g., one can output a synthetic database that preserves all low-order marginals up to a small error. Moreover, we can get a gracefully degrading version of the results: we can compute a synthetic database such that the error in the low-order marginals is small, and increases smoothly with the order of the marginal.

One of the main algorithmic questions left open from this work is that of efficiency. In particular, solving the linear program could be a bottleneck when the number of attributes is large, and it seems possible that one could devise more efficient algorithms for this step. We remark that the simplex algorithm is already space efficient in this setting, since each vertex of the polytope that simplex traverses has a sparse description. We leave open the question of devising faster combinatorial algorithms for this problem.

We have optimized for a specific measure of data quality, the distance between the reported and true marginals. It would also be useful to analyze the effect of our techniques or variants thereof on statistical properties of the marginals, such as means, variances, covariances, regressions. See the related work on controlled tabular adjustment [11].

6. ACKNOWLEDGEMENTS

We would like to thank Larry Cox and Steve Fienberg for comments on an earlier version of this paper and general guidance though the statistics literature.

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COMPARATIVE STATISTICAL EVALUATION OF 3-D SECTION FROM 8-D COUNTS DATA

(AGE, EDUCATION, ANNUAL SALARY)

ACTUAL DATA VS CTA PROTECTED DATA USING IMSL ROUTINES

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REAL LIFE 8-D DATA USED

3-D SECTION X (AGE, EDUCATION, ANNUAL SALARY)
section # 46

A: Age – three categories
B: Education – five categories
C: Annual Salary – two categories

ACTUAL DATA

Table 1: C = 1
A (row) by B (column)

	1	2	3	4	5
1	1738.0	2444.0	1088.0	33.0	3036.0
2	3051.0	8930.0	5676.0	1245.0	5010.0
3	1253.0	1907.0	675.0	300.0	769.0

Table 2: C = 2
A (row) by B (column)

	1	2	3	4	5
1	11.0	20.0	28.0	4.0	30.0
2	221.0	2020.0	3657.0	2037.0	1694.0
3	134.0	463.0	563.0	466.0	339.0

CTA PROTECTED DATA

Table 1: C = 1
A (row) by B (column)

	1	2	3	4	5
1	1745.0	2453.0	1082.0	31.0	3034.0
2	3048.0	8933.0	5681.0	1240.0	5012.0
3	1255.0	1901.0	680.0	298.0	763.0

Table 2: C = 2
A (row) by B (column)

	1	2	3	4	5
1	6.0	17.0	31.0	6.0	29.0
2	226.0	2016.0	3653.0	2043.0	1691.0
3	127.0	467.0	562.0	471.0	343.0

PARTIAL ASSOCIATION STATISTICS USING IMSL ROUTINE "CTASC"

REAL LIFE NISS 8-D DATA USED

3-D SECTION X (AGE, EDUCATION, ANNUAL SALARY)

ACTUAL DATA

Variable	Number of Levels
1 A	3
2 B	5
3 C	2

Table 1: C = 1

A (row) by B (column)

	1	2	3	4	5
1	1738.0	2444.0	1088.0	33.0	3036.0
2	3051.0	8930.0	5676.0	1245.0	5010.0
3	1253.0	1907.0	675.0	300.0	769.0

Table 2: C = 2

A (row) by B (column)

	1	2	3	4	5
1	11.0	20.0	28.0	4.0	30.0
2	221.0	2020.0	3657.0	2037.0	1694.0
3	134.0	463.0	563.0	466.0	339.0

Partial Association Statistics

Omitted Effect	Chi-Square	Degrees of Freedom	P-value	Marginal Zeros
A	25535.30	2.0	.0000	.0
B	9153.81	4.0	.0000	.0
C	13958.71	1.0	.0000	.0
A*B	2584.77	8.0	.0000	.0
A*C	3089.65	2.0	.0000	.0
B*C	4606.03	4.0	.0000	.0
A*B*C	26.51	8.0	.0009	.0

Chi-square statistics for testing that all k and higher interactions are zero.

k	Likelihood Ratio	P-Value	Degrees of Freedom	Pearson	P-Value
1	61349.58	.0000	29.0	73429.19	.0000
2	12701.76	.0000	22.0	12810.05	.0000
3	26.51	.0009	8.0	28.43	.0004

Chi-square statistics for testing that all k-factor interactions are simultaneously zero.

k	Likelihood Ratio	P-Value	Degrees of Freedom	Pearson	P-Value
1	48647.82	.0000	7.0	60619.14	.0000
2	12675.24	.0000	14.0	12781.62	.0000
3	26.51	.0009	8.0	28.43	.0004

PARTIAL ASSOCIATION STATISTICS USING IMSL ROUTINE "CTASC"

REAL LIFE NISS 8-D DATA USED

3-D SECTION X (AGE, EDUCATION, ANNUAL SALARY)

CTA PROTECTED DATA

Variable	Number of Levels
1 A	3
2 B	5
3 C	2

Table 1: C = 1

A (row) by B (column)

	1	2	3	4	5
1	1745.0	2453.0	1082.0	31.0	3034.0
2	3048.0	8933.0	5681.0	1240.0	5012.0
3	1255.0	1901.0	680.0	298.0	763.0

Table 2: C = 2

A (row) by B (column)

	1	2	3	4	5
1	6.0	17.0	31.0	6.0	29.0
2	226.0	2016.0	3653.0	2043.0	1691.0
3	127.0	467.0	562.0	471.0	343.0

Partial Association Statistics

Omitted Effect	Chi-Square	Degrees of Freedom	P-value	Marginal Zeros
A	25539.01	2.0	.0000	.0
B	9150.00	4.0	.0000	.0
C	13958.07	1.0	.0000	.0
A*B	2572.01	8.0	.0000	.0
A*C	3110.17	2.0	.0000	.0
B*C	4655.57	4.0	.0000	.0
A*B*C	24.14	8.0	.0022	.0

Chi-square statistics for testing that all k and higher interactions are zero.

k	Likelihood Ratio	P-Value	Degrees of Freedom	Pearson	P-Value
1	61423.50	.0000	29.0	73484.04	.0000
2	12776.41	.0000	22.0	12879.93	.0000
3	24.14	.0022	8.0	27.01	.0007

Chi-square statistics for testing that all k-factor interactions are simultaneously zero.

k	Likelihood Ratio	P-Value	Degrees of Freedom	Pearson	P-Value
1	48647.08	.0000	7.0	60604.11	.0000
2	12752.27	.0000	14.0	12852.92	.0000
3	24.14	.0022	8.0	27.01	.0007

ITERATIVE PROPORTIONAL FIT USING IMSL ROUTINE "PRPFT"

REAL LIFE NISS 8-D DATA USED

3-D SECTION X (AGE, EDUCATION, ANNUAL SALARY)

i j k	CTA value	IPF fit	Actual Value	IPF fit	CTA% Diff	Fitted % Diff
1 1 1	1745.0	1746.1	1738.0	1743.8	.40	.13
2 1 1	3048.0	3036.8	3051.0	3030.4	-.10	.21
3 1 1	1255.0	1265.1	1253.0	1267.8	.16	-.21
1 2 1	2453.0	2450.5	2444.0	2443.6	.37	.28
2 2 1	8933.0	8960.8	8930.0	8959.3	.03	.02
3 2 1	1901.0	1875.7	1907.0	1878.0	-.31	-.12
1 3 1	1082.0	1087.6	1088.0	1089.4	-.55	-.17
2 3 1	5681.0	5653.7	5676.0	5649.7	.09	.07
3 3 1	680.0	701.7	675.0	700.0	.74	.25
1 4 1	31.0	35.0	33.0	34.9	-6.06	.18
2 4 1	1240.0	1267.1	1245.0	1274.9	-.40	-.61
3 4 1	298.0	266.9	300.0	268.2	-.67	-.50
1 5 1	3034.0	3025.9	3036.0	3027.3	-.07	-.05
2 5 1	5012.0	4995.6	5010.0	4997.7	.04	-.04
3 5 1	763.0	787.6	769.0	790.0	-.78	-.31
1 1 2	6.0	4.9	11.0	5.2	-45.45	-6.01
2 1 2	226.0	237.2	221.0	241.6	2.26	-1.82
3 1 2	127.0	116.9	134.0	119.2	-5.22	-1.92
1 2 2	17.0	19.5	20.0	20.4	-15.00	-4.06
2 2 2	2016.0	1988.2	2020.0	1990.7	-.20	-.12
3 2 2	467.0	492.3	463.0	492.0	.86	.06
1 3 2	31.0	25.4	28.0	26.6	10.71	-4.50
2 3 2	3653.0	3680.3	3657.0	3683.3	-.11	-.08
3 3 2	562.0	540.3	563.0	538.0	-.18	.42
1 4 2	6.0	2.0	4.0	2.1	50.00	-3.02
2 4 2	2043.0	2015.9	2037.0	2007.1	.29	.43
3 4 2	471.0	502.1	466.0	497.8	1.07	.87
1 5 2	29.0	37.1	30.0	38.7	-3.33	-4.13
2 5 2	1691.0	1707.4	1694.0	1706.3	-.18	.07
3 5 2	343.0	318.4	339.0	318.0	1.18	.13

FITTED MODEL: (A*B, A*C, B*C)

COMPUTE MODEL ESTIMATES AND ASSOCIATED STATISTICS FOR A HIERARCHICAL LOG-LINEAR MODEL USING IMSL ROUTINE 'CTLLN'

REAL LIFE NISS 8-D DATA USED

3-D SECTION X (AGE, EDUCATION, ANNUAL SALARY)

ACTUAL DATA

Fitted Model: (A*B, A*C, B*C)

Variable	Number of Levels
1 A	3
2 B	5
3 C	2

Model Statistics	
Log-likelihood	8.0229
Likelihood ratio	26.51
Degrees of freedom	8.0
P-value	.0009

Coefficient Statistics

		Coefficient	Standard Error	Asymptotic Z-statistic	P-value
1	intercept	6.2219	.0213	292.76	.0000
2	A(1)	-1.6065	.0409	-39.29	.0000
3	A(2)	1.5546	.0213	73.11	.0000
4	B(1)	-.4645	.0253	-18.34	.0000
5	B(2)	.6527	.0169	38.70	.0000
6	B(3)	.4390	.0177	24.78	.0000
7	B(4)	-1.0828	.0458	-23.64	.0000
8	C	1.0280	.0187	54.91	.0000
9	A*B(1)	.4065	.0280	14.53	.0000
10	A*B(2)	.1391	.0265	5.26	.0008
11	A*B(3)	.0832	.0295	2.82	.0223
12	A*B(4)	-1.3939	.0893	-15.62	.0000
13	A*B(5)	-.5601	.0186	-30.19	.0000
14	A*B(6)	-.0809	.0158	-5.12	.0009
15	A*B(7)	.2100	.0177	11.86	.0000
16	A*B(8)	.6838	.0466	14.67	.0000
17	A*C(1)	1.1220	.0353	31.78	.0000
18	A*C(2)	-.5198	.0186	-27.94	.0000
19	B*C(1)	.7564	.0224	33.70	.0000
20	B*C(2)	.2439	.0114	21.48	.0000
21	B*C(3)	-.2943	.0107	-27.40	.0000
22	B*C(4)	-.7351	.0146	-50.41	.0000

Table 1: C = 1
A = 1 by B (column)

	1	2	3	4	5
Observed	1738.00	2444.00	1088.00	33.00	3036.00
Fit	1743.79	2443.65	1089.37	34.94	3027.25
Root chi-square	-.14	.01	-.04	-.33	.16
Likelihood	-11.56	.71	-2.75	-3.77	17.52
Freeman-Tukey	-.13	.01	-.03	-.29	.16

Residual	-5.79	.35	-1.37	-1.94	8.75

A = 2 by B (column)

	1	2	3	4	5
Observed	3051.00	8930.00	5676.00	1245.00	5010.00
Fit	3030.39	8959.33	5649.66	1274.87	4997.74
Root chi-square	.37	-.31	.35	-.84	.17
Likelihood	41.36	-58.57	52.80	-59.04	24.55
Freeman-Tukey	.38	-.31	.35	-.83	.18
Residual	20.61	-29.33	26.34	-29.87	12.26

A = 3 by B (column)

	1	2	3	4	5
Observed	1253.00	1907.00	675.00	300.00	769.00
Fit	1267.82	1878.02	699.96	268.19	790.00
Root chi-square	-.42	.67	-.94	1.94	-.75
Likelihood	-29.47	58.40	-49.02	67.26	-41.45
Freeman-Tukey	-.41	.67	-.94	1.90	-.74
Residual	-14.82	28.98	-24.96	31.81	-21.00

Table 2: C = 2

A = 1 by B (column)

	1	2	3	4	5
Observed	11.00	20.00	28.00	4.00	30.00
Fit	5.21	20.35	26.63	2.06	38.75
Root chi-square	2.54	-.08	.27	1.35	-1.41
Likelihood	16.43	-.70	2.82	5.30	-15.35
Freeman-Tukey	2.11	-.02	.31	1.19	-1.44
Residual	5.79	-.35	1.37	1.94	-8.75

A = 2 by B (column)

	1	2	3	4	5
Observed	221.00	2020.00	3657.00	2037.00	1694.00
Fit	241.61	1990.67	3683.34	2007.13	1706.26
Root chi-square	-1.33	.66	-.43	.67	-.30
Likelihood	-39.41	59.09	-52.48	60.19	-24.43
Freeman-Tukey	-1.34	.66	-.43	.67	-.29
Residual	-20.61	29.33	-26.34	29.87	-12.26

A = 3 by B (column)

	1	2	3	4	5
Observed	134.00	463.00	563.00	466.00	339.00
Fit	119.18	491.98	538.04	497.81	318.00
Root chi-square	1.36	-1.31	1.08	-1.43	1.18
Likelihood	31.42	-56.21	51.06	-61.55	43.37
Freeman-Tukey	1.34	-1.31	1.07	-1.44	1.17
Residual	14.82	-28.98	24.96	-31.81	21.00

Asymptotic Coefficient Covariance

	1	2	3	4	5
1	4.5166E-04	7.9186E-04	-4.1877E-04	-2.3688E-05	-1.3991E-04
2		1.6721E-03	-8.1154E-04	-2.1653E-04	-2.1766E-04
3			4.5220E-04	1.1681E-04	1.1619E-04
4				6.4176E-04	-4.3974E-06
5					2.8454E-04

	6	7	8	9	10
1	-1.3687E-04	4.4036E-04	-3.1634E-04	-2.0677E-04	-2.1792E-04
2	-2.1692E-04	9.0154E-04	-5.7855E-04	-4.2762E-04	-4.6902E-04
3	1.0611E-04	-4.5811E-04	2.9671E-04	2.1146E-04	2.2648E-04
4	-1.4692E-05	-6.0819E-04	-1.0040E-04	2.9284E-04	2.1705E-04
5	1.0478E-04	-4.9082E-04	7.6776E-06	2.1532E-04	2.7673E-04

6	3.1391E-04	-4.9884E-04	2.7038E-05	2.0404E-04	2.0901E-04
7		2.0979E-03	5.0042E-05	-9.3986E-04	-9.3644E-04
8			3.5050E-04	-1.5535E-05	-2.5832E-06
9				7.8243E-04	4.3000E-04
10					6.9977E-04

	11	12	13	14	15
1	-2.2412E-04	8.8946E-04	1.0928E-04	1.1780E-04	1.1077E-04
2	-4.5689E-04	1.8373E-03	2.1090E-04	2.2635E-04	2.2831E-04
3	2.2724E-04	-9.1125E-04	-9.3444E-05	-1.2924E-04	-1.2340E-04
4	2.0377E-04	-9.4338E-04	-2.0368E-04	-1.0630E-04	-8.7364E-05
5	2.0993E-04	-9.3654E-04	-1.0946E-04	-1.9272E-04	-9.0437E-05
6	3.1555E-04	-9.5048E-04	-8.7438E-05	-9.1617E-05	-2.4750E-04
7	-9.5214E-04	3.7529E-03	5.0188E-04	4.9491E-04	5.0852E-04
8	7.8917E-06	9.6029E-06	1.9062E-05	7.9302E-06	-8.3844E-06
9	3.6775E-04	-2.0006E-03	-3.1937E-04	-2.1432E-04	-2.0307E-04
10	3.9525E-04	-1.9713E-03	-2.1451E-04	-2.9253E-04	-2.1228E-04
11	8.6815E-04	-2.0202E-03	-2.0424E-04	-2.1296E-04	-3.3909E-04
12		7.9675E-03	9.6509E-04	9.5727E-04	9.7670E-04
13			3.4428E-04	8.8858E-05	5.9464E-05
14				2.4979E-04	9.0332E-05
15					3.1320E-04

	16	17	18	19	20
1	-4.5352E-04	-5.7350E-04	2.9218E-04	-9.0941E-05	1.6788E-05
2	-9.1109E-04	-1.1795E-03	5.8032E-04	4.0375E-06	5.9516E-06
3	4.6755E-04	5.8062E-04	-3.0731E-04	-8.2219E-06	-2.2811E-06
4	4.9617E-04	-1.1927E-05	5.6127E-06	-4.3284E-04	1.1285E-04
5	4.9632E-04	-1.3553E-05	1.4786E-05	1.1505E-04	-9.1212E-05
6	5.1071E-04	-3.2709E-06	1.6594E-06	1.0331E-04	-1.0617E-05
7	-2.0058E-03	2.1742E-05	-2.5645E-05	9.7265E-05	-1.2493E-05
8	-2.1134E-05	5.8272E-04	-3.1571E-04	8.3659E-05	-2.8479E-05
9	9.6316E-04	-5.5195E-05	1.1578E-05	-6.6035E-05	4.5883E-06
10	9.5654E-04	-3.6818E-05	1.0635E-05	2.8380E-06	-3.4939E-05
11	9.7901E-04	1.4458E-05	1.7958E-06	1.1109E-05	-2.6554E-07
12	-3.8468E-03	8.9567E-05	-2.8268E-05	4.2674E-05	2.9911E-05
13	-5.6426E-04	1.3331E-05	-2.9682E-05	1.8311E-05	-1.0243E-06
14	-5.2911E-04	1.1124E-05	-1.7481E-05	-4.3727E-06	1.4372E-05
15	-5.3985E-04	-1.3298E-06	9.0132E-06	-8.8527E-07	2.5063E-07
16	2.1729E-03	-2.7384E-05	4.5185E-05	-8.4273E-06	-1.3704E-05
17		1.2463E-03	-5.9475E-04	2.0302E-06	4.6625E-06
18			3.4626E-04	1.5440E-05	-2.5409E-06
19				5.0360E-04	-1.1720E-04
20					1.2896E-04

	21	22
1	2.5821E-05	2.1532E-05
2	3.6809E-06	-4.1725E-05
3	1.8486E-06	2.0634E-05
4	1.0330E-04	1.0107E-04
5	-1.1849E-05	-1.3110E-05
6	-6.2335E-05	-2.2304E-05
7	-1.9966E-05	-5.5383E-05
8	-3.0172E-05	6.8021E-06
9	1.1005E-05	3.8353E-05
10	7.5893E-07	2.9311E-05
11	-4.8379E-05	3.3679E-05
12	3.1571E-05	-1.3596E-04
13	4.0398E-07	-1.5907E-05
14	2.1194E-06	-1.2900E-05
15	1.8693E-05	-1.5609E-05
16	-2.0138E-05	5.9764E-05
17	8.6966E-08	1.8636E-05

18	-9.3811E-06	-1.0810E-05
19	-1.1458E-04	-1.4538E-04
20	1.1364E-05	-2.1378E-05
21	1.1537E-04	-1.6178E-05
22		2.1263E-04

COMPUTE MODEL ESTIMATES AND ASSOCIATED STATISTICS FOR A HIERARCHICAL LOG-LINEAR MODEL USING IMSL ROUTINE 'CTLLN'

REAL LIFE NISS 8-D DATA USED

3-D SECTION X (AGE, EDUCATION, ANNUAL SALARY)

CTA PROTECTED DATA

Fitted Model: (A*B, A*C, B*C)

Variable	Number of Levels
1 A	3
2 B	5
3 C	2

Model Statistics	
Log-likelihood	8.0237
Likelihood ratio	24.14
Degrees of freedom	8.0
P-value	.0022

Coefficient Statistics

	Coefficient	Standard Error	Asymptotic Z-statistic	P-value
1 intercept	6.2135	.0216	288.02	.0000
2 A(1)	-1.6199	.0415	-39.00	.0000
3 A(2)	1.5611	.0216	72.36	.0000
4 B(1)	-.4726	.0255	-18.53	.0000
5 B(2)	.6544	.0169	38.76	.0000
6 B(3)	.4405	.0177	24.84	.0000
7 B(4)	-1.0790	.0458	-23.56	.0000
8 C	1.0358	.0191	54.26	.0000
9 A*B(1)	.4060	.0280	14.52	.0000
10 A*B(2)	.1400	.0265	5.29	.0007
11 A*B(3)	.0797	.0295	2.70	.0269
12 A*B(4)	-1.3904	.0893	-15.58	.0000
13 A*B(5)	-.5583	.0186	-30.08	.0000
14 A*B(6)	-.0812	.0158	-5.14	.0009
15 A*B(7)	.2103	.0177	11.88	.0000
16 A*B(8)	.6810	.0466	14.61	.0000
17 A*C(1)	1.1368	.0361	31.53	.0000
18 A*C(2)	-.5264	.0190	-27.76	.0000
19 B*C(1)	.7654	.0226	33.82	.0000
20 B*C(2)	.2434	.0114	21.38	.0000
21 B*C(3)	-.2947	.0108	-27.37	.0000
22 B*C(4)	-.7415	.0146	-50.75	.0000

Table 1: C = 1
A = 1 by B (column)

	1	2	3	4	5
Observed	1745.00	2453.00	1082.00	31.00	3034.00
Fit	1746.10	2450.47	1087.57	35.00	3025.85
Root chi-square	-.03	.05	-.17	-.68	.15
Likelihood	-2.20	5.06	-11.12	-7.52	16.31
Freeman-Tukey	-.02	.06	-.16	-.65	.15

Residual	-1.10	2.53	-5.57	-4.00	8.15

A = 2 by B (column)

	1	2	3	4	5
Observed	3048.00	8933.00	5681.00	1240.00	5012.00
Fit	3036.79	8960.80	5653.72	1267.14	4995.55
Root chi-square	.20	-.29	.36	-.76	.23
Likelihood	22.47	-55.51	54.70	-53.70	32.95
Freeman-Tukey	.21	-.29	.37	-.76	.24
Residual	11.21	-27.80	27.28	-27.14	16.45

A = 3 by B (column)

	1	2	3	4	5
Observed	1255.00	1901.00	680.00	298.00	763.00
Fit	1265.11	1875.73	701.71	266.86	787.59
Root chi-square	-.28	.58	-.82	1.91	-.88
Likelihood	-20.14	50.88	-42.74	65.79	-48.41
Freeman-Tukey	-.28	.59	-.82	1.87	-.87
Residual	-10.11	25.27	-21.71	31.14	-24.59

Table 2: C = 2

A = 1 by B (column)

	1	2	3	4	5
Observed	6.00	17.00	31.00	6.00	29.00
Fit	4.90	19.53	25.43	2.00	37.15
Root chi-square	.50	-.57	1.11	2.83	-1.34
Likelihood	2.43	-4.71	12.29	13.18	-14.36
Freeman-Tukey	.56	-.53	1.09	2.10	-1.37
Residual	1.10	-2.53	5.57	4.00	-8.15

A = 2 by B (column)

	1	2	3	4	5
Observed	226.00	2016.00	3653.00	2043.00	1691.00
Fit	237.21	1988.20	3680.28	2015.86	1707.45
Root chi-square	-.73	.62	-.45	.60	-.40
Likelihood	-21.89	55.98	-54.37	54.65	-32.73
Freeman-Tukey	-.72	.63	-.45	.61	-.39
Residual	-11.21	27.80	-27.28	27.14	-16.45

A = 3 by B (column)

	1	2	3	4	5
Observed	127.00	467.00	562.00	471.00	343.00
Fit	116.89	492.27	540.29	502.14	318.41
Root chi-square	.94	-1.14	.93	-1.39	1.38
Likelihood	21.07	-49.22	44.28	-60.32	51.04
Freeman-Tukey	.94	-1.14	.94	-1.40	1.37
Residual	10.11	-25.27	21.71	-31.14	24.59

Asymptotic Coefficient Covariance

	1	2	3	4	5
1	4.6540E-04	8.1840E-04	-4.3199E-04	-2.1396E-05	-1.4034E-04
2		1.7252E-03	-8.3815E-04	-2.1638E-04	-2.1757E-04
3			4.6544E-04	1.1661E-04	1.1611E-04
4				6.5033E-04	-6.5611E-06
5					2.8508E-04

	6	7	8	9	10
1	-1.3728E-04	4.3935E-04	-3.3016E-04	-2.0652E-04	-2.1780E-04
2	-2.1658E-04	9.0089E-04	-6.0533E-04	-4.2718E-04	-4.6884E-04
3	1.0600E-04	-4.5762E-04	3.1005E-04	2.1135E-04	2.2641E-04
4	-1.6865E-05	-6.1024E-04	-1.0271E-04	2.9278E-04	2.1713E-04
5	1.0528E-04	-4.9018E-04	8.0856E-06	2.1538E-04	2.7665E-04

6	3.1445E-04	-4.9819E-04	2.7444E-05	2.0391E-04	2.0890E-04
7		2.0980E-03	5.1073E-05	-9.3980E-04	-9.3640E-04
8			3.6446E-04	-1.5726E-05	-2.6745E-06
9				7.8249E-04	4.3021E-04
10					6.9966E-04

	11	12	13	14	15
1	-2.2382E-04	8.8871E-04	1.0908E-04	1.1772E-04	1.1067E-04
2	-4.5649E-04	1.8361E-03	2.1081E-04	2.2628E-04	2.2805E-04
3	2.2698E-04	-9.1080E-04	-9.3249E-05	-1.2916E-04	-1.2332E-04
4	2.0366E-04	-9.4335E-04	-2.0383E-04	-1.0628E-04	-8.7296E-05
5	2.0983E-04	-9.3649E-04	-1.0945E-04	-1.9266E-04	-9.0447E-05
6	3.1614E-04	-9.5069E-04	-8.7385E-05	-9.1623E-05	-2.4748E-04
7	-9.5237E-04	3.7530E-03	5.0189E-04	4.9480E-04	5.0839E-04
8	7.8094E-06	1.0025E-05	1.9231E-05	8.0047E-06	-8.3188E-06
9	3.6773E-04	-2.0009E-03	-3.1902E-04	-2.1450E-04	-2.0309E-04
10	3.9527E-04	-1.9715E-03	-2.1468E-04	-2.9243E-04	-2.1224E-04
11	8.6882E-04	-2.0207E-03	-2.0428E-04	-2.1292E-04	-3.3967E-04
12		7.9689E-03	9.6514E-04	9.5744E-04	9.7717E-04
13			3.4449E-04	8.8903E-05	5.9440E-05
14				2.4976E-04	9.0360E-05
15					3.1318E-04

	16	17	18	19	20
1	-4.5301E-04	-6.0024E-04	3.0549E-04	-9.3134E-05	1.7289E-05
2	-9.1063E-04	-1.2329E-03	6.0706E-04	4.0733E-06	6.0527E-06
3	4.6710E-04	6.0737E-04	-3.2064E-04	-8.2262E-06	-2.3227E-06
4	4.9614E-04	-1.2097E-05	5.8035E-06	-4.4135E-04	1.1503E-04
5	4.9621E-04	-1.3684E-05	1.4870E-05	1.1723E-04	-9.1801E-05
6	5.1059E-04	-3.4600E-06	1.7598E-06	1.0548E-04	-1.1095E-05
7	-2.0055E-03	2.2343E-05	-2.6080E-05	9.9272E-05	-1.3115E-05
8	-2.1474E-05	6.0958E-04	-3.2914E-04	8.5803E-05	-2.9027E-05
9	9.6319E-04	-5.5760E-05	1.1770E-05	-6.6272E-05	4.5449E-06
10	9.5669E-04	-3.7161E-05	1.0778E-05	2.7798E-06	-3.5100E-05
11	9.7950E-04	1.4088E-05	1.9633E-06	1.1065E-05	-3.2256E-07
12	-3.8477E-03	9.1022E-05	-2.8884E-05	4.3023E-05	3.0201E-05
13	-5.6444E-04	1.3483E-05	-2.9974E-05	1.8235E-05	-9.7921E-07
14	-5.2913E-04	1.1267E-05	-1.7596E-05	-4.3240E-06	1.4385E-05
15	-5.3981E-04	-1.1569E-06	8.9074E-06	-8.4788E-07	2.8429E-07
16	2.1731E-03	-2.7973E-05	4.5747E-05	-8.4877E-06	-1.3821E-05
17		1.3001E-03	-6.2162E-04	2.0783E-06	4.6386E-06
18			3.5972E-04	1.5394E-05	-2.5208E-06
19				5.1216E-04	-1.1933E-04
20					1.2961E-04

	21	22
1	2.6300E-05	2.2170E-05
2	3.6804E-06	-4.2005E-05
3	1.8395E-06	2.0755E-05
4	1.0546E-04	1.0310E-04
5	-1.2325E-05	-1.3716E-05
6	-6.2898E-05	-2.2932E-05
7	-2.0582E-05	-5.5537E-05
8	-3.0710E-05	6.3211E-06
9	1.0974E-05	3.8690E-05
10	7.0653E-07	2.9626E-05
11	-4.8566E-05	3.3977E-05
12	3.1867E-05	-1.3724E-04
13	4.7227E-07	-1.6029E-05
14	2.1501E-06	-1.3036E-05
15	1.8725E-05	-1.5728E-05
16	-2.0288E-05	6.0277E-05
17	1.5954E-07	1.8607E-05

18	-9.3932E-06	-1.0778E-05
19	-1.1668E-04	-1.4757E-04
20	1.1894E-05	-2.0940E-05
21	1.1594E-04	-1.5717E-05
22		2.1346E-04

CTA_8D.PDF

CTA ADJUSTED

TWENTY-EIGHT 2-D

AND

FIFTY-SIX 3-D

SECTIONS OF

8-D COUNTS DATA

File Format

Field 1: CTA adjusted Cell Count
Field 2: Actual Cell Count
Field 3: deviation from true cell value
Field 4: Percent Deviation from true cell value
Fields 5 through 12: Numeric Subscripts

CTA-PROTECTED TWENTY-EIGHT 2-D SECTIONS

zero-D Cross Section

```
48844 48842   2    .00 * * * * * * * *
======================================
```

Eight 1-D Cross Sections

```
 8434  8432   2    .02 1 * * * * * * *
33543 33541   2    .00 2 * * * * * * *
 6867  6869  -2   -.02 3 * * * * * * *

 6550  6549   1    .01 * 1 * * * * * *
33909 33906   3    .00 * 2 * * * * * *
 5556  5557  -1   -.01 * 3 * * * * * *
 2829  2830  -1   -.03 * 4 * * * * * *

 6407  6408  -1   -.01 * * 1 * * * * *
15787 15784   3    .01 * * 2 * * * * *
11689 11687   2    .01 * * 3 * * * * *
 4089  4085   4    .09 * * 4 * * * * *
10872 10878  -6   -.05 * * 5 * * * * *

23044 23044        .00 * * * 1 * * * *
25800 25798   2    .00 * * * 2 * * * *

41765 41762   3    .00 * * * * 1 * * *
 7079  7080  -1   -.01 * * * * 2 * * *

32659 32650   9    .02 * * * * * 1 * *
16185 16192  -7   -.04 * * * * * 2 * *

11682 11687  -5   -.04 * * * * * * 1 *
22794 22803  -9   -.03 * * * * * * 2 *
14368 14352  16    .11 * * * * * * 3 *

37156 37155   1    .00 * * * * * * * 1
11688 11687   1    .00 * * * * * * * 2
======================================
```

Twenty-Eight 2-D Cross Sections

```
  587   585   2    .34 1 1 * * * * * *
 5020  5020        .00 2 1 * * * * * *
  943   944  -1   -.10 3 1 * * * * * *
 6578  6577   1    .01 1 2 * * * * * *
23698 23697   1    .00 2 2 * * * * * *
 3633  3632   1    .02 3 2 * * * * * *
  231   231        .00 1 3 * * * * * *
 3931  3930   1    .02 2 3 * * * * * *
 1394  1396  -2   -.14 3 3 * * * * * *
 1038  1039  -1   -.09 1 4 * * * * * *
  894   894        .00 2 4 * * * * * *
  897   897        .00 3 4 * * * * * *
--------------------------------------
 1751  1749   2    .11 1 * 1 * * * * *
 3274  3272   2    .06 2 * 1 * * * * *
 1382  1387  -5   -.36 3 * 1 * * * * *
 2470  2464   6    .24 1 * 2 * * * * *
10949 10950  -1   -.00 2 * 2 * * * * *
 2368  2370  -2   -.08 3 * 2 * * * * *
 1113  1116  -3   -.26 1 * 3 * * * * *
 9334  9333   1    .01 2 * 3 * * * * *
 1242  1238   4    .32 3 * 3 * * * * *
   37    37        .00 1 * 4 * * * * *
 3283  3282   1    .03 2 * 4 * * * * *
  769   766   3    .39 3 * 4 * * * * *
 3063  3066  -3   -.09 1 * 5 * * * * *
 6703  6704  -1   -.01 2 * 5 * * * * *
 1106  1108  -2   -.18 3 * 5 * * * * *
--------------------------------------
  360   358   2    .55 * 1 1 * * * * *
 4812  4813  -1   -.02 * 2 1 * * * * *
  595   597  -2   -.33 * 3 1 * * * * *
  640   640        .00 * 4 1 * * * * *
 1573  1571   2    .12 * 1 2 * * * * *
11684 11682   2    .01 * 2 2 * * * * *
 1706  1705   1    .05 * 3 2 * * * * *
  824   826  -2   -.24 * 4 2 * * * * *
 1976  1977  -1   -.05 * 1 3 * * * * *
 7879  7876   3    .03 * 2 3 * * * * *
 1425  1424   1    .07 * 3 3 * * * * *
  409   410  -1   -.24 * 4 3 * * * * *
 1201  1201        .00 * 1 4 * * * * *
 2000  2000        .00 * 2 4 * * * * *
  777   775   2    .25 * 3 4 * * * * *
  111   109   2   1.83 * 4 4 * * * * *
 1440  1442  -2   -.13 * 1 5 * * * * *
 7534  7535  -1   -.01 * 2 5 * * * * *
 1053  1056  -3   -.28 * 3 5 * * * * *
  845   845        .00 * 4 5 * * * * *
--------------------------------------
  778   779  -1   -.12 1 * * 1 * * * *
17990 17987   3    .01 2 * * 1 * * * *
 4276  4278  -2   -.04 3 * * 1 * * * *
 7656  7653   3    .03 1 * * 2 * * * *
15553 15554  -1   -.00 2 * * 2 * * * *
 2591  2591        .00 3 * * 2 * * * *
--------------------------------------
 3234  3225   9    .27 * 1 * 1 * * * *
14947 14950  -3   -.02 * 2 * 1 * * * *
 3877  3877        .00 * 3 * 1 * * * *
  986   992  -6   -.60 * 4 * 1 * * * *
 3316  3324  -8   -.24 * 1 * 2 * * * *
18962 18956   6    .03 * 2 * 2 * * * *
 1679  1680  -1   -.06 * 3 * 2 * * * *
 1843  1838   5    .27 * 4 * 2 * * * *
--------------------------------------
```

2727	2726	1	.03	*	*	1	1	*	*	*	*
7460	7457	3	.04	*	*	2	1	*	*	*	*
5998	5994	4	.06	*	*	3	1	*	*	*	*
2571	2570	1	.03	*	*	4	1	*	*	*	*
4288	4297	-9	-.20	*	*	5	1	*	*	*	*
3680	3682	-2	-.05	*	*	1	2	*	*	*	*
8327	8327		.00	*	*	2	2	*	*	*	*
5691	5693	-2	-.03	*	*	3	2	*	*	*	*
1518	1515	3	.19	*	*	4	2	*	*	*	*
6584	6581	3	.04	*	*	5	2	*	*	*	*

7251	7253	-2	-.02	1	*	*	*	1	*	*	*
28435	28432	3	.01	2	*	*	*	1	*	*	*
6079	6077	2	.03	3	*	*	*	1	*	*	*
1183	1179	4	.33	1	*	*	*	2	*	*	*
5108	5109	-1	-.02	2	*	*	*	2	*	*	*
788	792	-4	-.50	3	*	*	*	2	*	*	*

5240	5240		.00	*	1	*	*	1	*	*	*
29027	29024	3	.01	*	2	*	*	1	*	*	*
5166	5161	5	.09	*	3	*	*	1	*	*	*
2332	2337	-5	-.21	*	4	*	*	1	*	*	*
1310	1309	1	.07	*	1	*	*	2	*	*	*
4882	4882		.00	*	2	*	*	2	*	*	*
390	396	-6	-1.51	*	3	*	*	2	*	*	*
497	493	4	.81	*	4	*	*	2	*	*	*

5257	5259	-2	-.03	*	*	1	*	1	*	*	*
13389	13387	2	.01	*	*	2	*	1	*	*	*
10205	10205		.00	*	*	3	*	1	*	*	*
3632	3622	10	.27	*	*	4	*	1	*	*	*
9282	9289	-7	-.07	*	*	5	*	1	*	*	*
1150	1149	1	.08	*	*	1	*	2	*	*	*
2398	2397	1	.04	*	*	2	*	2	*	*	*
1484	1482	2	.13	*	*	3	*	2	*	*	*
457	463	-6	-1.29	*	*	4	*	2	*	*	*
1590	1589	1	.06	*	*	5	*	2	*	*	*

20536	20533	3	.01	*	*	*	1	1	*	*	*
21229	21229		.00	*	*	*	2	1	*	*	*
2508	2511	-3	-.11	*	*	*	1	2	*	*	*
4571	4569	2	.04	*	*	*	2	2	*	*	*

4626	4613	13	.28	1	*	*	*	*	1	*	*
23258	23269	-11	-.04	2	*	*	*	*	1	*	*
4775	4768	7	.14	3	*	*	*	*	1	*	*
3808	3819	-11	-.28	1	*	*	*	*	2	*	*
10285	10272	13	.12	2	*	*	*	*	2	*	*
2092	2101	-9	-.42	3	*	*	*	*	2	*	*

4095	4076	19	.46	*	1	*	*	*	1	*	*
22310	22307	3	.01	*	2	*	*	*	1	*	*
4718	4717	1	.02	*	3	*	*	*	1	*	*
1536	1550	-14	-.90	*	4	*	*	*	1	*	*
2455	2473	-18	-.72	*	1	*	*	*	2	*	*
11599	11599		.00	*	2	*	*	*	2	*	*
838	840	-2	-.23	*	3	*	*	*	2	*	*
1293	1280	13	1.01	*	4	*	*	*	2	*	*

4414	4419	-5	-.11	*	*	1	*	*	1	*	*
10690	10687	3	.02	*	*	2	*	*	1	*	*
7861	7849	12	.15	*	*	3	*	*	1	*	*
2994	2995	-1	-.03	*	*	4	*	*	1	*	*
6700	6700		.00	*	*	5	*	*	1	*	*
1993	1989	4	.20	*	*	1	*	*	2	*	*
5097	5097		.00	*	*	2	*	*	2	*	*
3828	3838	-10	-.26	*	*	3	*	*	2	*	*
1095	1090	5	.45	*	*	4	*	*	2	*	*
4172	4178	-6	-.14	*	*	5	*	*	2	*	*

20232	20235	-3	-.01	*	*	*	1	*	1	*	*
12427	12415	12	.09	*	*	*	2	*	1	*	*
2812	2809	3	.10	*	*	*	1	*	2	*	*
13373	13383	-10	-.07	*	*	*	2	*	2	*	*

28742	28735	7	.02	*	*	*	*	1	1	*	*
3917	3915	2	.05	*	*	*	*	2	1	*	*
13023	13027	-4	-.03	*	*	*	*	1	2	*	*
3162	3165	-3	-.09	*	*	*	*	2	2	*	*

4289	4292	-3	-.07	1	*	*	*	*	*	1	*
5055	5054	1	.02	2	*	*	*	*	*	1	*
2338	2341	-3	-.12	3	*	*	*	*	*	1	*
3157	3158	-1	-.03	1	*	*	*	*	*	2	*
16759	16756	3	.01	2	*	*	*	*	*	2	*
2878	2889	-11	-.38	3	*	*	*	*	*	2	*
988	982	6	.61	1	*	*	*	*	*	3	*
11729	11731	-2	-.01	2	*	*	*	*	*	3	*
1651	1639	12	.73	3	*	*	*	*	*	3	*

1316	1319	-3	-.22	*	1	*	*	*	*	1	*
7726	7732	-6	-.07	*	2	*	*	*	*	1	*
1184	1180	4	.33	*	3	*	*	*	*	1	*
1456	1456		.00	*	4	*	*	*	*	1	*
3651	3655	-4	-.10	*	1	*	*	*	*	2	*
16631	16627	4	.02	*	2	*	*	*	*	2	*
1478	1480	-2	-.13	*	3	*	*	*	*	2	*
1034	1041	-7	-.67	*	4	*	*	*	*	2	*
1583	1575	8	.50	*	1	*	*	*	*	3	*
9552	9547	5	.05	*	2	*	*	*	*	3	*
2894	2897	-3	-.10	*	3	*	*	*	*	3	*
339	333	6	1.80	*	4	*	*	*	*	3	*

2250	2257	-7	-.31	*	*	1	*	*	*	1	*
3408	3405	3	.08	*	*	2	*	*	*	1	*
2099	2105	-6	-.28	*	*	3	*	*	*	1	*
692	682	10	1.46	*	*	4	*	*	*	1	*
3233	3238	-5	-.15	*	*	5	*	*	*	1	*
3026	3023	3	.09	*	*	1	*	*	*	2	*
8273	8282	-9	-.10	*	*	2	*	*	*	2	*
5287	5275	12	.22	*	*	3	*	*	*	2	*
1363	1377	-14	-1.01	*	*	4	*	*	*	2	*
4845	4846	-1	-.02	*	*	5	*	*	*	2	*
1131	1128	3	.26	*	*	1	*	*	*	3	*
4106	4097	9	.22	*	*	2	*	*	*	3	*
4303	4307	-4	-.09	*	*	3	*	*	*	3	*
2034	2026	8	.39	*	*	4	*	*	*	3	*
2794	2794		.00	*	*	5	*	*	*	3	*

3359	3368	-9	-.26	*	*	*	1	*	*	1	*
8323	8319	4	.04	*	*	*	2	*	*	1	*
10831	10840	-9	-.08	*	*	*	1	*	*	2	*
11963	11963		.00	*	*	*	2	*	*	2	*
8854	8836	18	.20	*	*	*	1	*	*	3	*
5514	5516	-2	-.03	*	*	*	2	*	*	3	*

9850	9859	-9	-.09	*	*	*	*	1	*	1	*
1832	1828	4	.21	*	*	*	*	2	*	1	*
18807	18794	13	.06	*	*	*	*	1	*	2	*
3987	4009	-22	-.54	*	*	*	*	2	*	2	*
13108	13109	-1	-.00	*	*	*	*	1	*	3	*
1260	1243	17	1.36	*	*	*	*	2	*	3	*

5493	5498	-5	-.09	*	*	*	*	*	1	1	*
6189	6189		.00	*	*	*	*	*	2	1	*
15437	15428	9	.05	*	*	*	*	*	1	2	*
7357	7375	-18	-.24	*	*	*	*	*	2	2	*
11729	11724	5	.04	*	*	*	*	*	1	3	*
2639	2628	11	.41	*	*	*	*	*	2	3	*

8345	8339	6	.07	1	*	*	*	*	*	*	1
23914	23912	2	.00	2	*	*	*	*	*	*	1
4897	4904	-7	-.14	3	*	*	*	*	*	*	1
89	93	-4	-4.30	1	*	*	*	*	*	*	2
9629	9629		.00	2	*	*	*	*	*	*	2
1970	1965	5	.25	3	*	*	*	*	*	*	2

4551	4531	20	.44	*	1	*	*	*	*	*	1
26507	26519	-12	-.04	*	2	*	*	*	*	*	1
3550	3542	8	.22	*	3	*	*	*	*	*	1
2548	2563	-15	-.58	*	4	*	*	*	*	*	1
1999	2018	-19	-.94	*	1	*	*	*	*	*	2
7402	7387	15	.20	*	2	*	*	*	*	*	2
2006	2015	-9	-.44	*	3	*	*	*	*	*	2
281	267	14	5.24	*	4	*	*	*	*	*	2

6048	6042	6	.09	*	*	1	*	*	*	*	1
13287	13281	6	.04	*	*	2	*	*	*	*	1
7443	7439	4	.05	*	*	3	*	*	*	*	1
1569	1578	-9	-.57	*	*	4	*	*	*	*	1
8809	8815	-6	-.06	*	*	5	*	*	*	*	1
359	366	-7	-1.91	*	*	1	*	*	*	*	2
2500	2503	-3	-.12	*	*	2	*	*	*	*	2
4246	4248	-2	-.04	*	*	3	*	*	*	*	2
2520	2507	13	.51	*	*	4	*	*	*	*	2
2063	2063		.00	*	*	5	*	*	*	*	2

12988	12988		.00	*	*	*	1	*	*	*	1
24168	24167	1	.00	*	*	*	2	*	*	*	1
10056	10056		.00	*	*	*	1	*	*	*	2
1632	1631	1	.06	*	*	*	2	*	*	*	2

31169	31155	14	.04	*	*	*	*	1	*	*	1
5987	6000	-13	-.21	*	*	*	*	2	*	*	1
10596	10607	-11	-.10	*	*	*	*	1	*	*	2
1092	1080	12	1.11	*	*	*	*	2	*	*	2

22740	22732	8	.03	*	*	*	*	*	1	*	1
14416	14423	-7	-.04	*	*	*	*	*	2	*	1
9919	9918	1	.01	*	*	*	*	*	1	*	2
1769	1769		.00	*	*	*	*	*	2	*	2

10591	10592	-1	-.00	*	*	*	*	*	*	1	1
17937	17953	-16	-.08	*	*	*	*	*	*	2	1
8628	8610	18	.20	*	*	*	*	*	*	3	1
1091	1095	-4	-.36	*	*	*	*	*	*	1	2
4857	4850	7	.14	*	*	*	*	*	*	2	2
5740	5742	-2	-.03	*	*	*	*	*	*	3	2

FIFTY-SIX 3-D SECTIONS FROM 8-D COUNTS DATA

Section: 1 ---- x(6,7,8)

4856	4862	-6	-.12	*	*	*	*	*	1	1	1
5735	5730	5	.08	*	*	*	*	*	2	1	1
11325	11320	5	.04	*	*	*	*	*	1	2	1
6612	6633	-21	-.31	*	*	*	*	*	2	2	1
6559	6550	9	.13	*	*	*	*	*	1	3	1
2069	2060	9	.43	*	*	*	*	*	2	3	1
637	636	1	.15	*	*	*	*	*	1	1	2
454	459	-5	-1.08	*	*	*	*	*	2	1	2
4112	4108	4	.09	*	*	*	*	*	1	2	2
745	742	3	.40	*	*	*	*	*	2	2	2
5170	5174	-4	-.07	*	*	*	*	*	1	3	2
570	568	2	.35	*	*	*	*	*	2	3	2

Section: 2 ---- x(5,7,8)

8865	8870	-5	-.05	*	*	*	*	1	*	1	1
1726	1722	4	.23	*	*	*	*	2	*	1	1
14527	14523	4	.02	*	*	*	*	1	*	2	1
3410	3430	-20	-.58	*	*	*	*	2	*	2	1
7777	7762	15	.19	*	*	*	*	1	*	3	1
851	848	3	.35	*	*	*	*	2	*	3	1
985	989	-4	-.40	*	*	*	*	1	*	1	2
106	106		.00	*	*	*	*	2	*	1	2
4280	4271	9	.21	*	*	*	*	1	*	2	2
577	579	-2	-.34	*	*	*	*	2	*	2	2
5331	5347	-16	-.29	*	*	*	*	1	*	3	2
409	395	14	3.54	*	*	*	*	2	*	3	2

Section: 3 ---- x(5,6,8)

19682	19670	12	.06	*	*	*	*	1	1	*	1
3058	3062	-4	-.13	*	*	*	*	2	1	*	1
11487	11485	2	.01	*	*	*	*	1	2	*	1
2929	2938	-9	-.30	*	*	*	*	2	2	*	1
9060	9065	-5	-.05	*	*	*	*	1	1	*	2
859	853	6	.70	*	*	*	*	2	1	*	2
1536	1542	-6	-.38	*	*	*	*	1	2	*	2
233	227	6	2.64	*	*	*	*	2	2	*	2

Section: 4 ---- x(5,6,7)

4750	4748	2	.04	*	*	*	*	1	1	1	*
743	750	-7	-.93	*	*	*	*	2	1	1	*
5100	5111	-11	-.21	*	*	*	*	1	2	1	*
1089	1078	11	1.02	*	*	*	*	2	2	1	*
13162	13148	14	.10	*	*	*	*	1	1	2	*
2275	2280	-5	-.21	*	*	*	*	2	1	2	*
5645	5646	-1	-.01	*	*	*	*	1	2	2	*
1712	1729	-17	-.98	*	*	*	*	2	2	2	*
10830	10839	-9	-.08	*	*	*	*	1	1	3	*
899	885	14	1.58	*	*	*	*	2	1	3	*
2278	2270	8	.35	*	*	*	*	1	2	3	*
361	358	3	.83	*	*	*	*	2	2	3	*

Section: 5 ---- x(4,7,8)

2424	2429	-5	-.20	*	*	*	1	*	*	1	1
8167	8163	4	.04	*	*	*	2	*	*	1	1
6548	6559	-11	-.16	*	*	*	1	*	*	2	1
11389	11394	-5	-.04	*	*	*	2	*	*	2	1
4016	4000	16	.40	*	*	*	1	*	*	3	1
4612	4610	2	.04	*	*	*	2	*	*	3	1
935	939	-4	-.42	*	*	*	1	*	*	1	2
156	156		.00	*	*	*	2	*	*	1	2
4283	4281	2	.04	*	*	*	1	*	*	2	2
574	569	5	.87	*	*	*	2	*	*	2	2
4838	4836	2	.04	*	*	*	1	*	*	3	2
902	906	-4	-.44	*	*	*	2	*	*	3	2

Section: 6 ---- x(4,6,8)

11322	11318	4	.03	*	*	*	1	*	1	*	1
11418	11414	4	.03	*	*	*	2	*	1	*	1
1666	1670	-4	-.24	*	*	*	1	*	2	*	1
12750	12753	-3	-.02	*	*	*	2	*	2	*	1
8910	8917	-7	-.07	*	*	*	1	*	1	*	2
1009	1001	8	.79	*	*	*	2	*	1	*	2
1146	1139	7	.61	*	*	*	1	*	2	*	2
623	630	-7	-1.11	*	*	*	2	*	2	*	2

Section: 7 ---- x(4,6,7)

2299	2310	-11	-.47	*	*	*	1	*	1	1	*
3194	3188	6	.18	*	*	*	2	*	1	1	*
1060	1058	2	.18	*	*	*	1	*	2	1	*
5129	5131	-2	-.03	*	*	*	2	*	2	1	*
9580	9579	1	.01	*	*	*	1	*	1	2	*
5857	5849	8	.13	*	*	*	2	*	1	2	*
1251	1261	-10	-.79	*	*	*	1	*	2	2	*
6106	6114	-8	-.13	*	*	*	2	*	2	2	*
8353	8346	7	.08	*	*	*	1	*	1	3	*
3376	3378	-2	-.05	*	*	*	2	*	1	3	*
501	490	11	2.24	*	*	*	1	*	2	3	*
2138	2138		.00	*	*	*	2	*	2	3	*

Section: 8 ---- x(4,5,8)

11386	11374	12	.10	*	*	*	1	1	*	*	1
19783	19781	2	.01	*	*	*	2	1	*	*	1
1602	1614	-12	-.74	*	*	*	1	2	*	*	1
4385	4386	-1	-.02	*	*	*	2	2	*	*	1
9150	9159	-9	-.09	*	*	*	1	1	*	*	2
1446	1448	-2	-.13	*	*	*	2	1	*	*	2
906	897	9	1.00	*	*	*	1	2	*	*	2
186	183	3	1.63	*	*	*	2	2	*	*	2

Section: 9 ---- x(4,5,7)

2938	2945	-7	-.23	*	*	*	1	1	*	1	*
6912	6914	-2	-.02	*	*	*	2	1	*	1	*
421	423	-2	-.47	*	*	*	1	2	*	1	*
1411	1405	6	.42	*	*	*	2	2	*	1	*
9356	9352	4	.04	*	*	*	1	1	*	2	*

9451	9442	9	.09	*	*	*	2	1	*	2	*
1475	1488	-13	-.87	*	*	*	1	2	*	2	*
2512	2521	-9	-.35	*	*	*	2	2	*	2	*
8242	8236	6	.07	*	*	*	1	1	*	3	*
4866	4873	-7	-.14	*	*	*	2	1	*	3	*
612	600	12	2.00	*	*	*	1	2	*	3	*
648	643	5	.77	*	*	*	2	2	*	3	*

Section:10 ---- x(4,5,6)

18244	18245	-1	-.00	*	*	*	1	1	1	*	*
10498	10490	8	.07	*	*	*	2	1	1	*	*
1988	1990	-2	-.10	*	*	*	1	2	1	*	*
1929	1925	4	.20	*	*	*	2	2	1	*	*
2292	2288	4	.17	*	*	*	1	1	2	*	*
10731	10739	-8	-.07	*	*	*	2	1	2	*	*
520	521	-1	-.19	*	*	*	1	2	2	*	*
2642	2644	-2	-.07	*	*	*	2	2	2	*	*

Section:11 ---- x(3,7,8)

2219	2223	-4	-.18	*	*	1	*	*	*	1	1
3223	3217	6	.18	*	*	2	*	*	*	1	1
1714	1715	-1	-.05	*	*	3	*	*	*	1	1
397	396	1	.25	*	*	4	*	*	*	1	1
3038	3041	-3	-.09	*	*	5	*	*	*	1	1
2844	2848	-4	-.14	*	*	1	*	*	*	2	1
7017	7021	-4	-.05	*	*	2	*	*	*	2	1
3574	3569	5	.14	*	*	3	*	*	*	2	1
601	614	-13	-2.11	*	*	4	*	*	*	2	1
3901	3901		.00	*	*	5	*	*	*	2	1
985	971	14	1.44	*	*	1	*	*	*	3	1
3047	3043	4	.13	*	*	2	*	*	*	3	1
2155	2155		.00	*	*	3	*	*	*	3	1
571	568	3	.52	*	*	4	*	*	*	3	1
1870	1873	-3	-.16	*	*	5	*	*	*	3	1
31	34	-3	-8.82	*	*	1	*	*	*	1	2
185	188	-3	-1.59	*	*	2	*	*	*	1	2
385	390	-5	-1.28	*	*	3	*	*	*	1	2
295	286	9	3.14	*	*	4	*	*	*	1	2
195	197	-2	-1.01	*	*	5	*	*	*	1	2
182	175	7	4.00	*	*	1	*	*	*	2	2
1256	1261	-5	-.39	*	*	2	*	*	*	2	2
1713	1706	7	.41	*	*	3	*	*	*	2	2
762	763	-1	-.13	*	*	4	*	*	*	2	2
944	945	-1	-.10	*	*	5	*	*	*	2	2
146	157	-11	-7.00	*	*	1	*	*	*	3	2
1059	1054	5	.47	*	*	2	*	*	*	3	2
2148	2152	-4	-.18	*	*	3	*	*	*	3	2
1463	1458	5	.34	*	*	4	*	*	*	3	2
924	921	3	.32	*	*	5	*	*	*	3	2

Section:12 ---- x(3,6,8)

4084	4082	2	.04	*	*	1	*	*	1	*	1
8517	8514	3	.03	*	*	2	*	*	1	*	1
4311	4301	10	.23	*	*	3	*	*	1	*	1
901	905	-4	-.44	*	*	4	*	*	1	*	1
4927	4930	-3	-.06	*	*	5	*	*	1	*	1
1964	1960	4	.20	*	*	1	*	*	2	*	1
4770	4767	3	.06	*	*	2	*	*	2	*	1
3132	3138	-6	-.19	*	*	3	*	*	2	*	1
668	673	-5	-.74	*	*	4	*	*	2	*	1
3882	3885	-3	-.07	*	*	5	*	*	2	*	1
330	337	-7	-2.07	*	*	1	*	*	1	*	2
2173	2173		.00	*	*	2	*	*	1	*	2
3550	3548	2	.05	*	*	3	*	*	1	*	2
2093	2090	3	.14	*	*	4	*	*	1	*	2
1773	1770	3	.16	*	*	5	*	*	1	*	2
29	29		.00	*	*	1	*	*	2	*	2
327	330	-3	-.90	*	*	2	*	*	2	*	2
696	700	-4	-.57	*	*	3	*	*	2	*	2
427	417	10	2.39	*	*	4	*	*	2	*	2
290	293	-3	-1.02	*	*	5	*	*	2	*	2

Section:13 ---- x(3,6,7)

1202	1205	-3	-.24	*	*	1	*	*	1	1	*
1513	1515	-2	-.13	*	*	2	*	*	1	1	*
996	991	5	.50	*	*	3	*	*	1	1	*
398	400	-2	-.50	*	*	4	*	*	1	1	*
1384	1387	-3	-.21	*	*	5	*	*	1	1	*
1048	1052	-4	-.38	*	*	1	*	*	2	1	*
1895	1890	5	.26	*	*	2	*	*	2	1	*
1103	1114	-11	-.98	*	*	3	*	*	2	1	*
294	282	12	4.25	*	*	4	*	*	2	1	*
1849	1851	-2	-.10	*	*	5	*	*	2	1	*
2260	2259	1	.04	*	*	1	*	*	1	2	*
5719	5721	-2	-.03	*	*	2	*	*	1	2	*
3458	3448	10	.29	*	*	3	*	*	1	2	*
945	947	-2	-.21	*	*	4	*	*	1	2	*
3055	3053	2	.06	*	*	5	*	*	1	2	*
766	764	2	.26	*	*	1	*	*	2	2	*
2554	2561	-7	-.27	*	*	2	*	*	2	2	*
1829	1827	2	.10	*	*	3	*	*	2	2	*
418	430	-12	-2.79	*	*	4	*	*	2	2	*
1790	1793	-3	-.16	*	*	5	*	*	2	2	*
952	955	-3	-.31	*	*	1	*	*	1	3	*
3458	3451	7	.20	*	*	2	*	*	1	3	*
3407	3410	-3	-.08	*	*	3	*	*	1	3	*
1651	1648	3	.18	*	*	4	*	*	1	3	*
2261	2260	1	.04	*	*	5	*	*	1	3	*
179	173	6	3.46	*	*	1	*	*	2	3	*
648	646	2	.31	*	*	2	*	*	2	3	*
896	897	-1	-.11	*	*	3	*	*	2	3	*
383	378	5	1.32	*	*	4	*	*	2	3	*
533	534	-1	-.18	*	*	5	*	*	2	3	*

Section:14 ---- x(3,5,8)

4948	4941	7	.14	*	*	1	*	1	*	*	1
11090	11086	4	.03	*	*	2	*	1	*	*	1
6345	6343	2	.03	*	*	3	*	1	*	*	1
1349	1352	-3	-.22	*	*	4	*	1	*	*	1
7437	7433	4	.05	*	*	5	*	1	*	*	1
1100	1101	-1	-.09	*	*	1	*	2	*	*	1
2197	2195	2	.09	*	*	2	*	2	*	*	1
1098	1096	2	.18	*	*	3	*	2	*	*	1
220	226	-6	-2.65	*	*	4	*	2	*	*	1

1372	1382	-10	-.72	*	*	5	*	2	*	*	1
309	318	-9	-2.83	*	*	1	*	1	*	*	2
2299	2301	-2	-.08	*	*	2	*	1	*	*	2
3860	3862	-2	-.05	*	*	3	*	1	*	*	2
2283	2270	13	.57	*	*	4	*	1	*	*	2
1845	1856	-11	-.59	*	*	5	*	1	*	*	2
50	48	2	4.16	*	*	1	*	2	*	*	2
201	202	-1	-.49	*	*	2	*	2	*	*	2
386	386		.00	*	*	3	*	2	*	*	2
237	237		.00	*	*	4	*	2	*	*	2
218	207	11	5.31	*	*	5	*	2	*	*	2

Section:15 ---- x(3,5,7)

1864	1873	-9	-.48	*	*	1	*	1	*	1	*
2825	2825		.00	*	*	2	*	1	*	1	*
1801	1802	-1	-.05	*	*	3	*	1	*	1	*
598	591	7	1.18	*	*	4	*	1	*	1	*
2762	2768	-6	-.21	*	*	5	*	1	*	1	*
386	384	2	.52	*	*	1	*	2	*	1	*
583	580	3	.51	*	*	2	*	2	*	1	*
298	303	-5	-1.65	*	*	3	*	2	*	1	*
94	91	3	3.29	*	*	4	*	2	*	1	*
471	470	1	.21	*	*	5	*	2	*	1	*
2413	2403	10	.41	*	*	1	*	1	*	2	*
6813	6816	-3	-.04	*	*	2	*	1	*	2	*
4457	4450	7	.15	*	*	3	*	1	*	2	*
1147	1149	-2	-.17	*	*	4	*	1	*	2	*
3977	3976	1	.02	*	*	5	*	1	*	2	*
613	620	-7	-1.12	*	*	1	*	2	*	2	*
1460	1466	-6	-.40	*	*	2	*	2	*	2	*
830	825	5	.60	*	*	3	*	2	*	2	*
216	228	-12	-5.26	*	*	4	*	2	*	2	*
868	870	-2	-.23	*	*	5	*	2	*	2	*
980	983	-3	-.30	*	*	1	*	1	*	3	*
3751	3746	5	.13	*	*	2	*	1	*	3	*
3947	3953	-6	-.15	*	*	3	*	1	*	3	*
1887	1882	5	.26	*	*	4	*	1	*	3	*
2543	2545	-2	-.07	*	*	5	*	1	*	3	*
151	145	6	4.13	*	*	1	*	2	*	3	*
355	351	4	1.14	*	*	2	*	2	*	3	*
356	354	2	.56	*	*	3	*	2	*	3	*
147	144	3	2.08	*	*	4	*	2	*	3	*
251	249	2	.80	*	*	5	*	2	*	3	*

Section:16 ---- x(3,5,6)

3757	3761	-4	-.10	*	*	1	*	1	1	*	*
9359	9361	-2	-.02	*	*	2	*	1	1	*	*
7061	7052	9	.12	*	*	3	*	1	1	*	*
2681	2672	9	.33	*	*	4	*	1	1	*	*
5884	5889	-5	-.08	*	*	5	*	1	1	*	*
657	658	-1	-.15	*	*	1	*	2	1	*	*
1331	1326	5	.37	*	*	2	*	2	1	*	*
800	797	3	.37	*	*	3	*	2	1	*	*
313	323	-10	-3.09	*	*	4	*	2	1	*	*
816	811	5	.61	*	*	5	*	2	1	*	*
1500	1498	2	.13	*	*	1	*	1	2	*	*
4030	4026	4	.09	*	*	2	*	1	2	*	*
3144	3153	-9	-.28	*	*	3	*	1	2	*	*
951	950	1	.10	*	*	4	*	1	2	*	*
3398	3400	-2	-.05	*	*	5	*	1	2	*	*
493	491	2	.40	*	*	1	*	2	2	*	*
1067	1071	-4	-.37	*	*	2	*	2	2	*	*
684	685	-1	-.14	*	*	3	*	2	2	*	*
144	140	4	2.85	*	*	4	*	2	2	*	*
774	778	-4	-.51	*	*	5	*	2	2	*	*

Section:17 ---- x(3,4,8)

2409	2408	1	.04	*	*	1	1	*	*	*	1
5198	5193	5	.09	*	*	2	1	*	*	*	1
2379	2377	2	.08	*	*	3	1	*	*	*	1
546	548	-2	-.36	*	*	4	1	*	*	*	1
2456	2462	-6	-.24	*	*	5	1	*	*	*	1
3639	3634	5	.13	*	*	1	2	*	*	*	1
8089	8088	1	.01	*	*	2	2	*	*	*	1
5064	5062	2	.04	*	*	3	2	*	*	*	1
1023	1030	-7	-.68	*	*	4	2	*	*	*	1
6353	6353		.00	*	*	5	2	*	*	*	1
318	318		.00	*	*	1	1	*	*	*	2
2262	2264	-2	-.08	*	*	2	1	*	*	*	2
3619	3617	2	.05	*	*	3	1	*	*	*	2
2025	2022	3	.14	*	*	4	1	*	*	*	2
1832	1835	-3	-.16	*	*	5	1	*	*	*	2
41	48	-7	-14.58	*	*	1	2	*	*	*	2
238	239	-1	-.41	*	*	2	2	*	*	*	2
627	631	-4	-.63	*	*	3	2	*	*	*	2
495	485	10	2.06	*	*	4	2	*	*	*	2
231	228	3	1.31	*	*	5	2	*	*	*	2

Section:18 ---- x(3,4,7)

517	520	-3	-.57	*	*	1	1	*	*	1	*
1065	1062	3	.28	*	*	2	1	*	*	1	*
790	801	-11	-1.37	*	*	3	1	*	*	1	*
377	374	3	.80	*	*	4	1	*	*	1	*
610	611	-1	-.16	*	*	5	1	*	*	1	*
1733	1737	-4	-.23	*	*	1	2	*	*	1	*
2343	2343		.00	*	*	2	2	*	*	1	*
1309	1304	5	.38	*	*	3	2	*	*	1	*
315	308	7	2.27	*	*	4	2	*	*	1	*
2623	2627	-4	-.15	*	*	5	2	*	*	1	*
1531	1530	1	.06	*	*	1	1	*	*	2	*
3890	3895	-5	-.12	*	*	2	1	*	*	2	*
2557	2550	7	.27	*	*	3	1	*	*	2	*
807	818	-11	-1.34	*	*	4	1	*	*	2	*
2046	2047	-1	-.04	*	*	5	1	*	*	2	*
1495	1493	2	.13	*	*	1	2	*	*	2	*
4383	4387	-4	-.09	*	*	2	2	*	*	2	*
2730	2725	5	.18	*	*	3	2	*	*	2	*
556	559	-3	-.53	*	*	4	2	*	*	2	*
2799	2799		.00	*	*	5	2	*	*	2	*
679	676	3	.44	*	*	1	1	*	*	3	*
2505	2500	5	.20	*	*	2	1	*	*	3	*
2651	2643	8	.30	*	*	3	1	*	*	3	*
1387	1378	9	.65	*	*	4	1	*	*	3	*
1632	1639	-7	-.42	*	*	5	1	*	*	3	*

452	452		.00	*	*	1	2	*	*	3	*
1601	1597	4	.25	*	*	2	2	*	*	3	*
1652	1664	-12	-.72	*	*	3	2	*	*	3	*
647	648	-1	-.15	*	*	4	2	*	*	3	*
1162	1155	7	.60	*	*	5	2	*	*	3	*

Section:19 ---- x(3,4,6)

2443	2446	-3	-.12	*	*	1	1	*	1	*	*
6550	6550		.00	*	*	2	1	*	1	*	*
5205	5202	3	.05	*	*	3	1	*	1	*	*
2303	2303		.00	*	*	4	1	*	1	*	*
3731	3734	-3	-.08	*	*	5	1	*	1	*	*
1971	1973	-2	-.10	*	*	1	2	*	1	*	*
4140	4137	3	.07	*	*	2	2	*	1	*	*
2656	2647	9	.34	*	*	3	2	*	1	*	*
691	692	-1	-.14	*	*	4	2	*	1	*	*
2969	2966	3	.10	*	*	5	2	*	1	*	*
284	280	4	1.42	*	*	1	1	*	2	*	*
910	907	3	.33	*	*	2	1	*	2	*	*
793	792	1	.12	*	*	3	1	*	2	*	*
268	267	1	.37	*	*	4	1	*	2	*	*
557	563	-6	-1.06	*	*	5	1	*	2	*	*
1709	1709		.00	*	*	1	2	*	2	*	*
4187	4190	-3	-.07	*	*	2	2	*	2	*	*
3035	3046	-11	-.36	*	*	3	2	*	2	*	*
827	823	4	.48	*	*	4	2	*	2	*	*
3615	3615		.00	*	*	5	2	*	2	*	*

Section:20 ---- x(3,4,5)

2349	2348	1	.04	*	*	1	1	1	*	*	*
6657	6653	4	.06	*	*	2	1	1	*	*	*
5409	5406	3	.05	*	*	3	1	1	*	*	*
2294	2294		.00	*	*	4	1	1	*	*	*
3827	3832	-5	-.13	*	*	5	1	1	*	*	*
2908	2911	-3	-.10	*	*	1	2	1	*	*	*
6732	6734	-2	-.03	*	*	2	2	1	*	*	*
4796	4799	-3	-.06	*	*	3	2	1	*	*	*
1338	1328	10	.75	*	*	4	2	1	*	*	*
5455	5457	-2	-.03	*	*	5	2	1	*	*	*
378	378		.00	*	*	1	1	2	*	*	*
803	804	-1	-.12	*	*	2	1	2	*	*	*
589	588	1	.17	*	*	3	1	2	*	*	*
277	276	1	.36	*	*	4	1	2	*	*	*
461	465	-4	-.86	*	*	5	1	2	*	*	*
772	771	1	.13	*	*	1	2	2	*	*	*
1595	1593	2	.12	*	*	2	2	2	*	*	*
895	894	1	.11	*	*	3	2	2	*	*	*
180	187	-7	-3.74	*	*	4	2	2	*	*	*
1129	1124	5	.44	*	*	5	2	2	*	*	*

Section:21 ---- x(2,7,8)

1124	1122	2	.17	*	1	*	*	*	*	1	1
7186	7194	-8	-.11	*	2	*	*	*	*	1	1
937	924	13	1.40	*	3	*	*	*	*	1	1
1344	1352	-8	-.59	*	4	*	*	*	*	1	1
2575	2574	1	.03	*	1	*	*	*	*	2	1
13427	13433	-6	-.04	*	2	*	*	*	*	2	1
997	997		.00	*	3	*	*	*	*	2	1
938	949	-11	-1.15	*	4	*	*	*	*	2	1
852	835	17	2.03	*	1	*	*	*	*	3	1
5894	5892	2	.03	*	2	*	*	*	*	3	1
1616	1621	-5	-.30	*	3	*	*	*	*	3	1
266	262	4	1.52	*	4	*	*	*	*	3	1
192	197	-5	-2.53	*	1	*	*	*	*	1	2
540	538	2	.37	*	2	*	*	*	*	1	2
247	256	-9	-3.51	*	3	*	*	*	*	1	2
112	104	8	7.69	*	4	*	*	*	*	1	2
1076	1081	-5	-.46	*	1	*	*	*	*	2	2
3204	3194	10	.31	*	2	*	*	*	*	2	2
481	483	-2	-.41	*	3	*	*	*	*	2	2
96	92	4	4.34	*	4	*	*	*	*	2	2
731	740	-9	-1.21	*	1	*	*	*	*	3	2
3658	3655	3	.08	*	2	*	*	*	*	3	2
1278	1276	2	.15	*	3	*	*	*	*	3	2
73	71	2	2.81	*	4	*	*	*	*	3	2

Section:22 ---- x(2,6,8)

2490	2468	22	.89	*	1	*	*	*	1	*	1
16011	16015	-4	-.02	*	2	*	*	*	1	*	1
2894	2890	4	.13	*	3	*	*	*	1	*	1
1345	1359	-14	-1.03	*	4	*	*	*	1	*	1
2061	2063	-2	-.09	*	1	*	*	*	2	*	1
10496	10504	-8	-.07	*	2	*	*	*	2	*	1
656	652	4	.61	*	3	*	*	*	2	*	1
1203	1204	-1	-.08	*	4	*	*	*	2	*	1
1605	1608	-3	-.18	*	1	*	*	*	1	*	2
6299	6292	7	.11	*	2	*	*	*	1	*	2
1824	1827	-3	-.16	*	3	*	*	*	1	*	2
191	191		.00	*	4	*	*	*	1	*	2
394	410	-16	-3.90	*	1	*	*	*	2	*	2
1103	1095	8	.73	*	2	*	*	*	2	*	2
182	188	-6	-3.19	*	3	*	*	*	2	*	2
90	76	14	18.42	*	4	*	*	*	2	*	2

Section:23 ---- x(2,6,7)

588	585	3	.51	*	1	*	*	*	1	1	*
3367	3370	-3	-.08	*	2	*	*	*	1	1	*
837	837		.00	*	3	*	*	*	1	1	*
701	706	-5	-.70	*	4	*	*	*	1	1	*
728	734	-6	-.81	*	1	*	*	*	2	1	*
4359	4362	-3	-.06	*	2	*	*	*	2	1	*
347	343	4	1.16	*	3	*	*	*	2	1	*
755	750	5	.66	*	4	*	*	*	2	1	*
2388	2379	9	.37	*	1	*	*	*	1	2	*
11196	11193	3	.02	*	2	*	*	*	1	2	*
1254	1252	2	.16	*	3	*	*	*	1	2	*
599	604	-5	-.82	*	4	*	*	*	1	2	*
1263	1276	-13	-1.01	*	1	*	*	*	2	2	*
5435	5434	1	.01	*	2	*	*	*	2	2	*
224	228	-4	-1.75	*	3	*	*	*	2	2	*
435	437	-2	-.45	*	4	*	*	*	2	2	*
1119	1112	7	.62	*	1	*	*	*	1	3	*
7747	7744	3	.03	*	2	*	*	*	1	3	*
2627	2628	-1	-.03	*	3	*	*	*	1	3	*

```
  236   240   -4   -1.66 * 4 * * * 1 3 *
  464   463    1     .21 * 1 * * * 2 3 *
 1805  1803    2     .11 * 2 * * * 2 3 *
  267   269   -2    -.74 * 3 * * * 2 3 *
  103    93   10   10.75 * 4 * * * 2 3 *
--------------------------------------
     Section:24 ---- x(2,5,8)
 3523  3510   13     .37 * 1 * * 1 * * 1
22279 22282   -3    -.01 * 2 * * 1 * * 1
 3280  3268   12     .36 * 3 * * 1 * * 1
 2087  2095   -8    -.38 * 4 * * 1 * * 1
 1028  1021    7     .68 * 1 * * 2 * * 1
 4228  4237   -9    -.21 * 2 * * 2 * * 1
  270   274   -4   -1.46 * 3 * * 2 * * 1
  461   468   -7   -1.49 * 4 * * 2 * * 1
 1717  1730  -13    -.75 * 1 * * 1 * * 2
 6748  6742    6     .08 * 2 * * 1 * * 2
 1886  1893   -7    -.37 * 3 * * 1 * * 2
  245   242    3    1.24 * 4 * * 1 * * 2
  282   288   -6   -2.08 * 1 * * 2 * * 2
  654   645    9    1.39 * 2 * * 2 * * 2
  120   122   -2   -1.63 * 3 * * 2 * * 2
   36    25   11   44.00 * 4 * * 2 * * 2
--------------------------------------
     Section:25 ---- x(2,5,7)
 1046  1053   -7    -.66 * 1 * * 1 * 1 *
 6483  6480    3     .04 * 2 * * 1 * 1 *
 1101  1101          .00 * 3 * * 1 * 1 *
 1220  1225   -5    -.40 * 4 * * 1 * 1 *
  270   266    4    1.50 * 1 * * 2 * 1 *
 1243  1252   -9    -.71 * 2 * * 2 * 1 *
   83    79    4    5.06 * 3 * * 2 * 1 *
  236   231    5    2.16 * 4 * * 2 * 1 *
 2803  2802    1     .03 * 1 * * 1 * 2 *
13826 13817    9     .06 * 2 * * 1 * 2 *
 1352  1349    3     .22 * 3 * * 1 * 2 *
  826   826          .00 * 4 * * 1 * 2 *
  848   853   -5    -.58 * 1 * * 2 * 2 *
 2805  2810   -5    -.17 * 2 * * 2 * 2 *
  126   131   -5   -3.81 * 3 * * 2 * 2 *
  208   215   -7   -3.25 * 4 * * 2 * 2 *
 1391  1385    6     .43 * 1 * * 1 * 3 *
 8718  8727   -9    -.10 * 2 * * 1 * 3 *
 2713  2711    2     .07 * 3 * * 1 * 3 *
  286   286          .00 * 4 * * 1 * 3 *
  192   190    2    1.05 * 1 * * 2 * 3 *
  834   820   14    1.70 * 2 * * 2 * 3 *
  181   186   -5   -2.68 * 3 * * 2 * 3 *
   53    47    6   12.76 * 4 * * 2 * 3 *
--------------------------------------
     Section:26 ---- x(2,5,6)
 3406  3400    6     .17 * 1 * * 1 1 * *
19611 19602    9     .04 * 2 * * 1 1 * *
 4408  4407    1     .02 * 3 * * 1 1 * *
 1317  1326   -9    -.67 * 4 * * 1 1 * *
  689   676   13    1.92 * 1 * * 2 1 * *
 2699  2705   -6    -.22 * 2 * * 2 1 * *
  310   310          .00 * 3 * * 2 1 * *
  219   224   -5   -2.23 * 4 * * 2 1 * *
 1834  1840   -6    -.32 * 1 * * 1 2 * *
 9416  9422   -6    -.06 * 2 * * 1 2 * *
  758   754    4     .53 * 3 * * 1 2 * *
 1015  1011    4     .39 * 4 * * 1 2 * *
  621   633  -12   -1.89 * 1 * * 2 2 * *
 2183  2177    6     .27 * 2 * * 2 2 * *
   80    86   -6   -6.97 * 3 * * 2 2 * *
  278   269    9    3.34 * 4 * * 2 2 * *
--------------------------------------
     Section:27 ---- x(2,4,8)
 1519  1505   14     .93 * 1 * 1 * * * 1
 8614  8623   -9    -.10 * 2 * 1 * * * 1
 2120  2109   11     .52 * 3 * 1 * * * 1
  735   751  -16   -2.13 * 4 * 1 * * * 1
 3032  3026    6     .19 * 1 * 2 * * * 1
17893 17896   -3    -.01 * 2 * 2 * * * 1
 1430  1433   -3    -.20 * 3 * 2 * * * 1
 1813  1812    1     .05 * 4 * 2 * * * 1
 1715  1720   -5    -.29 * 1 * 1 * * * 2
 6333  6327    6     .09 * 2 * 1 * * * 2
 1757  1768  -11    -.62 * 3 * 1 * * * 2
  251   241   10    4.14 * 4 * 1 * * * 2
  284   298  -14   -4.69 * 1 * 2 * * * 2
 1069  1060    9     .84 * 2 * 2 * * * 2
  249   247    2     .81 * 3 * 2 * * * 2
   30    26    4   15.38 * 4 * 2 * * * 2
--------------------------------------
     Section:28 ---- x(2,4,7)
  428   435   -7   -1.60 * 1 * 1 * * 1 *
 1726  1731   -5    -.28 * 2 * 1 * * 1 *
  701   704   -3    -.42 * 3 * 1 * * 1 *
  504   498    6    1.20 * 4 * 1 * * 1 *
  888   884    4     .45 * 1 * 2 * * 1 *
 6000  6001   -1    -.01 * 2 * 2 * * 1 *
  483   476    7    1.47 * 3 * 2 * * 1 *
  952   958   -6    -.62 * 4 * 2 * * 1 *
 1890  1885    5     .26 * 1 * 1 * * 2 *
 7604  7604          .00 * 2 * 1 * * 2 *
 1011  1009    2     .19 * 3 * 1 * * 2 *
  326   342  -16   -4.67 * 4 * 1 * * 2 *
 1761  1770   -9    -.50 * 1 * 2 * * 2 *
 9027  9023    4     .04 * 2 * 2 * * 2 *
  467   471   -4    -.84 * 3 * 2 * * 2 *
  708   699    9    1.28 * 4 * 2 * * 2 *
  916   905   11    1.21 * 1 * 1 * * 3 *
 5617  5615    2     .03 * 2 * 1 * * 3 *
 2165  2164    1     .04 * 3 * 1 * * 3 *
  156   152    4    2.63 * 4 * 1 * * 3 *
  667   670   -3    -.44 * 1 * 2 * * 3 *
 3935  3932    3     .07 * 2 * 2 * * 3 *
  729   733   -4    -.54 * 3 * 2 * * 3 *
  183   181    2    1.10 * 4 * 2 * * 3 *
--------------------------------------
```

Section:29 ---- x(2,4,6)

2786	2777	9	.32	*	1	*	1	*	1	*	*
13117	13120	-3	-.02	*	2	*	1	*	1	*	*
3588	3591	-3	-.08	*	3	*	1	*	1	*	*
741	747	-6	-.80	*	4	*	1	*	1	*	*
1309	1299	10	.77	*	1	*	2	*	1	*	*
9193	9187	6	.06	*	2	*	2	*	1	*	*
1130	1126	4	.35	*	3	*	2	*	1	*	*
795	803	-8	-.99	*	4	*	2	*	1	*	*
448	448		.00	*	1	*	1	*	2	*	*
1830	1830		.00	*	2	*	1	*	2	*	*
289	286	3	1.04	*	3	*	1	*	2	*	*
245	245		.00	*	4	*	1	*	2	*	*
2007	2025	-18	-.88	*	1	*	2	*	2	*	*
9769	9769		.00	*	2	*	2	*	2	*	*
549	554	-5	-.90	*	3	*	2	*	2	*	*
1048	1035	13	1.25	*	4	*	2	*	2	*	*

Section:30 ---- x(2,4,5)

2742	2733	9	.32	*	1	*	1	1	*	*	*
13282	13284	-2	-.01	*	2	*	1	1	*	*	*
3648	3643	5	.13	*	3	*	1	1	*	*	*
864	873	-9	-1.03	*	4	*	1	1	*	*	*
2498	2507	-9	-.35	*	1	*	2	1	*	*	*
15745	15740	5	.03	*	2	*	2	1	*	*	*
1518	1518		.00	*	3	*	2	1	*	*	*
1468	1464	4	.27	*	4	*	2	1	*	*	*
492	492		.00	*	1	*	1	2	*	*	*
1665	1666	-1	-.06	*	2	*	1	2	*	*	*
229	234	-5	-2.13	*	3	*	1	2	*	*	*
122	119	3	2.52	*	4	*	1	2	*	*	*
818	817	1	.12	*	1	*	2	2	*	*	*
3217	3216	1	.03	*	2	*	2	2	*	*	*
161	162	-1	-.61	*	3	*	2	2	*	*	*
375	374	1	.26	*	4	*	2	2	*	*	*

Section:31 ---- x(2,3,8)

340	336	4	1.19	*	1	1	*	*	*	*	1
4573	4570	3	.06	*	2	1	*	*	*	*	1
510	511	-1	-.19	*	3	1	*	*	*	*	1
625	625		.00	*	4	1	*	*	*	*	1
1261	1255	6	.47	*	1	2	*	*	*	*	1
9982	9983	-1	-.01	*	2	2	*	*	*	*	1
1291	1285	6	.46	*	3	2	*	*	*	*	1
753	758	-5	-.66	*	4	2	*	*	*	*	1
1303	1295	8	.61	*	1	3	*	*	*	*	1
5025	5029	-4	-.08	*	2	3	*	*	*	*	1
796	787	9	1.14	*	3	3	*	*	*	*	1
319	328	-9	-2.74	*	4	3	*	*	*	*	1
525	523	2	.38	*	1	4	*	*	*	*	1
766	771	-5	-.64	*	2	4	*	*	*	*	1
227	227		.00	*	3	4	*	*	*	*	1
51	57	-6	-10.52	*	4	4	*	*	*	*	1
1122	1122		.00	*	1	5	*	*	*	*	1
6161	6166	-5	-.08	*	2	5	*	*	*	*	1
726	732	-6	-.82	*	3	5	*	*	*	*	1
800	795	5	.62	*	4	5	*	*	*	*	1
20	22	-2	-9.09	*	1	1	*	*	*	*	2
239	243	-4	-1.64	*	2	1	*	*	*	*	2
85	86	-1	-1.16	*	3	1	*	*	*	*	2
15	15		.00	*	4	1	*	*	*	*	2
312	316	-4	-1.26	*	1	2	*	*	*	*	2
1702	1699	3	.17	*	2	2	*	*	*	*	2
415	420	-5	-1.19	*	3	2	*	*	*	*	2
71	68	3	4.41	*	4	2	*	*	*	*	2
673	682	-9	-1.32	*	1	3	*	*	*	*	2
2854	2847	7	.24	*	2	3	*	*	*	*	2
629	637	-8	-1.25	*	3	3	*	*	*	*	2
90	82	8	9.75	*	4	3	*	*	*	*	2
676	678	-2	-.29	*	1	4	*	*	*	*	2
1234	1229	5	.40	*	2	4	*	*	*	*	2
550	548	2	.36	*	3	4	*	*	*	*	2
60	52	8	15.38	*	4	4	*	*	*	*	2
318	320	-2	-.62	*	1	5	*	*	*	*	2
1373	1369	4	.29	*	2	5	*	*	*	*	2
327	324	3	.92	*	3	5	*	*	*	*	2
45	50	-5	-10.00	*	4	5	*	*	*	*	2

Section:32 ---- x(2,3,7)

112	118	-6	-5.08	*	1	1	*	*	*	1	*
1627	1626	1	.06	*	2	1	*	*	*	1	*
179	182	-3	-1.64	*	3	1	*	*	*	1	*
332	331	1	.30	*	4	1	*	*	*	1	*
301	297	4	1.34	*	1	2	*	*	*	1	*
2355	2360	-5	-.21	*	2	2	*	*	*	1	*
347	343	4	1.16	*	3	2	*	*	*	1	*
405	405		.00	*	4	2	*	*	*	1	*
345	348	-3	-.86	*	1	3	*	*	*	1	*
1287	1287		.00	*	2	3	*	*	*	1	*
258	258		.00	*	3	3	*	*	*	1	*
209	212	-3	-1.41	*	4	3	*	*	*	1	*
203	201	2	.99	*	1	4	*	*	*	1	*
265	262	3	1.14	*	2	4	*	*	*	1	*
165	163	2	1.22	*	3	4	*	*	*	1	*
59	56	3	5.35	*	4	4	*	*	*	1	*
355	355		.00	*	1	5	*	*	*	1	*
2192	2197	-5	-.22	*	2	5	*	*	*	1	*
235	234	1	.42	*	3	5	*	*	*	1	*
451	452	-1	-.22	*	4	5	*	*	*	1	*
212	210	2	.95	*	1	1	*	*	*	2	*
2379	2378	1	.04	*	2	1	*	*	*	2	*
195	191	4	2.09	*	3	1	*	*	*	2	*
240	244	-4	-1.63	*	4	1	*	*	*	2	*
1040	1047	-7	-.66	*	1	2	*	*	*	2	*
6424	6422	2	.03	*	2	2	*	*	*	2	*
478	482	-4	-.83	*	3	2	*	*	*	2	*
331	331		.00	*	4	2	*	*	*	2	*
1067	1065	2	.18	*	1	3	*	*	*	2	*
3726	3723	3	.08	*	2	3	*	*	*	2	*
371	367	4	1.09	*	3	3	*	*	*	2	*
123	120	3	2.50	*	4	3	*	*	*	2	*
493	495	-2	-.40	*	1	4	*	*	*	2	*
680	684	-4	-.58	*	2	4	*	*	*	2	*
167	169	-2	-1.18	*	3	4	*	*	*	2	*

23	29	-6	-20.69	*	4	4	*	*	*	2	*
839	838	1	.11	*	1	5	*	*	*	2	*
3422	3420	2	.05	*	2	5	*	*	*	2	*
267	271	-4	-1.47	*	3	5	*	*	*	2	*
317	317		.00	*	4	5	*	*	*	2	*
36	30	6	20.00	*	1	1	*	*	*	3	*
806	809	-3	-.37	*	2	1	*	*	*	3	*
221	224	-3	-1.33	*	3	1	*	*	*	3	*
68	65	3	4.61	*	4	1	*	*	*	3	*
232	227	5	2.20	*	1	2	*	*	*	3	*
2905	2900	5	.17	*	2	2	*	*	*	3	*
881	880	1	.11	*	3	2	*	*	*	3	*
88	90	-2	-2.22	*	4	2	*	*	*	3	*
564	564		.00	*	1	3	*	*	*	3	*
2866	2866		.00	*	2	3	*	*	*	3	*
796	799	-3	-.37	*	3	3	*	*	*	3	*
77	78	-1	-1.28	*	4	3	*	*	*	3	*
505	505		.00	*	1	4	*	*	*	3	*
1055	1054	1	.09	*	2	4	*	*	*	3	*
445	443	2	.45	*	3	4	*	*	*	3	*
29	24	5	20.83	*	4	4	*	*	*	3	*
246	249	-3	-1.20	*	1	5	*	*	*	3	*
1920	1918	2	.10	*	2	5	*	*	*	3	*
551	551		.00	*	3	5	*	*	*	3	*
77	76	1	1.31	*	4	5	*	*	*	3	*

Section:33 ---- x(2,3,6)

240	234	6	2.56	*	1	1	*	*	1	*	*
3296	3302	-6	-.18	*	2	1	*	*	1	*	*
508	508		.00	*	3	1	*	*	1	*	*
370	375	-5	-1.33	*	4	1	*	*	1	*	*
1001	1000	1	.10	*	1	2	*	*	1	*	*
7761	7759	2	.02	*	2	2	*	*	1	*	*
1484	1482	2	.13	*	3	2	*	*	1	*	*
444	446	-2	-.44	*	4	2	*	*	1	*	*
1227	1221	6	.49	*	1	3	*	*	1	*	*
5216	5210	6	.11	*	2	3	*	*	1	*	*
1197	1193	4	.33	*	3	3	*	*	1	*	*
221	225	-4	-1.77	*	4	3	*	*	1	*	*
753	752	1	.13	*	1	4	*	*	1	*	*
1491	1491		.00	*	2	4	*	*	1	*	*
670	671	-1	-.14	*	3	4	*	*	1	*	*
80	81	-1	-1.23	*	4	4	*	*	1	*	*
874	869	5	.57	*	1	5	*	*	1	*	*
4546	4545	1	.02	*	2	5	*	*	1	*	*
859	863	-4	-.46	*	3	5	*	*	1	*	*
421	423	-2	-.47	*	4	5	*	*	1	*	*
120	124	-4	-3.22	*	1	1	*	*	2	*	*
1516	1511	5	.33	*	2	1	*	*	2	*	*
87	89	-2	-2.24	*	3	1	*	*	2	*	*
270	265	5	1.88	*	4	1	*	*	2	*	*
572	571	1	.17	*	1	2	*	*	2	*	*
3923	3923		.00	*	2	2	*	*	2	*	*
222	223	-1	-.44	*	3	2	*	*	2	*	*
380	380		.00	*	4	2	*	*	2	*	*
749	756	-7	-.92	*	1	3	*	*	2	*	*
2663	2666	-3	-.11	*	2	3	*	*	2	*	*
228	231	-3	-1.29	*	3	3	*	*	2	*	*
188	185	3	1.62	*	4	3	*	*	2	*	*
448	449	-1	-.22	*	1	4	*	*	2	*	*
509	509		.00	*	2	4	*	*	2	*	*
107	104	3	2.88	*	3	4	*	*	2	*	*
31	28	3	10.71	*	4	4	*	*	2	*	*
566	573	-7	-1.22	*	1	5	*	*	2	*	*
2988	2990	-2	-.06	*	2	5	*	*	2	*	*
194	193	1	.51	*	3	5	*	*	2	*	*
424	422	2	.47	*	4	5	*	*	2	*	*

Section:34 ---- x(2,3,5)

271	267	4	1.49	*	1	1	*	1	*	*	*
3932	3935	-3	-.07	*	2	1	*	1	*	*	*
552	550	2	.36	*	3	1	*	1	*	*	*
502	507	-5	-.98	*	4	1	*	1	*	*	*
1234	1233	1	.08	*	1	2	*	1	*	*	*
9909	9907	2	.02	*	2	2	*	1	*	*	*
1585	1585		.00	*	3	2	*	1	*	*	*
661	662	-1	-.15	*	4	2	*	1	*	*	*
1598	1598		.00	*	1	3	*	1	*	*	*
6939	6938	1	.01	*	2	3	*	1	*	*	*
1320	1321	-1	-.07	*	3	3	*	1	*	*	*
348	348		.00	*	4	3	*	1	*	*	*
1032	1032		.00	*	1	4	*	1	*	*	*
1776	1774	2	.11	*	2	4	*	1	*	*	*
725	720	5	.69	*	3	4	*	1	*	*	*
99	96	3	3.12	*	4	4	*	1	*	*	*
1105	1110	-5	-.45	*	1	5	*	1	*	*	*
6471	6470	1	.01	*	2	5	*	1	*	*	*
984	985	-1	-.10	*	3	5	*	1	*	*	*
722	724	-2	-.27	*	4	5	*	1	*	*	*
89	91	-2	-2.19	*	1	1	*	2	*	*	*
880	878	2	.22	*	2	1	*	2	*	*	*
43	47	-4	-8.51	*	3	1	*	2	*	*	*
138	133	5	3.75	*	4	1	*	2	*	*	*
339	338	1	.29	*	1	2	*	2	*	*	*
1775	1775		.00	*	2	2	*	2	*	*	*
121	120	1	.83	*	3	2	*	2	*	*	*
163	164	-1	-.61	*	4	2	*	2	*	*	*
378	379	-1	-.26	*	1	3	*	2	*	*	*
940	938	2	.21	*	2	3	*	2	*	*	*
105	103	2	1.94	*	3	3	*	2	*	*	*
61	62	-1	-1.61	*	4	3	*	2	*	*	*
169	169		.00	*	1	4	*	2	*	*	*
224	226	-2	-.88	*	2	4	*	2	*	*	*
52	55	-3	-5.45	*	3	4	*	2	*	*	*
12	13	-1	-7.69	*	4	4	*	2	*	*	*
335	332	3	.90	*	1	5	*	2	*	*	*
1063	1065	-2	-.18	*	2	5	*	2	*	*	*
69	71	-2	-2.81	*	3	5	*	2	*	*	*
123	121	2	1.65	*	4	5	*	2	*	*	*

Section:35 ---- x(2,3,4)

171	168	3	1.78	*	1	1	1	*	*	*	*
1955	1955		.00	*	2	1	1	*	*	*	*
406	406		.00	*	3	1	1	*	*	*	*
195	197	-2	-1.01	*	4	1	1	*	*	*	*
781	776	5	.64	*	1	2	1	*	*	*	*
5135	5137	-2	-.03	*	2	2	1	*	*	*	*
1200	1199	1	.08	*	3	2	1	*	*	*	*
344	345	-1	-.29	*	4	2	1	*	*	*	*
972	971	1	.10	*	1	3	1	*	*	*	*
3828	3826	2	.05	*	2	3	1	*	*	*	*
995	993	2	.20	*	3	3	1	*	*	*	*
203	204	-1	-.49	*	4	3	1	*	*	*	*
689	689		.00	*	1	4	1	*	*	*	*
1230	1231	-1	-.08	*	2	4	1	*	*	*	*
569	568	1	.17	*	3	4	1	*	*	*	*
83	82	1	1.22	*	4	4	1	*	*	*	*
621	621		.00	*	1	5	1	*	*	*	*
2799	2801	-2	-.07	*	2	5	1	*	*	*	*
707	711	-4	-.56	*	3	5	1	*	*	*	*
161	164	-3	-1.82	*	4	5	1	*	*	*	*
189	190	-1	-.52	*	1	1	2	*	*	*	*
2857	2858	-1	-.03	*	2	1	2	*	*	*	*
189	191	-2	-1.04	*	3	1	2	*	*	*	*
445	443	2	.45	*	4	1	2	*	*	*	*
792	795	-3	-.37	*	1	2	2	*	*	*	*
6549	6545	4	.06	*	2	2	2	*	*	*	*
506	506		.00	*	3	2	2	*	*	*	*
480	481	-1	-.20	*	4	2	2	*	*	*	*
1004	1006	-2	-.19	*	1	3	2	*	*	*	*
4051	4050	1	.02	*	2	3	2	*	*	*	*
430	431	-1	-.23	*	3	3	2	*	*	*	*
206	206		.00	*	4	3	2	*	*	*	*
512	512		.00	*	1	4	2	*	*	*	*
770	769	1	.13	*	2	4	2	*	*	*	*
208	207	1	.48	*	3	4	2	*	*	*	*
28	27	1	3.70	*	4	4	2	*	*	*	*
819	821	-2	-.24	*	1	5	2	*	*	*	*
4735	4734	1	.02	*	2	5	2	*	*	*	*
346	345	1	.29	*	3	5	2	*	*	*	*
684	681	3	.44	*	4	5	2	*	*	*	*

Section:36 ---- x(1,7,8)

4280	4281	-1	-.02	1	*	*	*	*	*	1	1
4321	4320	1	.02	2	*	*	*	*	*	1	1
1990	1991	-1	-.05	3	*	*	*	*	*	1	1
3114	3117	-3	-.09	1	*	*	*	*	*	2	1
12802	12801	1	.00	2	*	*	*	*	*	2	1
2021	2035	-14	-.68	3	*	*	*	*	*	2	1
951	941	10	1.06	1	*	*	*	*	*	3	1
6791	6791		.00	2	*	*	*	*	*	3	1
886	878	8	.91	3	*	*	*	*	*	3	1
9	11	-2	-18.18	1	*	*	*	*	*	1	2
734	734		.00	2	*	*	*	*	*	1	2
348	350	-2	-.57	3	*	*	*	*	*	1	2
43	41	2	4.87	1	*	*	*	*	*	2	2
3957	3955	2	.05	2	*	*	*	*	*	2	2
857	854	3	.35	3	*	*	*	*	*	2	2
37	41	-4	-9.75	1	*	*	*	*	*	3	2
4938	4940	-2	-.04	2	*	*	*	*	*	3	2
765	761	4	.52	3	*	*	*	*	*	3	2

Section:37 ---- x(1,6,8)

4558	4546	12	.26	1	*	*	*	*	1	*	1
15149	15158	-9	-.05	2	*	*	*	*	1	*	1
3033	3028	5	.16	3	*	*	*	*	1	*	1
3787	3793	-6	-.15	1	*	*	*	*	2	*	1
8765	8754	11	.12	2	*	*	*	*	2	*	1
1864	1876	-12	-.64	3	*	*	*	*	2	*	1
68	67	1	1.49	1	*	*	*	*	1	*	2
8109	8111	-2	-.02	2	*	*	*	*	1	*	2
1742	1740	2	.11	3	*	*	*	*	1	*	2
21	26	-5	-19.23	1	*	*	*	*	2	*	2
1520	1518	2	.13	2	*	*	*	*	2	*	2
228	225	3	1.33	3	*	*	*	*	2	*	2

Section:38 ---- x(1,6,7)

1954	1952	2	.10	1	*	*	*	*	1	1	*
2189	2198	-9	-.40	2	*	*	*	*	1	1	*
1350	1348	2	.14	3	*	*	*	*	1	1	*
2335	2340	-5	-.21	1	*	*	*	*	2	1	*
2866	2856	10	.35	2	*	*	*	*	2	1	*
988	993	-5	-.50	3	*	*	*	*	2	1	*
1942	1929	13	.67	1	*	*	*	*	1	2	*
11441	11446	-5	-.04	2	*	*	*	*	1	2	*
2054	2053	1	.04	3	*	*	*	*	1	2	*
1215	1229	-14	-1.13	1	*	*	*	*	2	2	*
5318	5310	8	.15	2	*	*	*	*	2	2	*
824	836	-12	-1.43	3	*	*	*	*	2	2	*
730	732	-2	-.27	1	*	*	*	*	1	3	*
9628	9625	3	.03	2	*	*	*	*	1	3	*
1371	1367	4	.29	3	*	*	*	*	1	3	*
258	250	8	3.20	1	*	*	*	*	2	3	*
2101	2106	-5	-.23	2	*	*	*	*	2	3	*
280	272	8	2.94	3	*	*	*	*	2	3	*

Section:39 ---- x(1,5,8)

7177	7174	3	.04	1	*	*	*	1	*	*	1
19733	19728	5	.02	2	*	*	*	1	*	*	1
4259	4253	6	.14	3	*	*	*	1	*	*	1
1168	1165	3	.25	1	*	*	*	2	*	*	1
4181	4184	-3	-.07	2	*	*	*	2	*	*	1
638	651	-13	-1.99	3	*	*	*	2	*	*	1
74	79	-5	-6.32	1	*	*	*	1	*	*	2
8702	8704	-2	-.02	2	*	*	*	1	*	*	2
1820	1824	-4	-.21	3	*	*	*	1	*	*	2
15	14	1	7.14	1	*	*	*	2	*	*	2
927	925	2	.21	2	*	*	*	2	*	*	2
150	141	9	6.38	3	*	*	*	2	*	*	2

Section:40 ---- x(1,5,7)

3669	3678	-9	-.24	1	*	*	*	1	*	1	*
4101	4102	-1	-.02	2	*	*	*	1	*	1	*
2080	2079	1	.04	3	*	*	*	1	*	1	*
620	614	6	.97	1	*	*	*	2	*	1	*
954	952	2	.21	2	*	*	*	2	*	1	*
258	262	-4	-1.52	3	*	*	*	2	*	1	*
2699	2688	11	.40	1	*	*	*	1	*	2	*
13632	13631	1	.00	2	*	*	*	1	*	2	*
2476	2475	1	.04	3	*	*	*	1	*	2	*
458	470	-12	-2.55	1	*	*	*	2	*	2	*
3127	3125	2	.06	2	*	*	*	2	*	2	*
402	414	-12	-2.89	3	*	*	*	2	*	2	*
883	887	-4	-.45	1	*	*	*	1	*	3	*
10702	10699	3	.02	2	*	*	*	1	*	3	*
1523	1523		.00	3	*	*	*	1	*	3	*
105	95	10	10.52	1	*	*	*	2	*	3	*
1027	1032	-5	-.48	2	*	*	*	2	*	3	*
128	116	12	10.34	3	*	*	*	2	*	3	*

Section:41 ---- x(1,5,6)

4021	4014	7	.17	1	*	*	*	1	1	*	*
20404	20408	-4	-.02	2	*	*	*	1	1	*	*
4317	4313	4	.09	3	*	*	*	1	1	*	*
605	599	6	1.00	1	*	*	*	2	1	*	*
2854	2861	-7	-.24	2	*	*	*	2	1	*	*
458	455	3	.65	3	*	*	*	2	1	*	*
3230	3239	-9	-.27	1	*	*	*	1	2	*	*
8031	8024	7	.08	2	*	*	*	1	2	*	*
1762	1764	-2	-.11	3	*	*	*	1	2	*	*
578	580	-2	-.34	1	*	*	*	2	2	*	*
2254	2248	6	.26	2	*	*	*	2	2	*	*
330	337	-7	-2.07	3	*	*	*	2	2	*	*

Section:42 ---- x(1,4,8)

731	727	4	.55	1	*	*	1	*	*	*	1
9692	9692		.00	2	*	*	1	*	*	*	1
2565	2569	-4	-.15	3	*	*	1	*	*	*	1
7614	7612	2	.02	1	*	*	2	*	*	*	1
14222	14220	2	.01	2	*	*	2	*	*	*	1
2332	2335	-3	-.12	3	*	*	2	*	*	*	1
47	52	-5	-9.61	1	*	*	1	*	*	*	2
8298	8295	3	.03	2	*	*	1	*	*	*	2
1711	1709	2	.11	3	*	*	1	*	*	*	2
42	41	1	2.43	1	*	*	2	*	*	*	2
1331	1334	-3	-.22	2	*	*	2	*	*	*	2
259	256	3	1.17	3	*	*	2	*	*	*	2

Section:43 ---- x(1,4,7)

175	184	-9	-4.89	1	*	*	1	*	*	1	*
1923	1923		.00	2	*	*	1	*	*	1	*
1261	1261		.00	3	*	*	1	*	*	1	*
4114	4108	6	.14	1	*	*	2	*	*	1	*
3132	3131	1	.03	2	*	*	2	*	*	1	*
1077	1080	-3	-.27	3	*	*	2	*	*	1	*
421	412	9	2.18	1	*	*	1	*	*	2	*
8618	8615	3	.03	2	*	*	1	*	*	2	*
1792	1813	-21	-1.15	3	*	*	1	*	*	2	*
2736	2746	-10	-.36	1	*	*	2	*	*	2	*
8141	8141		.00	2	*	*	2	*	*	2	*
1086	1076	10	.92	3	*	*	2	*	*	2	*
182	183	-1	-.54	1	*	*	1	*	*	3	*
7449	7449		.00	2	*	*	1	*	*	3	*
1223	1204	19	1.57	3	*	*	1	*	*	3	*
806	799	7	.87	1	*	*	2	*	*	3	*
4280	4282	-2	-.04	2	*	*	2	*	*	3	*
428	435	-7	-1.60	3	*	*	2	*	*	3	*

Section:44 ---- x(1,4,6)

562	558	4	.71	1	*	*	1	*	1	*	*
15725	15736	-11	-.07	2	*	*	1	*	1	*	*
3945	3941	4	.10	3	*	*	1	*	1	*	*
4064	4055	9	.22	1	*	*	2	*	1	*	*
7533	7533		.00	2	*	*	2	*	1	*	*
830	827	3	.36	3	*	*	2	*	1	*	*
216	221	-5	-2.26	1	*	*	1	*	2	*	*
2265	2251	14	.62	2	*	*	1	*	2	*	*
331	337	-6	-1.78	3	*	*	1	*	2	*	*
3592	3598	-6	-.16	1	*	*	2	*	2	*	*
8020	8021	-1	-.01	2	*	*	2	*	2	*	*
1761	1764	-3	-.17	3	*	*	2	*	2	*	*

Section:45 ---- x(1,4,5)

686	687	-1	-.14	1	*	*	1	1	*	*	*
15950	15944	6	.03	2	*	*	1	1	*	*	*
3900	3902	-2	-.05	3	*	*	1	1	*	*	*
6565	6566	-1	-.01	1	*	*	2	1	*	*	*
12485	12488	-3	-.02	2	*	*	2	1	*	*	*
2179	2175	4	.18	3	*	*	2	1	*	*	*
92	92		.00	1	*	*	1	2	*	*	*
2040	2043	-3	-.14	2	*	*	1	2	*	*	*
376	376		.00	3	*	*	1	2	*	*	*
1091	1087	4	.36	1	*	*	2	2	*	*	*
3068	3066	2	.06	2	*	*	2	2	*	*	*
412	416	-4	-.96	3	*	*	2	2	*	*	*

Section:46 ---- x(1,3,8)

1745	1738	7	.40	1	*	1	*	*	*	*	1
3048	3051	-3	-.09	2	*	1	*	*	*	*	1
1255	1253	2	.16	3	*	1	*	*	*	*	1
2453	2444	9	.36	1	*	2	*	*	*	*	1
8933	8930	3	.03	2	*	2	*	*	*	*	1
1901	1907	-6	-.31	3	*	2	*	*	*	*	1
1082	1088	-6	-.55	1	*	3	*	*	*	*	1
5681	5676	5	.08	2	*	3	*	*	*	*	1
680	675	5	.74	3	*	3	*	*	*	*	1
31	33	-2	-6.06	1	*	4	*	*	*	*	1
1240	1245	-5	-.40	2	*	4	*	*	*	*	1
298	300	-2	-.66	3	*	4	*	*	*	*	1
3034	3036	-2	-.06	1	*	5	*	*	*	*	1
5012	5010	2	.04	2	*	5	*	*	*	*	1
763	769	-6	-.78	3	*	5	*	*	*	*	1
6	11	-5	-45.45	1	*	1	*	*	*	*	2
226	221	5	2.26	2	*	1	*	*	*	*	2

127	134	-7	-5.22	3	*	1	*	*	*	*	2
17	20	-3	-15.00	1	*	2	*	*	*	*	2
2016	2020	-4	-.19	2	*	2	*	*	*	*	2
467	463	4	.86	3	*	2	*	*	*	*	2
31	28	3	10.71	1	*	3	*	*	*	*	2
3653	3657	-4	-.10	2	*	3	*	*	*	*	2
562	563	-1	-.17	3	*	3	*	*	*	*	2
6	4	2	50.00	1	*	4	*	*	*	*	2
2043	2037	6	.29	2	*	4	*	*	*	*	2
471	466	5	1.07	3	*	4	*	*	*	*	2
29	30	-1	-3.33	1	*	5	*	*	*	*	2
1691	1694	-3	-.17	2	*	5	*	*	*	*	2
343	339	4	1.18	3	*	5	*	*	*	*	2

Section:47 ---- x(1,3,7)

1140	1143	-3	-.26	1	*	1	*	*	*	1	*
613	617	-4	-.64	2	*	1	*	*	*	1	*
497	497		.00	3	*	1	*	*	*	1	*
908	901	7	.77	1	*	2	*	*	*	1	*
1657	1656	1	.06	2	*	2	*	*	*	1	*
843	848	-5	-.59	3	*	2	*	*	*	1	*
430	432	-2	-.46	1	*	3	*	*	*	1	*
1284	1287	-3	-.23	2	*	3	*	*	*	1	*
385	386	-1	-.25	3	*	3	*	*	*	1	*
17	16	1	6.25	1	*	4	*	*	*	1	*
442	440	2	.45	2	*	4	*	*	*	1	*
233	226	7	3.09	3	*	4	*	*	*	1	*
1794	1800	-6	-.33	1	*	5	*	*	*	1	*
1059	1054	5	.47	2	*	5	*	*	*	1	*
380	384	-4	-1.04	3	*	5	*	*	*	1	*
473	477	-4	-.83	1	*	1	*	*	*	2	*
1911	1905	6	.31	2	*	1	*	*	*	2	*
642	641	1	.15	3	*	1	*	*	*	2	*
1190	1192	-2	-.16	1	*	2	*	*	*	2	*
6041	6043	-2	-.03	2	*	2	*	*	*	2	*
1042	1047	-5	-.47	3	*	2	*	*	*	2	*
501	497	4	.80	1	*	3	*	*	*	2	*
4278	4275	3	.07	2	*	3	*	*	*	2	*
508	503	5	.99	3	*	3	*	*	*	2	*
10	11	-1	-9.09	1	*	4	*	*	*	2	*
1126	1126		.00	2	*	4	*	*	*	2	*
227	240	-13	-5.41	3	*	4	*	*	*	2	*
983	981	2	.20	1	*	5	*	*	*	2	*
3403	3407	-4	-.11	2	*	5	*	*	*	2	*
459	458	1	.21	3	*	5	*	*	*	2	*
138	129	9	6.97	1	*	1	*	*	*	3	*
750	750		.00	2	*	1	*	*	*	3	*
243	249	-6	-2.41	3	*	1	*	*	*	3	*
372	371	1	.27	1	*	2	*	*	*	3	*
3251	3251		.00	2	*	2	*	*	*	3	*
483	475	8	1.68	3	*	2	*	*	*	3	*
182	187	-5	-2.67	1	*	3	*	*	*	3	*
3772	3771	1	.02	2	*	3	*	*	*	3	*
349	349		.00	3	*	3	*	*	*	3	*
10	10		.00	1	*	4	*	*	*	3	*
1715	1716	-1	-.05	2	*	4	*	*	*	3	*
309	300	9	3.00	3	*	4	*	*	*	3	*
286	285	1	.35	1	*	5	*	*	*	3	*
2241	2243	-2	-.08	2	*	5	*	*	*	3	*
267	266	1	.37	3	*	5	*	*	*	3	*

Section:48 ---- x(1,3,6)

1061	1063	-2	-.18	1	*	1	*	*	1	*	*
2364	2364		.00	2	*	1	*	*	1	*	*
989	992	-3	-.30	3	*	1	*	*	1	*	*
1474	1470	4	.27	1	*	2	*	*	1	*	*
7692	7694	-2	-.02	2	*	2	*	*	1	*	*
1524	1523	1	.06	3	*	2	*	*	1	*	*
556	547	9	1.64	1	*	3	*	*	1	*	*
6397	6400	-3	-.04	2	*	3	*	*	1	*	*
908	902	6	.66	3	*	3	*	*	1	*	*
16	15	1	6.66	1	*	4	*	*	1	*	*
2360	2364	-4	-.16	2	*	4	*	*	1	*	*
618	616	2	.32	3	*	4	*	*	1	*	*
1519	1518	1	.06	1	*	5	*	*	1	*	*
4445	4447	-2	-.04	2	*	5	*	*	1	*	*
736	735	1	.13	3	*	5	*	*	1	*	*
690	686	4	.58	1	*	1	*	*	2	*	*
910	908	2	.22	2	*	1	*	*	2	*	*
393	395	-2	-.50	3	*	1	*	*	2	*	*
996	994	2	.20	1	*	2	*	*	2	*	*
3257	3256	1	.03	2	*	2	*	*	2	*	*
844	847	-3	-.35	3	*	2	*	*	2	*	*
557	569	-12	-2.10	1	*	3	*	*	2	*	*
2937	2933	4	.13	2	*	3	*	*	2	*	*
334	336	-2	-.59	3	*	3	*	*	2	*	*
21	22	-1	-4.54	1	*	4	*	*	2	*	*
923	918	5	.54	2	*	4	*	*	2	*	*
151	150	1	.66	3	*	4	*	*	2	*	*
1544	1548	-4	-.25	1	*	5	*	*	2	*	*
2258	2257	1	.04	2	*	5	*	*	2	*	*
370	373	-3	-.80	3	*	5	*	*	2	*	*

Section:49 ---- x(1,3,5)

1518	1514	4	.26	1	*	1	*	1	*	*	*
2614	2617	-3	-.11	2	*	1	*	1	*	*	*
1125	1128	-3	-.26	3	*	1	*	1	*	*	*
2068	2067	1	.04	1	*	2	*	1	*	*	*
9193	9194	-1	-.01	2	*	2	*	1	*	*	*
2128	2126	2	.09	3	*	2	*	1	*	*	*
983	983		.00	1	*	3	*	1	*	*	*
8097	8097		.00	2	*	3	*	1	*	*	*
1125	1125		.00	3	*	3	*	1	*	*	*
28	29	-1	-3.44	1	*	4	*	1	*	*	*
2894	2888	6	.20	2	*	4	*	1	*	*	*
710	705	5	.70	3	*	4	*	1	*	*	*
2654	2660	-6	-.22	1	*	5	*	1	*	*	*
5637	5636	1	.01	2	*	5	*	1	*	*	*
991	993	-2	-.20	3	*	5	*	1	*	*	*
233	235	-2	-.85	1	*	1	*	2	*	*	*
660	655	5	.76	2	*	1	*	2	*	*	*
257	259	-2	-.77	3	*	1	*	2	*	*	*
402	397	5	1.25	1	*	2	*	2	*	*	*
1756	1756		.00	2	*	2	*	2	*	*	*

240	244	-4	-1.63	3	*	2	*	2	*	*	*
130	133	-3	-2.25	1	*	3	*	2	*	*	*
1237	1236	1	.08	2	*	3	*	2	*	*	*
117	113	4	3.54	3	*	3	*	2	*	*	*
9	8	1	12.50	1	*	4	*	2	*	*	*
389	394	-5	-1.26	2	*	4	*	2	*	*	*
59	61	-2	-3.27	3	*	4	*	2	*	*	*
409	406	3	.73	1	*	5	*	2	*	*	*
1066	1068	-2	-.18	2	*	5	*	2	*	*	*
115	115		.00	3	*	5	*	2	*	*	*

Section:50 ---- x(1,3,4)

145	146	-1	-.68	1	*	1	1	*	*	*	*
1745	1743	2	.11	2	*	1	1	*	*	*	*
837	837		.00	3	*	1	1	*	*	*	*
320	317	3	.94	1	*	2	1	*	*	*	*
5756	5755	1	.01	2	*	2	1	*	*	*	*
1384	1385	-1	-.07	3	*	2	1	*	*	*	*
118	119	-1	-.84	1	*	3	1	*	*	*	*
5043	5042	1	.02	2	*	3	1	*	*	*	*
837	833	4	.48	3	*	3	1	*	*	*	*
3	3		.00	1	*	4	1	*	*	*	*
2022	2022		.00	2	*	4	1	*	*	*	*
546	545	1	.18	3	*	4	1	*	*	*	*
192	194	-2	-1.03	1	*	5	1	*	*	*	*
3424	3425	-1	-.02	2	*	5	1	*	*	*	*
672	678	-6	-.88	3	*	5	1	*	*	*	*
1606	1603	3	.18	1	*	1	2	*	*	*	*
1529	1529		.00	2	*	1	2	*	*	*	*
545	550	-5	-.90	3	*	1	2	*	*	*	*
2150	2147	3	.14	1	*	2	2	*	*	*	*
5193	5195	-2	-.03	2	*	2	2	*	*	*	*
984	985	-1	-.10	3	*	2	2	*	*	*	*
995	997	-2	-.20	1	*	3	2	*	*	*	*
4291	4291		.00	2	*	3	2	*	*	*	*
405	405		.00	3	*	3	2	*	*	*	*
34	34		.00	1	*	4	2	*	*	*	*
1261	1260	1	.07	2	*	4	2	*	*	*	*
223	221	2	.90	3	*	4	2	*	*	*	*
2871	2872	-1	-.03	1	*	5	2	*	*	*	*
3279	3279		.00	2	*	5	2	*	*	*	*
434	430	4	.93	3	*	5	2	*	*	*	*

Section:51 ---- x(1,2,8)

581	574	7	1.22	1	1	*	*	*	*	*	1
3324	3319	5	.15	2	1	*	*	*	*	*	1
646	638	8	1.25	3	1	*	*	*	*	*	1
6507	6509	-2	-.03	1	2	*	*	*	*	*	1
17365	17365		.00	2	2	*	*	*	*	*	1
2635	2645	-10	-.37	3	2	*	*	*	*	*	1
222	220	2	.90	1	3	*	*	*	*	*	1
2435	2431	4	.16	2	3	*	*	*	*	*	1
893	891	2	.22	3	3	*	*	*	*	*	1
1035	1036	-1	-.09	1	4	*	*	*	*	*	1
790	797	-7	-.87	2	4	*	*	*	*	*	1
723	730	-7	-.95	3	4	*	*	*	*	*	1
6	11	-5	-45.45	1	1	*	*	*	*	*	2
1696	1701	-5	-.29	2	1	*	*	*	*	*	2
297	306	-9	-2.94	3	1	*	*	*	*	*	2
71	68	3	4.41	1	2	*	*	*	*	*	2
6333	6332	1	.01	2	2	*	*	*	*	*	2
998	987	11	1.11	3	2	*	*	*	*	*	2
9	11	-2	-18.18	1	3	*	*	*	*	*	2
1496	1499	-3	-.20	2	3	*	*	*	*	*	2
501	505	-4	-.79	3	3	*	*	*	*	*	2
3	3		.00	1	4	*	*	*	*	*	2
104	97	7	7.21	2	4	*	*	*	*	*	2
174	167	7	4.19	3	4	*	*	*	*	*	2

Section:52 ---- x(1,2,7)

320	316	4	1.26	1	1	*	*	*	*	1	*
727	732	-5	-.68	2	1	*	*	*	*	1	*
269	271	-2	-.73	3	1	*	*	*	*	1	*
3292	3297	-5	-.15	1	2	*	*	*	*	1	*
3376	3377	-1	-.03	2	2	*	*	*	*	1	*
1058	1058		.00	3	2	*	*	*	*	1	*
100	95	5	5.26	1	3	*	*	*	*	1	*
592	591	1	.16	2	3	*	*	*	*	1	*
492	494	-2	-.40	3	3	*	*	*	*	1	*
577	584	-7	-1.19	1	4	*	*	*	*	1	*
360	354	6	1.69	2	4	*	*	*	*	1	*
519	518	1	.19	3	4	*	*	*	*	1	*
204	208	-4	-1.92	1	1	*	*	*	*	2	*
2935	2934	1	.03	2	1	*	*	*	*	2	*
512	513	-1	-.19	3	1	*	*	*	*	2	*
2493	2490	3	.12	1	2	*	*	*	*	2	*
12405	12404	1	.00	2	2	*	*	*	*	2	*
1733	1733		.00	3	2	*	*	*	*	2	*
81	84	-3	-3.57	1	3	*	*	*	*	2	*
1035	1034	1	.09	2	3	*	*	*	*	2	*
362	362		.00	3	3	*	*	*	*	2	*
379	376	3	.79	1	4	*	*	*	*	2	*
384	384		.00	2	4	*	*	*	*	2	*
271	281	-10	-3.55	3	4	*	*	*	*	2	*
63	61	2	3.27	1	1	*	*	*	*	3	*
1358	1354	4	.29	2	1	*	*	*	*	3	*
162	160	2	1.25	3	1	*	*	*	*	3	*
793	790	3	.38	1	2	*	*	*	*	3	*
7917	7916	1	.01	2	2	*	*	*	*	3	*
842	841	1	.11	3	2	*	*	*	*	3	*
50	52	-2	-3.84	1	3	*	*	*	*	3	*
2304	2305	-1	-.04	2	3	*	*	*	*	3	*
540	540		.00	3	3	*	*	*	*	3	*
82	79	3	3.79	1	4	*	*	*	*	3	*
150	156	-6	-3.84	2	4	*	*	*	*	3	*
107	98	9	9.18	3	4	*	*	*	*	3	*

Section:53 ---- x(1,2,6)

300	292	8	2.74	1	1	*	*	*	1	*	*
3204	3202	2	.06	2	1	*	*	*	1	*	*
591	582	9	1.54	3	1	*	*	*	1	*	*
3640	3637	3	.08	1	2	*	*	*	1	*	*
16285	16285		.00	2	2	*	*	*	1	*	*
2385	2385		.00	3	2	*	*	*	1	*	*

172	167	5	2.99	1	3	*	*	*	1	*	*
3359	3363	-4	-.11	2	3	*	*	*	1	*	*
1187	1187		.00	3	3	*	*	*	1	*	*
514	517	-3	-.58	1	4	*	*	*	1	*	*
410	419	-9	-2.14	2	4	*	*	*	1	*	*
612	614	-2	-.32	3	4	*	*	*	1	*	*
287	293	-6	-2.04	1	1	*	*	*	2	*	*
1816	1818	-2	-.11	2	1	*	*	*	2	*	*
352	362	-10	-2.76	3	1	*	*	*	2	*	*
2938	2940	-2	-.06	1	2	*	*	*	2	*	*
7413	7412	1	.01	2	2	*	*	*	2	*	*
1248	1247	1	.08	3	2	*	*	*	2	*	*
59	64	-5	-7.81	1	3	*	*	*	2	*	*
572	567	5	.88	2	3	*	*	*	2	*	*
207	209	-2	-.95	3	3	*	*	*	2	*	*
524	522	2	.38	1	4	*	*	*	2	*	*
484	475	9	1.89	2	4	*	*	*	2	*	*
285	283	2	.70	3	4	*	*	*	2	*	*

Section:54 ---- x(1,2,5)

474	475	-1	-.21	1	1	*	*	1	*	*	*
3991	3992	-1	-.02	2	1	*	*	1	*	*	*
775	773	2	.25	3	1	*	*	1	*	*	*
5705	5701	4	.07	1	2	*	*	1	*	*	*
20149	20153	-4	-.02	2	2	*	*	1	*	*	*
3173	3170	3	.09	3	2	*	*	1	*	*	*
213	213		.00	1	3	*	*	1	*	*	*
3607	3604	3	.08	2	3	*	*	1	*	*	*
1346	1344	2	.14	3	3	*	*	1	*	*	*
859	864	-5	-.57	1	4	*	*	1	*	*	*
688	683	5	.73	2	4	*	*	1	*	*	*
785	790	-5	-.63	3	4	*	*	1	*	*	*
113	110	3	2.72	1	1	*	*	2	*	*	*
1029	1028	1	.09	2	1	*	*	2	*	*	*
168	171	-3	-1.75	3	1	*	*	2	*	*	*
873	876	-3	-.34	1	2	*	*	2	*	*	*
3549	3544	5	.14	2	2	*	*	2	*	*	*
460	462	-2	-.43	3	2	*	*	2	*	*	*
18	18		.00	1	3	*	*	2	*	*	*
324	326	-2	-.61	2	3	*	*	2	*	*	*
48	52	-4	-7.69	3	3	*	*	2	*	*	*
179	175	4	2.28	1	4	*	*	2	*	*	*
206	211	-5	-2.37	2	4	*	*	2	*	*	*
112	107	5	4.67	3	4	*	*	2	*	*	*

Section:55 ---- x(1,2,4)

60	53	7	13.20	1	1	*	1	*	*	*	*
2651	2648	3	.11	2	1	*	1	*	*	*	*
523	524	-1	-.19	3	1	*	1	*	*	*	*
643	647	-4	-.61	1	2	*	1	*	*	*	*
12213	12210	3	.02	2	2	*	1	*	*	*	*
2091	2093	-2	-.09	3	2	*	1	*	*	*	*
25	26	-1	-3.84	1	3	*	1	*	*	*	*
2756	2756		.00	2	3	*	1	*	*	*	*
1096	1095	1	.09	3	3	*	1	*	*	*	*
50	53	-3	-5.66	1	4	*	1	*	*	*	*
370	373	-3	-.80	2	4	*	1	*	*	*	*
566	566		.00	3	4	*	1	*	*	*	*
527	532	-5	-.94	1	1	*	2	*	*	*	*
2369	2372	-3	-.12	2	1	*	2	*	*	*	*
420	420		.00	3	1	*	2	*	*	*	*
5935	5930	5	.08	1	2	*	2	*	*	*	*
11485	11487	-2	-.01	2	2	*	2	*	*	*	*
1542	1539	3	.19	3	2	*	2	*	*	*	*
206	205	1	.48	1	3	*	2	*	*	*	*
1175	1174	1	.08	2	3	*	2	*	*	*	*
298	301	-3	-.99	3	3	*	2	*	*	*	*
988	986	2	.20	1	4	*	2	*	*	*	*
524	521	3	.57	2	4	*	2	*	*	*	*
331	331		.00	3	4	*	2	*	*	*	*

Section:56 ---- x(1,2,3)

64	62	2	3.22	1	1	1	*	*	*	*	*
186	185	1	.54	2	1	1	*	*	*	*	*
110	111	-1	-.90	3	1	1	*	*	*	*	*
1388	1388		.00	1	2	1	*	*	*	*	*
2615	2615		.00	2	2	1	*	*	*	*	*
809	810	-1	-.12	3	2	1	*	*	*	*	*
59	59		.00	1	3	1	*	*	*	*	*
299	299		.00	2	3	1	*	*	*	*	*
237	239	-2	-.83	3	3	1	*	*	*	*	*
240	240		.00	1	4	1	*	*	*	*	*
174	173	1	.57	2	4	1	*	*	*	*	*
226	227	-1	-.44	3	4	1	*	*	*	*	*
113	111	2	1.80	1	1	2	*	*	*	*	*
1179	1179		.00	2	1	2	*	*	*	*	*
281	281		.00	3	1	2	*	*	*	*	*
2079	2078	1	.04	1	2	2	*	*	*	*	*
8264	8264		.00	2	2	2	*	*	*	*	*
1341	1340	1	.07	3	2	2	*	*	*	*	*
75	73	2	2.74	1	3	2	*	*	*	*	*
1193	1192	1	.08	2	3	2	*	*	*	*	*
438	440	-2	-.45	3	3	2	*	*	*	*	*
203	202	1	.49	1	4	2	*	*	*	*	*
313	315	-2	-.63	2	4	2	*	*	*	*	*
308	309	-1	-.32	3	4	2	*	*	*	*	*
136	138	-2	-1.44	1	1	3	*	*	*	*	*
1643	1643		.00	2	1	3	*	*	*	*	*
197	196	1	.51	3	1	3	*	*	*	*	*
885	884	1	.11	1	2	3	*	*	*	*	*
6381	6381		.00	2	2	3	*	*	*	*	*
613	611	2	.32	3	2	3	*	*	*	*	*
33	33		.00	1	3	3	*	*	*	*	*
1119	1119		.00	2	3	3	*	*	*	*	*
273	272	1	.36	3	3	3	*	*	*	*	*
59	61	-2	-3.27	1	4	3	*	*	*	*	*
191	190	1	.52	2	4	3	*	*	*	*	*
159	159		.00	3	4	3	*	*	*	*	*
12	12		.00	1	1	4	*	*	*	*	*
994	994		.00	2	1	4	*	*	*	*	*
195	195		.00	3	1	4	*	*	*	*	*
25	25		.00	1	2	4	*	*	*	*	*
1694	1694		.00	2	2	4	*	*	*	*	*
281	281		.00	3	2	4	*	*	*	*	*

558	557	1	.18	2	3	4	*	*	*	*	*
219	218	1	.45	3	3	4	*	*	*	*	*
37	37		.00	2	4	4	*	*	*	*	*
74	72	2	2.77	3	4	4	*	*	*	*	*
262	262		.00	1	1	5	*	*	*	*	*
1018	1019	-1	-.09	2	1	5	*	*	*	*	*
160	161	-1	-.62	3	1	5	*	*	*	*	*
2201	2202	-1	-.04	1	2	5	*	*	*	*	*
4744	4743	1	.02	2	2	5	*	*	*	*	*
589	590	-1	-.16	3	2	5	*	*	*	*	*
64	66	-2	-3.03	1	3	5	*	*	*	*	*
762	763	-1	-.13	2	3	5	*	*	*	*	*
227	227		.00	3	3	5	*	*	*	*	*
536	536		.00	1	4	5	*	*	*	*	*
179	179		.00	2	4	5	*	*	*	*	*
130	130		.00	3	4	5	*	*	*	*	*