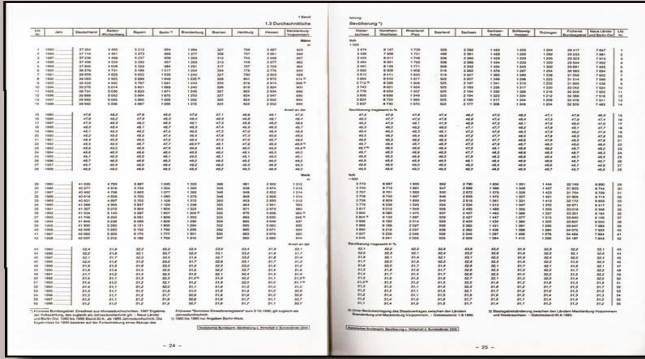


Testing CTA as Additivity Module



The image shows two pages of a statistical data table, likely from a census report. The table is organized into columns and rows, with various headers and sub-headers. The data appears to be numerical, possibly representing percentages or counts. The pages are numbered 24 and 25 at the bottom.

for Perturbed Census 2021 EU Hypercube Data

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Division Mathematical Statistical Methods*

Background

EU-Project „Harmonized Protection of Census Data in the ESS“

- recommended to test / use as SDC method for EU Census hypercubes and Grid Data
 - Targeted Record Swapping and/or
 - Random noise based on the Cell key method (Fraser and Wooton, ABS, 2005)

Background

Properties of Cell key method noise:

- **Statistical properties determined by noise design**
 - **Noise Variance V (constant, identical for all counts)**
 - **Noise Mean = 0 for each count („unbiased“)**
 - **Fixed Maximum Perturbation D**
 - **No small counts (1's, 2's) in noisy data**
- **Noise exactly consistent between hypercubes / grids**
- **Noise „drawn“ independently, based on Cell Keys**

Background

Hypercube Data after CKM noise not additive

- Viz.: Males + Females \neq Total

Naive approach

- (hierarchical) aggregation of „interior“ cells

Problem

- Naive approach damages design properties of the noise:
 - Increase of maximum perturbation (like: from 3 to > 300)
 - Increase of noise variance (like: from 0,5 to 130)
- Large (absolute) inconsistencies between hypercubes

„Calibrating“ noise might do better?

- Iterative Methods (f.i. Iterative Proportional Fitting), or
- Optimization based method
 - Controlled Tabular Adjustment (CTA)

Controlled Tabular Adjustment (CTA, Castro et al.)

Find vector of adjusted counts x_i subject to sets of constraints:

- (1) „Adjusted hypercube is additive“
- (2) Box constraints on deviations between „original“ (y_i) and adjusted (x_i) entries of the vector of counts
- (3) Protection levels for „sensitive“ cells ($i \in P$)
 - Upper protection $x_i \geq y_i + upl_i$ or
 - Lower protection $x_i \leq y_i - lpl_i$

CTA Optimization problem in term of deviations $z_i := x_i - y_i$:

$$\min_z \sum_{i=1}^n w_i |z_i|$$

$$s.t. \quad (1) \quad Az = 0$$

$$(2) \quad l_i \leq z_i \leq u_i \quad , i = 1, \dots, n$$

$$(3) \quad z_i \leq lpl_i \text{ or } z_i \geq upl_i, i \in P$$

Scenario I: Test CTA to restore additivity to EU-Census hypercube 9.2 after perturbation by CKM noise

EU-Census hypercube 9.2 (one of ca. 150 EU-Census hypercubes)

- 4-dimensional, hierarchical hypercube presenting frequency counts by
 - geo_m 42 categories („synthetic“ part of NW Germany)
 - sex 2 categories
 - age_m 21 categories
 - yae_h 24 categories
- Number of cells: 133,560
- Number of „additivity constraints“: 129,822

Test hypercube 9.2: GEO.M x AGE.M x YAE.H x SEX

GEO.M	AGE.M	YAE.H	SEX
@01 @@010 @@@01051 @@@01053 @@@01054 @@@01055 @@@01056 @@@01057 @@@01058 @@@01059 @@@01060 @@@01061 @@@01062 @02 @@020 @@@02000 @03 @@031 @@@03151 @@@03152 @@@03153 @@@03154 @@@03155 @@@03156 @@@03157 @@@03158 @032 @@@03251 @@@03252 @@@03254 @@@03255 @@@03256 @@@03257 @033 @@@03351 @@@03352 @@@03353 @@@03354 @@@03355 @@@03356 @@@03357 @@@03358 @@@03359 @@@03360 @@@03361 @034 @@@03451 @@@03452 @@@03453 @@@03454 @@@03455 @@@03456	@1. @@1.1. @@1.2. @@1.3. @2. @@2.1. @@2.2. @@2.3. @3. @@3.1. @@3.2. @@3.3. @@3.4. @4. @@4.1. @@4.2. @@4.3. @5. @@5.1. @@5.2. @@5.3. @@5.4. @6. @@6.1. @@6.2. @@6.3. @@6.4.	@1. @@1.1. @@@1.1.1. @@@1.1.2. @1.2. @@@1.2.1. @@@1.2.2. @@@1.2.3. @@@1.2.4. @@@1.2.5. @1.3. @@@1.3.1. @@@1.3.2. @@@1.3.3. @@@1.3.4. @@@1.3.5. @1.4. @@@1.4.1. @@@1.4.2. @@@1.4.3. @@@1.4.4. @@@1.4.5. @1.5. @1.6. @1.7. @1.8. @1.9. @2. @3.	@1 @2

Settings of scenario I

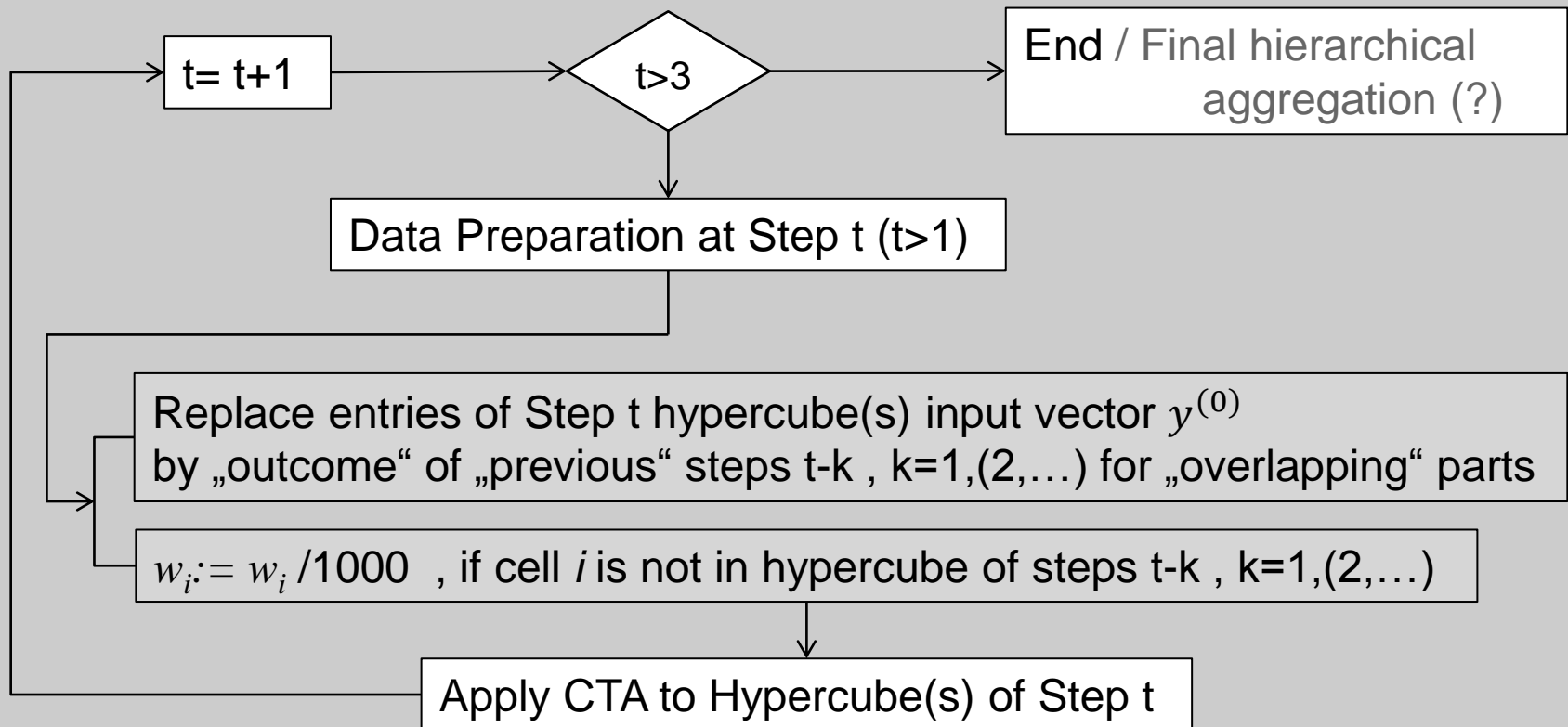
- Cell key method noise
 - D=3 and V=1

- No sensitive cells ($P = \emptyset$)
- Weights: $w_i = (y_i)^{-\frac{1}{2}}$
- Box constraints: $l_i = -10$ und $u_i = +10$
- Commercial LP/MILP Solver

- Two approaches:
 - Solve in a single step
 - Not successfull (?)
 - Execution stopped (manually) after 1 week
 - Stepwise procedure
 - Blocking Strategy

Stepwise blocking strategy – 3 steps

Input $y^{(0)}$: Noisy hypercube after CKM



Blocking strategy – Step 1

GEO.M	AGE.M	YAE.H	SEX
<pre> @01 @@010 @@@01051 @@@01053 @@@01054 @@@01055 @@@01056 @@@01057 @@@01058 @@@01059 @@@01060 @@@01061 @@@01062 @02 @@020 @@@02000 @03 @@031 @@@03151 @@@03152 @@@03153 @@@03154 @@@03155 @@@03156 @@@03157 @@@03158 @@032 @@@03251 @@@03252 @@@03254 @@@03255 @@@03256 @@@03257 @@033 @@@03351 @@@03352 @@@03353 @@@03354 @@@03355 @@@03356 @@@03357 @@@03358 @@@03359 @@@03360 @@@03361 @@034 @@@03451 @@@03452 @@@03453 @@@03454 @@@03455 @@@03456 </pre>	<pre> @1. @@1.1. @@1.2. @@1.3. @2. @@2.1. @@2.2. @@2.3. @3. @@3.1. @@3.2. @@3.3. @@3.4. @4. @@4.1. @@4.2. @@4.3. @5. @@5.1. @@5.2. @@5.3. @@5.4. @6. @@6.1. @@6.2. @@6.3. @@6.4. </pre>	<pre> @1. @@1.1. @@@1.1.1. @@@1.1.2. @1.2. @@@1.2.1. @@@1.2.2. @@@1.2.3. @@@1.2.4. @@@1.2.5. @1.3. @@@1.3.1. @@@1.3.2. @@@1.3.3. @@@1.3.4. @@@1.3.5. @1.4. @@@1.4.1. @@@1.4.2. @@@1.4.3. @@@1.4.4. @@@1.4.5. @1.5. @1.6. @1.7. @1.8. @1.9. @2. @3. </pre>	<pre> @1 @2 </pre> <p>Step 1 „CTA for hypercube of 3-way margins“</p>

Blocking strategy – Step 1

GEO.M	AGE.M	YAH	SEX
<pre>@01 @@010 @@@01051 @@@01053 @@@01054 @@@01055 @@@01056 @@@01057 @@@01058 @@@01059 @@@01060 @@@01061 @@@01062 @02 @@020 @@@02000 @03 @@031 @@@03151 @@@03152 @@@03153 @@@03154 @@@03155 @@@03156 @@@03157 @@@03158 @@@032 @@@03251 @@@03252 @@@03254 @@@03255 @@@03256 @@@03257 @@@033 @@@03351 @@@03352 @@@03353 @@@03354 @@@03355 @@@03356 @@@03357 @@@03358 @@@03359 @@@03360 @@@03361 @@@034 @@@03451 @@@03452 @@@03453 @@@03454 @@@03455 @@@03456</pre>	<pre>@1. @@1.1. @@1.2. @@1.3. @2. @@2.1. @@2.2. @@2.3. @3. @@3.1. @@3.2. @@3.3. @@3.4. @4. @@4.1. @@4.2. @@4.3. @5. @@5.1. @@5.2. @@5.3. @@5.4. @6. @@6.1. @@6.2. @@6.3. @@6.4.</pre>	<pre>@1. @@1.1. @@@1.1.1. @@@1.1.2. @1.2. @@@1.2.1. @@@1.2.2. @@@1.2.3. @@@1.2.4. @@@1.2.5. @1.3. @@@1.3.1. @@@1.3.2. @@@1.3.3. @@@1.3.4. @@@1.3.5. @1.4. @@@1.4.1. @@@1.4.2. @@@1.4.3. @@@1.4.4. @@@1.4.5. @1.5. @@1.6. @@1.7. @@1.8. @@1.9. @2. @3.</pre>	<pre>@1 @2</pre> <p>Step 1 „CTA for hypercube of 3-way margins“</p> <p>X Skip variable</p>

Blocking strategy – Step 2

GEO.M	AGE.M	YAE.H	SEX
<pre> @01 @@010 @@@01051 @@@01053 @@@01054 @@@01055 @@@01056 @@@01057 @@@01058 @@@01059 @@@01060 @@@01061 @@@01062 @02 @@020 @@@02000 @03 @@031 @@@03151 @@@03152 @@@03153 @@@03154 @@@03155 @@@03156 @@@03157 @@@03158 @@032 @@@03251 @@@03252 @@@03254 @@@03255 @@@03256 @@@03257 @@033 @@@03351 @@@03352 @@@03353 @@@03354 @@@03355 @@@03356 @@@03357 @@@03358 @@@03359 @@@03360 @@@03361 @@034 @@@03451 @@@03452 @@@03453 @@@03454 @@@03455 @@@03456 </pre>	<pre> @1. @@1.1. @@1.2. @@1.3. @2. @@2.1. @@2.2. @@2.3. @3. @@3.1. @@3.2. @@3.3. @@3.4. @4. @@4.1. @@4.2. @@4.3. @5. @@5.1. @@5.2. @@5.3. @@5.4. @6. @@6.1. @@6.2. @@6.3. @@6.4. </pre>	<pre> @1. @@1.1. @@@1.1.1. @@@1.1.2. @2. @@2.1. @@@2.1.1. @@@2.1.2. @@@2.1.3. @@@2.1.4. @@@2.1.5. @3. @@3.1. @@@3.1.1. @@@3.1.2. @@@3.1.3. @@@3.1.4. @@@3.1.5. @4. @@4.1. @@@4.1.1. @@@4.1.2. @@@4.1.3. @@@4.1.4. @@@4.1.5. @5. @@5.1. @@@5.1.1. @@@5.1.2. @@@5.1.3. @@@5.1.4. @@@5.1.5. @6. @@6.1. @@@6.1.1. @@@6.1.2. @@@6.1.3. @@@6.1.4. @@@6.1.5. @7. @@7.1. @@@7.1.1. @@@7.1.2. @@@7.1.3. @@@7.1.4. @@@7.1.5. @8. @@8.1. @@@8.1.1. @@@8.1.2. @@@8.1.3. @@@8.1.4. @@@8.1.5. @9. @@9.1. @@@9.1.1. @@@9.1.2. @@@9.1.3. @@@9.1.4. @@@9.1.5. @2. @3. </pre>	<pre> @1 @2 </pre> <p>Step 2 „CTA for hypercube of 4-way GEO.L margins“</p>

Blocking strategy – Step 2

GEO.M	AGE.M	YAE.H	SEX
@01	@1.	@1.	@1
@@010	@@1.1.	@@1.1.	@2
@@@01051	@@1.2.	@@@1.1.1.	
@@@01053	@@1.3.	@@@1.1.2.	
@@@01054	@2.	@@1.2.	
@@@01055	@@2.1.	@@@1.2.1.	
@@@01056	@@2.2.	@@@1.2.2.	
@@@01057	@@2.3.	@@@1.2.3.	
@@@01058	@3.	@@@1.2.4.	
@@@01059	@@3.1.	@@@1.2.5.	
@@@01060	@@3.2.	@@1.3.	
@@@01061	@@3.3.	@@@1.3.1.	
@@@01062	@@3.4.	@@@1.3.2.	
@02	@4.	@@@1.3.3.	
@@020	@@4.1.	@@@1.3.4.	
@@@02000	@@4.2.	@@@1.3.5.	
@03	@@4.3.	@@1.4.	
@@031	@5.	@@@1.4.1.	
@@@03151	@@5.1.	@@@1.4.2.	
@@@03152	@@5.2.	@@@1.4.3.	
@@@03153	@@5.3.	@@@1.4.4.	
@@@03154	@@5.4.	@@@1.4.5.	
@@@03155	@6.	@@1.5.	
@@@03156	@@6.1.	@@1.6.	
@@@03157	@@6.2.	@@1.7.	
@@@03158	@@6.3.	@@1.8.	
@@032	@@6.4.	@@1.9.	
@@@03251		@2.	
@@@03252		@3.	
@@@03254			
@@@03255			
@@@03256			
@@@03257			
@@033			
@@@03351			
@@@03352			
@@@03353			
@@@03354			
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@@@03361			
@@034			
@@@03451			
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@@@03454			
@@@03455			
@@@03456			

Step 2
„CTA for hypercube of
4-way GEO.L margins“

> GEO.L margins

Blocking strategy – Step 3

GEO.M	AGE.M	YAE.H	SEX
<pre> @01 @@010 @@@01051 @@@01053 @@@01054 @@@01055 @@@01056 @@@01057 @@@01058 @@@01059 @@@01060 @@@01061 @@@01062 @02 @@020 @@@02000 @03 @@031 @@@03151 @@@03152 @@@03153 @@@03154 @@@03155 @@@03156 @@@03157 @@@03158 @@032 @@@03251 @@@03252 @@@03254 @@@03255 @@@03256 @@@03257 @@033 @@@03351 @@@03352 @@@03353 @@@03354 @@@03355 @@@03356 @@@03357 @@@03358 @@@03359 @@@03360 @@@03361 @@034 @@@03451 @@@03452 @@@03453 @@@03454 @@@03455 @@@03456 </pre>	<pre> @1. @@1.1. @@1.2. @@1.3. @2. @@2.1. @@2.2. @@2.3. @3. @@3.1. @@3.2. @@3.3. @@3.4. @4. @@4.1. @@4.2. @@4.3. @5. @@5.1. @@5.2. @@5.3. @@5.4. @6. @@6.1. @@6.2. @@6.3. @@6.4. </pre>	<pre> @1. @@1.1. @@@1.1.1. @@@1.1.2. @1.2. @@@1.2.1. @@@1.2.2. @@@1.2.3. @@@1.2.4. @@@1.2.5. @1.3. @@@1.3.1. @@@1.3.2. @@@1.3.3. @@@1.3.4. @@@1.3.5. @1.4. @@@1.4.1. @@@1.4.2. @@@1.4.3. @@@1.4.4. @@@1.4.5. @1.5. @1.6. @1.7. @1.8. @1.9. @2. @3. </pre>	<pre> @1 @2 </pre> <p>Step 3 „CTA for six 4-way hypercubes“</p>

Blocking strategy – Step 3

GEO.M	AGE.M	YAE.H	SEX
@01	@1.	@1.	@1
@@010	@@1.1.	@@1.1.	@2
@@@01051	@@1.2.	@@@1.1.1.	
@@@01053	@@1.3.	@@@1.1.2.	
@@@01054	@2.	@@1.2.	
@@@01055	@@2.1.	@@@1.2.1.	
@@@01056	@@2.2.	@@@1.2.2.	
@@@01057	@@2.3.	@@@1.2.3.	
@@@01058	@3.	@@@1.2.4.	
@@@01059	@@3.1.	@@@1.2.5.	
@@@01060	@@3.2.	@@1.3.	
@@@01061	@@3.3.	@@@1.3.1.	
@@@01062	@@3.4.	@@@1.3.2.	
@02	@4.	@@@1.3.3.	
@@020	@@4.1.	@@@1.3.4.	
@@@02000	@@4.2.	@@@1.3.5.	
@03	@@4.3.	@@1.4.	
@@031	@5.	@@@1.4.1.	
@@@03151	@@5.1.	@@@1.4.2.	
@@@03152	@@5.2.	@@@1.4.3.	
@@@03153	@@5.3.	@@@1.4.4.	
@@@03154	@@5.4.	@@@1.4.5.	
@@@03155	@6.	@@1.5.	
@@@03156	@@6.1.	@@1.6.	
@@@03157	@@6.2.	@@1.7.	
@@@03158	@@6.3.	@@1.8.	
@@032	@@6.4.	@@1.9.	
@@@03251		@2.	
@@@03252		@3.	
@@@03254			
@@@03255			
@@@03256			
@@@03257			
@@033			
@@@03351			
@@@03352			
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@@@03359			
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@@034			
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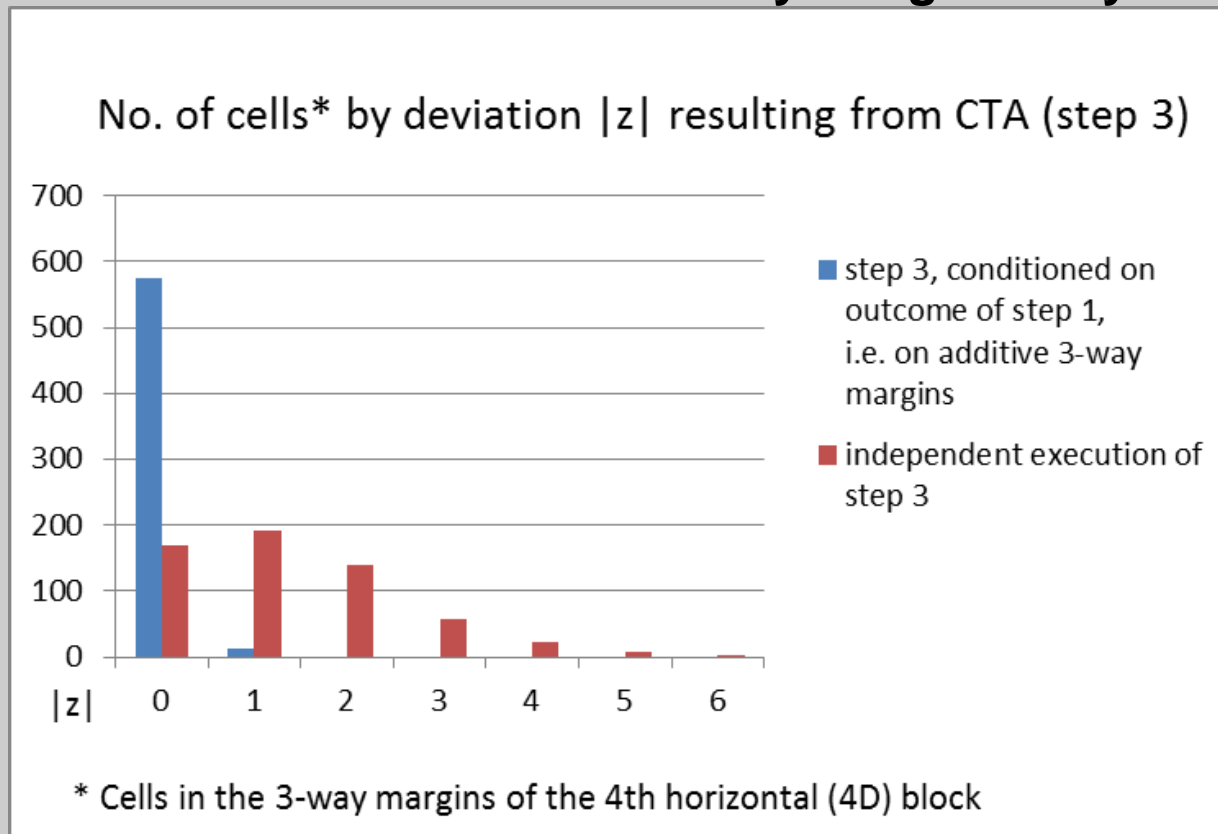
Step 3
„CTA for six
4-way hypercubes“

 6 separate GEO blocks

Results for blocking approach in test scenario I

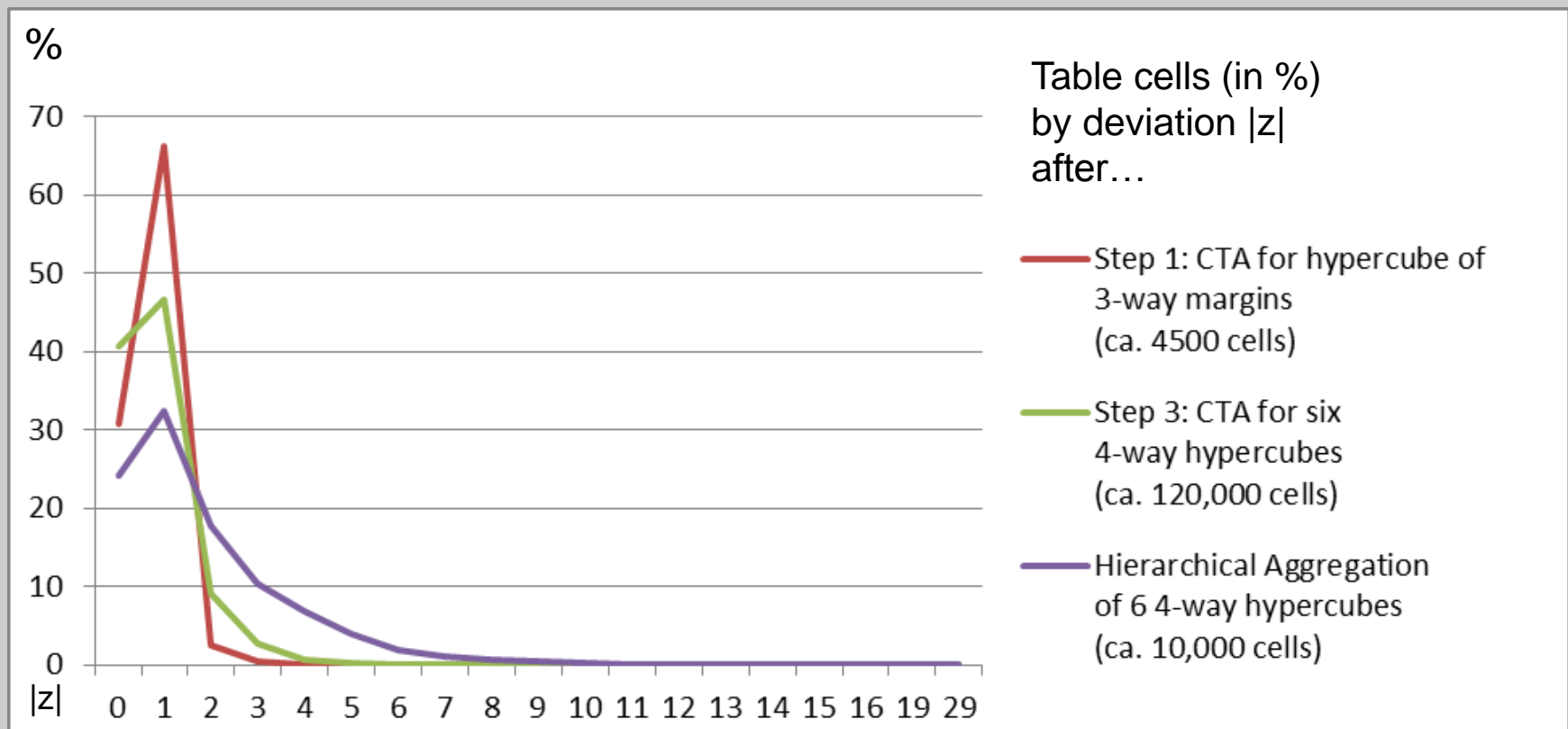
Step 1 (CTA on 3-way margin hypercube) preserves between-hypercube consistency very well

- **Example: CTA deviations after step 3, for block 4**
- **Results for 3-way margins only**



Results for blocking approach in test scenario I

- „Smaller hypercube“ (Step 1) => „Smaller perturbation“
- Changes after CTA (Step 3) much smaller than after (final) hierarchical aggregation
 - Including Step 2 (CTA of Geo.L 4-way hypercube, not yet tried) might help



Scenario II - complex case: regard ones and twoes as sensitive cells

Find vector of adjusted counts x_i subject to sets of constraints:

- (1) „Adjusted hypercube is additive“
- (2) Box constraints on deviations between „original“ (y_i) and adjusted (x_i) entries of the vector of counts
- **(3) Protection levels for „sensitive“ cells ($i \in P$)**
 - **Upper protection** $x_i \geq y_i + upl_i$ **or**
 - **Lower protection** $x_i \leq y_i - lpl_i$

CTA Optimization problem in term of deviations $z_i := x_i - y_i$:

$$\min_z \sum_{i=1}^n w_i |z_i|$$

$$s.t. \quad Az = 0$$

$$l_i \leq z_i \leq u_i, \quad i = 1, \dots, n$$

$$z_i \leq -lpl_i \text{ or } z_i \geq upl_i, \quad i \in P$$

Iterative strategy for the complex case

Feasible solution: entries need to be zero or above a given threshold N (i.e. N=2)

Iterative strategy consists of three phases:

- Initial Phase
 - Starting with a suitable non-additive random noise solution
 - Run CTA instance as applied in the „simple case“ (scenario I)
- Second Phase (iteratively)
 - Define sensitive cells $P = \{i_1, i_2, \dots, i_p\}$ and protection levels
 - Run CTA instance using protection levels, modified boundaries (especially for non-sensitive bottom level cells) and weights
- Final Phase
 - Stop second phase if ...
 - ... feasible solution is available OR
 - ... no further reduction of sensitive cells is possible
 - In case of remaining sensitive cells:
deterministic rounding and/or aggregation of bottom level cells

Results of the iterative strategy

Cells	Before CTA	Initial Phase	Second Phase – Iteration ...						Final Phase*
			1	2	3	4	5	5*	
0	1,474	1,488	1,552	1,564	1,570	1,570	1,570	1,075	1,076
1	0	61	16	10	4	5	4	1	0
2	0	106	31	14	6	2	2	1	0
> 2	15,326	15,145	15,201	15,212	15,220	15,223	15,224	4,215	4,216
All	16,800	16,800	16,800	16,800	16,800	16,800	16,800	5,292	5,292
CPU time		56 min	7 min	6 s	6 s	3 s	3 s		

* bottom level cells

Initial/Second Phase:

- Modified lower boundaries for non-sensitive cells: $\min(10; \max(y_i - 3; 0))$
 - in order to prevent these cells to be changed to sensitive cells
 - "Optimal CTA table found (optimal within tolerances)"

Results of the iterative strategy

Cells	Before CTA	Initial Phase	Second Phase – Iteration ...					Final Phase*	
			1	2	3	4	5		5*
0	1,474	1,488	1,552	1,564	1,570	1,570	1,570	1,075	1,076
1	0	61	16	10	4	5	4	1	0
2	0	106	31	14	0	2	2	1	0
> 2	15,326	15,145	15,201	15,212	15,220	15,223	15,224	4,215	4,216
All	16,800	16,800	16,800	16,800	16,800	16,800	16,800	5,292	5,292
CPU time		56 min	7 min	6 s	6 s	3 s	3 s		



* bottom level cells

Initial/Second Phase:

- Modified lower boundaries for non-sensitive cells: $\min(10; \max(y_i - 3; 0))$
 - in order to prevent these cells to be changed to sensitive cells
 - "Optimal CTA table found (optimal within tolerances)"

Comparison: iterative CTA strategy vs. simple aggregation

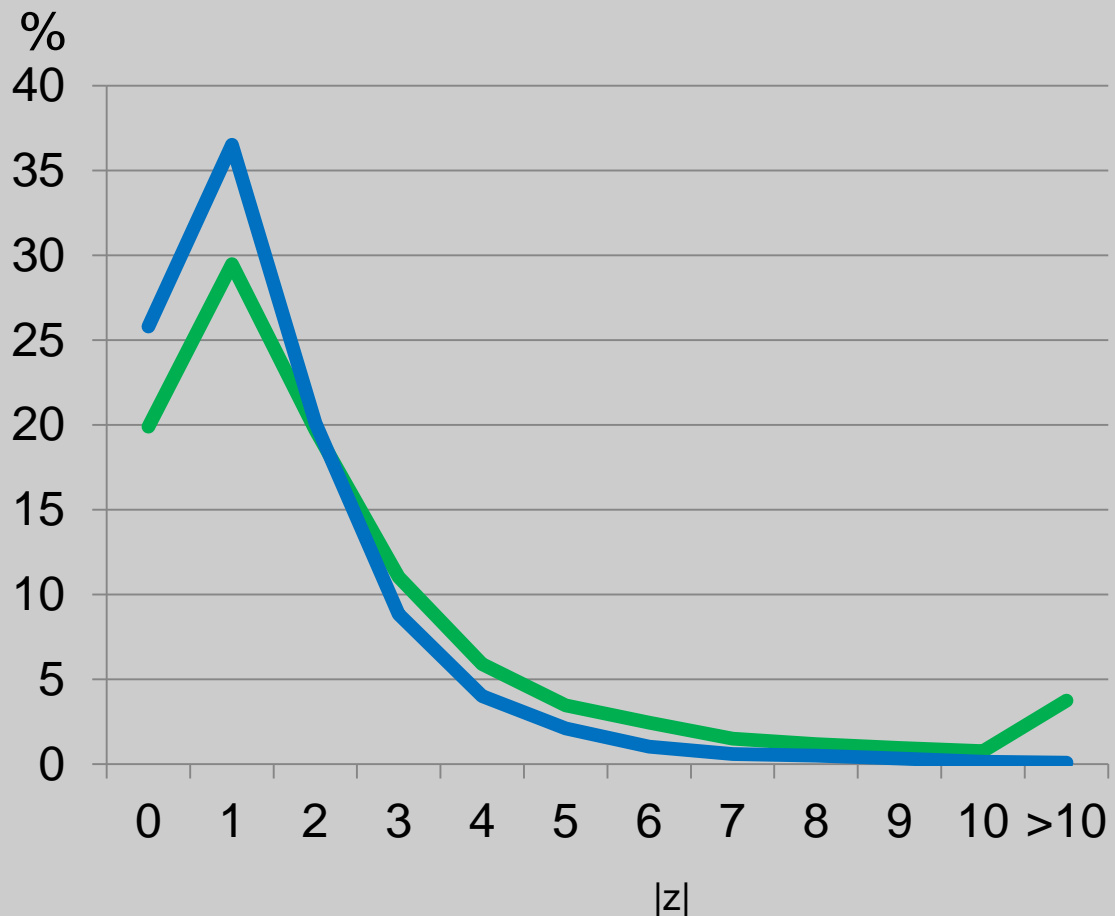


Table cells (in %)
by deviation $|z|$ after...

- Random noise plus hierarchical aggregation of bottom level cells
→ maximum deviation is **175**
- CTA plus hierarchical aggregation of bottom level cells
→ maximum deviation is **16**

Comparison: iterative CTA strategy vs. simple aggregation

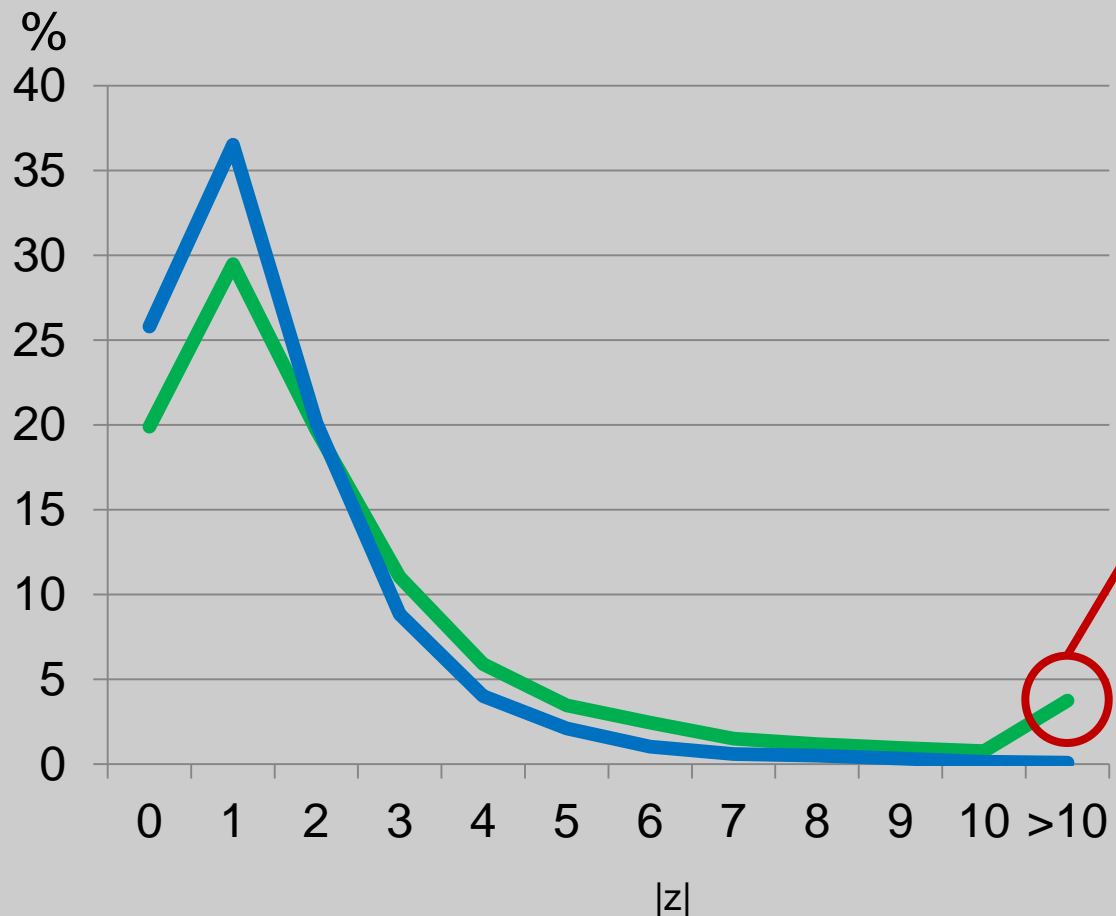


Table cells (in %)
by deviation $|z|$ after...

— Random noise plus hierarchical aggregation of bottom level cells

→ maximum deviation is **175**

— CTA plus hierarchical aggregation of bottom level cells

→ maximum deviation is **16**

Summary and Conclusion

Summary:

- Starting point: Non-additive but consistent hypercubes protected by random noise with Cell Key Method design properties
- Evaluations using synthetic EU hypercube data
- Restoring additivity at once too complex, therefore ...
 - Blocking strategies and iterative approaches make CTA optimization problems feasible
 - CTA techniques lead to much less perturbation in hypercube margins than simple summation of the noisy lowest level counts

Conclusions:

- Recommendation: to preserve consistency and keep perturbation “low” the “goals” of additivity “corrections” should be revised:
 - either not restore additivity at all, or
 - restore additivity to sub-hypercubes rather than to full hypercubes (i.e. devise heuristical strategies)

Acknowledgements

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- **Gießing, S. (2016):** Computational issues in the design of transition probabilities and disclosure risk estimation for additive noise; Privacy in Statistical Databases, Dubrovnik 2016.

1. Bestand										
1.3 Durchschnittliche										
St.	Jahr	Durchschnitt	Bevölkerung	Bevölkerung	Bevölkerung	Bevölkerung	Bevölkerung	Bevölkerung	Bevölkerung	Bevölkerung
1	1980	27 200	4 900	5 212	484	1 204	267	768	2 207	500
2	1981	27 100	4 888	5 217	486	1 201	267	768	2 207	500
3	1982	27 000	4 876	5 222	488	1 198	267	768	2 207	500
4	1983	26 900	4 864	5 227	490	1 195	267	768	2 207	500
5	1984	26 800	4 852	5 232	492	1 192	267	768	2 207	500
6	1985	26 700	4 840	5 237	494	1 189	267	768	2 207	500
7	1986	26 600	4 828	5 242	496	1 186	267	768	2 207	500
8	1987	26 500	4 816	5 247	498	1 183	267	768	2 207	500
9	1988	26 400	4 804	5 252	500	1 180	267	768	2 207	500
10	1989	26 300	4 792	5 257	502	1 177	267	768	2 207	500
11	1990	26 200	4 780	5 262	504	1 174	267	768	2 207	500
12	1991	26 100	4 768	5 267	506	1 171	267	768	2 207	500
13	1992	26 000	4 756	5 272	508	1 168	267	768	2 207	500
14	1993	25 900	4 744	5 277	510	1 165	267	768	2 207	500
15	1994	25 800	4 732	5 282	512	1 162	267	768	2 207	500
16	1995	25 700	4 720	5 287	514	1 159	267	768	2 207	500
17	1996	25 600	4 708	5 292	516	1 156	267	768	2 207	500
18	1997	25 500	4 696	5 297	518	1 153	267	768	2 207	500
19	1998	25 400	4 684	5 302	520	1 150	267	768	2 207	500
20	1999	25 300	4 672	5 307	522	1 147	267	768	2 207	500
21	2000	25 200	4 660	5 312	524	1 144	267	768	2 207	500
22	2001	25 100	4 648	5 317	526	1 141	267	768	2 207	500
23	2002	25 000	4 636	5 322	528	1 138	267	768	2 207	500
24	2003	24 900	4 624	5 327	530	1 135	267	768	2 207	500
25	2004	24 800	4 612	5 332	532	1 132	267	768	2 207	500
26	2005	24 700	4 600	5 337	534	1 129	267	768	2 207	500
27	2006	24 600	4 588	5 342	536	1 126	267	768	2 207	500
28	2007	24 500	4 576	5 347	538	1 123	267	768	2 207	500
29	2008	24 400	4 564	5 352	540	1 120	267	768	2 207	500
30	2009	24 300	4 552	5 357	542	1 117	267	768	2 207	500
31	2010	24 200	4 540	5 362	544	1 114	267	768	2 207	500
32	2011	24 100	4 528	5 367	546	1 111	267	768	2 207	500
33	2012	24 000	4 516	5 372	548	1 108	267	768	2 207	500
34	2013	23 900	4 504	5 377	550	1 105	267	768	2 207	500
35	2014	23 800	4 492	5 382	552	1 102	267	768	2 207	500
36	2015	23 700	4 480	5 387	554	1 099	267	768	2 207	500
37	2016	23 600	4 468	5 392	556	1 096	267	768	2 207	500
38	2017	23 500	4 456	5 397	558	1 093	267	768	2 207	500
39	2018	23 400	4 444	5 402	560	1 090	267	768	2 207	500
40	2019	23 300	4 432	5 407	562	1 087	267	768	2 207	500
41	2020	23 200	4 420	5 412	564	1 084	267	768	2 207	500
42	2021	23 100	4 408	5 417	566	1 081	267	768	2 207	500
43	2022	23 000	4 396	5 422	568	1 078	267	768	2 207	500
44	2023	22 900	4 384	5 427	570	1 075	267	768	2 207	500
45	2024	22 800	4 372	5 432	572	1 072	267	768	2 207	500
46	2025	22 700	4 360	5 437	574	1 069	267	768	2 207	500
47	2026	22 600	4 348	5 442	576	1 066	267	768	2 207	500
48	2027	22 500	4 336	5 447	578	1 063	267	768	2 207	500
49	2028	22 400	4 324	5 452	580	1 060	267	768	2 207	500
50	2029	22 300	4 312	5 457	582	1 057	267	768	2 207	500
51	2030	22 200	4 300	5 462	584	1 054	267	768	2 207	500
52	2031	22 100	4 288	5 467	586	1 051	267	768	2 207	500
53	2032	22 000	4 276	5 472	588	1 048	267	768	2 207	500
54	2033	21 900	4 264	5 477	590	1 045	267	768	2 207	500
55	2034	21 800	4 252	5 482	592	1 042	267	768	2 207	500
56	2035	21 700	4 240	5 487	594	1 039	267	768	2 207	500
57	2036	21 600	4 228	5 492	596	1 036	267	768	2 207	500
58	2037	21 500	4 216	5 497	598	1 033	267	768	2 207	500
59	2038	21 400	4 204	5 502	600	1 030	267	768	2 207	500
60	2039	21 300	4 192	5 507	602	1 027	267	768	2 207	500
61	2040	21 200	4 180	5 512	604	1 024	267	768	2 207	500
62	2041	21 100	4 168	5 517	606	1 021	267	768	2 207	500
63	2042	21 000	4 156	5 522	608	1 018	267	768	2 207	500
64	2043	20 900	4 144	5 527	610	1 015	267	768	2 207	500
65	2044	20 800	4 132	5 532	612	1 012	267	768	2 207	500
66	2045	20 700	4 120	5 537	614	1 009	267	768	2 207	500
67	2046	20 600	4 108	5 542	616	1 006	267	768	2 207	500
68	2047	20 500	4 096	5 547	618	1 003	267	768	2 207	500
69	2048	20 400	4 084	5 552	620	1 000	267	768	2 207	500
70	2049	20 300	4 072	5 557	622	997	267	768	2 207	500
71	2050	20 200	4 060	5 562	624	994	267	768	2 207	500
72	2051	20 100	4 048	5 567	626	991	267	768	2 207	500
73	2052	20 000	4 036	5 572	628	988	267	768	2 207	500
74	2053	19 900	4 024	5 577	630	985	267	768	2 207	500
75	2054	19 800	4 012	5 582	632	982	267	768	2 207	500
76	2055	19 700	4 000	5 587	634	979	267	768	2 207	500
77	2056	19 600	3 988	5 592	636	976	267	768	2 207	500
78	2057	19 500	3 976	5 597	638	973	267	768	2 207	500
79	2058	19 400	3 964	5 602	640	970	267	768	2 207	500
80	2059	19 300	3 952	5 607	642	967	267	768	2 207	500
81	2060	19 200	3 940	5 612	644	964	267	768	2 207	500
82	2061	19 100	3 928	5 617	646	961	267	768	2 207	500
83	2062	19 000	3 916	5 622	648	958	267	768	2 207	500
84	2063	18 900	3 904	5 627	650	955	267	768	2 207	500
85	2064	18 800	3 892	5 632	652	952	267	768	2 207	500
86	2065	18 700	3 880	5 637	654	949	267	768	2 207	500
87	2066	18 600	3 868	5 642	656	946	267	768	2 207	500
88	2067	18 500	3 856	5 647	658	943	267	768	2 207	500
89	2068	18 400	3 844	5 652	660	940	267	768	2 207	500
90	2069	18 300	3 832	5 657	662	937	267	768	2 207	500
91	2070	18 200	3 820	5 662	664	934	267	768	2 207	500
92	2071	18 100	3 808	5 667	666	931	267	768	2 207	500
93	2072	18 000	3 796	5 672	668	928	267	768	2 207	500
94	2073	17 900	3 784	5 677	670	925	267	768	2 207	500
95	2074	17 800	3 772	5 682	672	922	267	768	2 207	500
96	2075	17 700	3 760	5 687	674	919	267	768	2 207	500
97	2076	17 600	3 748	5 692	676	916	267	768	2 207	500
98	2077	17 500	3 736	5 697	678	913	267	768	2 207	500
99	2078	17 400	3 724	5 702	680	910	267	768	2 207	500
100	2079	17 300	3 712	5 707	682	907	267	768	2 207	500
101	2080	17 200	3 700	5 712	684	904	267	768	2 207	500
102	2081	17 100	3 688	5 717	686	901	267	768	2 207	500
103	2082	17 000	3 676	5 722	688	898	267	768	2 207	500
104	2083	16 900	3 664	5 727	690	895	267	768	2 207	500
105	2084	16 800	3 652							