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KRUGER et al.

(54) SYSTEM AND METHOD FOR ANALYZING AND CORRECTING RETAIL DATA

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G06F 17/30 (2006.01)

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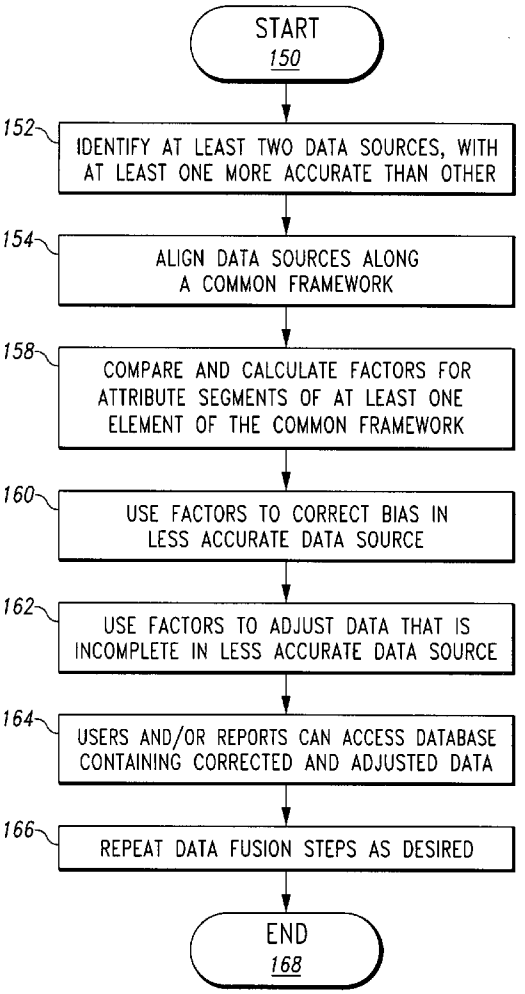
(57) **ABSTRACT**

A computer system and method is disclosed that analyzes and corrects retail data. The system and method includes several client workstations and one or more servers coupled together over a network. A database stores various data used by the system. A business logic server uses competitive and complementary fusion to analyze and correct some of the data sources stored in database server. The data fusion process itself is an iterative one—utilizing both competitive and complementary fusion methods. In competitive fusion, two or more data sources that provide overlapping attributes are compared against each other. More accurate/reliable sources are used to correct less accurate/reliable sources. In complementary fusion, relationships modeled where data sources overlap are projected to areas of the data framework in which fewer sources exist—enhancing the accuracy/reliability of those fewer sources even in the absence of the other sources upon which the models were based.



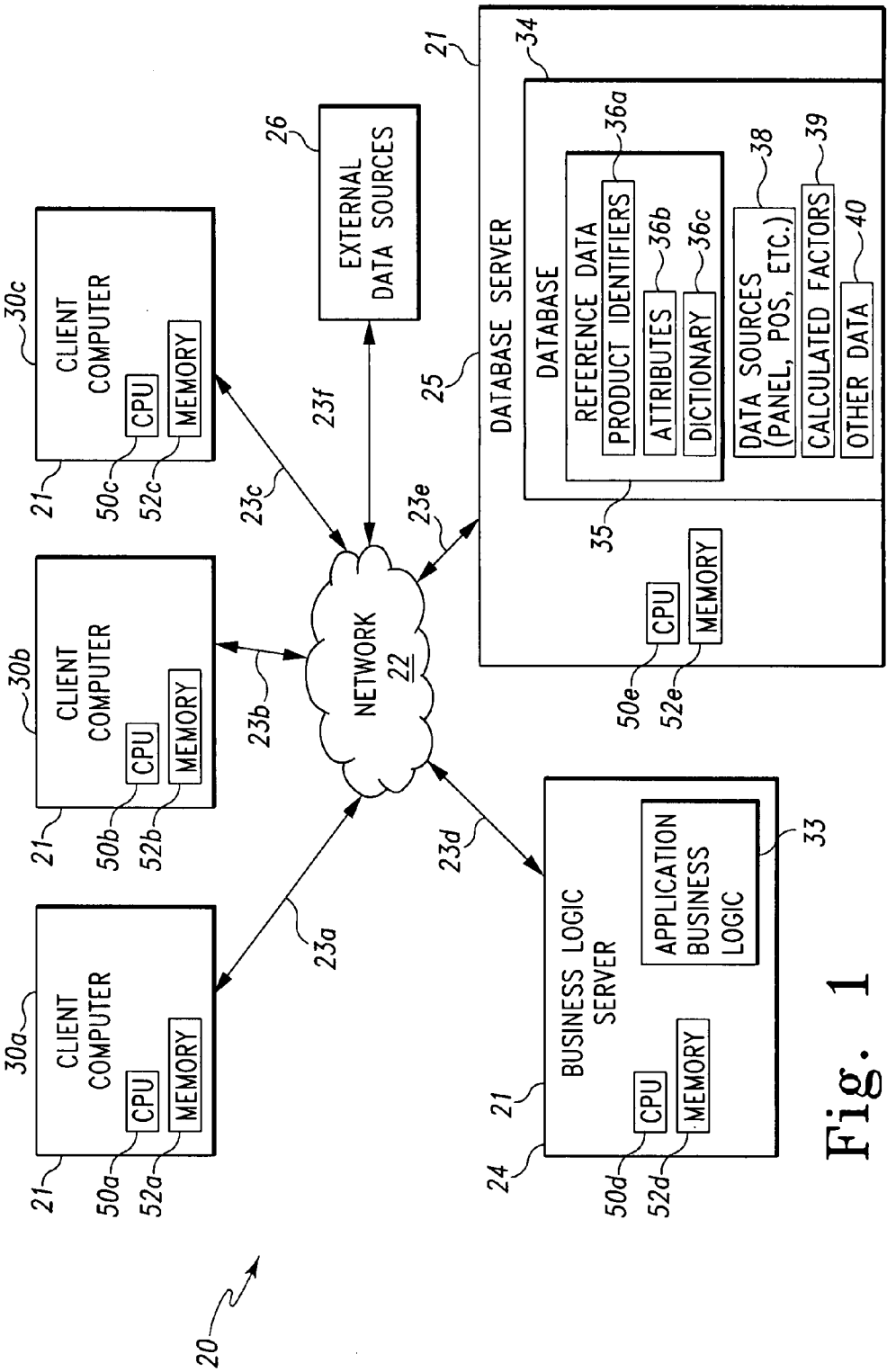
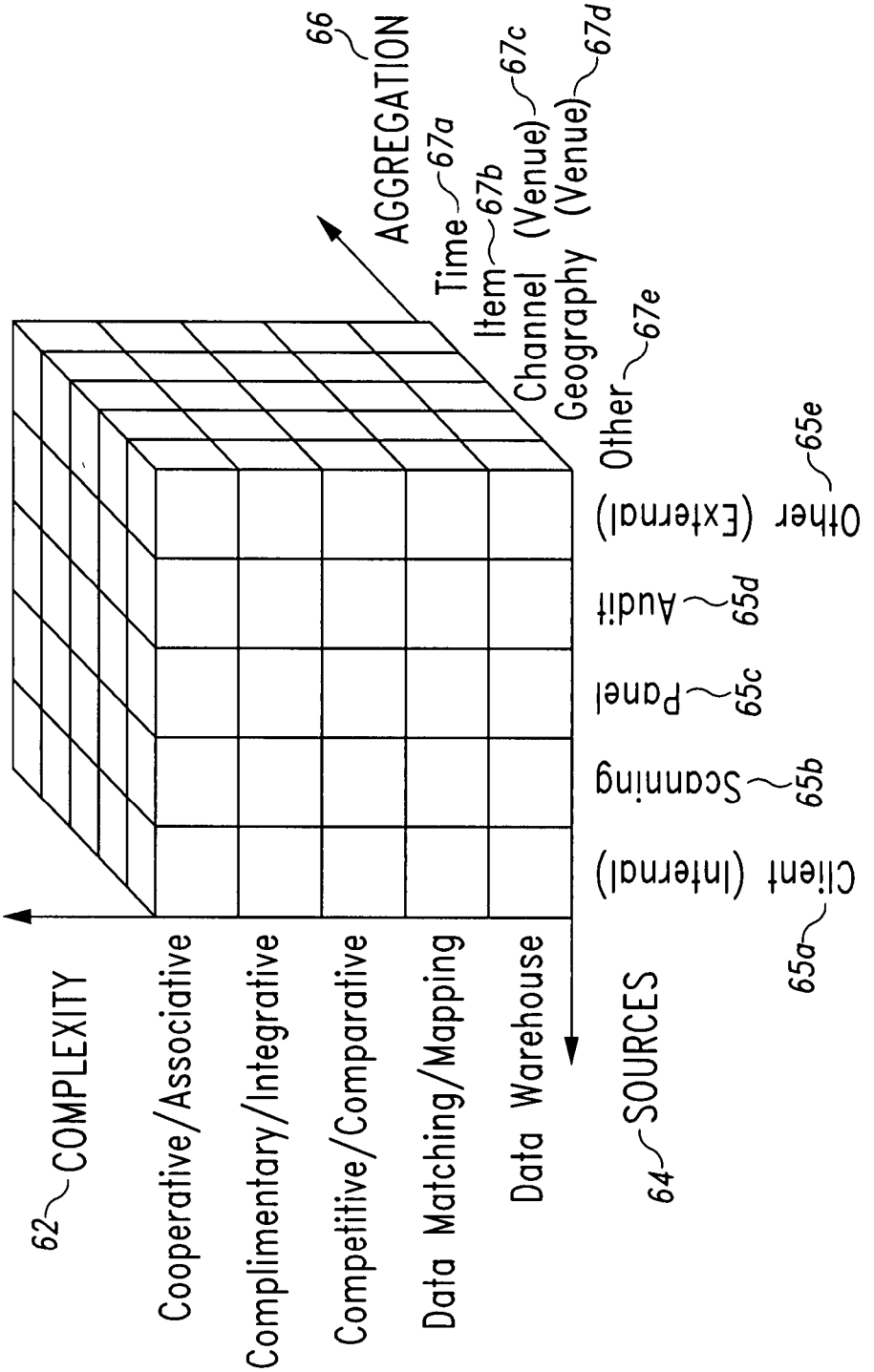

20
30a
CLIENT COMPUTER
CPU
MEMORY
21
50a
52a
30b
CLIENT COMPUTER
CPU
MEMORY
21
50b
52b
30c
CLIENT COMPUTER
CPU
MEMORY
21
50c
52c
NETWORK 22
23a
23b
23c
23d
23e
23f
26
EXTERNAL DATA SOURCES
21
34
DATABASE SERVER
25
DATABASE
REFERENCE DATA
PRODUCT IDENTIFIERS
36a
ATTRIBUTES
36b
DICTIONARY
36c
35
DATA SOURCES (PANEL, POS, ETC.)
38
CALCULATED FACTORS
39
OTHER DATA
40
CPU
MEMORY
50e
52e
BUSINESS LOGIC SERVER
21
24
APPLICATION BUSINESS LOGIC
33
CPU
MEMORY
50d
52d

Fig. 1

Fig. 2


60
66
AGGREGATION
Time 67a
Item 67b
Channel (Venue) 67c
Geography (Venue) 67d
Other 67e
62 COMPLEXITY
Cooperative/Associative
Complimentary/Integrative
Competitive/Comparative
Data Matching/Mapping
Data Warehouse
64 SOURCES
Client (Internal) 65a
Scanning 65b
Panel 65c
Audit 65d
Other (External) 65e

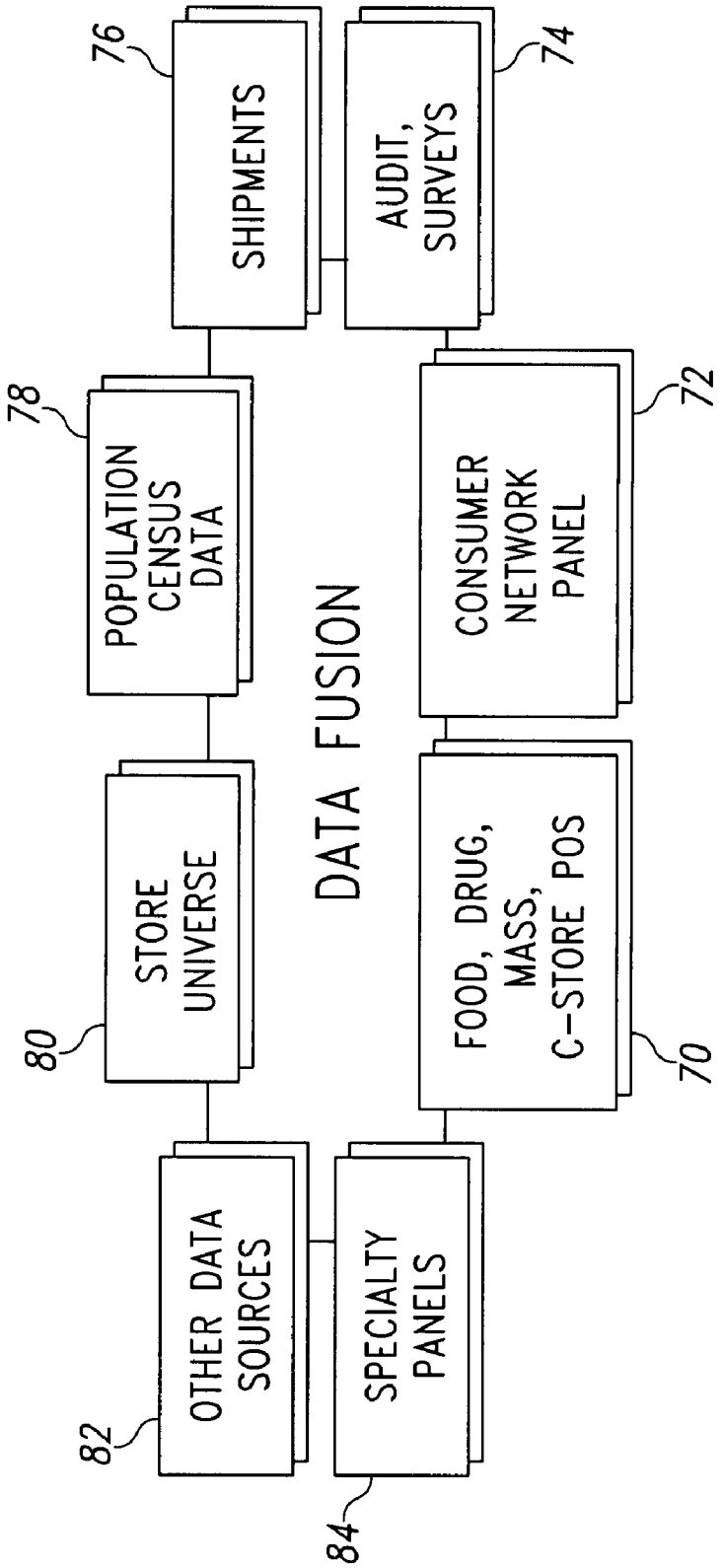

DATA FUSION
SHIPMENTS
76
AUDIT, SURVEYS
74
POPULATION CENSUS DATA
78
CONSUMER NETWORK PANEL
72
STORE UNIVERSE
80
FOOD, DRUG, MASS, C-STORE POS
70
OTHER DATA SOURCES
82
SPECIALTY PANELS
84

Fig. 3

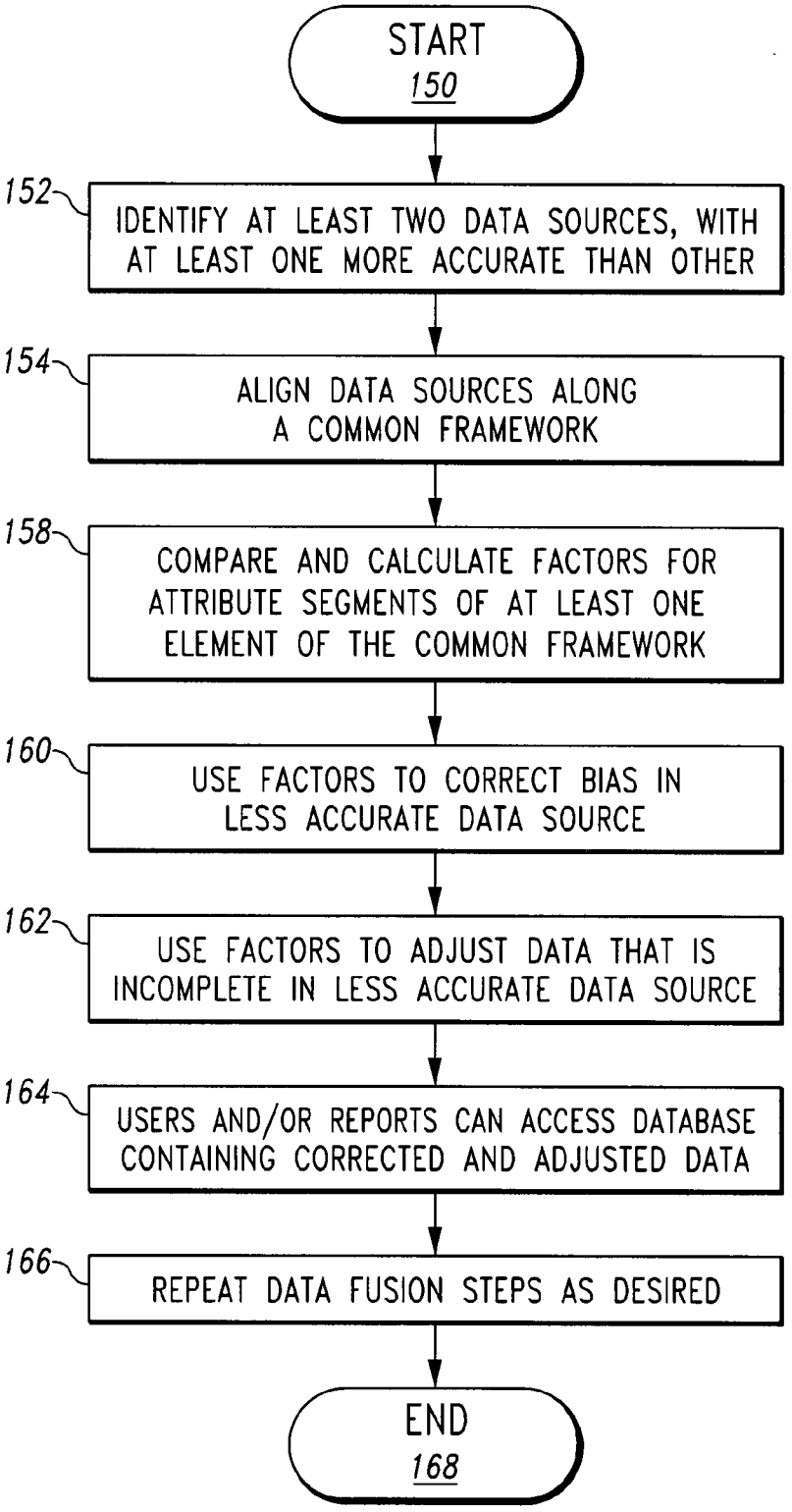

START
150
152
IDENTIFY AT LEAST TWO DATA SOURCES, WITH AT LEAST ONE MORE ACCURATE THAN OTHER
154
ALIGN DATA SOURCES ALONG A COMMON FRAMEWORK
158
COMPARE AND CALCULATE FACTORS FOR ATTRIBUTE SEGMENTS OF AT LEAST ONE ELEMENT OF THE COMMON FRAMEWORK
160
USE FACTORS TO CORRECT BIAS IN LESS ACCURATE DATA SOURCE
162
USE FACTORS TO ADJUST DATA THAT IS INCOMPLETE IN LESS ACCURATE DATA SOURCE
164
USERS AND/OR REPORTS CAN ACCESS DATABASE CONTAINING CORRECTED AND ADJUSTED DATA
166
REPEAT DATA FUSION STEPS AS DESIRED
END
168

Fig. 4

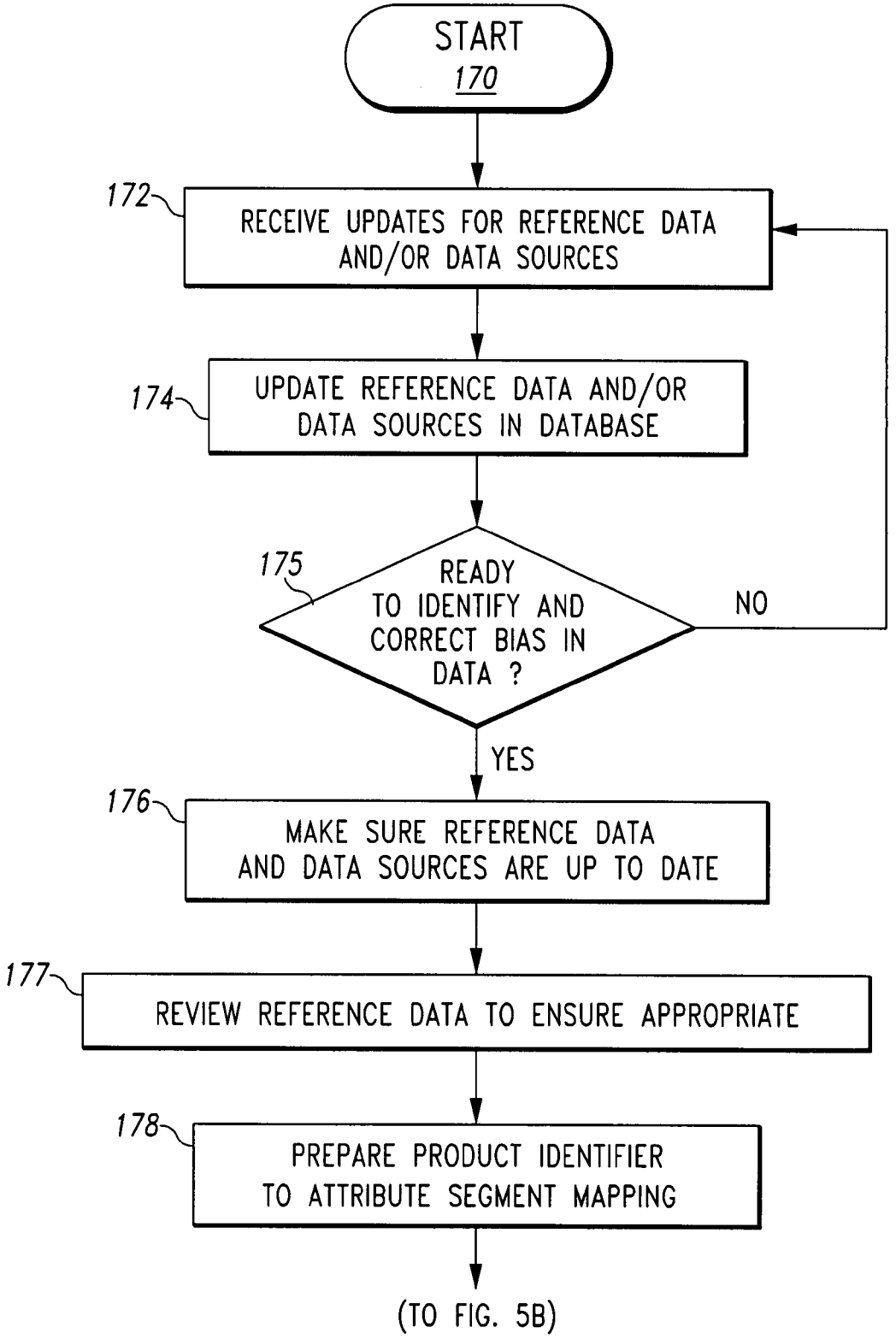

START
170
172
RECEIVE UPDATES FOR REFERENCE DATA AND/OR DATA SOURCES
174
UPDATE REFERENCE DATA AND/OR DATA SOURCES IN DATABASE
175
READY TO IDENTIFY AND CORRECT BIAS IN DATA ?
NO
YES
176
MAKE SURE REFERENCE DATA AND DATA SOURCES ARE UP TO DATE
177
REVIEW REFERENCE DATA TO ENSURE APPROPRIATE
178
PREPARE PRODUCT IDENTIFIER TO ATTRIBUTE SEGMENT MAPPING
(TO FIG. 5B)

Fig. 5A

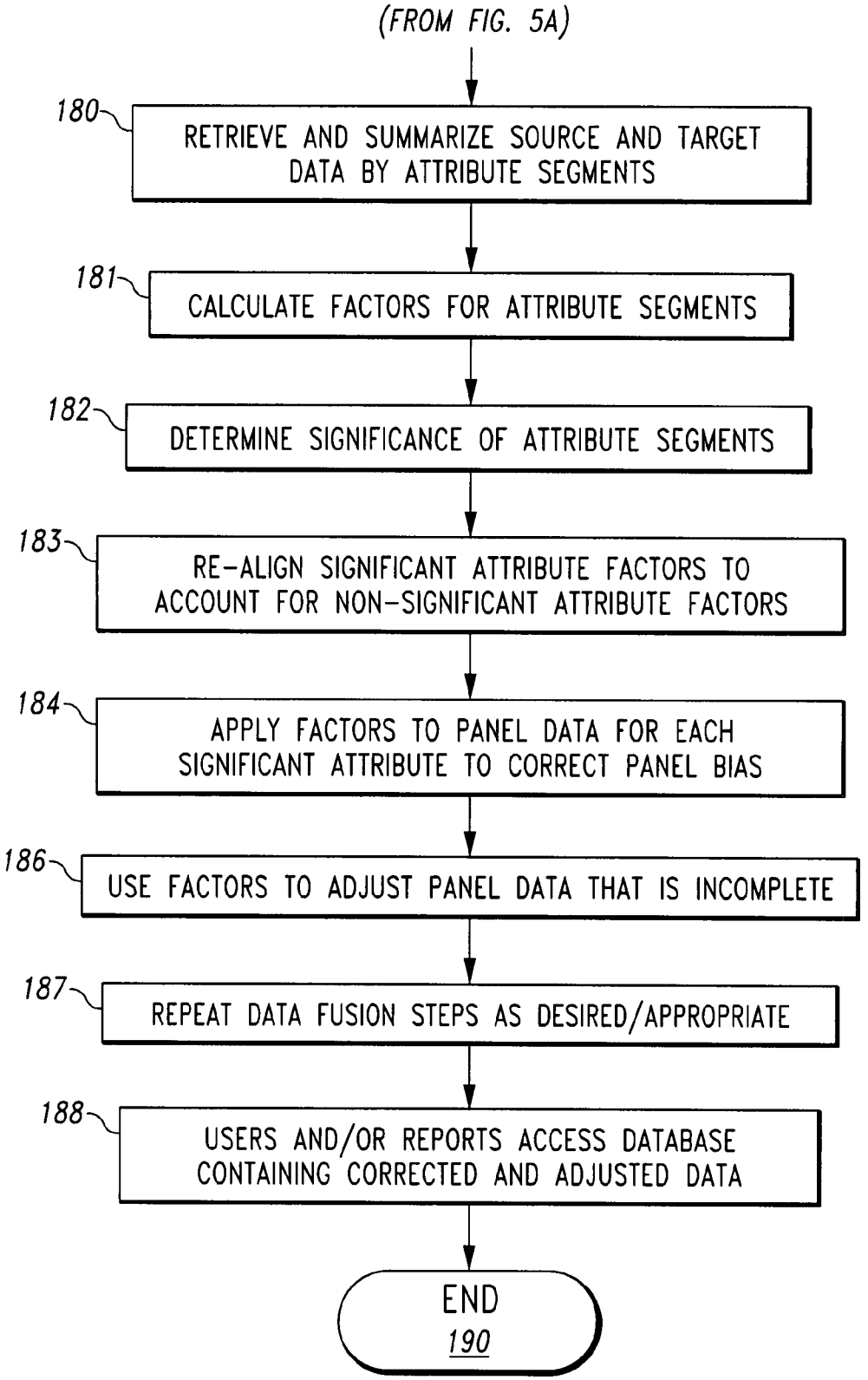

(FROM FIG. 5A)
180
RETRIEVE AND SUMMARIZE SOURCE AND TARGET DATA BY ATTRIBUTE SEGMENTS
181
CALCULATE FACTORS FOR ATTRIBUTE SEGMENTS
182
DETERMINE SIGNIFICANCE OF ATTRIBUTE SEGMENTS
183
RE-ALIGN SIGNIFICANT ATTRIBUTE FACTORS TO ACCOUNT FOR NON-SIGNIFICANT ATTRIBUTE FACTORS
184
APPLY FACTORS TO PANEL DATA FOR EACH SIGNIFICANT ATTRIBUTE TO CORRECT PANEL BIAS
186
USE FACTORS TO ADJUST PANEL DATA THAT IS INCOMPLETE
187
REPEAT DATA FUSION STEPS AS DESIRED/APPROPRIATE
188
USERS AND/OR REPORTS ACCESS DATABASE CONTAINING CORRECTED AND ADJUSTED DATA
END
190

Fig. 5B

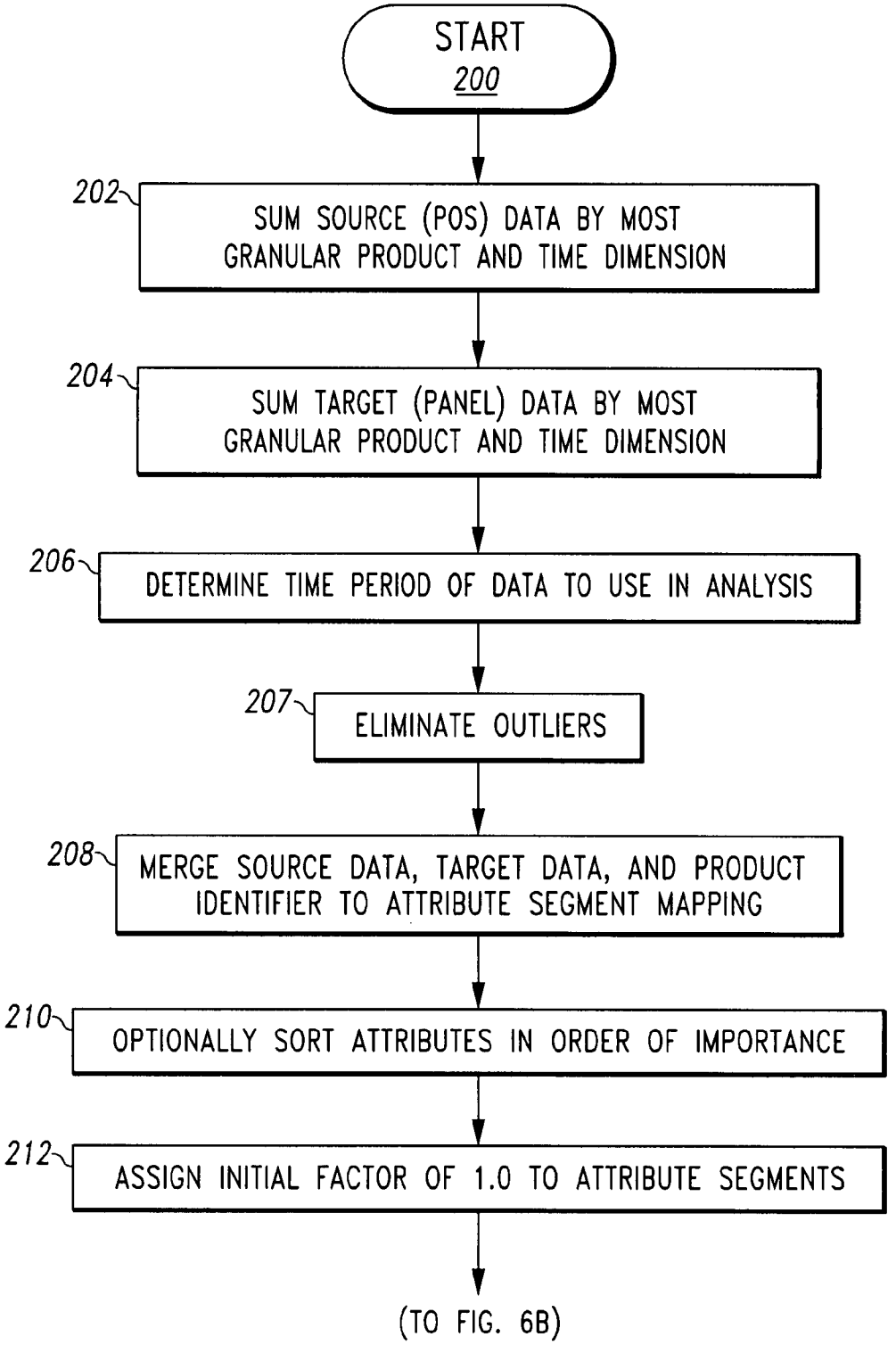

START
200
202
SUM SOURCE (POS) DATA BY MOST GRANULAR PRODUCT AND TIME DIMENSION
204
SUM TARGET (PANEL) DATA BY MOST GRANULAR PRODUCT AND TIME DIMENSION
206
DETERMINE TIME PERIOD OF DATA TO USE IN ANALYSIS
207
ELIMINATE OUTLIERS
208
MERGE SOURCE DATA, TARGET DATA, AND PRODUCT IDENTIFIER TO ATTRIBUTE SEGMENT MAPPING
210
OPTIONALLY SORT ATTRIBUTES IN ORDER OF IMPORTANCE
212
ASSIGN INITIAL FACTOR OF 1.0 TO ATTRIBUTE SEGMENTS
(TO FIG. 6B)

Fig. 6A

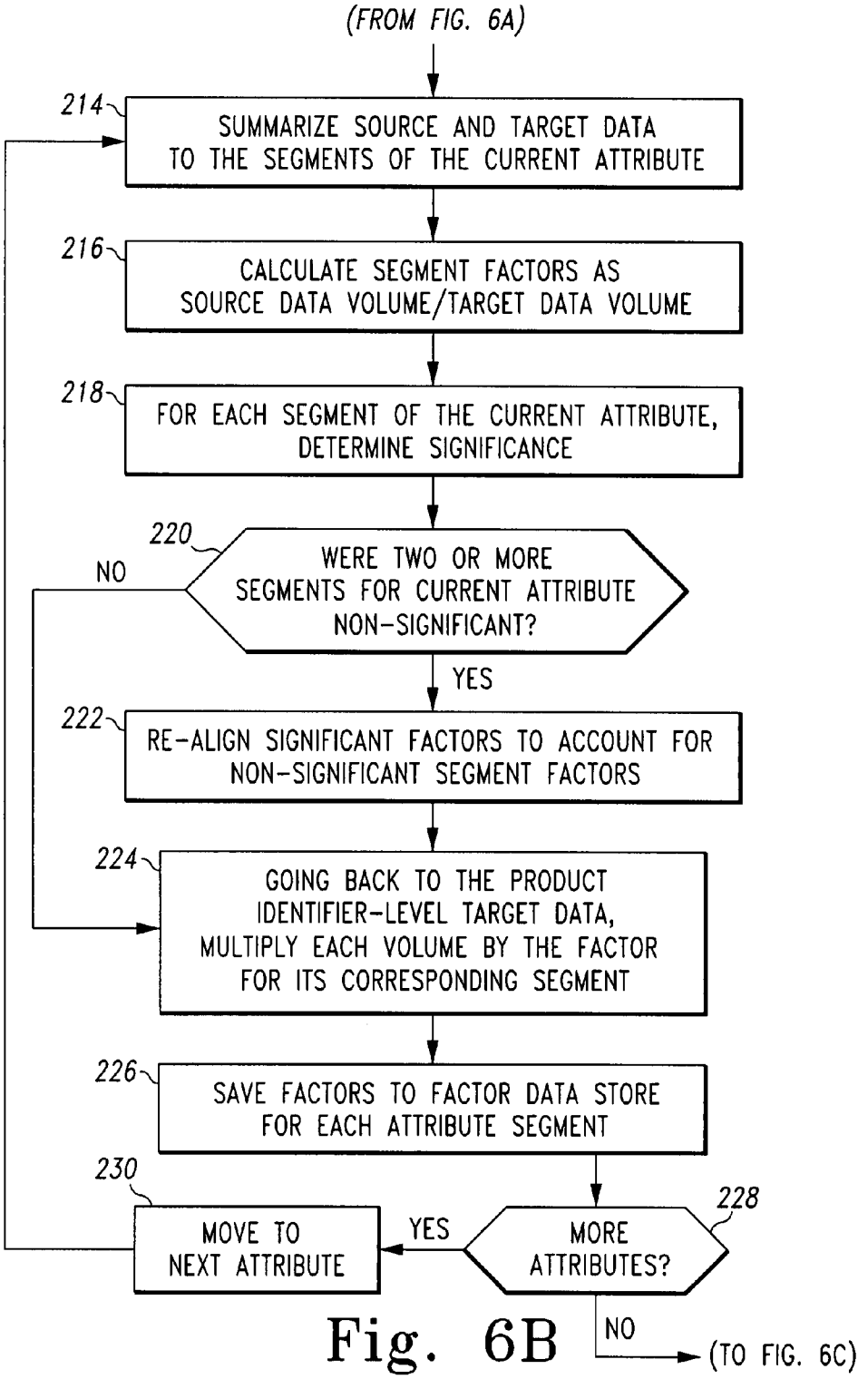

(FROM FIG. 6A)
214
SUMMARIZE SOURCE AND TARGET DATA TO THE SEGMENTS OF THE CURRENT ATTRIBUTE
216
CALCULATE SEGMENT FACTORS AS SOURCE DATA VOLUME/TARGET DATA VOLUME
218
FOR EACH SEGMENT OF THE CURRENT ATTRIBUTE, DETERMINE SIGNIFICANCE
220
WERE TWO OR MORE SEGMENTS FOR CURRENT ATTRIBUTE NON-SIGNIFICANT?
NO
YES
222
RE-ALIGN SIGNIFICANT FACTORS TO ACCOUNT FOR NON-SIGNIFICANT SEGMENT FACTORS
224
GOING BACK TO THE PRODUCT IDENTIFIER-LEVEL TARGET DATA, MULTIPLY EACH VOLUME BY THE FACTOR FOR ITS CORRESPONDING SEGMENT
226
SAVE FACTORS TO FACTOR DATA STORE FOR EACH ATTRIBUTE SEGMENT
228
MORE ATTRIBUTES?
YES
230
MOVE TO NEXT ATTRIBUTE
NO
(TO FIG. 6C)

Fig. 6B

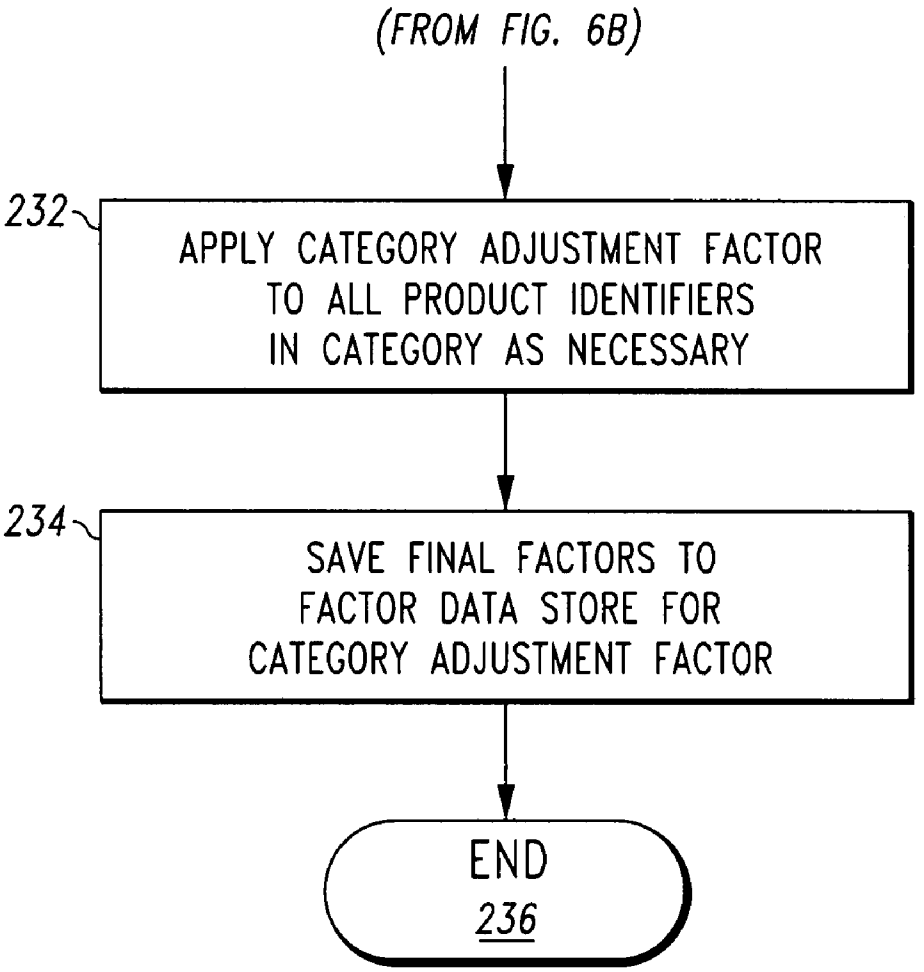

(FROM FIG. 6B)
232
APPLY CATEGORY ADJUSTMENT FACTOR TO ALL PRODUCT IDENTIFIERS IN CATEGORY AS NECESSARY
234
SAVE FINAL FACTORS TO FACTOR DATA STORE FOR CATEGORY ADJUSTMENT FACTOR
END
236

Fig. 6C

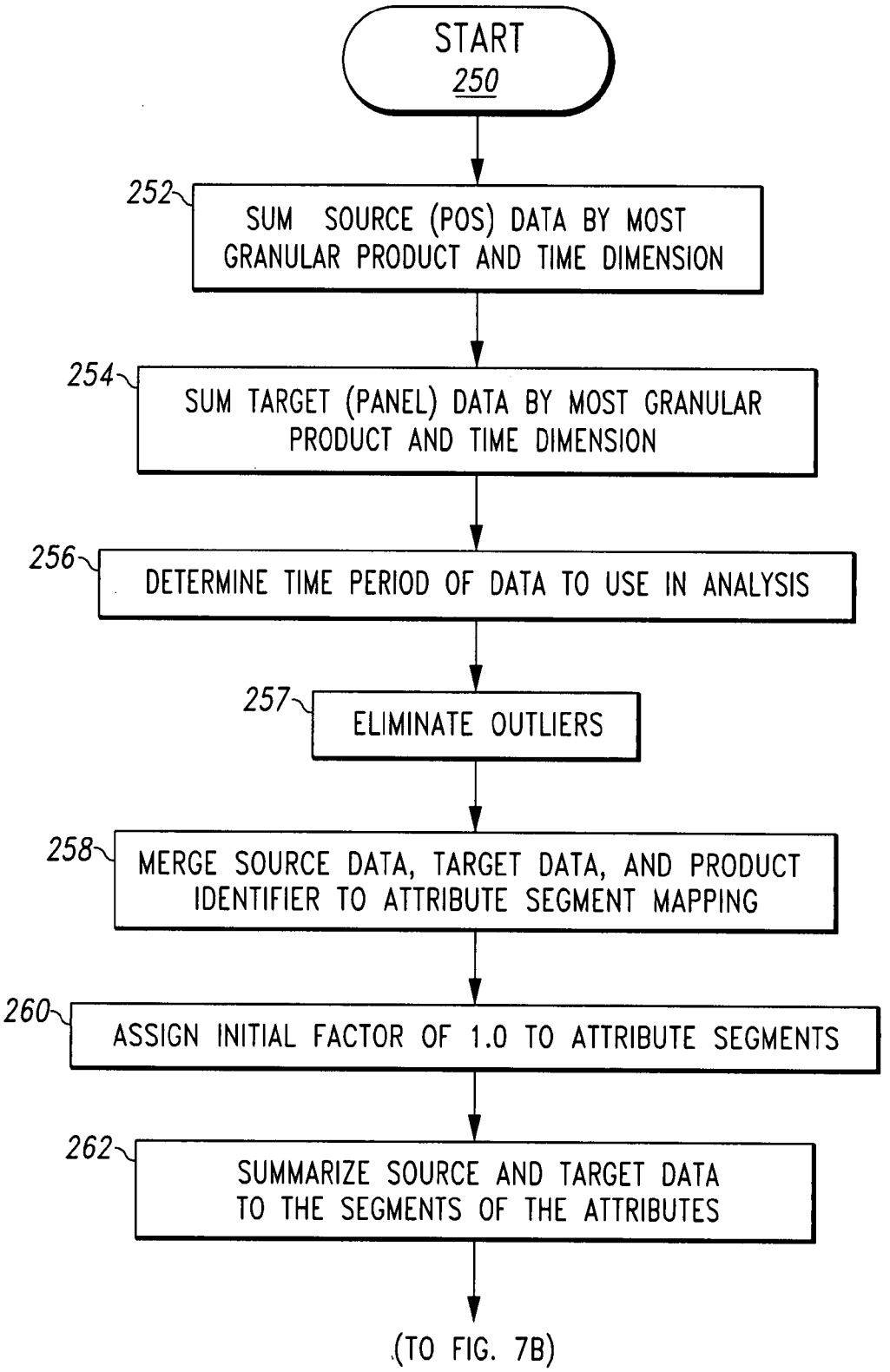

START
250
252
SUM SOURCE (POS) DATA BY MOST GRANULAR PRODUCT AND TIME DIMENSION
254
SUM TARGET (PANEL) DATA BY MOST GRANULAR PRODUCT AND TIME DIMENSION
256
DETERMINE TIME PERIOD OF DATA TO USE IN ANALYSIS
257
ELIMINATE OUTLIERS
258
MERGE SOURCE DATA, TARGET DATA, AND PRODUCT IDENTIFIER TO ATTRIBUTE SEGMENT MAPPING
260
ASSIGN INITIAL FACTOR OF 1.0 TO ATTRIBUTE SEGMENTS
262
SUMMARIZE SOURCE AND TARGET DATA TO THE SEGMENTS OF THE ATTRIBUTES
(TO FIG. 7B)

Fig. 7A

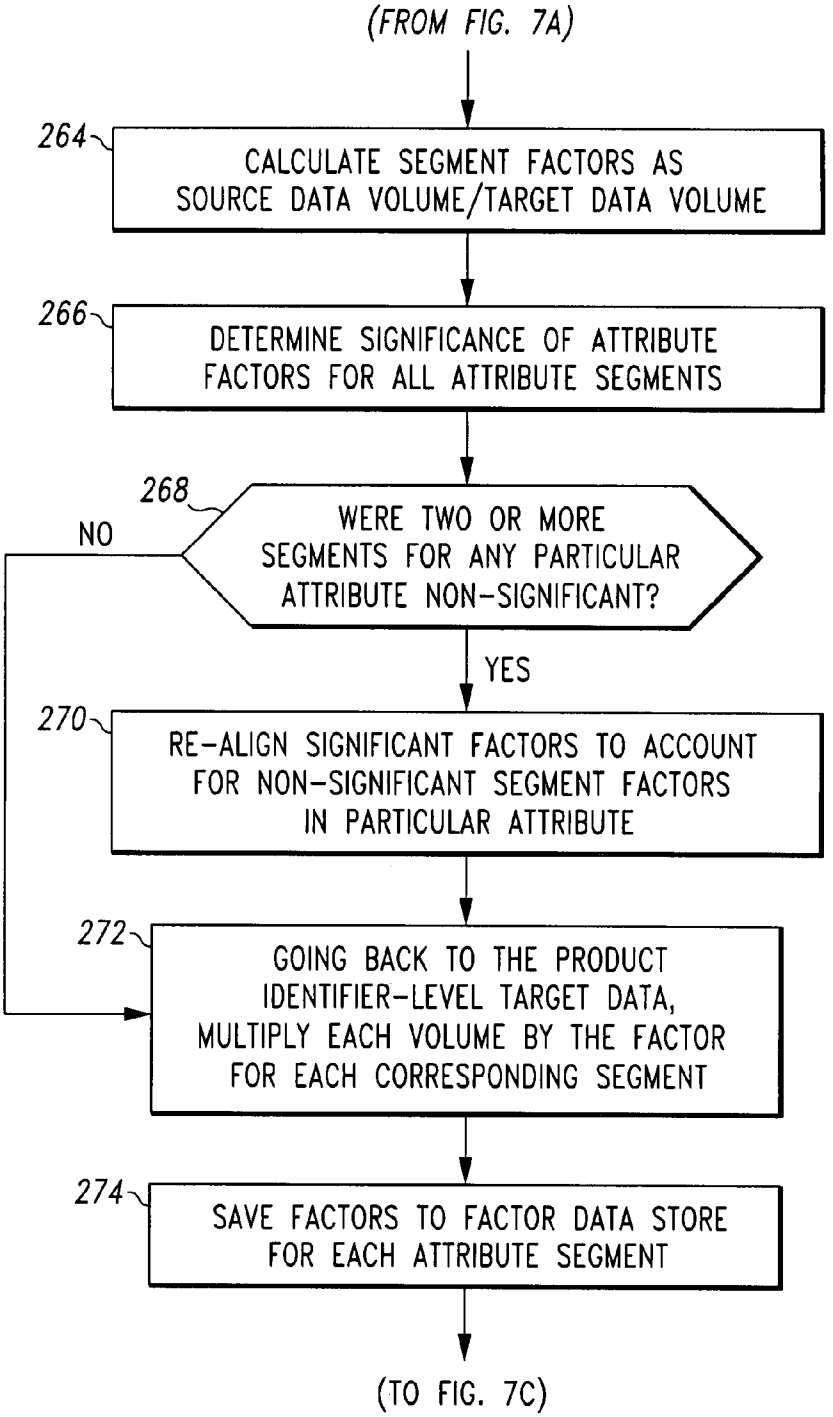

(FROM FIG. 7A)
264
CALCULATE SEGMENT FACTORS AS SOURCE DATA VOLUME/TARGET DATA VOLUME
266
DETERMINE SIGNIFICANCE OF ATTRIBUTE FACTORS FOR ALL ATTRIBUTE SEGMENTS
268
WERE TWO OR MORE SEGMENTS FOR ANY PARTICULAR ATTRIBUTE NON-SIGNIFICANT?
NO
YES
270
RE-ALIGN SIGNIFICANT FACTORS TO ACCOUNT FOR NON-SIGNIFICANT SEGMENT FACTORS IN PARTICULAR ATTRIBUTE
272
GOING BACK TO THE PRODUCT IDENTIFIER-LEVEL TARGET DATA, MULTIPLY EACH VOLUME BY THE FACTOR FOR EACH CORRESPONDING SEGMENT
274
SAVE FACTORS TO FACTOR DATA STORE FOR EACH ATTRIBUTE SEGMENT
(TO FIG. 7C)

Fig. 7B

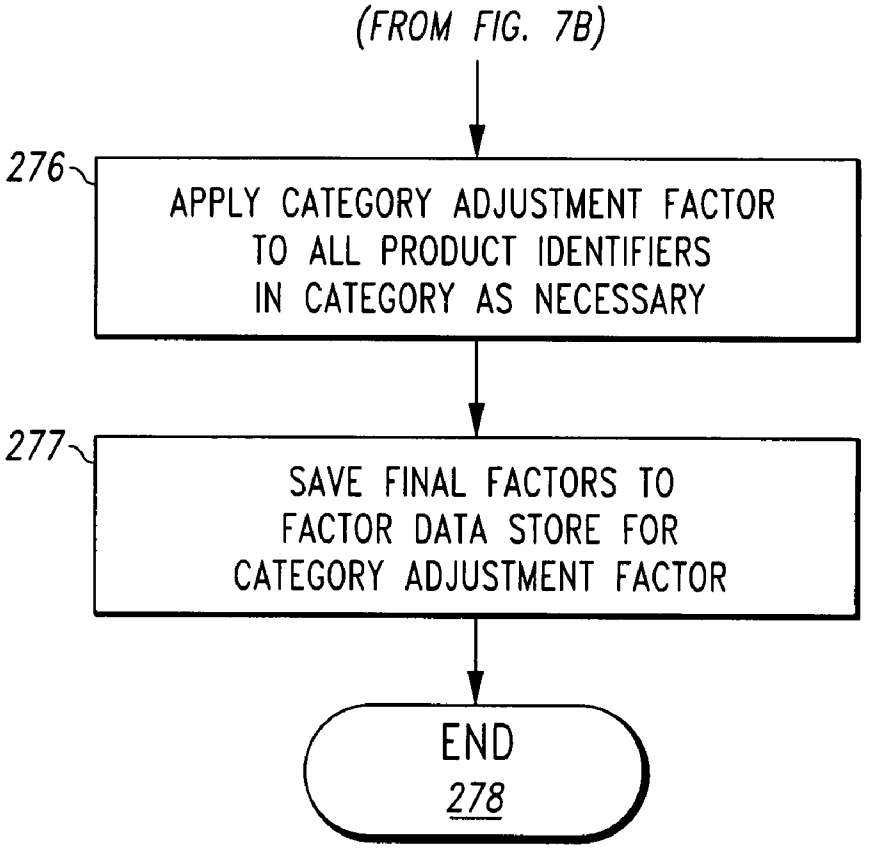

(FROM FIG. 7B)
276
APPLY CATEGORY ADJUSTMENT FACTOR TO ALL PRODUCT IDENTIFIERS IN CATEGORY AS NECESSARY
277
SAVE FINAL FACTORS TO FACTOR DATA STORE FOR CATEGORY ADJUSTMENT FACTOR
END
278

Fig. 7C

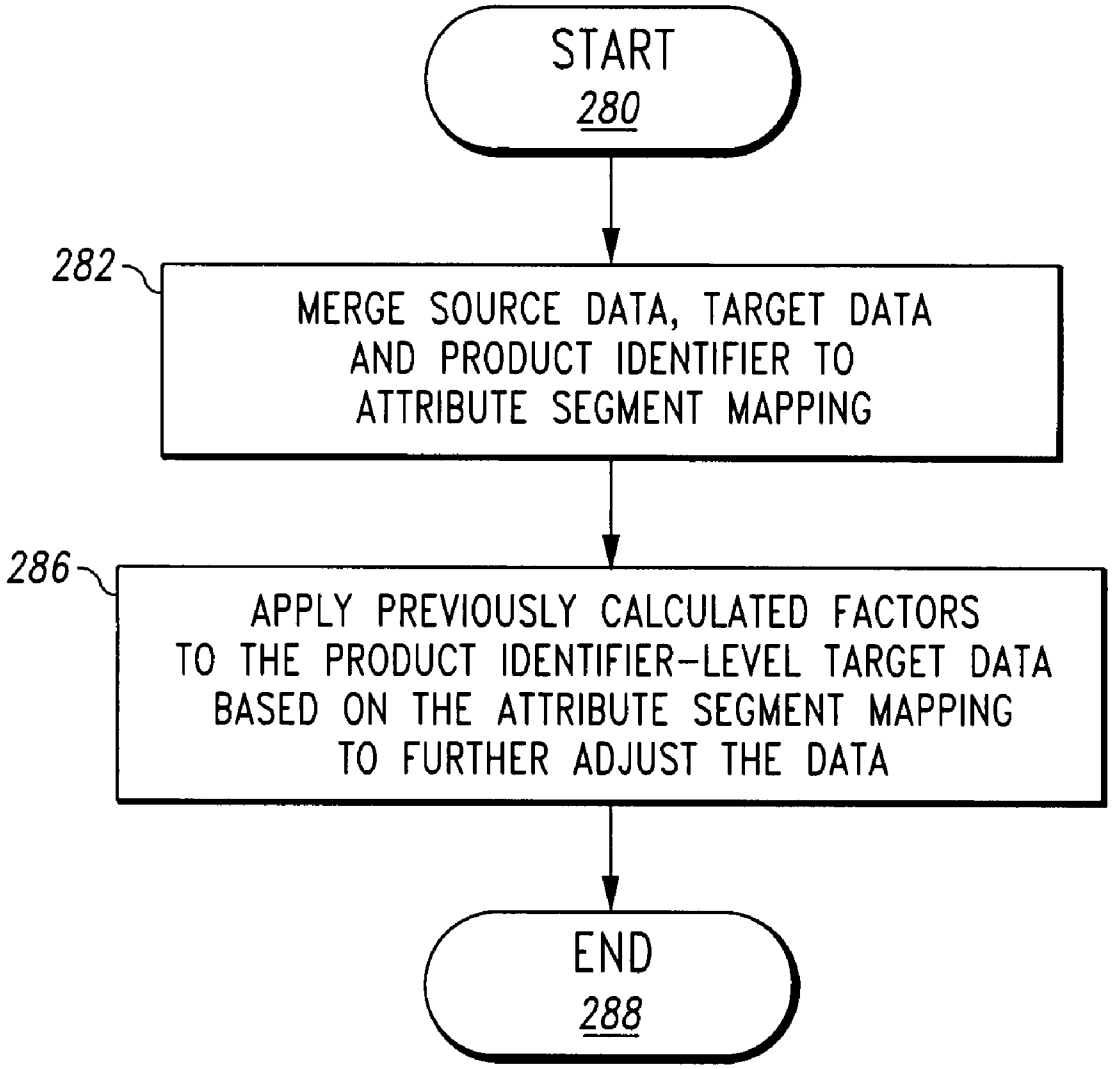

START
280
282
MERGE SOURCE DATA, TARGET DATA AND PRODUCT IDENTIFIER TO ATTRIBUTE SEGMENT MAPPING
286
APPLY PREVIOUSLY CALCULATED FACTORS TO THE PRODUCT IDENTIFIER-LEVEL TARGET DATA BASED ON THE ATTRIBUTE SEGMENT MAPPING TO FURTHER ADJUST THE DATA
END
288

Fig. 8

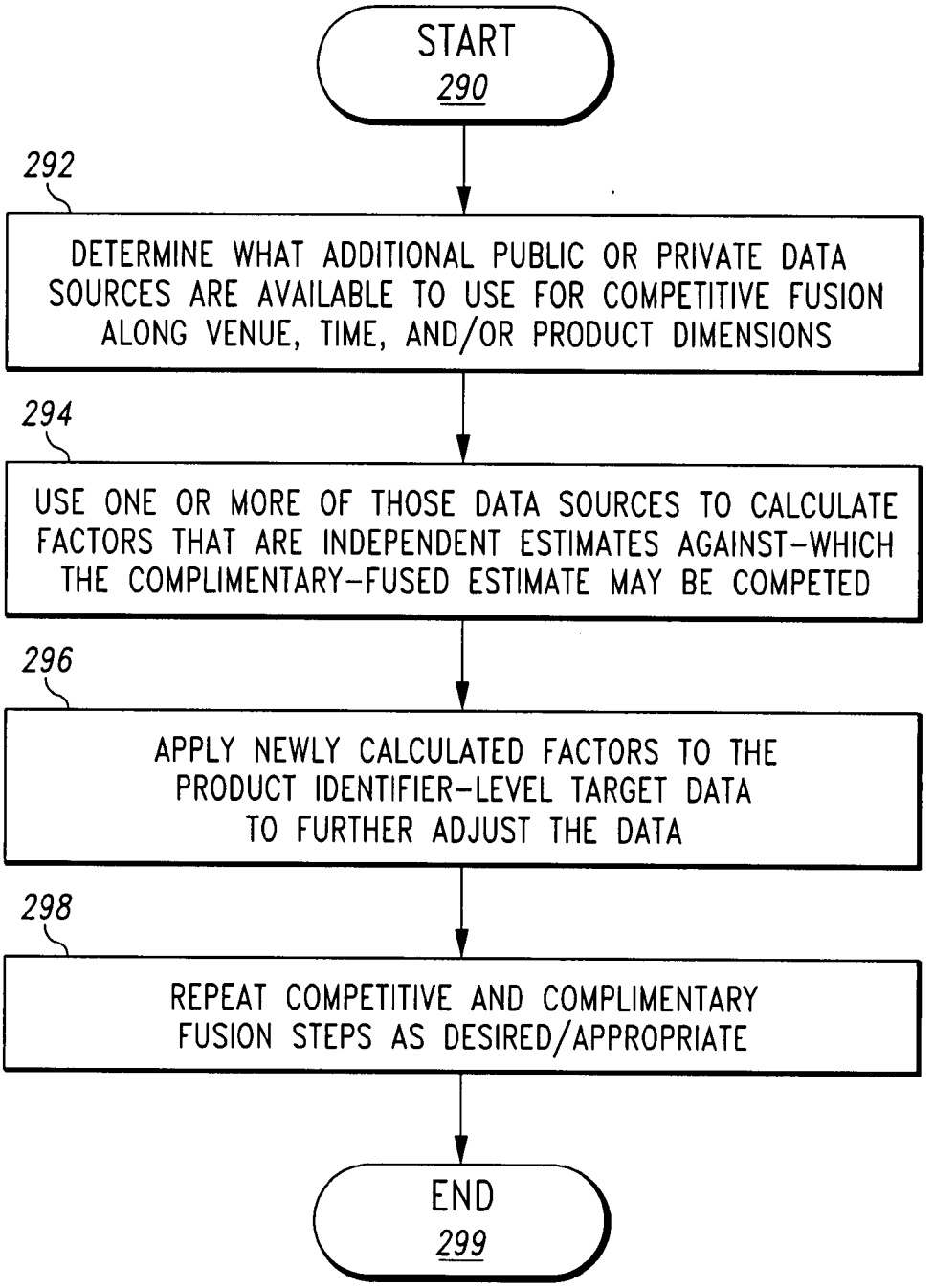

START
290
292
DETERMINE WHAT ADDITIONAL PUBLIC OR PRIVATE DATA SOURCES ARE AVAILABLE TO USE FOR COMPETITIVE FUSION ALONG VENUE, TIME, AND/OR PRODUCT DIMENSIONS
294
USE ONE OR MORE OF THOSE DATA SOURCES TO CALCULATE FACTORS THAT ARE INDEPENDENT ESTIMATES AGAINST-WHICH THE COMPLIMENTARY-FUSED ESTIMATE MAY BE COMPETED
296
APPLY NEWLY CALCULATED FACTORS TO THE PRODUCT IDENTIFIER-LEVEL TARGET DATA TO FURTHER ADJUST THE DATA
298
REPEAT COMPETITIVE AND COMPLIMENTARY FUSION STEPS AS DESIRED/APPROPRIATE
END
299

Fig. 9

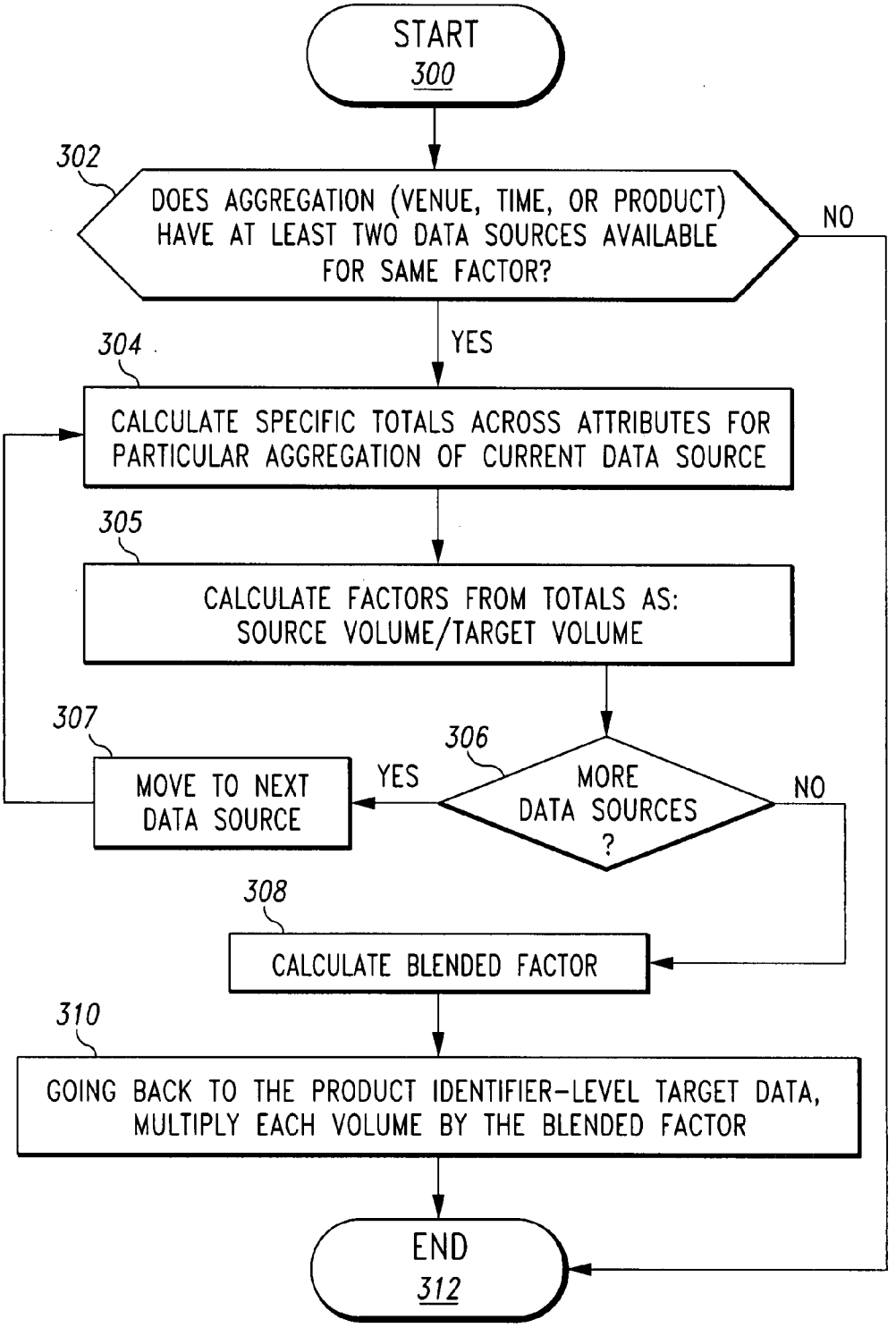
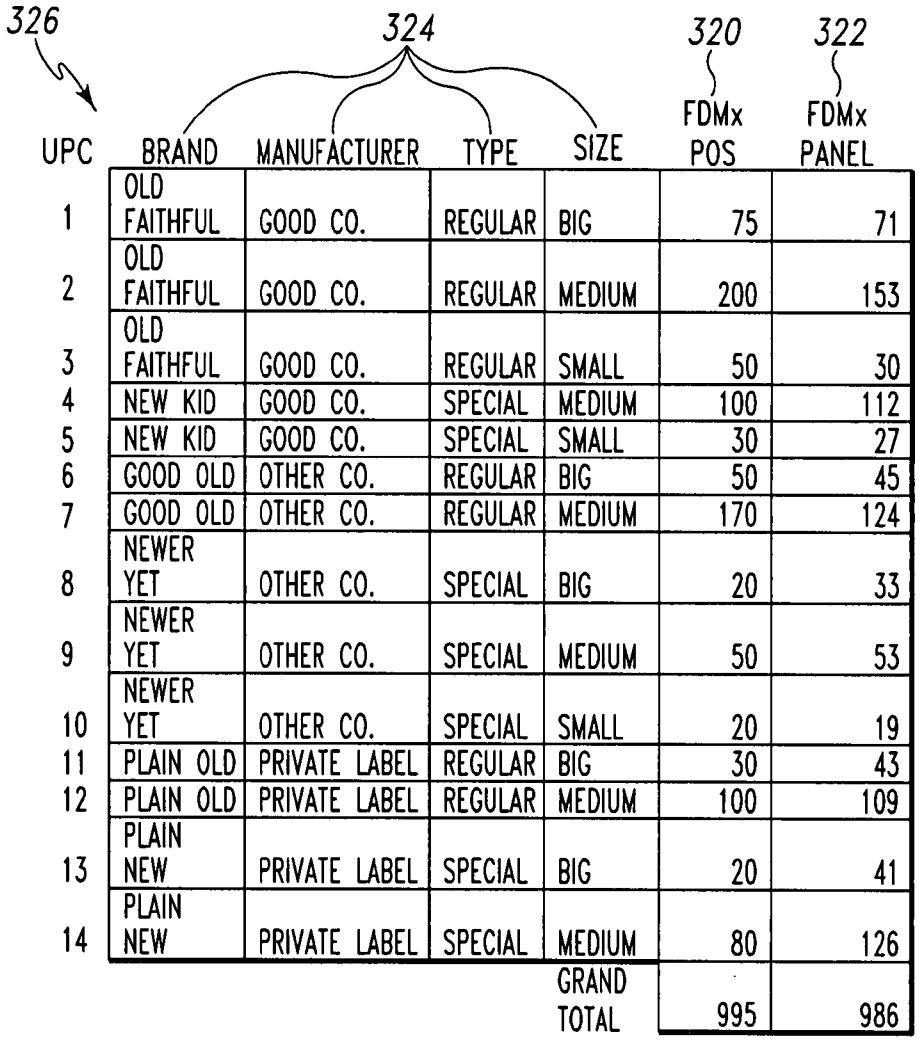

START
300
302
DOES AGGREGATION (VENUE, TIME, OR PRODUCT) HAVE AT LEAST TWO DATA SOURCES AVAILABLE FOR SAME FACTOR?
NO
YES
304
CALCULATE SPECIFIC TOTALS ACROSS ATTRIBUTES FOR PARTICULAR AGGREGATION OF CURRENT DATA SOURCE
305
CALCULATE FACTORS FROM TOTALS AS: SOURCE VOLUME/TARGET VOLUME
306
MORE DATA SOURCES ?
YES
NO
307
MOVE TO NEXT DATA SOURCE
308
CALCULATE BLENDED FACTOR
310
GOING BACK TO THE PRODUCT IDENTIFIER-LEVEL TARGET DATA, MULTIPLY EACH VOLUME BY THE BLENDED FACTOR
END
312

Fig. 10



UPC	BRAND	MANUFACTURER	TYPE	SIZE	FDMx POS	FDMx PANEL
1	OLD FAITHFUL	GOOD CO.	REGULAR	BIG	75	71
2	OLD FAITHFUL	GOOD CO.	REGULAR	MEDIUM	200	153
3	OLD FAITHFUL	GOOD CO.	REGULAR	SMALL	50	30
4	NEW KID	GOOD CO.	SPECIAL	MEDIUM	100	112
5	NEW KID	GOOD CO.	SPECIAL	SMALL	30	27
6	GOOD OLD	OTHER CO.	REGULAR	BIG	50	45
7	GOOD OLD	OTHER CO.	REGULAR	MEDIUM	170	124
8	NEWER YET	OTHER CO.	SPECIAL	BIG	20	33
9	NEWER YET	OTHER CO.	SPECIAL	MEDIUM	50	53
10	NEWER YET	OTHER CO.	SPECIAL	SMALL	20	19
11	PLAIN OLD	PRIVATE LABEL	REGULAR	BIG	30	43
12	PLAIN OLD	PRIVATE LABEL	REGULAR	MEDIUM	100	109
13	PLAIN NEW	PRIVATE LABEL	SPECIAL	BIG	20	41
14	PLAIN NEW	PRIVATE LABEL	SPECIAL	MEDIUM	80	126
				GRAND TOTAL	995	986

Fig. 11

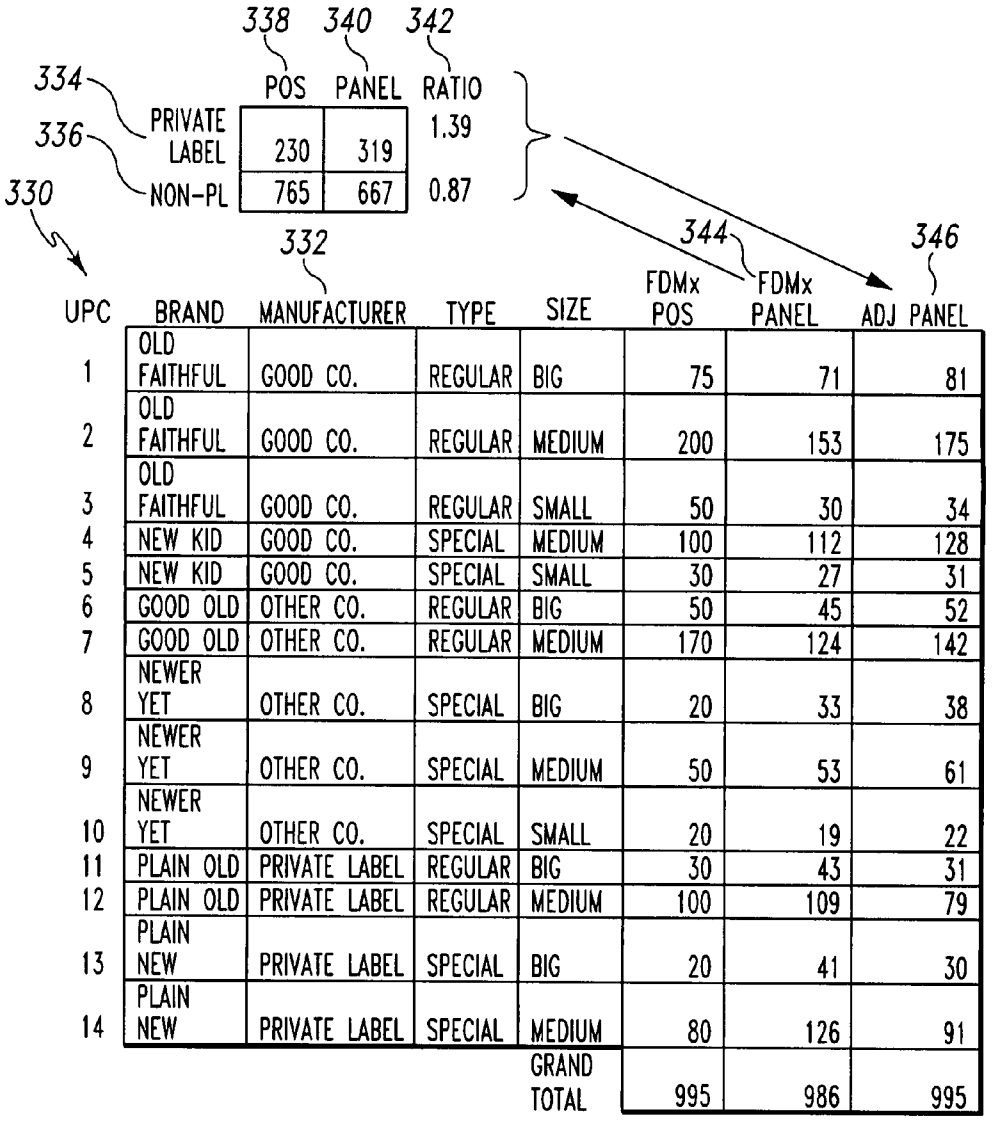

338
340
342
334
POS
PANEL
RATIO
PRIVATE LABEL
336
230
319
1.39
NON-PL
765
667
0.87
330
332
344
346
FDMx POS
FDMx PANEL
ADJ PANEL
UPC
BRAND
MANUFACTURER
TYPE
SIZE
1 OLD FAITHFUL GOOD CO. REGULAR BIG 75 71 81
2 OLD FAITHFUL GOOD CO. REGULAR MEDIUM 200 153 175
3 OLD FAITHFUL GOOD CO. REGULAR SMALL 50 30 34
4 NEW KID GOOD CO. SPECIAL MEDIUM 100 112 128
5 NEW KID GOOD CO. SPECIAL SMALL 30 27 31
6 GOOD OLD OTHER CO. REGULAR BIG 50 45 52
7 GOOD OLD OTHER CO. REGULAR MEDIUM 170 124 142
8 NEWER YET OTHER CO. SPECIAL BIG 20 33 38
9 NEWER YET OTHER CO. SPECIAL MEDIUM 50 53 61
10 NEWER YET OTHER CO. SPECIAL SMALL 20 19 22
11 PLAIN OLD PRIVATE LABEL REGULAR BIG 30 43 31
12 PLAIN OLD PRIVATE LABEL REGULAR MEDIUM 100 109 79
13 PLAIN NEW PRIVATE LABEL SPECIAL BIG 20 41 30
14 PLAIN NEW PRIVATE LABEL SPECIAL MEDIUM 80 126 91
GRAND TOTAL 995 986 995

Fig. 12

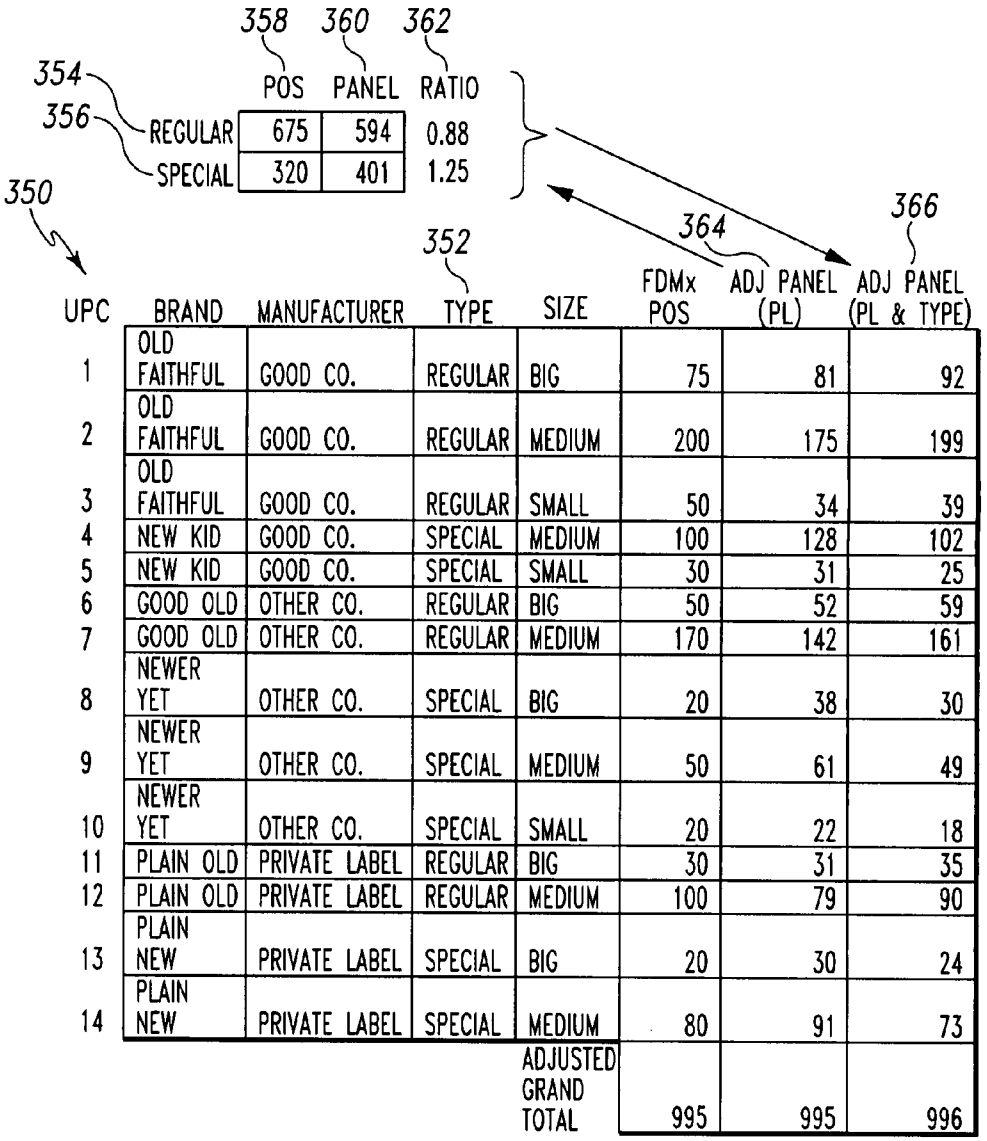
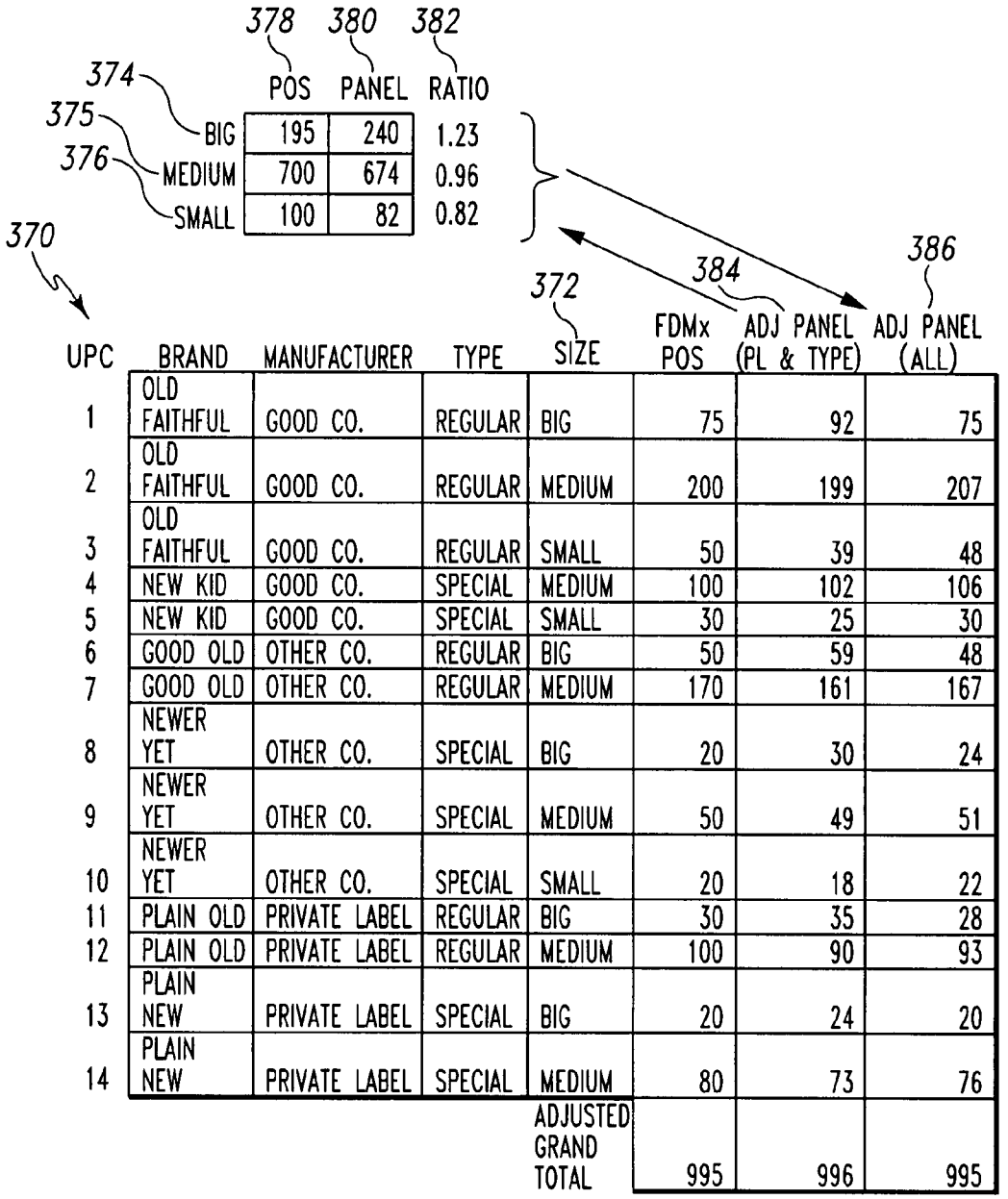

358
360
362
354
356
POS
PANEL
RATIO
REGULAR
675
594
0.88
SPECIAL
320
401
1.25
350
352
364
366
UPC
BRAND
MANUFACTURER
TYPE
SIZE
FDMx POS
ADJ PANEL (PL)
ADJ PANEL (PL & TYPE)
1 OLD FAITHFUL GOOD CO. REGULAR BIG 75 81 92
2 OLD FAITHFUL GOOD CO. REGULAR MEDIUM 200 175 199
3 OLD FAITHFUL GOOD CO. REGULAR SMALL 50 34 39
4 NEW KID GOOD CO. SPECIAL MEDIUM 100 128 102
5 NEW KID GOOD CO. SPECIAL SMALL 30 31 25
6 GOOD OLD OTHER CO. REGULAR BIG 50 52 59
7 GOOD OLD OTHER CO. REGULAR MEDIUM 170 142 161
8 NEWER YET OTHER CO. SPECIAL BIG 20 38 30
9 NEWER YET OTHER CO. SPECIAL MEDIUM 50 61 49
10 NEWER YET OTHER CO. SPECIAL SMALL 20 22 18
11 PLAIN OLD PRIVATE LABEL REGULAR BIG 30 31 35
12 PLAIN OLD PRIVATE LABEL REGULAR MEDIUM 100 79 90
13 PLAIN NEW PRIVATE LABEL SPECIAL BIG 20 30 24
14 PLAIN NEW PRIVATE LABEL SPECIAL MEDIUM 80 91 73
ADJUSTED GRAND TOTAL 995 995 996

Fig. 13



UPC	BRAND	MANUFACTURER	TYPE	SIZE	FDMx POS	ADJ PANEL (PL & TYPE)	ADJ PANEL (ALL)
1	OLD FAITHFUL	GOOD CO.	REGULAR	BIG	75	92	75
2	OLD FAITHFUL	GOOD CO.	REGULAR	MEDIUM	200	199	207
3	OLD FAITHFUL	GOOD CO.	REGULAR	SMALL	50	39	48
4	NEW KID	GOOD CO.	SPECIAL	MEDIUM	100	102	106
5	NEW KID	GOOD CO.	SPECIAL	SMALL	30	25	30
6	GOOD OLD	OTHER CO.	REGULAR	BIG	50	59	48
7	GOOD OLD	OTHER CO.	REGULAR	MEDIUM	170	161	167
8	NEWER YET	OTHER CO.	SPECIAL	BIG	20	30	24
9	NEWER YET	OTHER CO.	SPECIAL	MEDIUM	50	49	51
10	NEWER YET	OTHER CO.	SPECIAL	SMALL	20	18	22
11	PLAIN OLD	PRIVATE LABEL	REGULAR	BIG	30	35	28
12	PLAIN OLD	PRIVATE LABEL	REGULAR	MEDIUM	100	90	93
13	PLAIN NEW	PRIVATE LABEL	SPECIAL	BIG	20	24	20
14	PLAIN NEW	PRIVATE LABEL	SPECIAL	MEDIUM	80	73	76
				ADJUSTED GRAND TOTAL	995	996	995

Fig. 14

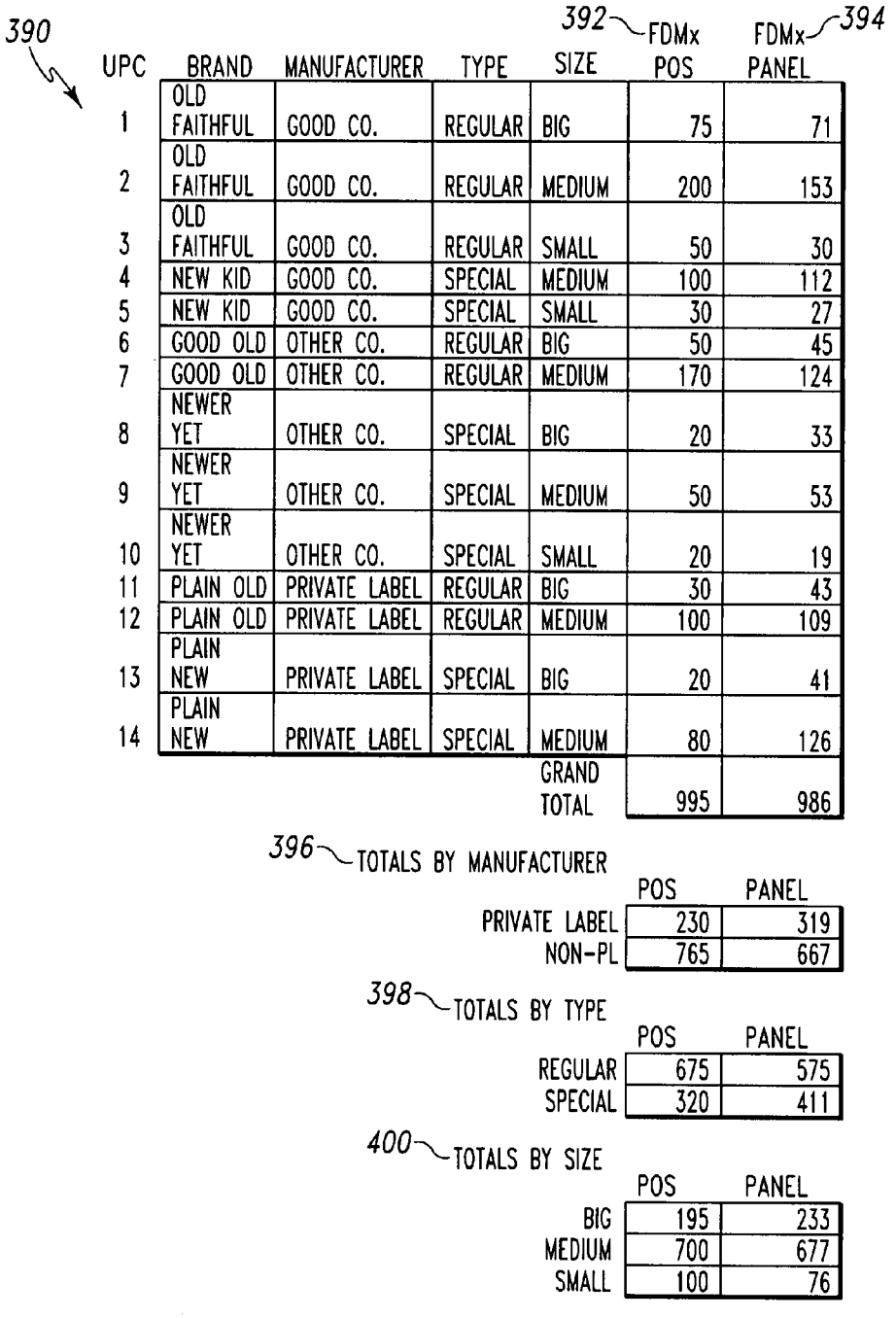
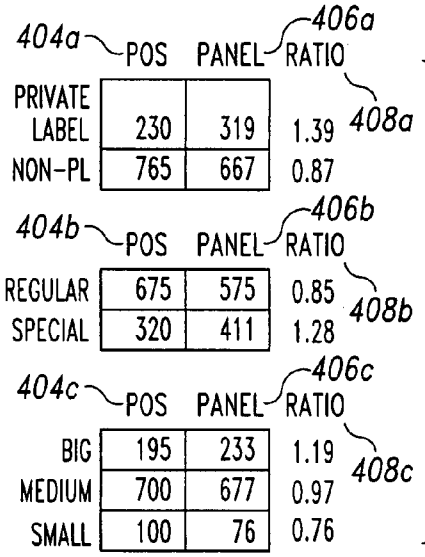

390
392
FDMx POS
394
FDMx PANEL
UPC
BRAND
MANUFACTURER
TYPE
SIZE
1 OLD FAITHFUL GOOD CO. REGULAR BIG 75 71
2 OLD FAITHFUL GOOD CO. REGULAR MEDIUM 200 153
3 OLD FAITHFUL GOOD CO. REGULAR SMALL 50 30
4 NEW KID GOOD CO. SPECIAL MEDIUM 100 112
5 NEW KID GOOD CO. SPECIAL SMALL 30 27
6 GOOD OLD OTHER CO. REGULAR BIG 50 45
7 GOOD OLD OTHER CO. REGULAR MEDIUM 170 124
8 NEWER YET OTHER CO. SPECIAL BIG 20 33
9 NEWER YET OTHER CO. SPECIAL MEDIUM 50 53
10 NEWER YET OTHER CO. SPECIAL SMALL 20 19
11 PLAIN OLD PRIVATE LABEL REGULAR BIG 30 43
12 PLAIN OLD PRIVATE LABEL REGULAR MEDIUM 100 109
13 PLAIN NEW PRIVATE LABEL SPECIAL BIG 20 41
14 PLAIN NEW PRIVATE LABEL SPECIAL MEDIUM 80 126
GRAND TOTAL 995 986
396
TOTALS BY MANUFACTURER
POS PANEL
PRIVATE LABEL 230 319
NON-PL 765 667
398
TOTALS BY TYPE
POS PANEL
REGULAR 675 575
SPECIAL 320 411
400
TOTALS BY SIZE
POS PANEL
BIG 195 233
MEDIUM 700 677
SMALL 100 76

Fig. 15



UPC	BRAND	MANUFACTURER	TYPE	SIZE	FDMx POS	FDMx PANEL	ADJ PANEL
1	OLD FAITHFUL	GOOD CO.	REGULAR	BIG	75	71	80
2	OLD FAITHFUL	GOOD CO.	REGULAR	MEDIUM	200	153	213
3	OLD FAITHFUL	GOOD CO.	REGULAR	SMALL	50	30	53
4	NEW KID	GOOD CO.	SPECIAL	MEDIUM	100	112	103
5	NEW KID	GOOD CO.	SPECIAL	SMALL	30	27	32
6	GOOD OLD	OTHER CO.	REGULAR	BIG	50	45	51
7	GOOD OLD	OTHER CO.	REGULAR	MEDIUM	170	124	173
8	NEWER YET	OTHER CO.	SPECIAL	BIG	20	33	25
9	NEWER YET	OTHER CO.	SPECIAL	MEDIUM	50	53	49
10	NEWER YET	OTHER CO.	SPECIAL	SMALL	20	19	22
11	PLAIN OLD	PRIVATE LABEL	REGULAR	BIG	30	43	30
12	PLAIN OLD	PRIVATE LABEL	REGULAR	MEDIUM	100	109	95
13	PLAIN NEW	PRIVATE LABEL	SPECIAL	BIG	20	41	19
14	PLAIN NEW	PRIVATE LABEL	SPECIAL	MEDIUM	80	126	73
				ADJUSTED GRAND TOTAL	995	986	1018

Fig. 16

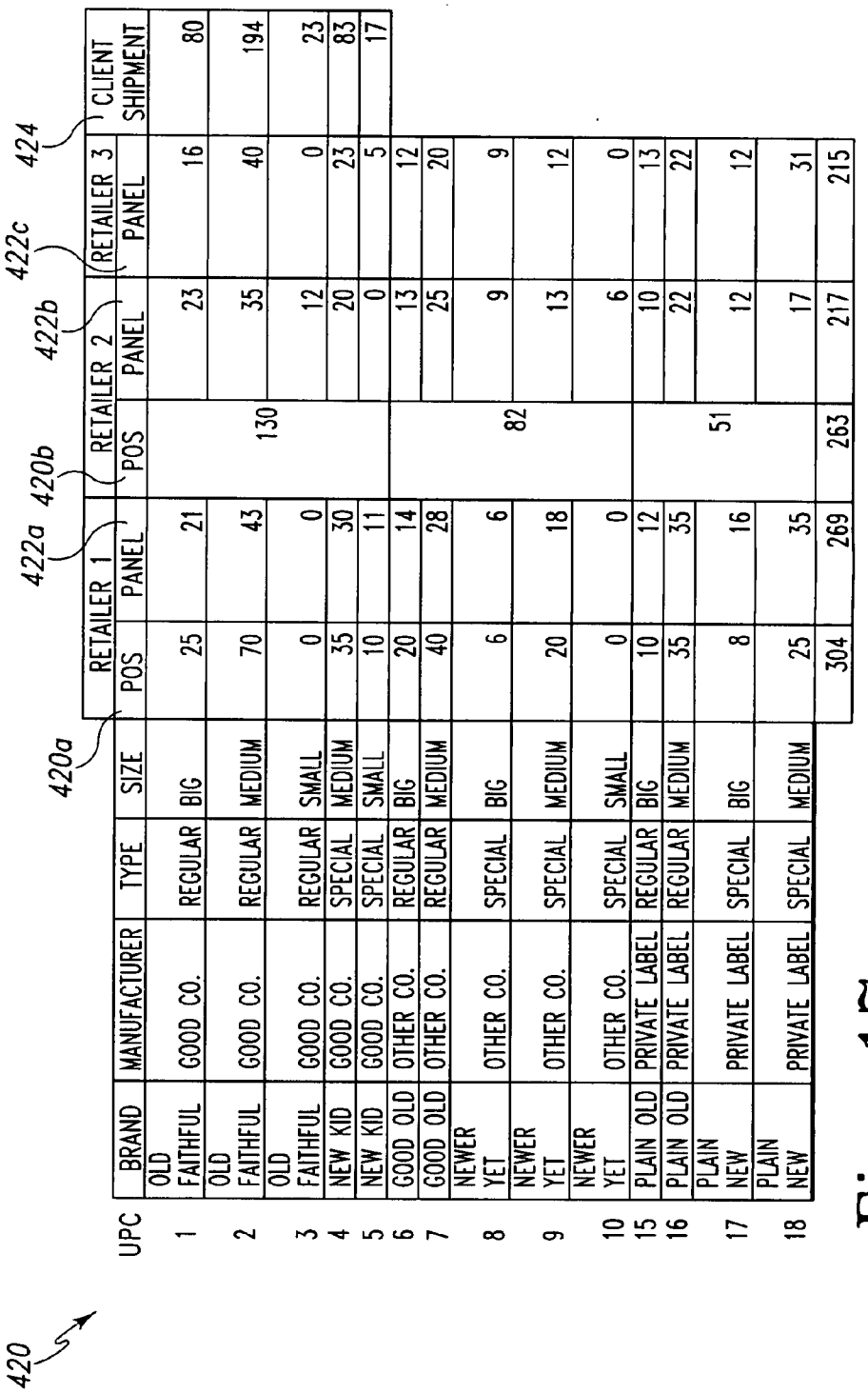
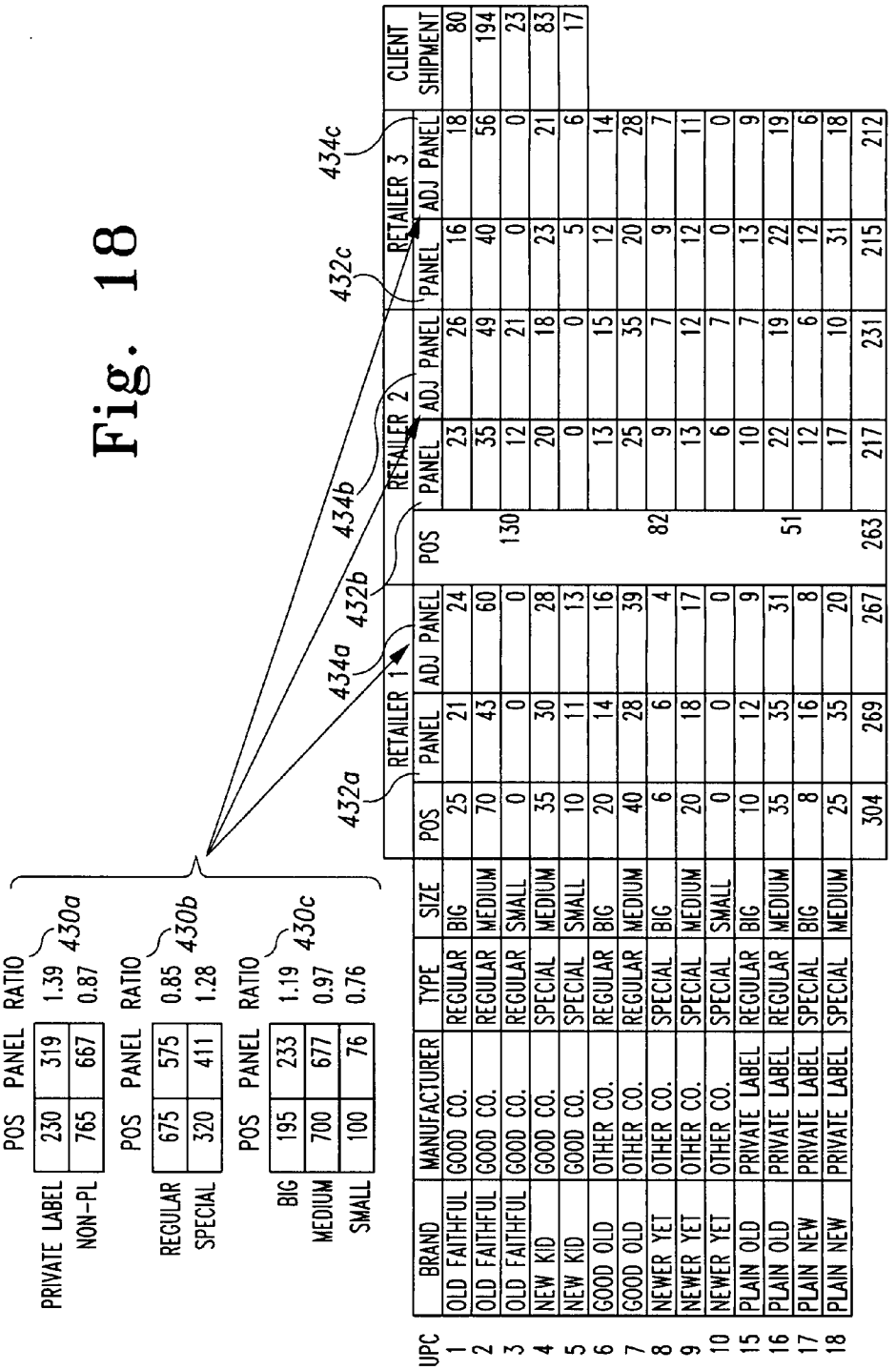

420
420a
422a
420b
422b
422c
424
RETAILER 1
RETAILER 2
RETAILER 3
CLIENT SHIPMENT
UPC
BRAND
MANUFACTURER
TYPE
SIZE
POS
PANEL
POS
PANEL
PANEL
1 OLD FAITHFUL GOOD CO. REGULAR BIG 25 21 23 16 80
2 OLD FAITHFUL GOOD CO. REGULAR MEDIUM 70 43 130 35 40 194
3 OLD FAITHFUL GOOD CO. REGULAR SMALL 0 0 12 0 23
4 NEW KID GOOD CO. SPECIAL MEDIUM 35 30 20 23 83
5 NEW KID GOOD CO. SPECIAL SMALL 10 11 0 5 17
6 GOOD OLD OTHER CO. REGULAR BIG 20 14 13 12
7 GOOD OLD OTHER CO. REGULAR MEDIUM 40 28 25 20
8 NEWER YET OTHER CO. SPECIAL BIG 6 6 82 9 9
9 NEWER YET OTHER CO. SPECIAL MEDIUM 20 18 13 12
10 NEWER YET OTHER CO. SPECIAL SMALL 0 0 6 0
15 PLAIN OLD PRIVATE LABEL REGULAR BIG 10 12 10 13
16 PLAIN OLD PRIVATE LABEL REGULAR MEDIUM 35 35 51 22 22
17 PLAIN NEW PRIVATE LABEL SPECIAL BIG 8 16 12 12
18 PLAIN NEW PRIVATE LABEL SPECIAL MEDIUM 25 35 17 31
304 269 263 217 215

Fig. 17

Fig. 18


POS PANEL RATIO
PRIVATE LABEL 230 319 1.39
NON-PL 765 667 0.87
430a
POS PANEL RATIO
REGULAR 675 575 0.85
SPECIAL 320 411 1.28
430b
POS PANEL RATIO
BIG 195 233 1.19
MEDIUM 700 677 0.97
SMALL 100 76 0.76
430c
UPC BRAND MANUFACTURER TYPE SIZE POS PANEL ADJ PANEL POS PANEL ADJ PANEL PANEL ADJ PANEL SHIPMENT
1 OLD FAITHFUL GOOD CO. REGULAR BIG 25 21 24 23 26 16 18 80
2 OLD FAITHFUL GOOD CO. REGULAR MEDIUM 70 43 60 35 49 40 56 194
3 OLD FAITHFUL GOOD CO. REGULAR SMALL 0 0 0 12 21 0 0 23
4 NEW KID GOOD CO. SPECIAL MEDIUM 35 30 28 20 18 23 21 83
5 NEW KID GOOD CO. SPECIAL SMALL 10 11 13 0 0 5 6 17
6 GOOD OLD OTHER CO. REGULAR BIG 20 14 16 13 15 12 14
7 GOOD OLD OTHER CO. REGULAR MEDIUM 40 28 39 25 35 20 28
8 NEWER YET OTHER CO. SPECIAL BIG 6 6 4 9 7 9 7
9 NEWER YET OTHER CO. SPECIAL MEDIUM 20 18 17 13 12 12 11
10 NEWER YET OTHER CO. SPECIAL SMALL 0 0 0 6 7 0 0
15 PLAIN OLD PRIVATE LABEL REGULAR BIG 10 12 9 10 7 13 9
16 PLAIN OLD PRIVATE LABEL REGULAR MEDIUM 35 35 31 22 19 22 19
17 PLAIN NEW PRIVATE LABEL SPECIAL BIG 8 16 8 12 6 12 6
18 PLAIN NEW PRIVATE LABEL SPECIAL MEDIUM 25 35 20 17 10 31 18
304 269 267 263 217 231 215 212
130 82 51
RETAILER 1
RETAILER 2
RETAILER 3
CLIENT
432a
434a
432b
434b
432c
434c

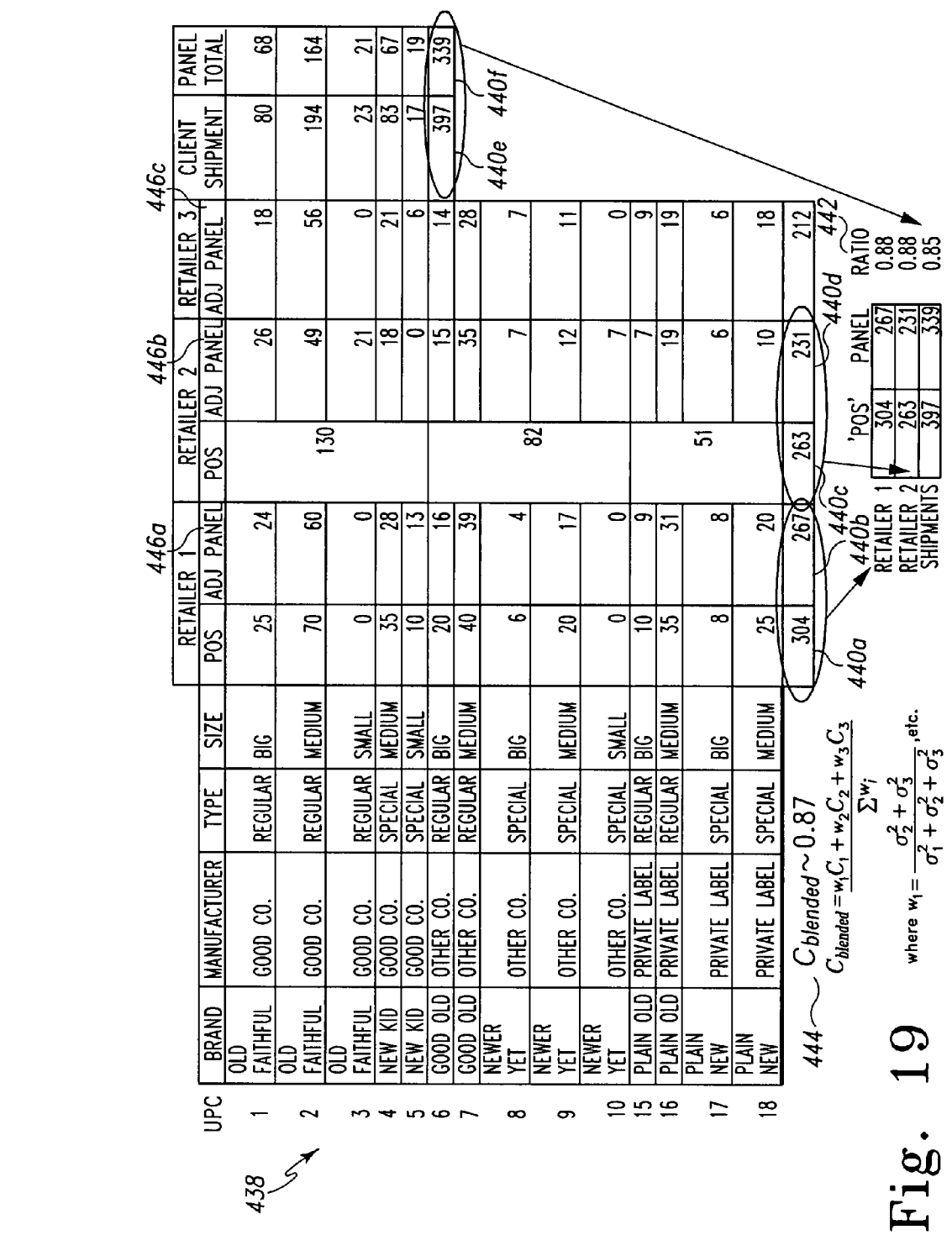
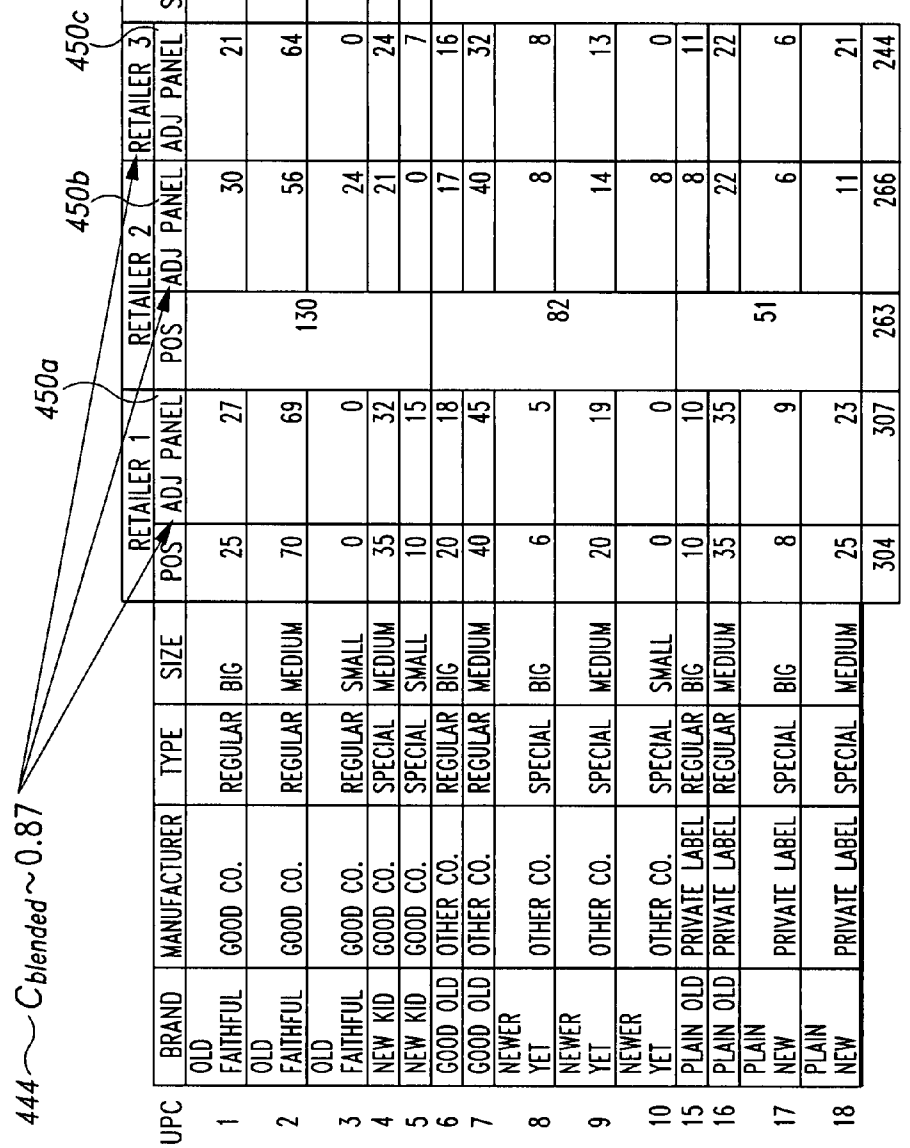

438
UPC
BRAND
MANUFACTURER
TYPE
SIZE
RETAILER 1
POS
ADJ PANEL
RETAILER 2
POS
ADJ PANEL
RETAILER 3
ADJ PANEL
CLIENT SHIPMENT
PANEL TOTAL
446a
446b
446c
OLD FAITHFUL
GOOD CO.
REGULAR
BIG
25
24
26
18
80
68
OLD FAITHFUL
GOOD CO.
REGULAR
MEDIUM
70
60
130
49
56
194
164
OLD FAITHFUL
GOOD CO.
REGULAR
SMALL
0
0
21
0
23
21
NEW KID
GOOD CO.
SPECIAL
MEDIUM
35
28
18
21
83
67
NEW KID
GOOD CO.
SPECIAL
SMALL
10
13
0
6
17
19
GOOD OLD
OTHER CO.
REGULAR
BIG
20
16
15
14
397
339
GOOD OLD
OTHER CO.
REGULAR
MEDIUM
40
39
35
28
440e
440f
NEWER YET
OTHER CO.
SPECIAL
BIG
6
4
82
7
7
NEWER YET
OTHER CO.
SPECIAL
MEDIUM
20
17
12
11
NEWER YET
OTHER CO.
SPECIAL
SMALL
0
0
7
0
PLAIN OLD
PRIVATE LABEL
REGULAR
BIG
10
9
7
9
PLAIN OLD
PRIVATE LABEL
REGULAR
MEDIUM
35
31
19
19
PLAIN NEW
PRIVATE LABEL
SPECIAL
BIG
8
8
51
6
6
PLAIN NEW
PRIVATE LABEL
SPECIAL
MEDIUM
25
20
10
18
304
2670
263
231
212
444
$C_{blended} \sim 0.87$
$C_{blended} = \frac{w_1C_1 + w_2C_2 + w_3C_3}{\Sigma w_i}$
where $w_1 = \frac{\sigma_2^2 + \sigma_3^2}{\sigma_1^2 + \sigma_2^2 + \sigma_3^2}$, etc.
440a
440b
440c
440d
442
RETAILER 1 SHIPMENTS
RETAILER 2 SHIPMENTS
'POS' PANEL
RATIO
304 267 0.88
263 231 0.88
397 339 0.85

Fig. 19



UPC	BRAND	MANUFACTURER	TYPE	SIZE	RETAILER 1 POS	RETAILER 1 ADJ PANEL	RETAILER 2 POS	RETAILER 2 ADJ PANEL	RETAILER 3 ADJ PANEL	CLIENT SHIPMENT
1	OLD FAITHFUL	GOOD CO.	REGULAR	BIG	25	27	130	30	21	80
2	OLD FAITHFUL	GOOD CO.	REGULAR	MEDIUM	70	69		56	64	194
3	OLD FAITHFUL	GOOD CO.	REGULAR	SMALL	0	0		24	0	23
4	NEW KID	GOOD CO.	SPECIAL	MEDIUM	35	32		21	24	83
5	NEW KID	GOOD CO.	SPECIAL	SMALL	10	15		0	7	17
6	GOOD OLD	OTHER CO.	REGULAR	BIG	20	18	82	17	16	
7	GOOD OLD	OTHER CO.	REGULAR	MEDIUM	40	45		40	32	
8	NEWER YET	OTHER CO.	SPECIAL	BIG	6	5		8	8	
9	NEWER YET	OTHER CO.	SPECIAL	MEDIUM	20	19		14	13	
10	NEWER YET	OTHER CO.	SPECIAL	SMALL	0	0		8	0	
15	PLAIN OLD	PRIVATE LABEL	REGULAR	BIG	10	10	51	8	11	
16	PLAIN OLD	PRIVATE LABEL	REGULAR	MEDIUM	35	35		22	22	
17	PLAIN NEW	PRIVATE LABEL	SPECIAL	BIG	8	9		6	6	
18	PLAIN NEW	PRIVATE LABEL	SPECIAL	MEDIUM	25	23		11	21	
					304	307	263	266	244	

Fig. 20

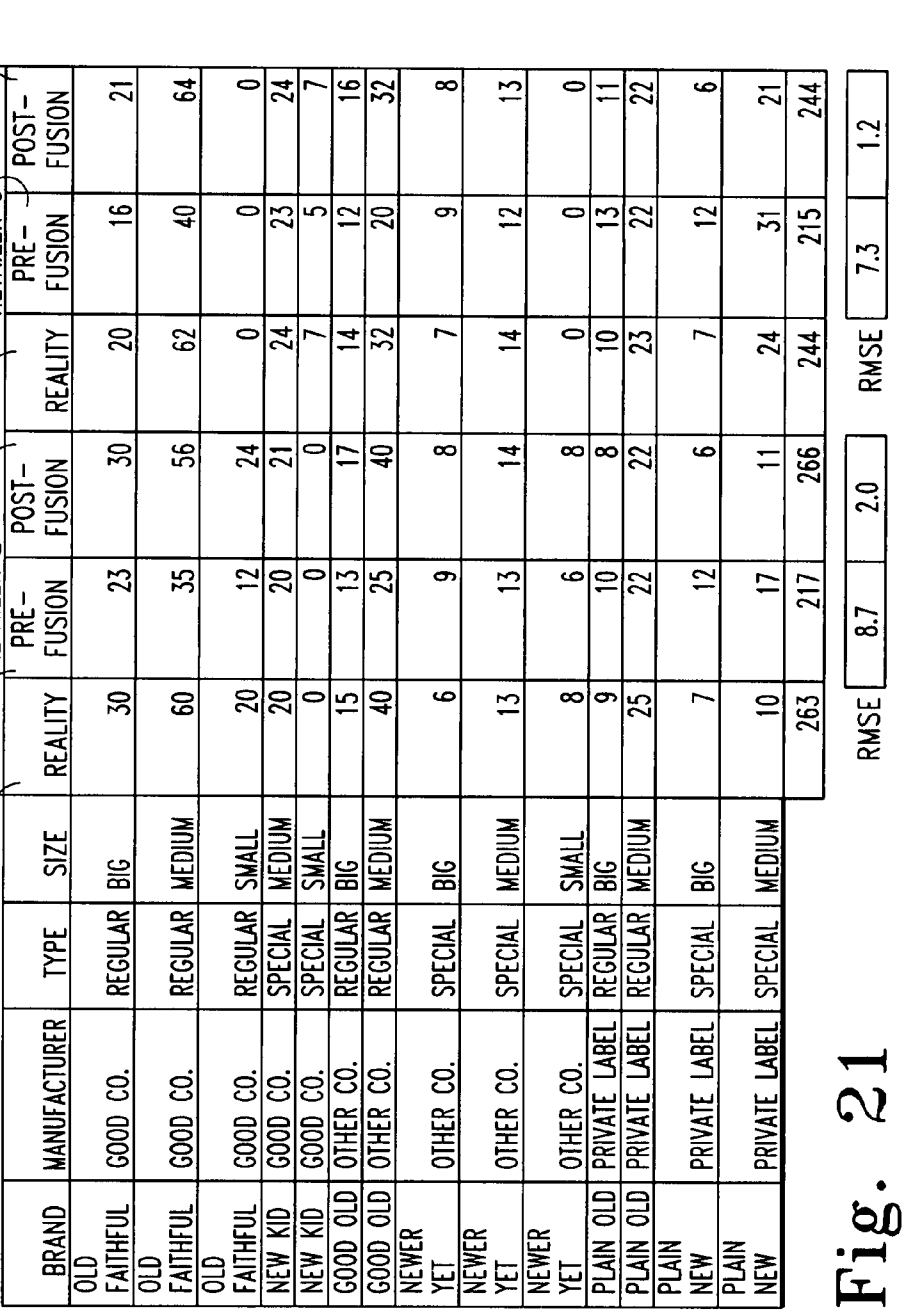

460
462a
462b
464a
464b
466a
466b
RETAILER 2
RETAILER 3
UPC
BRAND
MANUFACTURER
TYPE
SIZE
REALITY
PRE-FUSION
POST-FUSION
REALITY
PRE-FUSION
POST-FUSION
1 OLD FAITHFUL GOOD CO. REGULAR BIG 30 23 30 20 16 21
2 OLD FAITHFUL GOOD CO. REGULAR MEDIUM 60 35 56 62 40 64
3 OLD FAITHFUL GOOD CO. REGULAR SMALL 20 12 24 0 0 0
4 NEW KID GOOD CO. SPECIAL MEDIUM 20 20 21 24 23 24
5 NEW KID GOOD CO. SPECIAL SMALL 0 0 0 7 5 7
6 GOOD OLD OTHER CO. REGULAR BIG 15 13 17 14 12 16
7 GOOD OLD OTHER CO. REGULAR MEDIUM 40 25 40 32 20 32
8 NEWER YET OTHER CO. SPECIAL BIG 6 9 8 7 9 8
9 NEWER YET OTHER CO. SPECIAL MEDIUM 13 13 14 14 12 13
10 NEWER YET OTHER CO. SPECIAL SMALL 8 6 8 0 0 0
15 PLAIN OLD PRIVATE LABEL REGULAR BIG 9 10 8 10 13 11
16 PLAIN OLD PRIVATE LABEL REGULAR MEDIUM 25 22 22 23 22 22
17 PLAIN NEW PRIVATE LABEL SPECIAL BIG 7 12 6 7 12 6
18 PLAIN NEW PRIVATE LABEL SPECIAL MEDIUM 10 17 11 24 31 21
263 217 266 244 215 244
RMSE 8.7 2.0 RMSE 7.3 1.2

Fig. 21

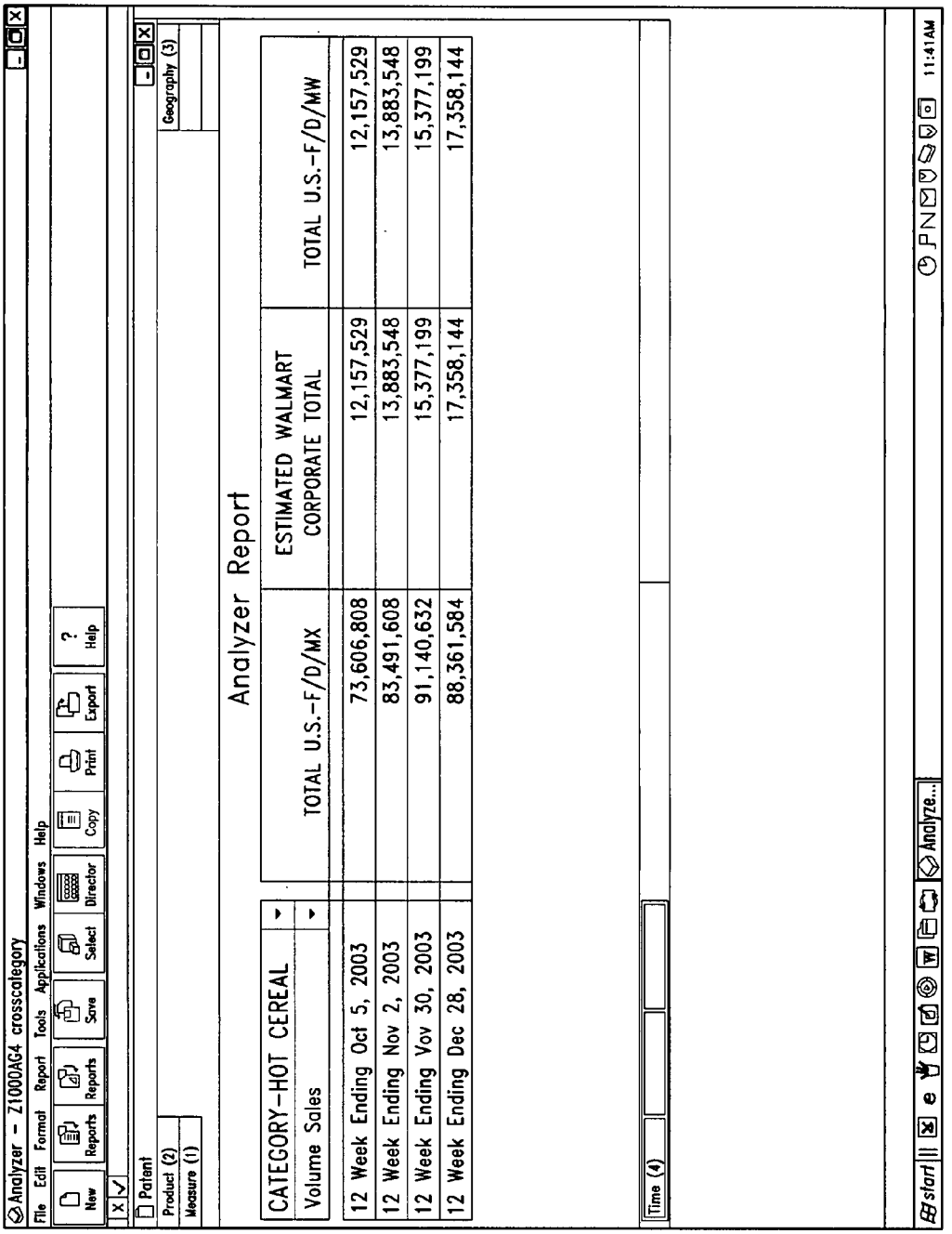

Analyzer - Z1000AG4 crosscategory
File Edit Format Report Tools Applications Windows Help
New Reports Reports Save Select Director Copy Print Export Help
Patent
Product (2)
Measure (1)
Geography (3)
Analyzer Report
CATEGORY-HOT CEREAL
Volume Sales
TOTAL U.S.-F/D/MX
ESTIMATED WALMART CORPORATE TOTAL
TOTAL U.S.-F/D/MW
12 Week Ending Oct 5, 2003 73,606,808 12,157,529 12,157,529
12 Week Ending Nov 2, 2003 83,491,608 13,883,548 13,883,548
12 Week Ending Vov 30, 2003 91,140,632 15,377,199 15,377,199
12 Week Ending Dec 28, 2003 88,361,584 17,358,144 17,358,144
Time (4)
start
Analyze...
11:41AM

Fig. 22

SYSTEM AND METHOD FOR ANALYZING AND CORRECTING RETAIL DATA

BACKGROUND

[0001] The present invention relates to computer software, and more particularly, but not exclusively, relates to systems and methods for analyzing and correcting retail data.

[0002] The measurement of sales in retail channels can be done via a variety of methods. Initially, sample-based audits of consumer purchases at check-out were extensively utilized—but were costly and subject to significant potential inaccuracies. With the advent and accuracy improvement in scanner-based point of sale (POS) data, tracking services such as those offered by Information Resources, Inc. (IRI), and A.C. Nielsen (ACN) are able to provide highly-granular (in terms of item, venue, and time), highly-accurate measurement of sales in several retail channels—including food/grocery, drug, mass merchandise, convenience, and military commissary. These POS-based offerings can be sample-based—i.e., rely on a statistically determined subset of the target population—or census-based—i.e., use all available data from all available venues.

[0003] While POS-based measurement offerings do an excellent job of reporting "what" sold, they provide little insight into "why" something sold—since they provide no consumer-level data. To fill this need, market research companies such as IRI and ACN have recruited national consumer panels—in which panelists report their households' purchases on a regular basis. This longitudinal sample allows the development of much deeper consumer insights (e.g., brand switching, trial and repeat, etc.).

[0004] However, consumer panels are not without their problems. As with any sample-based survey, consumer panels are subject to two types of errors—i.e., sampling errors and biases—where the total error is given by the sum: $(\text{Total Error})^2=(\text{Sampling Error})^2+(\text{Bias})^2$.

[0005] Sampling errors are those errors attributable to the normal (random) variation that would be expected due to the fact that, by the very act of sampling, measurements are not being taken from the entire population. Sampling errors can be reduced by increasing the sample size since the standard deviation of the sampling distribution (often referred to as the "standard error") decreases with the square root of the sample size.

[0006] Biases are systematic errors that affect any sample taken by a particular sampling method. Because these errors are systematic, they are not affected by the size of the sample. Examples of panel biases include, but are not limited to:

[0007] Recruitment bias—in which households recruited to participate in the panel are not representative of the target population (e.g., the overall population of the United States);

[0008] Self-selection bias —in which households who choose to participate in the panel have slightly different buying habits than the average household (e.g., an orientation toward using promotions or adopting new products);

[0009] Panelist turnover bias—in which the reporting effectiveness (accuracy and consistency) of panelists may vary over the time period in which they participate in the panel;

[0010] Hereditary bias—in which individuals within a household share a tendency toward certain behaviors or medical conditions;

[0011] Compliance bias—in which certain purchases or purchase occasions are consistently underreported by panelists;

[0012] Item placement bias—in which panelists report products purchased that have not been accurately captured and/or classified in the hierarchy maintained by the data collector; and

[0013] Projection bias—in which the weighting or projection system cannot fully adjust all geo-demographics or is stressed by over- or under-sampled segments of the target population.

[0014] While both bias and sampling error are present in consumer panel data, for panels of a size significant enough to be of use in tracking consumer purchases (e.g., the IRI and ACN panels), the vast majority of the error that is present is due to bias. Further, since bias is unaffected by sample size, the negative impact of bias relative to the negative impact of sampling error worsens as the panel size increases.

[0015] The negative impact of bias is substantially larger than that of sampling error for most products. Increasing the size of the sample (i.e., the size of the panel) will reduce only the sampling error and may, in fact, worsen any bias that may be present. Given the sizes of today's consumer panels, there is limited advantage to be gained by increasing the size of the panel—since over 90% of the total error is often due to non-sampling errors (i.e., bias).

[0016] There has been little progress in the area of developing a systematic method of identifying and quantifying these biases. Further advancements are needed in this area.

[0017] Another area of concern in retail sales measurement is "coverage". Coverage includes both the number of channels in which measurements are reported and the business usefulness of those measurements. While Information Resources, Inc.'s (IRI's) point-of-sale (POS) based services provide excellent coverage of the Food/Grocery, Drug, Mass (excluding WALMART®), Convenience, and Military channels, these channels may account for only 50% of a manufacturer's sales—and as little as 20% of its sales growth. Non-tracked, growth channels—e.g., Club, Dollar, WALMART®—are, thus, becoming an increasingly important part of manufacturers' businesses while at the same time having little data available in the way of actionable sales measurement information. Further advancements are also needed in this area.

SUMMARY

[0018] One form of the present invention is a unique system for analyzing and correcting retail data.

[0019] Other forms include unique systems and methods to identify, quantify, and correct consumer panel biases. Yet another form includes unique systems and methods to model relationships where data sources overlap to project values in areas in which fewer sources exist.

[0020] Another form includes operating a computer system that has several client workstations and servers coupled together over a network. At least one server is a database server that stores sale data for various data sources, product identifier and attribute categorizations, calculated factors, and other data. External sources can be used to feed the data store on a scheduled or on-demand basis. At least one server is a server that contains business logic for analyzing and correcting some of the data sources stored in database server. Some client workstations can be used to administer settings used in process of analyzing and correcting the data sources.

Other client workstations can be used to view the corrected and/or uncorrected data in a multi-dimensional format using a graphical user interface.

[0021] Another form includes providing a computer system that uses multiple data sources to support inferences that would not be feasible based upon any single data source when used alone. Sales are positioned along product, venue, and time dimension hierarchies. Characteristics of the data source determine the level of aggregation at which the data can be positioned in the framework. For example, POS data may be available weekly in a particular channel; however, direct store delivery (DSD) data may be available at a daily level, and still other measures may be available only at a monthly or quarterly level. The situation is similar along the product and venue dimensions—ranging from the specificity of the sale of a particular UPC-coded item at a particular store to the generality of total category sales within a channel (across all geographies).

[0022] Once this data framework is populated, the data fusion process itself is an iterative one, utilizing both competitive and complementary fusion methods. In "competitive fusion", two or more data sources that provide overlapping measurements along at least one dimension are compared ("competed") against each other at some level of aggregation along the product, venue, and time dimensions. More accurate/reliable sources are used to correct less accurate/reliable sources. In "complementary fusion", relationships modeled where data sources overlap are projected to areas of the data framework in which fewer (or even a single) sources exist—enhancing the accuracy/reliability of those fewer (or single) sources even in domains where data from of the other sources upon which the models were based do not exist. The process is iterative in that the competitive and complementary fusion methodologies can be repeated at varying level of aggregation of the data framework.

[0023] Another form includes providing a method for identifying and quantifying biases in consumer panel data so that the inherent utility of the consumer panel data may be enhanced. This method is termed competitive fusion. At least two data sources are used, with at least one assumed to be more accurate than the other—e.g., scanner-based POS data and consumer panel purchase data. The data sources are aligned along a common framework (i.e., data model or hierarchy) along the dimensions of product (item), venue (channel and/or geography), and/or time, with aggregation along these dimensions as necessary. The attributes associated with the framework are identified along which the framework may be characterized. The data sources are compared along these attributes—quantifying the impact of the attributes on the less-accurate data source.

[0024] After these biases have been identified and quantified, the usefulness of the consumer panel data may be enhanced. The effect of the biases may be corrected for via modeling; i.e., the raw data may be adjusted to reduce or eliminate the effect of the biases. Furthermore, as appropriate, panel management practices may be changed in order to remove or lessen the source of bias in the panel itself.

[0025] Yet another form of the present invention includes providing a method for using complementary fusion to "project" the results and relationships from the competitive fusion method onto consumer panel data in a channel with incomplete/less data than desired (e.g. data from WAL-MART®) to help enhance the accuracy of the Panel data source. At this point, competitive fusion may be used again in several possible ways and at several levels of aggregation along the venue, time, and/or product dimensions in order to develop independent estimates against which the complementary-fused estimate may be competed:

[0026] Publicly available data about the incomplete channel (e.g., channel reports, reported sales and financials, store databases, geo-demographics, etc.) may be used to develop an independent venue (channel) estimate.

[0027] Publicly available data about the category of interest (e.g., category studies, industry reports, reported sales/financials, etc.) may be used to develop an independent category estimate.

[0028] Private data from manufacturer-partners (e.g., shipment data, delivery data, retailer-supplied data, etc.) may be used to develop independent channel and category estimates. Due to the potentially sensitive nature of some of these data sources, this competitive fusion may be performed inside a manufacturer's facility—as an auxiliary input to the baseline model.

[0029] Private data from retailer-partners within a Collaborative Retail Exchange may be used in some venues to develop independent channel and category estimates.

[0030] Yet other forms, embodiments, objects, advantages, benefits, features, and aspects of the present invention will become apparent from the detailed description and drawings contained herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] FIG. **1** is a diagrammatic view of a computer system of one embodiment of the present invention.

[0032] FIG. **2** is a multi-dimensional diagram illustrating the data space used by the system of FIG. **1**.

[0033] FIG. **3** is a block diagram illustrating selected data sources that are used by the system of FIG. **1**.

[0034] FIG. **4** is a high-level process flow diagram for the system of FIG. **1**.

[0035] FIG. **5**A is a first part process flow diagram for the system of FIG. **1** demonstrating the stages involved in performing competitive and complementary fusion.

[0036] FIG. **5**B is a second part process flow diagram for the system of FIG. **1** demonstrating the stages involved in performing competitive and complementary fusion.

[0037] FIG. **6**A is a first part process flow diagram for the system of FIG. **1** demonstrating a preferred process for calculating and applying factors in competitive fusion.

[0038] FIG. **6**B is a second part process flow diagram for the system of FIG. **1** demonstrating a preferred process for calculating and applying factors in competitive fusion.

[0039] FIG. **6**C is a third part process flow diagram for the system of FIG. **1** demonstrating a preferred process for calculating and applying factors in competitive fusion.

[0040] FIG. **7**A is a first part process flow diagram for the system of FIG. **1** demonstrating an alternate process for calculating and applying factors in competitive fusion.

[0041] FIG. **7**B is a second part process flow diagram for the system of FIG. **1** demonstrating an alternate process for calculating and applying factors in competitive fusion.

[0042] FIG. **7**C is a third part process flow diagram for the system of FIG. **1** demonstrating an alternate process for calculating and applying factors in competitive fusion.

[0043] FIG. **8** is a process flow diagram for the system of FIG. **1** demonstrating the stages involved in performing complementary fusion.

[0044] FIG. **9** is a process flow diagram for the system of FIG. **1** demonstrating the stages involved in iteratively performing competitive and complementary fusion steps.

[0045] FIG. **10** is a process flow diagram for the system of FIG. **1** demonstrating the stages involved in calculating blended factors where multiple factor measures are available for the same factor.

[0046] FIG. **11** is a data table illustrating hypothetical data elements stored in the database of FIG. **1** to be used in accordance with the procedure of FIG. **6**.

[0047] FIG. **12** is a data table illustrating hypothetical data elements that are stored in the database of FIG. **1** and are adjusted according to factors for a first attribute in accordance with the procedure of FIG. **6**.

[0048] FIG. **13** is a data table illustrating hypothetical data elements that are stored in the database of FIG. **1** and are adjusted according to factors for a second attribute in accordance with the procedure of FIG. **6**.

[0049] FIG. **14** is a data table illustrating hypothetical data elements that are stored in the database of FIG. **1** and are adjusted according to factors for a third attribute in accordance with the procedure of FIG. **6**.

[0050] FIG. **15** is a data table illustrating hypothetical data elements stored in the database of FIG. **1**, with attribute summaries, and used in accordance with the procedure of FIG. **7**.

[0051] FIG. **16** is a data table illustrating hypothetical data elements that are stored in the database of FIG. **1** and are adjusted according to factors for three attributes in accordance with the procedure of FIG. **7**.

[0052] FIG. **17** is a data table illustrating hypothetical data elements by retailer that are stored in the database of FIG. **1** and used in accordance with the complementary fusion procedure of FIG. **8**.

[0053] FIG. **18** is a data table illustrating hypothetical data elements by retailer that are stored in the database of FIG. **1**, adjusted using complementary fusion according to the factors calculated in accordance with the procedure of FIG. **7**, as described in the procedure of FIG. **8**.

[0054] FIG. **19** is a data table illustrating hypothetical data elements by retailer that are stored in the database of FIG. **1** and are used to perform another iteration of competitive fusion, including calculating blended factors, as described in the procedures of FIG. **9** and FIG. **10**.

[0055] FIG. **20** is a data table illustrating hypothetical data elements by retailer that are stored in the database of FIG. **1** and updated based upon the blended factor, as described in the procedures of FIG. **9** and FIG. **10**.

[0056] FIG. **21** is a data table illustrating hypothetical real, original, and corrected values stored in the database of FIG. **1** to show how the competitive and complementary fusion process helped improve the data, as described in the procedures of FIG. **9**.

[0057] FIG. **22** is a simulated screen of a user interface for one or more client workstations of FIG. **1** that allows a user to view the multi-dimensional elements in the database, as described in the procedures of FIG. **4** and FIG. **5**.

DETAILED DESCRIPTION OF SELECTED EMBODIMENTS

[0058] For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended. Any alterations and further modifications in the described embodiments, and any further applications of the principles of the invention as described herein are contemplated as would normally occur to one skilled in the art to which the invention relates.

[0059] One embodiment of the present invention includes a unique system for identifying, quantifying, and correcting consumer panel biases, and then using overlapping areas of the data sources to project values in areas where fewer or less complete sources exist. FIG. **1** is a diagrammatic view of computer system **20** of one embodiment of the present invention. Computer system **20** includes computer network **22**. Computer network **22** couples together a number of computers **21** over network pathways **23***a-e*. More specifically, system **20** includes several servers, namely business logic server **24** and database server **25**. System **20** also includes external data sources **26**, which in various embodiments include other computers, files, electronic and/or paper data sources. External data sources **26** are optionally coupled to network over pathway **23***f*. System **20** also includes client workstations **30***a*, **30***b*, and **30***c* (collectively client workstations **30**). While computers **21** are each illustrated as being either a server or a client, it should be understood that any of computers **21** may be arranged to provide both a client and server functionality, solely a client functionality, or solely a server functionality. Furthermore, it should be understood that while six computers **21** are illustrated, more or fewer may be utilized in alternative embodiments.

[0060] Computers **21** include one or more processors or CPUs (**50***a*, **50***b*, **50***c*, **50***d*, and **50***e*, respectively) and one or more types of memory (**52***a*, **52***b*, **52***c*, **52***d*, and **52***e*, respectively). Each memory **52***a*, **52***b*, **52***c*, **52***d*, and **52***e* includes a removable memory device. Each processor may be comprised of one or more components configured as a single unit. Alternatively, when of a multi-component form, a processor may have one or more components located remotely relative to the others. One or more components of each processor may be of the electronic variety defining digital circuitry, analog circuitry, or both. In one embodiment, each processor is of a conventional, integrated circuit microprocessor arrangement, such as one or more PENTIUM III or PENTIUM 4 processors supplied by INTEL Corporation of 2200 Mission College Boulevard, Santa Clara, Calif. 95052, USA.

[0061] Each memory (removable or generic) is one form of computer-readable device. Each memory may include one or more types of solid-state electronic memory, magnetic memory, or optical memory, just to name a few. By way of non-limiting example, each memory may include solid-state electronic Random Access Memory (RAM), Sequentially Accessible Memory (SAM) (such as the First-In, First-Out (FIFO) variety or the Last-In-First-Out (LIFO) variety), Programmable Read-Only Memory (PROM), Electronically Programmable Read-Only Memory (EPROM), or Electrically Erasable Programmable Read-Only Memory (EEPROM); an optical disc memory (such as a DVD or CD ROM); a magnetically encoded hard disc, floppy disc, tape, or cartridge media; or a combination of any of these memory types. Also, each memory may be volatile, nonvolatile, or a hybrid combination of volatile and nonvolatile varieties.

[0062] Although not shown in FIG. **1** to preserve clarity, in one embodiment each computer **21** is coupled to a display. Computers **21** may be of the same type, or be a heterogeneous combination of different computing devices. Likewise, the

displays may be of the same type, or a heterogeneous combination of different visual devices. Although again not shown to preserve clarity, each computer **21** may also include one or more operator input devices such as a keyboard, mouse, track ball, light pen, and/or microtelecommunicator, to name just a few representative examples. Also, besides display, one or more other output devices may be included such as loudspeaker(s) and/or a printer. Various display and input device arrangements are possible.

[0063] Computer network **22** can be in the form of a wired or wireless Local Area Network (LAN), Municipal Area Network (MAN), Wide Area Network (WAN) such as the Internet, a combination of these, or such other network arrangement as would occur to those skilled in the art. The operating logic of system **20** can be embodied in signals transmitted over network **22**, in programming instructions, dedicated hardware, or a combination of these. It should be understood that more or fewer computers **21** can be coupled together by computer network **22**.

[0064] In one embodiment, system **20** operates at one or more physical locations where business logic server **24** is configured as a server that hosts and runs application business logic **33**, database server **25** is configured as a database **34** that stores reference data **35** (e.g. product identifiers **36**a, attributes **36**b, and a dictionary **36**c), at least two retail data sources (such as point-of-sale and panel data) **38**, calculated factors **39**, and other data **40**. In one embodiment, external data **26** is imported to database server **25** from a mainframe extract file that is generated on a periodic basis. Various other scenarios are also possible for using and importing external data to database server **25**. In another embodiment, external data sources are not used. In one embodiment, database **34** of database server **25** is a relational database and/or a data warehouse. Alternatively or additionally, database **34** can be a series of files, a combination of database tables and external files, calls to external web or other services that return data, and various other arrangements for accessing data for use in a program as would occur to one of ordinary skill in the art. Client workstations **30** are configured for providing one or more user interfaces to allow a user to modify settings used by business logic **33** and/or to view the retail data sources **38** of database **34** in a multi-dimensional format. Typical applications of system **20** would include more or fewer client workstations of this type at one or more physical locations, but three have been illustrated in FIG. **1** to preserve clarity. Furthermore, although two servers are shown, it will be appreciated by those of ordinary skill in the art that the one or more features provided by business logic server **24** and database server **25** could be provided on the same computer or varying other arrangements of computers at one or more physical locations and still be within the spirit of the invention. Farms of dedicated servers could also be provided to support the specific features if desired.

[0065] FIG. **2** is a multi-dimensional cube **60** that illustrates a way of conceptually thinking about the elements stored in database **34** of system **20**. Cube **60** contains three dimensions: complexity **62**, sources **64**, and aggregation **66**. In one embodiment, at least part of the data in database **34** is categorized according to complexity **62**, sources **64**, and aggregation **66** axes of multi-dimensional cube **60** for analysis, viewing, and/or reporting. Cube **60** helps illustrate the concept that the aggregation dimension **66** is multi-dimensional, although other dimensions could be used than illustrated. Examples of elements of the source dimension **64** includes client (internal) data **65***a*, scanning (point-of-sale) data **65***b*, panel data **65***c*, audit data **66***d*, and other (external) data **66***e*, as a few examples. Examples of elements of the aggregation dimension **66** include time **67***a*, item (product) **67***b*, channel (venue) **67***c*, geography (venue) **67***d*, and other **67***e*, to name a few examples. Various dimensions of cube **60** are used in the competitive fusion and complementary fusion processes described herein.

[0066] FIG. **3** is a block diagram illustrating further examples of the one or more retail data sources (36 in FIG. **1** and 64 in FIG. **2**) that can be used by the system of FIG. **1** in the competitive fusion and complementary fusion processes described herein. Point-of-sale data **70**, consumer panel data **72**, audit/survey data **74** including causal (promotional) data, shipment data **76** from anywhere in supply chain, population census data **78** including geo-demographic data, store universe data **80**, other data sources **82**, and specialty panels **84** are examples of the types of data that can be used with system **20**. The types of data that can be used with system **20** are not limited to traditional retailers. For example, data collected during any part of the supply chain could be used as a data source.

[0067] Referring also to FIG. **4**, one embodiment for implementing system **20** is illustrated in flow chart form as procedure **150**, which demonstrates a high-level process for the system of FIG. **1** and will be discussed in more detail below. FIG. **4** illustrates the high-level procedures for performing "competitive fusion" and "complementary fusion". In "competitive fusion", two or more data sources that provide overlapping measurements along at least one dimension are compared ("competed") against each other at some level of aggregation along the product, venue, and/or time dimensions. More accurate/reliable sources are used to correct less accurate/reliable sources. In "complementary fusion", relationships modeled where data sources overlap are projected to areas of the data framework in which fewer (or even a single) sources exist—enhancing the accuracy/reliability of those fewer (or single) sources even in domains where data from of the other sources upon which the models were based do not exist. The process is iterative in that the competitive and complementary fusion methodologies can be repeated at varying level of aggregation of the data framework.

[0068] In one form, procedure **150** is at least partially implemented in the operating logic of system **20**. Procedure **150** begins with business logic server **24** identifying at least two data sources, with at least one data source being more accurate than another (stage **152**). At least one data source (see e.g. **36** in FIG. **1** and **64** in FIG. **2**) is used as the "reference" data source and another is used as the "target" data source with the biases to be identified and quantified. In one embodiment, the reference data source is more accurate than the target data source. For purposes of the tracking of sales in retail channels, scanner-based point-of-sale (POS) data is typically a good "reference" source, due to its inherent accuracy and high level of granularity along the dimensions of time, venue, and product. Alternatively or additionally, manufacturer-supplied shipment data, especially where such data is based upon direct store delivery (DSD) information, may be utilized as a "reference" source. As yet another alternative, retailer-specific data sources (e.g., "frequent shopper" program data from loyalty cards) are also appropriate.

[0069] Various examples herein illustrate using consumer panel purchase data as the target data source to be corrected. However, the current invention can be used with other data

sources, such as sample-based or survey-based data sources whose overall accuracy is limited by the presence of biases, to name a few non-limiting examples.

[0070] The product characteristics of the data sources should ideally be available at the item level, where "item" is by UPC, SKU, or another unique product identifier. In terms of the venue characteristics of the data sources, they should ideally be available at the retailer and market level, where "retailer" is a store (or chain of stores) within a particular retail channel and "market" is a geographic construct (e.g., Chicago area). In terms of the time characteristics of the data sources, they should ideally be available at the weekly level (or even daily in some cases), although monthly data (or 4-week "quad" data) or various other time frames are also acceptable. Where these levels of granularity are not possible, more aggregated levels of the product (e.g., "brand"), venue (e.g., "food" or "mass" channel for retailer and/or "region" or "total U.S." for market), and/or time (e.g., quarterly or annual data) dimensions may be used.

[0071] After the data sources have been identified (stage **152**), they are next aligned along a common framework (stage **154**), such as along the item, venue, and/or time dimensions. Depending upon the characteristics (and quality) of the data sources, some aggregation along these dimensions may be required in order for the alignment to be possible. For example, UPC-level POS data may need to be aggregated at the SKU or even brand level in order to be aligned with data from other sources (particularly in the cases in which venue-specific UPCs are involved). Similarly, store-level data may need to be aggregated at the local market or even regional level in order to be aligned with consumer panel purchase data. Finally, weekly (or even daily) POS data may need to be aggregated at the 4-week quad level in order to be aligned with shipment/delivery data. Various other arrangements for aligning the data along a common framework are also possible.

[0072] In one embodiment, the item structure is provided by a multiple-level hierarchy, in which UPCs are the lowest level and are aggregated along category-related characteristics. Venue structure is provided along both geographical and channel dimensions, with FIPS-code-level transactions being aligned along market and regions and store locations being part of a sub-chain, chain, and parent store hierarchy. Time structure is presently provided at the weekly level at the lowest level of aggregation, with daily data being aggregated at the weekly level before placement into the structure, although a daily data compatible structure or other variation is also possible.

[0073] As a result of aligning the data sources along a common framework (stage **154**), overlapping attribute segments of at least one dimension are available to use for data comparison and correction. Certain attributes associated with the data sources are identified along which more detailed comparisons may be made. In one embodiment, product attributes are available in from reference data **35** of database **34**. For example, one or more pieces of information from product identifier **36***a*, attributes **36***b*, and dictionary **36***c* references can be used to access or modify attributes, attribute hierarchies, and mappings. These attributes represent category-specific dimensions along which products in that category may be characterized (e.g., diet vs. regular in carbonated soft drinks, active ingredient in internal analgesics, product size in most categories). The term attribute used herein is meant in the generic sense to cover various types of descriptors.

[0074] Business logic server **24** compares the data sources and calculates factors for the attributes of at least one element of the common framework (stage **158**). Each segment of a given attribute will have its own factor, as described in detail herein. The presence of attribute-related bias may be identified by comparison of the data sources. In the examples illustrated herein, volumetric comparisons are made (e.g., equivalent units); however, various other measures (e.g., dollar sales, actual units) could also be utilized, as long as the same type of measure is being used for the comparison. For example, it would not be useful to compare dollar sales to actual units, but it would be useful to compare dollars to dollars. The comparison itself is between the value of the target data source (e.g., projected panel volume) and that of the reference data source (e.g., POS data). This comparison can be by way of two-sample inference, regression analysis, or other statistical tests appropriate for determining whether any differences between the two data sources are associated with the attributes along which they have been characterized at a statistically significant level. Where such differences (biases) are identified, they are quantified, and factors are calculated for use in bias correction/adjustment.

[0075] The factors are used to correct bias in the less accurate data source (stage **160**), which in this example is consumer panel data. By using the factors to correct the bias in the less accurate "target" data source, the effect of these biases is reduced or eliminated. These biases can be corrected by adjusting the raw data, or by way of post-adjustment.

[0076] In "complementary fusion", the factors are also used to supplement the data that is incomplete in the less complete data source (stage **162**), such as consumer panel data. Incomplete data is used in a general sense to mean that less data was provided than desired or that the data is less accurate than desired, to name a few non-limiting examples. Where highly accurate data (e.g. POS data) is not provided, less accurate data (e.g. panel data) becomes more important to analyze and correct. Relationships modeled where data sources overlap are projected to areas of the data framework in which fewer (or even a single) sources exist, enhancing the accuracy and reliability of those fewer (or single) sources even in domains where data from of the other sources upon which the models were based do not exist.

[0077] Users and/or reports can access database **34** from one of client workstations **30** to view/analyze the corrected and adjusted data (stage **164**). Users and/or reports can also access database **34** from one of client workstations **30** to view and/or modify settings used by system **20** to make data corrections. The steps are repeated as desired (stage **166**). The process then ends at stage **168**.

[0078] FIGS. **5**A-**5**B are first and second parts of a process flow diagram for the system of FIG. **1** demonstrating the stages involved in performing competitive and complementary fusion using POS and panel data as the data sources. While in this and other figures, the first data source (the "source" data source) is described as being POS data and the second data source (the "target" data source) is described as being panel data, it will be appreciated that the system and methodologies can be used with other data sources as appropriate. In one form, procedure **170** is at least partially implemented in the operating logic of system **20**. Procedure **170**

begins in FIG. **5**A with receiving updates for reference data **35** and/or data sources **38** on a periodic basis (stage **172**).

[0079] In one embodiment, a parameter specification for the number of weeks used in calculating the factors is thirteen, and the minimum week range included in database **34** is then set to be thirteen weeks prior to the update week. Database **34** may be built and maintained using various data sources and can include various types of data, as would occur to one of ordinary skill in the art. In one embodiment, system **20** supports the option to pull the desired period (e.g. all thirteen weeks) of the data sources **38**, append the recent period (e.g. four weeks) needed since the last factor update to the existing database **34**, and/or be able to recreate the data a week at a time. In such a scenario, for space conservation, the system can optionally drop the same number of weeks from the start week of database **34** as were appended to the end week. For example, if the option was chosen to append the four weeks needed since the last factor update, the system should drop the four oldest weeks from the existing database **34** when appending the four new weeks.

[0080] The received updates to reference data **35** and/or data sources **38** are stored in database **34** (stage **174**). At some point in time, such as on a scheduled or as-requested basis, the system determines that data adjustments should be made to correct bias (decision point **175**). Application business logic **33** ensures reference data **35** and data sources **38** are up to date, and if not, updates them accordingly (stage **176**). Optionally, reference data **35** is reviewed to ensure that the default attributes for the current category will be appropriate for the client or scenario, and adjustments are made to reference data **35** as appropriate (stage **177**). As one non-limiting example, attribute segments may be reviewed and translated to more succinct segmentations that better classify the product identifiers. Other variations are also possible.

[0081] A product-identifier-to-attribute-segment mapping is prepared for the product identifiers (e.g. UPC's) (stage **178**). If the attributes are determined to be irrelevant, they can be removed from further consideration in this process. The attribute table **36***b* is a reference table that maps each product identifier **36***a* to a set of attribute variables. While UPC's are described as a common product identifier, other identifiers could also be used. For example, not every dataset has a UPC, but may have a product identifier at a higher, lower, or equivalent level. Rules are used to determine supportable attribute segments and relevant attributes. In one embodiment, if segment assignment is missing then the UPC is assigned to a new segment "not supportable." All segments with less than a 5% share are assigned to "not supportable." Furthermore, in one embodiment, if the final "not supportable" category accounts for >50% of the category share, then the attribute is designated as "irrelevant." Other ways for determining relevance can also be used, or relevance can simply be ignored. Stage **178** can be repeated to arrive at the final level of segments to use (rolled-up or drilled-down) as appropriate.

[0082] Continuing with FIG. **5**B, source (e.g. POS) and target (e.g. panel) data **38** are retrieved from database **34** and summarized by attribute segments (stage **180**). Factors are calculated for attribute segments (stage **181**). The significance of the attribute segments is determined (stage **182**). If any non-significant factors are determined, the significant attribute factors can be re-aligned (stage **183**). The factors for each attribute segment are applied to the target (panel) data to correct bias (stage **184**). The factors are also applied to the target (panel) data to correct data that is incomplete (e.g. less available) (stage **186**). The competitive and/or complementary data fusion steps can be repeated as desired or appropriate (stage **187**). Users and/or reports can access database **34** from one of client workstations **30** to view/analyze the corrected and adjusted data (stage **188**). The procedure **170** then ends at stage **190**. FIGS. **6-10** illustrate the competitive and complementary fusion stages in further detail.

[0083] FIGS. **6**A-**6**C are first, second, and third parts of a process flow diagram for the system of FIG. **1** demonstrating a preferred process for iteratively calculating and applying factors in competitive fusion. In one form, procedure **200** is at least partially implemented in the operating logic of system **20**. Procedure **200** begins on FIG. **6**A with summing source (POS) data by the most granular product and time dimension (e.g. UPC) (stage **202**) and summing target (panel) data by the most granular product and time dimension (e.g. UPC) (stage **204**). In one embodiment, they are both summed to weekly (e.g. 52) totals. Business logic server **24** determines the period of time to use in the analysis (stage **206**), such as to use all of the weekly totals summed in the prior step or to use only part of the weekly totals that cover a desired time period, such as the most recent 13 weeks, to name a few examples. Outliers are also eliminated (stage **207**) at this point or another appropriate point before final calculations. For example, in one embodiment, although thirteen weeks are contained in the dataset, only **11** weeks are actually used in calculations. Research indicates that panel volume is extremely vulnerable to outliers. To minimize the potential impact of outliers, the week with the lowest coverage and the week with the highest coverage are eliminated from further use in calculations for the current update. In one embodiment, although the outlier weeks are eliminated from further use in calculations for the current update, they are not removed from the dataset as they may be used in subsequent updates. Business logic server **24** then merges the source (POS) data, target (panel) data, and product identifier to attribute segment mapping reference data (stage **208**). Attributes can optionally be sorted in order by importance (stage **210**). In one embodiment, the least important is first and the most important is last. If factors for the most important attribute segments are the last ones applied, it usually has the most significant mathematical effect because no lesser important attribute segment factor will be applied after that last calculation to further skew the results.

[0084] An initial factor of 1.0 is assigned to all attribute segment (stage **212**). Continuing with FIG. **6**B, source (POS) and target (panel) data are then summarized for the segments of the current attribute (stage **214**). A factor is calculated for each attribute segment of the current attribute as source data volume divided by target data volume (stage **216**). Other mathematical variations could also be used. For each segment of the current attribute, determine whether the attribute segment is significant (stage **218**). In one embodiment, shares are calculated for the attribute segments, such as by dividing the Calculation Period Segment Total U.S. POS volume by the Calculation Period Category Total U.S. POS volume. Significance is then determined by first analyzing a confidence interval (CI) for each share to determine if there is overlap between the POS share CI and the panel share CI. If there is overlap, then the difference between source and target shares is not significant and the attribute segment will be designated as "nonsignificant." Other ways for determining significance can also be used, or significance can be assumed.

[0085] In one embodiment, if two or more segments for the current attribute were nonsignificant (stage **220**), then the significant factors (that remain) will need to be re-aligned to account for non-significant segment factors being removed (stage **222**). At the product identifier-level target (POS) data, each volume is multiplied by the factor for the corresponding segment (stage **224**). Again, other mathematical variations could also be used. The factors for each attribute segment are then saved to factor data store **39** of database **34** (stage **226**). If another attribute is present (decision point **228**), the next attribute is made the current attribute (stage **230**) and stages **214-226** are repeated. These stages are repeated until all attributes are processed. Continuing with FIG. **6**C, a category adjustment factor is applied to all product identifiers as necessary (stage **232**) to adjust for the level of coverage. In one embodiment, the use of a category adjustment factor depends on the type of measure being used. For example, where volume is used, coverage adjustments may not be necessary, but where shares are used, further coverage adjustments may be necessary. Any final factors for the category adjustment factor are saved to the factor data store **39** of database **34** (stage **234**). The process **200** then ends at stage **236**.

[0086] FIGS. **7**A-**7**C are first, second, and third parts of a process flow diagram for the system of FIG. **1** demonstrating an alternate process for calculating and applying factors in competitive fusion. In one form, procedure **250** is at least partially implemented in the operating logic of system **20**. Procedure **250** begins on FIG. **7**A with summing the more reliable (source) data source (e.g., POS data) by the most granular product and time dimension (e.g. UPC) (stage **252**) and summing the less accurate (target) data source (e.g., panel data) by the most granular product and time dimension (stage **254**). Business logic server **24** determines the period of time to use in the analysis (stage **256**) and eliminates outliers (stage **257**), as discussed in FIG. **6**. Source data, target data, and product identifiers to attribute segment mapping data are merged (stage **258**). An initial factor of 1.0 is assigned to each attribute segment (stage **260**). Source and target data are summarized to the segments for all attributes (stage **262**).

[0087] Continuing with FIG. **7**B, factors are calculated for each attribute segment as source volume divided by target volume (stage **264**). Business logic server **24** determines whether the attribute segment is significant (stage **266**), as described in FIG. **6**. Where two or more segments for any particular attribute are insignificant (decision point **268**), then the significant factors are re-aligned to account for the elimination of the insignificant segment factors in the particular attribute (stage **270**). At the product identifier-level target data, each volume is multiplied by the factor for each corresponding segment (stage **272**). In other words, all of the factors applicable to the volume are applied simultaneously, as opposed to iteratively as shown in FIG. **6**. The factors are then saved to factor data store **39** for each attribute segment (stage **274**).

[0088] Continuing with FIG. **7**C, a category adjustment factor is applied to all product identifiers as necessary (stage **276**), as described in FIG. **6**. The final factors for the category adjustment factor are saved to the factor data store **39** of database **34** (stage **277**). The procedure **250** then ends at stage **278**. Procedure **250** should only be used in the appropriate circumstances, such as when the attributes are not affected by each other and iteration is not needed for greater accuracy, to name one example. If attributes are affected by each other and procedure **250** is used instead of the iterative procedure of FIG. **6**, then the results will be mathematically different, with the procedure of FIG. **6** producing a more accurate result.

[0089] FIG. **8** is a process flow diagram for the system of FIG. **1** demonstrating the stages involved in performing complementary fusion. In one form, procedure **280** is at least partially implemented in the operating logic of system **20**. Procedure **280** begins with merging source data, target data, and product identifier data to attribute segment mapping data (stage **282**). The factors previously calculated in accordance with FIG. **6** or FIG. **7** are applied to the product identifier-level target data based on the attribute segment mapping to correct the data for incompleteness (e.g. less data than desired) (stage **286**). The target data elements that are corrected in this process can be the same, different, or overlapping from the target data that was used to help calculate the factors. The procedure **280** then ends at stage **288**.

[0090] FIG. **9** is a process flow diagram for the system of FIG. **1** demonstrating the stages involved in performing repeating competitive and complementary fusion steps multiple times. In one form, procedure **290** is at least partially implemented in the operating logic of system **20**. Procedure **290** begins with determining what additional public or private data sources are available to use for competitive fusion along venue, time, and/or product dimensions (stage **292**). Using one or more of those data sources, additional factors are calculated that are independent estimates against which the complementary-fused estimate may be competed (stage **294**). The newly calculated factors are applied to the product identifier-level target data (e.g. POS data) to further adjust the data (stage **296**). The competitive and complementary fusion steps can be repeated as desired and/or appropriate (stage **298**). The procedure **290** then ends at stage **299**.

[0091] FIG. **10** is a process flow diagram for the system of FIG. **1** demonstrating the stages involved in calculating blended factors where multiple factor measures are available for the same factor. In one form, procedure **300** is at least partially implemented in the operating logic of system **20**. Procedure **300** can be used when competitive fusion is being performed and at least two data sources are available for the same factor (stage **302**). For each aggregation (venue, time, or product) that has at least two factor measures, calculate specific totals are calculated across attributes (stage **304**). Factors for each aggregation of the current data source are calculated by dividing source data volume by target data volume (stage **305**). If there are more data sources (decision point **306**), then move to the next data source (stage **307**) and repeat stages **304-305**. Then, calculate a blended factor (stage **308**) where the more accurate source is given a higher weight and the less accurate source is given a lower weight. One simple way of calculating a blended factor is to calculate a central tendency —e.g., mean or median—of the various factors as the overall factor. This treats all estimates as of equal value (reliability, accuracy, precision), which in reality may or may not be the case. In a preferred embodiment, the "blended factor" uses an "inverse-variance-weighted" method (see **444** on FIG. **19** as an example). This name originates from the fact that more "reliable" estimates—i.e., those with more precision and, thus, less variability—are given more weight than those that are less "reliable" (more variable). Once the blended estimate has been calculated, multiply each volume of the product identifier-level target data by the blended factor (stage **310**). The procedure **300** then ends at stage **312**.

[0092] A hypothetical example will now be described in FIGS. **11-21** to with reference to the procedures described in

FIGS. **6-10**. FIG. **11** is a data table illustrating hypothetical data elements that are adjusted according to the preferred embodiment competitive fusion procedure of FIG. **6**. POS data **320**, panel data **322**, and attribute information **324** are shown in a summarized form by UPC **326**. For each attribute and its corresponding segments, various steps are performed as discussed below.

[0093] Turning to FIG. **12**, the data is assumed to be relevant and the POS and panel data shown in table **330** are then summarized for the segments of the current attribute (stage **214**), which in the current iteration is manufacturer **332**. Private brand label summaries **334** and non-private brand label summaries **336** for POS **338** and panel data **340** are calculated from table **330** as illustrated. A factor **342** for each attribute segment of the current attribute, in this case private label manufacturer **334** and non-private label manufacturer **336** segments, is calculated as POS volume **338** divided by panel volume **340** (stage **216**). Business logic server **24** determines whether the current attribute segment is significant (stage **218**). For purposes of illustrating the current example, all attribute segments are also assumed significant. At the UPC level panel data, each panel volume **344** is multiplied by the factor **342** for its corresponding segment (stage **224**) to arrive at an adjusted panel value **346**. Factors **342** are saved to the factor data store **39** of database **34** (stage **226**).

[0094] As shown in FIGS. **13** and **14**, stages **214** to **226** repeat for each attribute, with previously adjusted data being used in the calculation. FIG. **13** illustrates data elements being adjusted according to factors calculated for a second attribute in accordance with the procedure of FIG. **6**. The POS and panel data shown in table **350** are then summarized for the segments of the current attribute (stage **214**), which in the current iteration is type **352**. Summaries for regular type **354** and special type **356** for POS **358** and panel data **360** are calculated from table **350** as illustrated. A factor **362** for each attribute segment of the current attribute, in this case regular type **354** and special type **356** segments, is calculated as POS Volume **358** divided by panel volume **360** (stage **216**). At the UPC level panel data, the previously adjusted panel volume **364** is multiplied by the factor **362** for its corresponding segment (stage **224**) to arrive at yet another adjusted panel value **366**. Factors **362** are saved to the factor data store **39** of database **34** (stage **226**).

[0095] FIG. **14** illustrates data elements being adjusted according to factors calculated for a third attribute in accordance with the procedure of FIG. **6**. The POS and panel data shown in table **370** are then summarized for the segments of the current attribute (stage **214**), which in the current iteration is size **372**. Summaries for size big **374**, size medium **375**, and size small **376** for POS **378** and panel data **380** are calculated from table **370** as illustrated. A factor **382** for each attribute segment of the current attribute, in this case size big **374**, medium **375**, and small **376** segments, is calculated as POS Volume **378** divided by panel volume **380** (stage **216**). At the UPC level panel data, each previously adjusted panel volume **384** is multiplied by the factor **382** for its corresponding segment (stage **224**) to arrive at yet another adjusted panel value **386**. Factors **382** are saved to the factor data store **39** of database **34** (stage **226**). After processing all attributes, the final factors are saved to the factor data store **39** of database **34** (stage **234**). The process then ends at stage **236**.

[0096] FIGS. **15** and **16** illustrate data elements being adjusted according to factors calculated according to an alternative embodiment competitive fusion process in accordance with the procedure of FIG. **7**. Business logic server **24** determines the period of time to use in the analysis (stage **256**), and merges POS, panel, and attribute information by UPC as shown in table **390** (stage **258**). POS data **392** and panel data **394** are summarized for all attribute segments (stage **262**), in this case by manufacturer **396**, type **398**, and size **400**. As shown in FIG. **16**, factors for each attribute segment **402** are calculated as each respective POS volume **404** divided by each respective panel volume **406** (stage **264**). Each panel volume **407** is multiplied by the factors **408**a-**408**c appropriate for its corresponding segment (stage **272**) to calculate an adjusted panel value **410**. The process then ends at stage **278**.

[0097] FIG. **17** is a data table illustrating hypothetical data elements by retailer that are stored in the database of FIG. **1** and used in accordance with the complementary fusion procedure of FIG. **8**. POS, panel and attribute information are merged by UPC (stage **282**) for multiple retailers, as shown in table **420**. Client shipment data **424**, another data source available, is also merged by UPC. Shares are calculated for POS data **420***a*-**420***b* and panel data **422***a*-**422***c* for the segments of each attribute (stage **284**). As shown in FIG. **18**, the previously calculated factors **430***a*-**430***c* (**408***a*-**408***c* in FIG. **16**) are applied to the UPC level panel data **432***a*-**432***c* to further adjust the data to correct for incompleteness (stage **286**) and arrive at an adjusted panel value **434***a*-**434***c*. The complementary fusion process then ends at stage **288**.

[0098] FIGS. **19** and **20** illustrate performing another iteration of competitive fusion, including calculating blended factors, as described in the procedures of FIG. **9** and FIG. **10**. Additional public or private data sources are identified as available to use for competitive fusion (stage **292**). As shown in table **438**, channel specific totals **440***a*-**440***f* across attributes have been identified for use in competitive fusion. In addition to POS and Panel totals for retailers **1** and **2** (**440***a*-**440***d*), client shipment total **440***e* and panel total **440***f* can also be used for comparison. Using these totals **440***a*-**440***f*, additional factors **442** have been calculated that are independent estimates against which the complementary-fused data from FIG. **18** may be competed (stage **294**). A blended factor **444** has been calculated since multiple data sources were available for the same factor (stages **302**-**308** in FIG. **10**). As shown in FIGS. **19** and **20**, each volume **446***a*-**446***c* of the previously adjusted UPC-level panel data is then multiplied by the blended factor to arrive at the newly adjusted panel values **450***a*-**450***c* (stage **298** in FIG. **9**, and stage **310** in FIG. **10**).

[0099] FIG. **21** is a data table illustrating hypothetical table **460** of end results for POS data elements by retailers **2** and **3**, with a comparison to reality FIGS. **462***a*-**462***b*, pre-fusion FIGS. **464***a*-**464***b*, and post-fusion FIGS. **466***a*-**466***b* to show how the competitive and complementary fusion processes according to FIGS. **4**-**10** and illustrated in the hypothetical of FIGS. **11**-**20** helped improve the data accuracy.

[0100] FIG. **22** is a simulated screen of a user interface for one or more client workstations **30** that allows a user to view the multi-dimensional elements in the database, as described in the procedures of FIG. **4** and FIG. **5**.

[0101] Alternatively or additionally, once data fusion has been performed as described herein, the updated data can be used by various systems, users, and/or reports as appropriate.

[0102] In one embodiment of the present invention, a method is disclosed comprising identifying a plurality of data sources, wherein at least a first data source is more accurate than a second data source; identifying a plurality of overlap-

ping attribute segments to use for comparing the data sources; calculating a factor as a function of each of the plurality of overlapping attribute segments; and using the factors to update a first group of values in the second data source to reduce bias.

[0103] In another embodiment of the present invention, a method is disclosed comprising receiving point-of-sale data and panel data on a periodic basis; identifying a plurality of product identifiers and a plurality of attributes to analyze; retrieving and summarizing the point-of-sale data and the panel data by the plurality of product identifiers, the plurality of attributes, and a plurality of corresponding attribute segments for a specified time period; calculating a factor for each attribute segment of a particular attribute; and applying the factors for the particular attribute segment to the panel data to correct panel bias.

[0104] In yet another embodiment, a method is disclosed comprising receiving point-of-sale data and panel data on a periodic basis; identifying a plurality of product identifiers and a plurality of attributes to analyze; retrieving and summarizing the point-of-sale data and the panel data by the plurality of product identifiers, the plurality of attributes, and a plurality of corresponding attribute segments for a specified time period; calculating a plurality of factors, wherein one factor is calculated for each attribute segment of the plurality of attributes; and applying the factors to the second data source to reduce bias; and applying the factors to the second data source to reduce incompleteness.

[0105] In yet a further embodiment, a method is disclosed comprising identifying a plurality of product identifiers and a plurality of attributes to analyze for at least two data sources, wherein at least a first data source is more accurate than a second data source; retrieving and summarizing the first data source and the second data source by the plurality of product identifiers, the plurality of attributes, and a plurality of corresponding attribute segments for a specified time period; calculating a plurality of factors, wherein one factor is calculated for each attribute segment of the plurality of attributes; applying the factors to the second data source to reduce bias; and applying the factors to a different or overlapping dataset of the second data source to reduce incompleteness.

[0106] In another embodiment, a system is disclosed that comprises one or more servers being operable to store retail data from at least two data sources, store product identifier and attribute categorizations, and store a plurality of factor calculations; wherein the at least two data sources includes a first data source that is more accurate than a second data source; and wherein one or more of said servers contains business logic that is operable to identify and retrieve a plurality of overlapping attribute segments to use for comparing the at least two data sources, compare each of the overlapping attribute segments, calculate a factor for each of the overlapping attribute segments, and use the factors to update a first group of values in the second data source to reduce bias.

[0107] In yet a further embodiment, an apparatus is disclosed that comprises a device encoded with logic executable by one or more processors to: identify and retrieve a plurality of overlapping attribute segments to use for comparing at least two data sources, wherein the at least two data sources includes a first data source that is more accurate than a second data source, compare each of the overlapping attribute segments, calculate a factor for each of the overlapping attribute segments, and use the factors to update a first group of values in the second data source to reduce bias.

[0108] A person of ordinary skill in the computer software art will recognize that the client and/or server arrangements, user interface screen content, and data layouts could be organized differently to include fewer or additional options or features than as portrayed in the illustrations and still be within the spirit of the invention.

[0109] While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all equivalents, changes, and modifications that come within the spirit of the inventions as described herein and/or by the following claims are desired to be protected.

What is claimed is:

1. A method comprising:

identifying a plurality of data sources, wherein at least a first data source is more accurate than a second data source;

identifying a plurality of overlapping attribute segments to use for comparing the data sources;

calculating a factor as a function of each of the plurality of overlapping attribute segments; and

using the factors to update a first group of values in the second data source to reduce bias.

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