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OFATS: Applying SDC using TAU-Argus



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Background



Background

- Prior to 2020 specialized SDC software was not being used when processing surveys in Business division
- This details steps taken when switching for Outward Foreign Affiliates Statistics (OFATS)



Background

OFATS SDC was carried out using SAS and manual checking

- Resource intensive
 - Was taking 3 people 5 days each to complete
- Unreliable (due to manual processes)
 - Approximate disclosure
 - Insufficient levels of secondary suppression applied



Background

OFATS SDC was carried out using SAS and manual checking

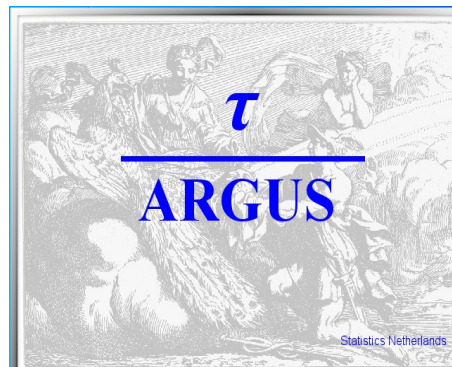
- Business Area attempted switching to specialized SDC software
 - **Unable to give project required resources**



Background

Methodology project started in September 2021 to switch OFATS

- TAU-Argus proved to be the most suitable option





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SDC for OFATS: Project details



Initial Analysis

3 variables being disseminated:

- Turnover (of affiliates)
- Persons engaged (by affiliates)
- Number of affiliates

Broken down by NACE and by Geography



NACE classification : nested hierarchy

Level 1

X9994
B0995
C3395
D3500
E3995
F4395
X9595
X9996

Level 2

C3395
C1205
C1895
C1995
C2805
C3095
C3390

Level 3

C1995
C1900
C2000
C2100
C2200

1 child : 1 parent



NACE classification : hierarchical file

X9994
@B0995
@@B0905
@@9B099
@C3395
@@C1205
@@C1895
@@@C1405
@@@C1805
@@@@C1600
@@@@C1700

@@C1995
@@@C1900
@@@C2000
@@@C2100
@@@C2200
@@C2805
@@@C2505
@@@@C2400
@@@@C2500
@@@C2600
@@@C2800



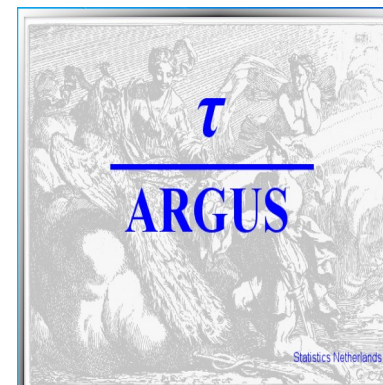
Geography classification: Non-nested hierarchy

C4: Offshore financial centres	
AD	Andorra
AG	Antigua and Barbuda
AI	Anguilla
AW	Aruba
BB	Barbados

E1: Europe	
AD: Andorra	
BE: Belgium	
DK: Denmark	
ES: Spain	
.....	
E7: America	
AG: Antigua and Barbuda	
AR: Argentina	
BB: Barbados	
BO: Bolivia	
BR: Brazil	
.....	

1 child : Could have more than 1 parent

?



Geography classification: Non-nested hierarchy

Disclosure protection of non-nested linked tables in Business Statistics

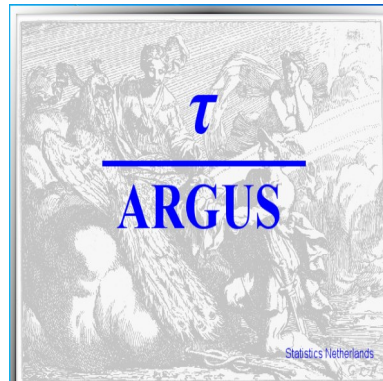
Luigi Virgili and Luisa Franconi

Division for Information Technology and Methodology, Istat, Roma, via C. Balbo, 16 Italy, e-mail virgili@istat.it, franconi@istat.it.

Abstract: The study of globalised economy requires more and more complex way to aggregate information resulting in the production of non-nested classification systems. This is the case of European structural business statistics where units are aggregated according to different criteria. The aim of this paper is to present the rationale followed to disentangle non-nested hierarchies, reduce them to a nested case and set a general procedures that can be used by a standard software package like Argus to protect a set of non-nested hierarchical linked tables. The application to the set of tables stemming from Foreign Affiliates Trade Statistics supplied to Eurostat is presented.



Geography classification: Non-nested hierarchy



E1: Europe
AD: Andorra
BE: Belgium
DK: Denmark
ES: Spain
.....

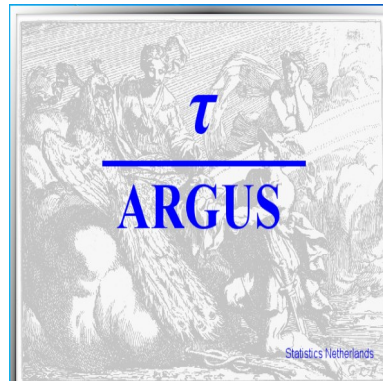
E7: America
AG: Antigua and Barbuda
AR: Argentina
BB: Barbados
BO: Bolivia
BR: Brazil
.....

C4: Offshore Financial Centres
AD: Andorra
AG: Antigua and Barbuda
BB: Barbados
BS: Bahamas
.....

Split into nested hierarchies



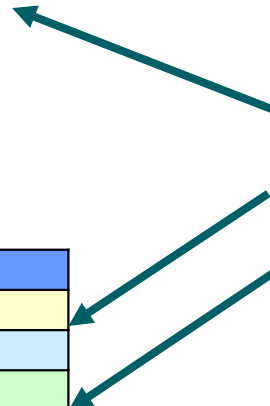
Geography classification: Non-nested hierarchy



E1: Europe
AD: Andorra
BE: Belgium
DK: Denmark
ES: Spain
.....

E7: America
AG: Antigua and Barbuda
AR: Argentina
BB: Barbados
BO: Bolivia
BR: Brazil
.....

C4: Offshore Financial Centres
AD: Andorra
AG: Antigua and Barbuda
BB: Barbados
BS: Bahamas
.....



Using a priori function



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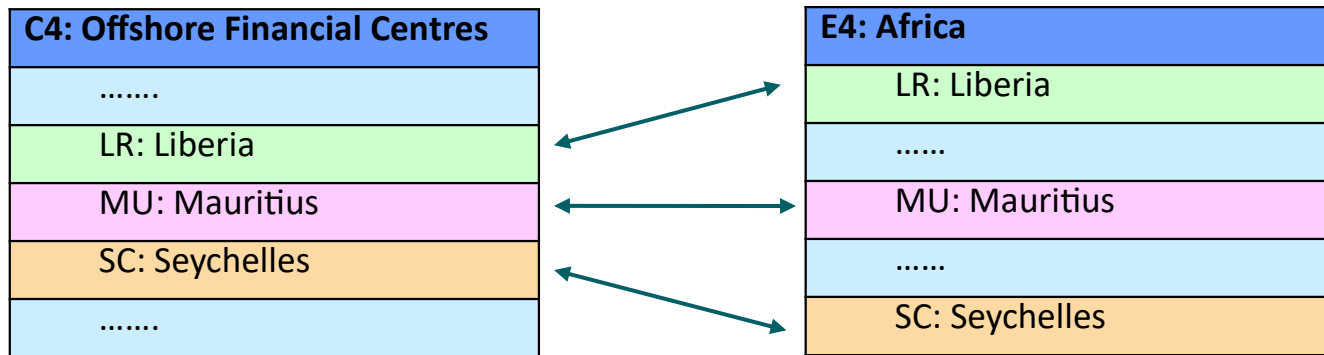
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SDC for OFATS: Detailed analysis



Detailed analysis

- 2 problematic values leading to non-nested hierarchy
 - **C4 : Offshore financial centres**
 - **Countries listed here also listed under different continents**



Detailed analysis

- 2 problematic values leading to non-nested hierarchy
 - **V3 : EU Countries (excl. compiling country)**
 - $Z9 \text{ (Rest of world)} = \text{V3 (EU)} + V4 \text{ (Non-EU)}$
 - $E1 \text{ (Europe)} = \text{V3 (EU)} + O1 \text{ (Other: Non-EU Europe)}$





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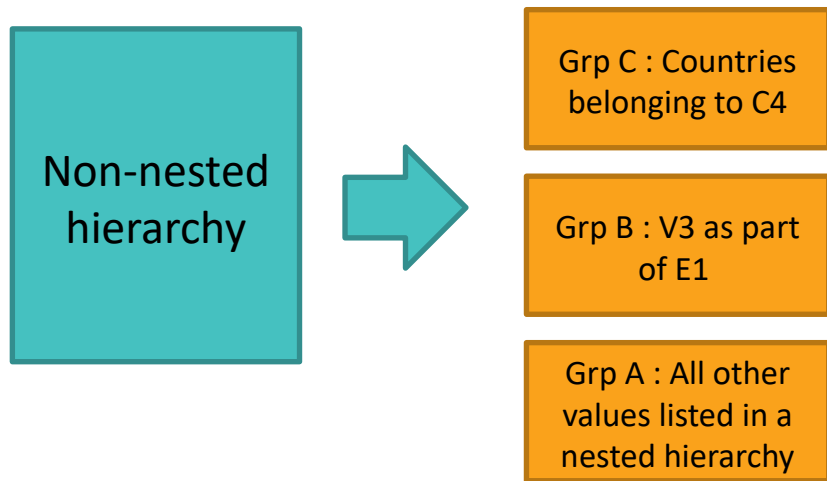
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Preparation of Hierarchical files and Order of processing



Key to solution

- **Split non-nested hierarchy into nested hierarchies**



Order of processing

- Preparation of hierarchical files and order of processing
 - **Process GrpC (C4: Offshore Financial Centres) first**



Order of processing

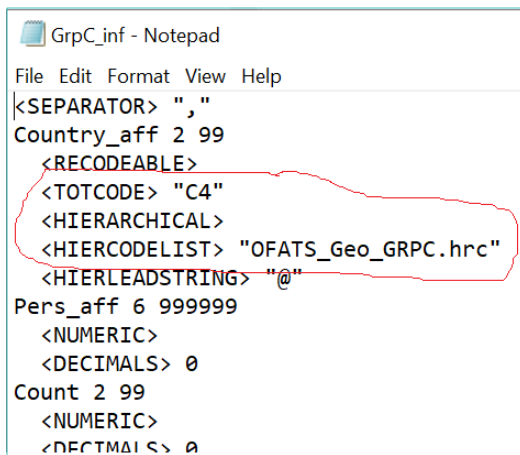
- Preparation of hierarchical files and order of processing
 - **Process GrpC (C4: Offshore Financial Centres) first**

C4: Offshore financial centres			
AD	Andorra	BZ	Belize
AG	Antigua and Barbuda	CK	Cook Islands
AI	Anguilla
AW	Aruba
BB	Barbados	VG	Virgin Islands, British
BH	Bahrain	VI	Virgin Islands, US
BM	Bermuda	VU	Vanuata
BS	Bahamas	WS	Samoa



Order of processing

- Preparation of hierarchical files and order of processing
 - **Process GrpC (C4: Offshore Financial Centres) first**

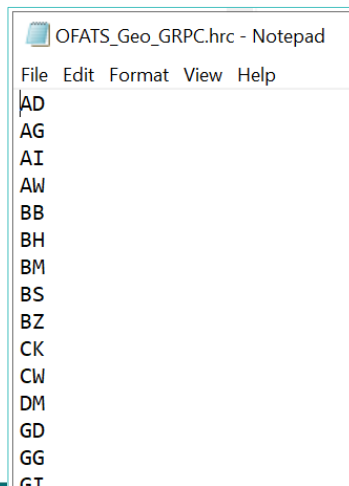


```
GrpC_inf - Notepad
File Edit Format View Help
<SEPARATOR> ","
Country_aff 2 99
<RECODEABLE>
<TOTCODE> "C4"
<HIERARCHICAL>
<HIERCODELIST> "OFATS_Geo_GRPc.hrc"
<HIERLEADSTRING> "@"
Pers_aff 6 999999
<NUMERIC>
<DECIMALS> 0
Count 2 99
<NUMERIC>
<DECIMALS> 0
```



Order of processing

- Preparation of hierarchical files and order of processing
 - **Process GrpC (C4: Offshore Financial Centres) first**



Order of processing

- Preparation of hierarchical files and order of processing
 - **No common elements between GrpC and GrpB**



Order of processing

- Preparation of hierarchical files and order of processing
 - **Process GrpB (E1: Europe) next**



Order of processing

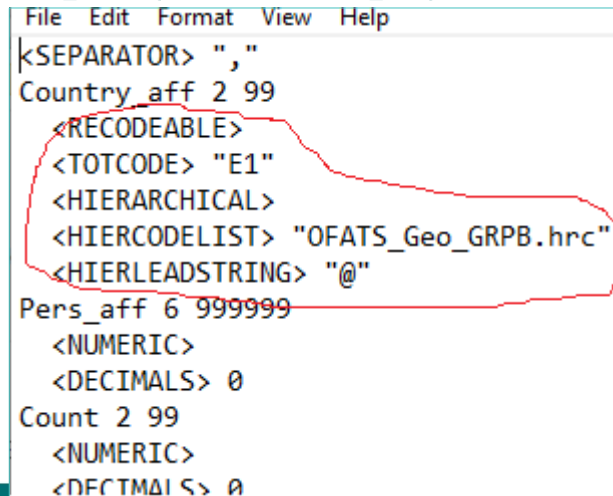
- Preparation of hierarchical files and order of processing
 - **Process GrpB (E1: Europe) next**

E1: Europe	
V3	EU
O1	Europe but outside of EU



Order of processing

- Preparation of hierarchical files and order of processing
 - **Process GrpB (E1: Europe) next**

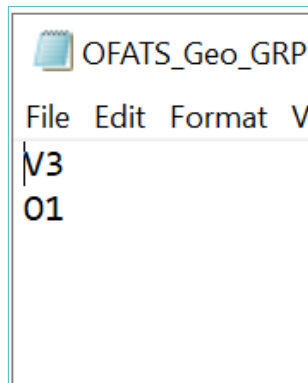


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File Edit Format View Help
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Country_aff 2 99
<RECODEABLE>
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<HIERARCHICAL>
<HIERCODELIST> "OFATS_Geo_GRPB.hrc"
<HIERLEADSTRING> "@"
Pers_aff 6 999999
<NUMERIC>
<DECIMALS> 0
Count 2 99
<NUMERIC>
<DEFCTMAI S> 0
```



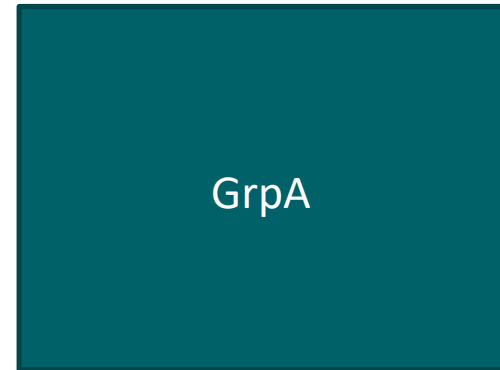
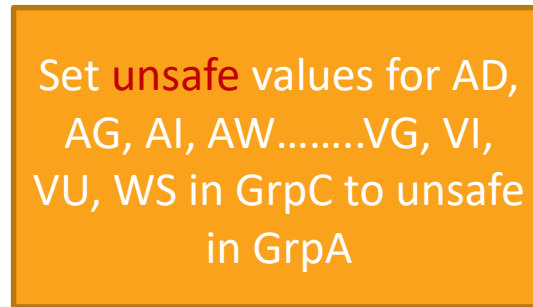
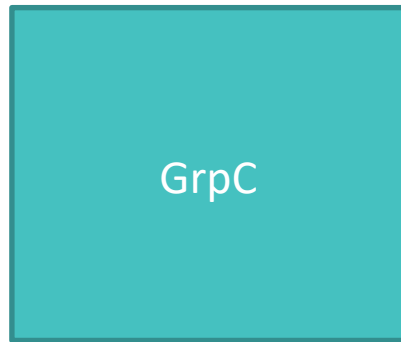
Order of processing

- Preparation of hierarchical files and order of processing
 - **Process GrpB (E1: Europe) next**



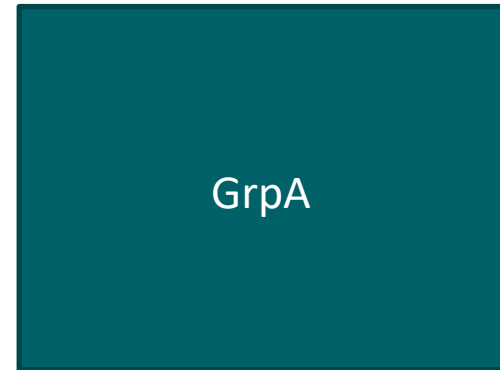
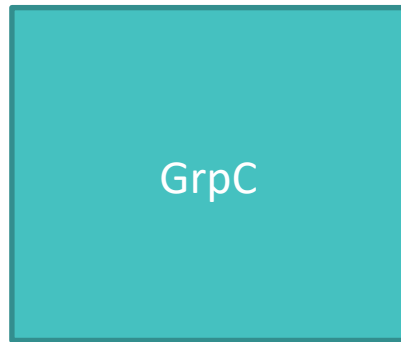
Order of processing

- Preparation of hierarchical files and order of processing
 - Common elements between GrpC and GrpA : **Unsafe**



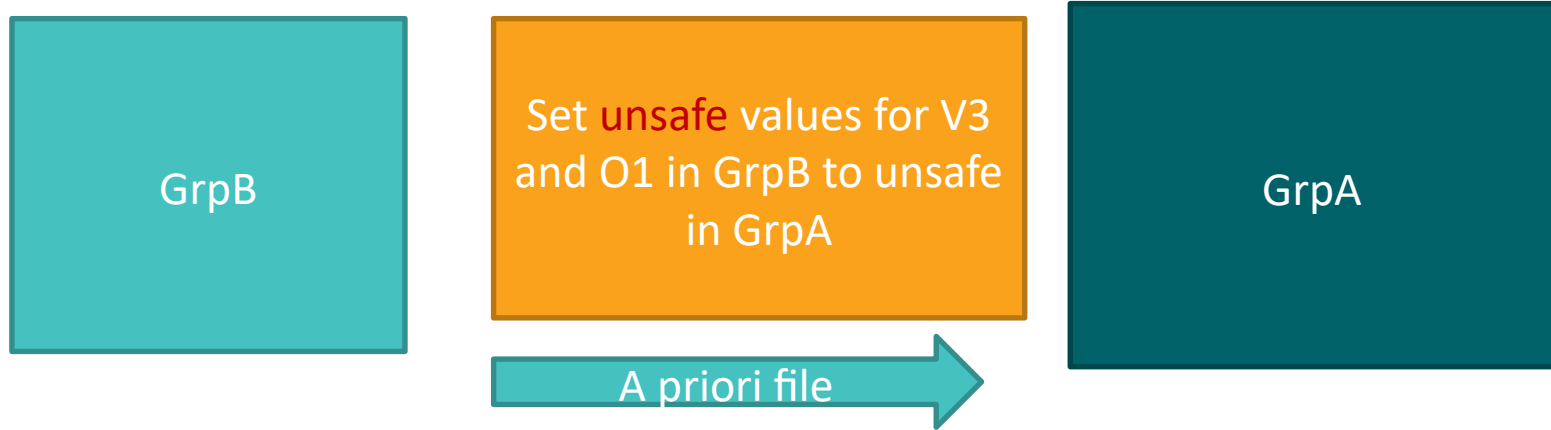
Order of processing

- Preparation of hierarchical files and order of processing
 - Common elements between GrpC and GrpA : **Safe**



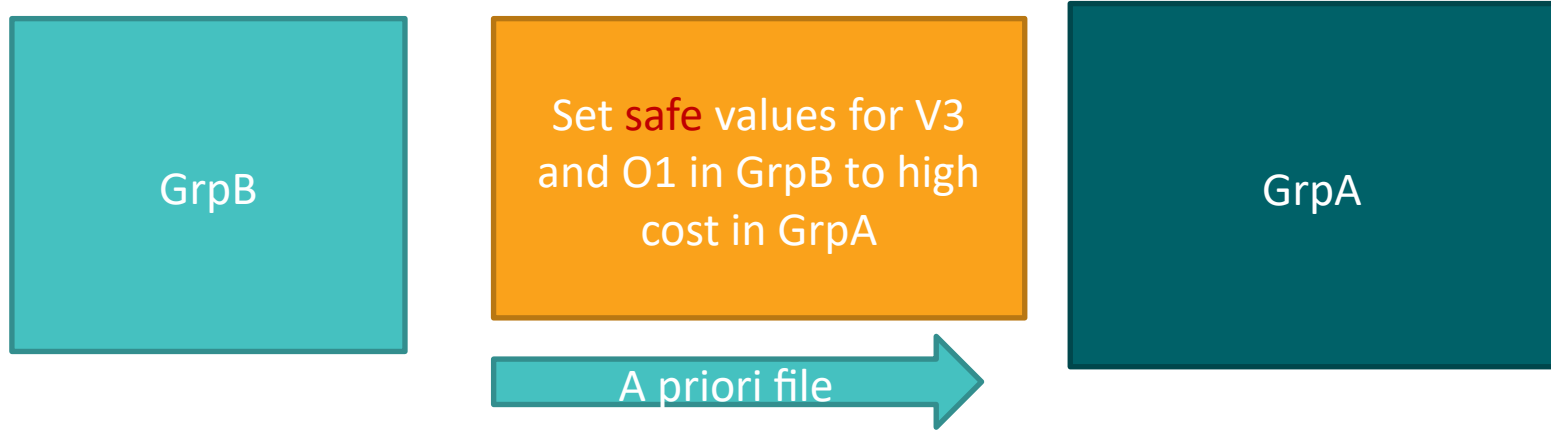
Order of processing

- Preparation of hierarchical files and order of processing
 - Common elements between GrpB and GrpA : **Unsafe**



Order of processing

- Preparation of hierarchical files and order of processing
 - Common elements between GrpB and GrpA : **Safe**



Order of processing

- Preparation of hierarchical files and order of processing
 - **Finally process GrpA**



Order of processing

- Preparation of hierarchical files and order of processing
 - **Finally process GrpA**

Z9 : Rest of world (excluding compiling country)	
V4: (Extra EU)	V3: EU (excl. compiling country)
E4: Africa	BE: Belgium
E7: America	BG: Bulgaria
F2: Asia	CZ: Czech Republic
F7: Oceania and polar regions	DK: Denmark
Z8: Extra EU not allocated	DE: Germany
O1: Europe but outside of EU	EE: Estonia



Order of processing

- Preparation of hierarchical files and order of processing
 - **Finally process GrpA**

Z9 : Rest of world excluding compiling country	
V4: (Extra EU)	V3: EU (excl. compiling country)
E4: Africa	BE: Belgium
AO: Angola	BG: Bulgaria
BF: Burkina Faso	CZ: Czech Republic
BI: Burundi	DK: Denmark
BJ: Benin	DE: Germany
BW: Botswana	EE: Estonia
....



Order of processing

- Preparation of hierarchical files and order of processing
 - **Finally process GrpA**

Z9 : Rest of world excluding compiling country	
V4: (Extra EU)	V3: EU (excl. compiling country)
E7: America	BE: Belgium
AG: Antigua and Barbuda	BG: Bulgaria
AI: Anguilla	CZ: Czech Republic
AR: Argentina	DK: Denmark
AW: Aruba	DE: Germany
BB: Barbados	EE: Estonia
....



Order of processing

- Preparation of hierarchical files and order of processing
 - **Finally process GrpA**

Z9 : Rest of world excluding compiling country	
V4: (Extra EU)	V3: EU (excl. compiling country)
F2: Asia	BE: Belgium
AE: United Arab Emirates	BG: Bulgaria
AF: Afghanistan	CZ: Czech Republic
AM: Armenia	DK: Denmark
AZ: Azerbaijan	DE: Germany
BD: Bangladesh	EE: Estonia
....



Order of processing

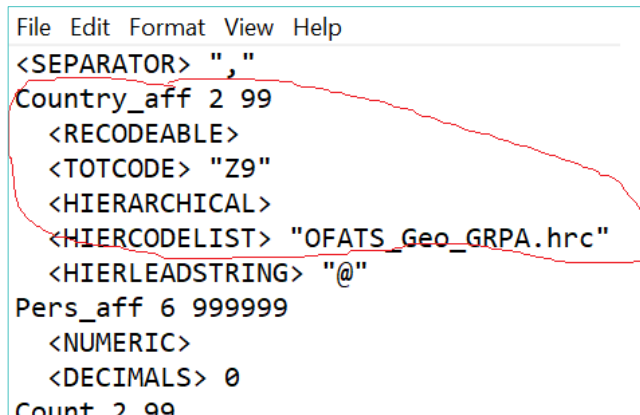
- Preparation of hierarchical files and order of processing
 - **Finally process GrpA**

Z9 : Rest of world excluding compiling country	
V4: (Extra EU)	V3: EU (excl. compiling country)
O1: Europe but outside of EU	BE: Belgium
AD: Andorra	BG: Bulgaria
AL: Anguilla	CZ: Czech Republic
BA: Bosnia and Herzegovina	DK: Denmark
BY: Belarus	DE: Germany
CH: Switzerland	EE: Estonia
....



Order of processing

- Preparation of hierarchical files and order of processing
 - **Finally process GrpA**

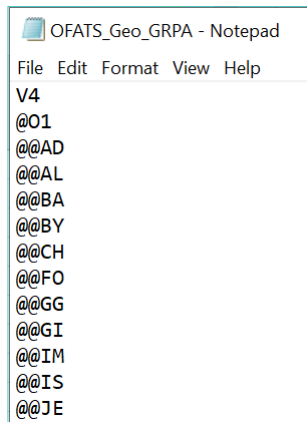


```
File Edit Format View Help
<SEPARATOR> ","
Country_aff 2 99
  <RECODEABLE>
  <TOTCODE> "Z9"
  <HIERARCHICAL>
  <HIERCODELIST> "OFATS_Geo_GRP.A.hrc"
  <HIERLEADSTRING> "@"
Pers_aff 6 999999
  <NUMERIC>
  <DECIMALS> 0
Count 2 99
```



Order of processing

- Preparation of hierarchical files and order of processing
 - **Finally process GrpA**



```
OFATS_Geo_GRP A - Notepad
File Edit Format View Help
V4
@O1
@@AD
@@AL
@@BA
@@BY
@@CH
@@FO
@@GG
@@GI
@@IM
@@IS
@@JE
```





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Issue with affiliates and totals



Issue with affiliates and totals

- Example A : Not suppressed but is disclosive

dmsunitid_pk	CompanyName	Instance	Name	Country_aff	Turnover	Nace_aff
11112222	KDTL GROUP PLC	1	KDTL Germany	DE	996,019,625	1623
11112222	KDTL GROUP PLC	2	KDTL France	FR	654,320,028	1623
11112222	KDTL GROUP PLC	3	KDTL Mexico	MX	832,211,362	1623
11112222	KDTL GROUP PLC	4	KDTL UK	GB	343,441,709	1623
11112222	KDTL GROUP PLC	5	KDTL Netherlands	NL	279,918,853	1623
11112222	KDTL GROUP PLC	6	KDTL Spain	ES	141,735,109	1721
11112222	KDTL GROUP PLC	7	KDTL Italy	IT	62,042,363	1721
11112222	KDTL GROUP PLC	8	KDTL Colombia	CO	86,634,233	1721
11112222	KDTL GROUP PLC	9	KDTL Sweden	SE	321,192,526	1721
11112222	KDTL GROUP PLC	10	KDTL USA	US	278,380,384	1721
11112222	KDTL GROUP PLC	11	KDTL Belgium	BE	57,874,971	1721



Issue with affiliates and totals

- Example B : Not suppressed but is disclosive

dmsunitid_pk	CompanyName	Instance	Name	Country_aff	Turnover	Nace_aff
11111111	SPRING SALES LTD	1	MARCH ENTERPRISES	FR	43	1610
22222222	SUMMER BROS HOLDINGS LTD	1	JUNE TIMBER LTD	FR	23,235,375	1610
22222222	SUMMER BROS HOLDINGS LTD	2	JULY WOOD LTD	DE	15,467,716	1610
22222222	SUMMER BROS HOLDINGS LTD	3	WARM TIMBER DESIGN LTD	FR	1,944,964	1610
33333333	AUTUMN LIMITED	1	SEPTEMBER SOLUTIONS LIMITED	FR	4,531,554	1610
33333333	AUTUMN LIMITED	2	OCTOBER TIMBER FRAME LTD	FR	3,390,528	1610



Issue with affiliates and totals - Solution

- Perform additional primary checks using SAS at
 - **NACE_aff * Geog_TOT * dmsunitid_pk level**
- Where Geog_TOT (Geographical totals) are:

Geographical Totals			
Z9	Rest of the world (excluding compiling country)	E7	America
V3	EU (excluding compiling country)	F2	Asia
V4	Extra EU	F7	Oceania and Polar Regions
E1	Europe	C4	Offshore financial centres
E4	Africa		



Issue with affiliates and totals

- Example A : For additional check becomes

dmsunitid_pk	CompanyName	Instance	Name	Country_aff	Turnover	Nace_aff
11112222	KDTL GROUP PLC	1	KDTL Germany	DE	996,019,625	1623
11112222	KDTL GROUP PLC	2	KDTL France	FR	654,320,028	1623
11112222	KDTL GROUP PLC	3	KDTL Mexico	MX	832,211,362	1623
11112222	KDTL GROUP PLC	4	KDTL UK	GB	343,441,709	1623
11112222	KDTL GROUP PLC	5	KDTL Netherlands	NL	279,918,853	1623
11112222	KDTL GROUP PLC	6	KDTL Spain	ES	141,735,109	1721
11112222	KDTL GROUP PLC	7	KDTL Italy	IT	62,042,363	1721
11112222	KDTL GROUP PLC	8	KDTL Colombia	CO	86,634,233	1721
11112222	KDTL GROUP PLC	9	KDTL Sweden	SE	321,192,526	1721
11112222	KDTL GROUP PLC	10	KDTL USA	US	278,380,384	1721
11112222	KDTL GROUP PLC	11	KDTL Belgium	BE	57,874,971	1721



Issue with affiliates and totals

- Example A : For additional check becomes

dmsunitid_pk	CompanyName	Instance	Name	Geog_TOT	Turnover	Nace_aff
11112222	KDTL GROUP PLC			Z9	3,105,911,577	1623
11112222	KDTL GROUP PLC			Z9	947,859,588	1721



Issue with affiliates and totals

- Example B : For additional check becomes

dmsunitid_pk	CompanyName	Instance	Name	Country_aff	Turnover	Nace_aff
11111111	SPRING SALES LTD	1	MARCH ENTERPRISES	FR	43	1610
22222222	SUMMER BROS HOLDINGS LTD	1	JUNE TIMBER LTD	FR	23,235,375	1610
22222222	SUMMER BROS HOLDINGS LTD	2	JULY WOOD LTD	ES	15,467,716	1610
22222222	SUMMER BROS HOLDINGS LTD	3	WARM TIMBER DESIGN LTD	IT	1,944,964	1610
33333333	AUTUMN LIMITED	1	SEPTEMBER SOLUTIONS LIMITED	FR	4,531,554	1610
33333333	AUTUMN LIMITED	2	OCTOBER TIMBER FRAME LTD	GR	3,390,528	1610



Issue with affiliates and totals

- Example B : For additional check becomes

dmsunitid_pk	CompanyName	Instance	Name	Geog_TOT	Turnover	Nace_aff
11111111	SPRING SALES LTD			V3	43	1610
22222222	SUMMER BROS HOLDINGS LTD			V3	40,648,054	1610
33333333	AUTUMN LIMITED			V3	7,922,081	1610





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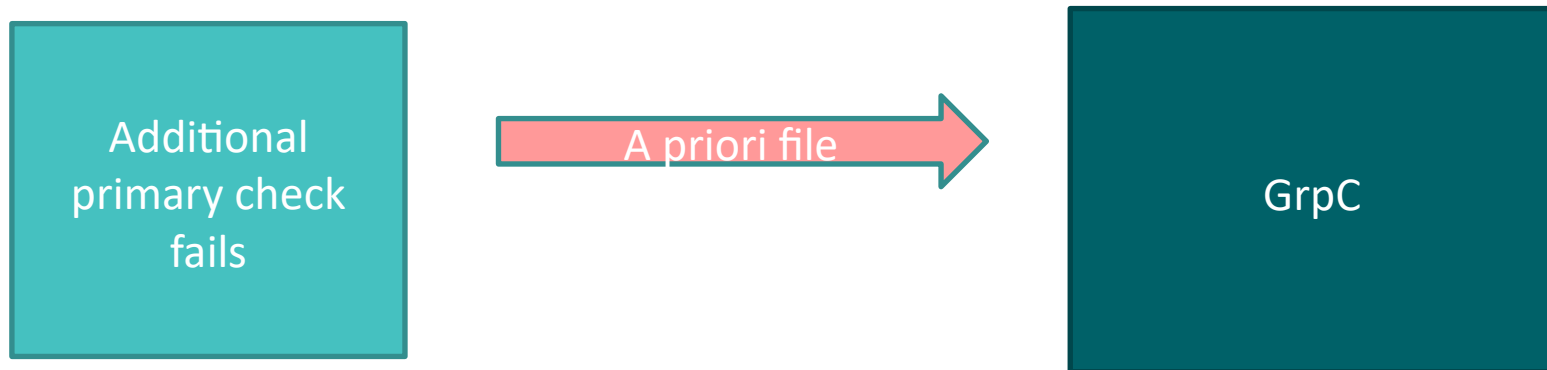
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Full Solution



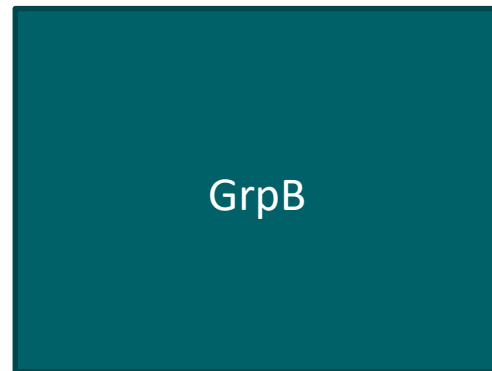
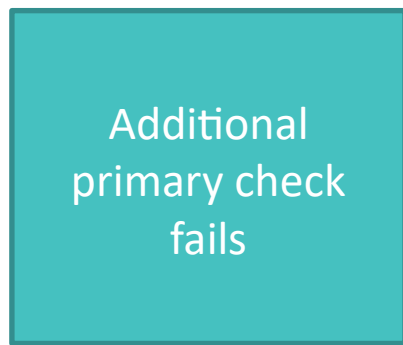
Full Solution

- Process GrpC
 - Pass in Additional primary check fails using a priori file



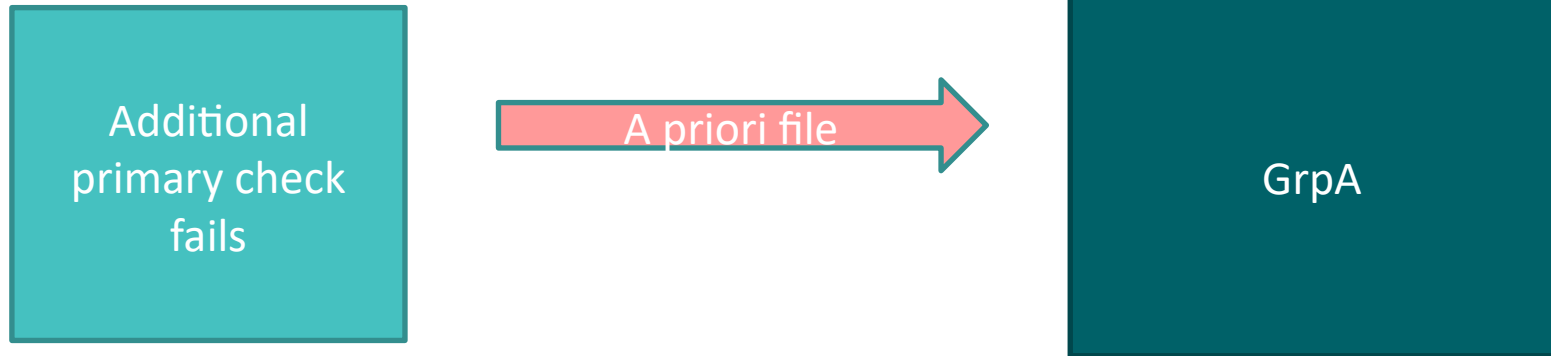
Full Solution

- Process GrpB
 - Pass in Additional primary check fails using a priori file



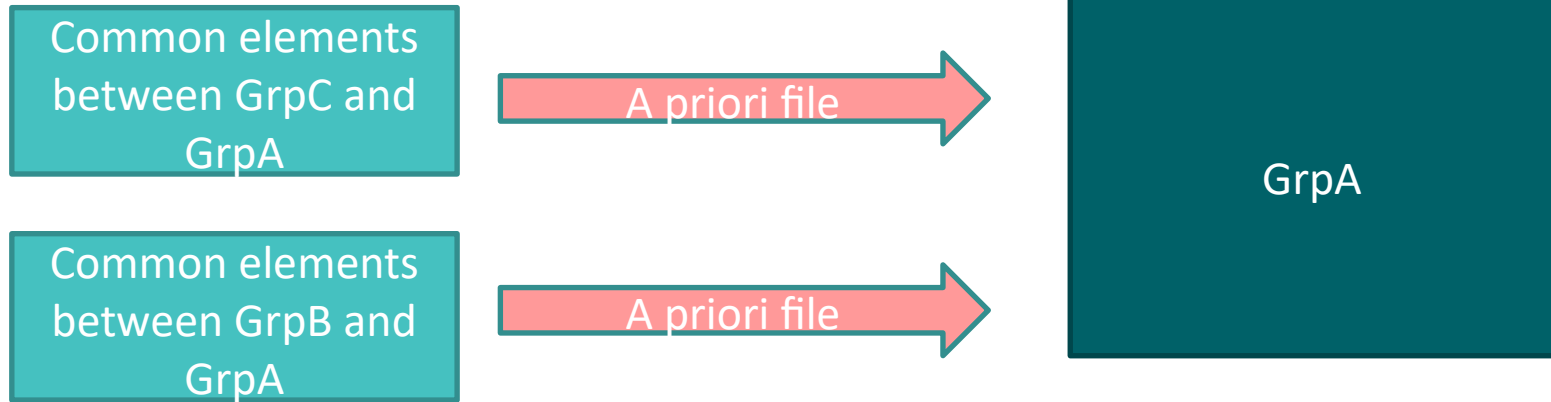
Full Solution

- Process GrpA
 - Pass in Additional primary check fails using a priori file



Full Solution

- **Process GrpA**
 - **Pass in detail of common elements using a priori files**





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Other recent Tabular SDC implementations





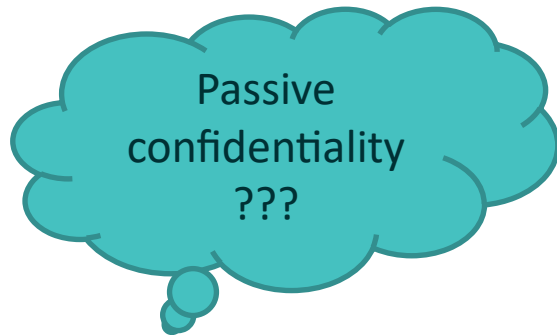
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Trade



Trade



- Passive confidentiality
 - Given a list of confidential codes. Only these considered for primary check fails
 - Dominance (1,80) and (2,90)
 - This list may be increasing dramatically in the near future and processing manually would be impractical



Trade

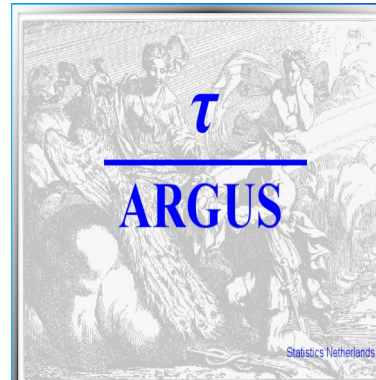
- Passive confidentiality – Primary Suppression

```
/* *****  
/* SECTION A - LEN 8  
/* All marked confidential need to be primary suppressed  
/* *****  
data cunonnull;  
    set checkfile;  
    if value ne .;  
run;  
  
proc sort data=cunonnull;  
    by CN Country;  
run;  
  
proc summary data= cunonnull;  
    by CN Country;  
    var value;  
    output out = Sum_Info_Len8 sum = Vlu_Len8;  
run;
```



Trade

- Secondary Suppression





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Business Demography



Business Demography

- Business Demography
 - NACE hierarchy is non-nested

S
S94
S95
S96

P-S
P-S_X_S94
S94



Business Demography

- Business Demography
 - NACE hierarchy is non-nested

S
S94
S95
S96

P-S
P-S_X_S94
S94



Acknowledgements

- The authors wish to thank Luigi Virgili and Luisa Franconi of ISTAT for their paper:
 - “Disclosure Protection of Non-Nested Linked Tables in Business Statistics”





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Thank you!

