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## The ISAE Manufacturing Survey Sample

### Validating the Nace Rev.2 Sectorial Allocation

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#### Abstract

After the full implementation of the new EU Standard Classification of Economic Activities (Nace Rev.2) in 2008, statistical agencies have increasingly dealt with the problem of redefining sampling designs and estimation techniques, especially in the case of stratified surveys with NACE codes as stratification variables. In light of this changes, the Italian Institute for Studies and Economic Analysis (Istituto di Studi e Analisi Economica - ISAE) is currently updating the sample design of its Business Tendency Survey (BTS). The focus of this paper is on finding a strata allocation methodology suitable to overcome the NACE Rev.2 changes. The analysis is carried out by considering two opposite needs: i) the strata allocation must retain multiple information; ii) the strata allocation must retain the optimality of the estimates. The allocation methods considered are: i) the classical Neyman  $x$ -optimal allocation, ii) the Neyman allocation used by ISAE, i.e. with direct application to areal stratification, iii) the multivariate Neyman allocation on qualitative variance according to Bethel formulation, iv) the Robust Optimal Allocation with Uniform Stratum Threshold (ROAUST). The ROAUST is a new allocation method which generates a new class of stratified estimators. Comparison among these methods is carried out via a *simulation device* - the Sequential Selection-Allocation (SSA). This simulation device constructs a new population list with units re-labelled within each stratum, such that the new labels corresponds to the order of selection in a SWOR resampling of the stratum units. This process is repeated a certain number  $N$  ( $N=1,000$  in the simulation presented in this paper) of times. From this new labelled population, all the allocation algorithms can be evaluated simultaneously.

Keywords: Business Survey, Stratified Sampling, Allocation Methods, Simulation techniques

JEL Classification: C42, C8, L10.

*Any completed sample is potentially  
a guide to improved future sampling  
(W. G. Cochran (1977), Sampling techniques, Wiley, New York, p.7)*

## **1. Introduction**

The Rev. 2 update of the NACE Statistical Classification of Economic Activities of the European Community (Eurostat, 2008) let many European statistical agencies face up to the necessity of rethinking many of their standard procedures in their routinely day-to-day work. Questionnaires, sample survey designs, methods of estimation, etc. need revision in order to maintain comparability with the previous existing NACE classification and integrity of time series. In Italy, the Italian Institute for Studies and Economic Analysis (Istituto di Studi e Analisi Economica - ISAE) is among those agencies whose previous work needs to be updated. In particular, the ISAE Business Tendency Survey (BTS) needs a radical revision. Since the economic activities used for stratification in this survey have changed in Rev. 2, the validation of the ISAE methodology is necessary especially in the stratification design.

This paper is focused on finding a strata allocation methodology suitable to overcome the NACE Rev.2 changes, and it represents an advancement of a joint research whose first findings have already preliminary tested with interesting results (Chiodini et al., 2009a, Chiodini et al., 2010). The analysis is carried out by bearing in mind that the strata allocation must retain multiple information and that it must produce optimal estimates. We compare three existing methods with a new method which is based on a threshold for inclusion in the strata. To validate the chosen allocation methods, an original simulation approach based on a unique experiment is applied (Chiodini et al., 2008b; Chiodini et al., 2009b; Chiodini et al., 2009c).

The Neyman optimum stratified random sampling is one of the most popular sampling designs in business surveys (industry, retail trade, construction, service and investments). This popularity can be explained with the fact that it results particularly fit when random samples must retain information and efficiency, for example when their size is small and a given level of precision is required. It is relatively simple to perform and provides efficient estimators of population parameters (Kozak et al., 2007; Särndal et al., 1992, p.100). However, a convenient balance between budget constraints and the achievement of a desired precision is often required. The consequence of this is that the resulting allocation may be sub-optimal (James et al. 2005). Moreover, the need of stratum representativeness from one side and the optimum allocation principle from the other are often in conflict for various reasons.

The population stratification is often based on predetermined rules according to some fixed administrative settings (e.g. NUTS areas) and economic classifications (i.e. firm sizes and sectors of activity). In this way, it is not often possible to subdivide a population into homogeneous strata so as to optimize a survey plan.

The business units population tends to have positively skewed distributions, with many small units and few very large ones. Therefore, the sample size has a considerable impact on the precision of survey estimates, leading to underestimation of the population characteristics. In the ISAE business survey for the Italian enterprises, the frame is selected by applying a cut-off which excludes firms with less than 10 employees (Malgarini et al., 2005). As the small sized firms represent about 80% of the overall population of firms, but only 20% of the total workforce employed in the overall population, the frame can be consequently reduced without significantly affecting the quality of the estimates. It is worth noting that several empirical analyses performed in the past have shown that some difficulties, such as the non-response rate, the birth mortality rate of the economic units and the errors of under - or over-coverage of the frame, become more relevant as the size of the units gets smaller (Cochran, W.G. 1977; ISTAT, 1989). This downsizing trend has become more relevant in recent years (e.g. 1991 and 2001 Italian Censuses outcomes, and 2001-2007 firms' registers).

Furthermore, a theoretically more efficient procedure could be that of creating the so-called "take-all" strata; from such strata, all the elements are included in the sample (Hidioglou, 1986; Lavallée and Hidioglou, 1988). This approach, however, is too costly considering that the participation of managers

to business surveys is voluntary and the survey has a monthly frequency so that the statistical burden could reach unbearable levels. It is probable that larger enterprises are more unwilling to respond than smaller enterprises are, and, as a consequence, their non-response rate would be critical for the quality and the reliability of the survey. In practice, a trade-off typically emerges between the desired precision and the required cost of a survey.

The paper is organised as follows. In section 2, the ISAE manufacturing survey is briefly introduced. In section 3 the strata selected and frame used are presented; in section 4 theoretical approaches are explained; in section 5 the selected allocation methods, and in section 6 the simulation procedure are briefly described; section 7 contains the findings of the simulations. Section 8 concludes the paper.

## **2. The ISAE Business Survey**

ISAE conducts the BTS in the Italian manufacturing industry on a monthly basis with the aim to investigate the “confidence” of economic operators by asking entrepreneurs and managers about assessments on current trends and expectations for the near future on both their own business and the general situation of the economy. Collected data are mainly of categorical type according to a three-level ordinal scale. The survey is part of the Joint Harmonised Business and Consumer Survey (BCS) program of the European Commission and is conducted according to a shared methodology, which essentially consists of a harmonised questionnaire and a common timetable (monthly frequency, fieldwork in the first half of the month, dispatching the results to the Commission 2-3 working days before the end of the month).

Data are collected via CATI (Computer Aided Telephonic Interviewing), partly integrated with fax interviews (some CAWI – Computer Aided Web Interviewing - interviews are scheduled in the future).

Apart from a recommended (by the European Commission) sample size of about 4,000 units, ISAE is relatively free to define any other aspects of the entire sampling process.

Although conceived mainly as purposive panel among managers (“expert witnesses”)<sup>1</sup>, ISAE has been developing its BTS sample over the years in order to better match the methodological developments of sampling theory. Since 1998, in accordance to the recommendations from European and world organizations (Martelli, 1998, EC, 2006 and 2007; OECD, 2003), the BTS has a stratified sampling design (according to 22 Nace Rev.1 sectors; 3 firm sizes and 19 Nuts-2 areas<sup>2</sup>) with univariate Neyman x-optimal allocation, based on workforce variance (see below, Sect. 3). The current ISAE sample does not differ much from one wave to another. Practically a fixed panel is established and surveyed each month. Whenever a firm permanently exits the survey and does not reappear in later waves, it is replaced by a similar one randomly selected in the same stratum.

Although the aforementioned constraints hold, this sample structure has been allowing satisfactory results during the years, as the confidence shows to be a good proxy of the economic evolution of the country. Figure 1 points out the capability of the survey to fit and even to anticipate the economic cycle.

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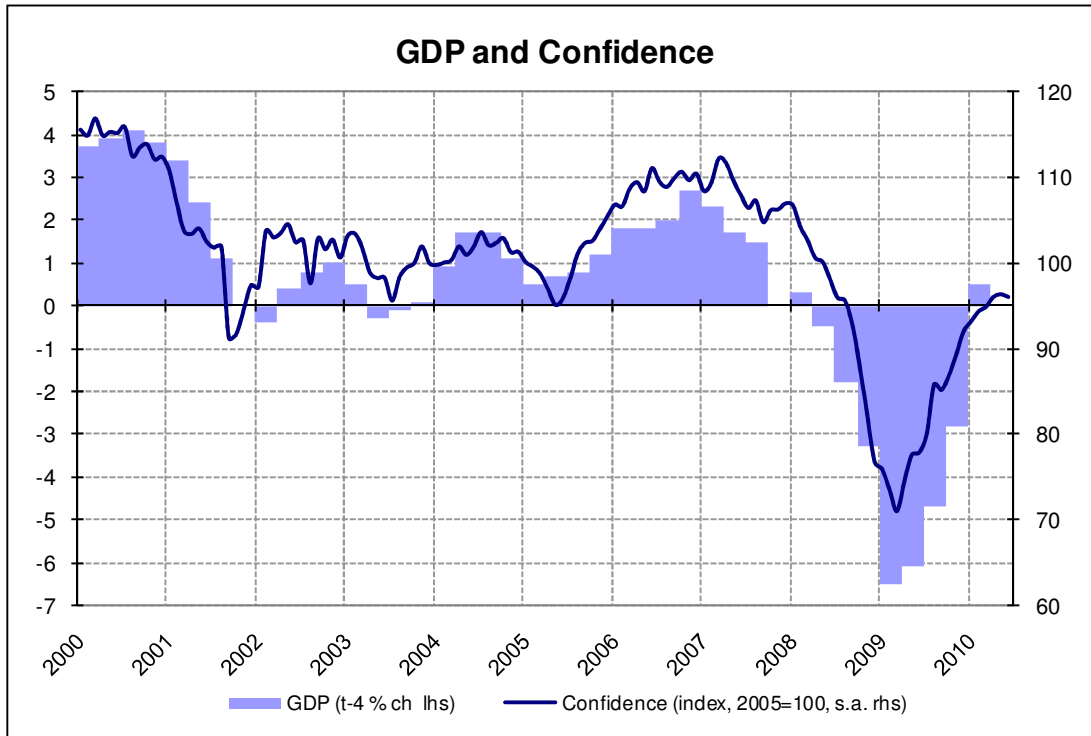
<sup>1</sup> Decision of European Commission of 15 November 1961. The BCS programme is implemented by DG ECFIN pursuant to the Commission’s institutional prerogatives. At present, this program is governed by Commission Decision C(97)2241 of 15 July 1997 and Commission Communication COM (2006)379 of 12 July 2006.

<sup>2</sup> NUTS is the acronym of Nomenclature of Territorial Units for Statistics (from the French nomenclature d’unités territoriales statistiques). It is a geocode standard for referencing the subdivisions of countries for statistical purposes. The standard is developed and regulated by the European Union, and thus only covers the member states of the EU in detail. The Nomenclature of Territorial Units for Statistics is instrumental in European Union’s Structural Fund delivery mechanisms. For each EU member country, a hierarchy of three NUTS levels is established by Eurostat; the subdivisions in some levels do not necessarily correspond to administrative divisions within the country (<http://en.wikipedia.org>). Defining the country as 0 level, for Italy, level 1 indicates partitions, and level 2 the regions.

### 3. Stratification and Frame

Besides the preservation of a good quality of the overall sample outcomes, the paper introduces advances in the sample definition which takes into account also the strata representativeness. To that purpose the main aspects to analyze while designing a sample are thereafter discussed.

**Figure 1 Italian GDP and Confidence**



Source: ISAE

The newly available register of enterprises for Italy, corresponding to the Nace Rev.2 classification, is the ASIA<sup>3</sup> register (ISTAT, 2009) provided by the Italian National Institute of Statistics (ISTAT). This register provides an exhaustive list of Italian enterprises classified according both to Nace Rev. 1.1 and Nace Rev. 2. It is available, however, with one and an half year of delay, as the most recent release we applied in this paper regards 2007 information.

In selecting the frame for our survey we considered a lower cut off by excluding firms with less than 10 employees. Therefore the selected frame comprises details for just over 86 thousand of enterprises (about 20% of the total), accounting for about 90 per cent of economic activity of the Italian manufacturing industry (i.e. in terms of firms' turnover).

**Table 1. Enterprises by stratum (Nuts-1, firm size, economic sectors), Italy, 2007 (units)**

<sup>3</sup> The ASIA archive is set up and yearly updated by the Italian National Statistical Institute by merging some main administrative archives, that is those of the Economy Department, Chamber of Commerce, Social Security (INPS), National Insurance Institute for Industrial Accidents (INAIL), Phone Company (Telecom) and National Electricity Board (ENEL). ASIA archive represents the most complete and updated source of the Italian firms' universe. It allows reliable and complete information for both building the sample and selecting the addresses, overcoming the usual problem to have a partial frame list in comparison to universe. It is disseminated with about 1 and a half year delay with respect to the information collected. The most recent version, released on October 2009, refers to 2007. This fact further allows keeping updated information on the Universe between the Census Surveys, which are, as well know, carried out every 10 years.

Sectors	North-West			North-East			Centre			South			Total
	10-49	50-249	250+	10-49	50-249	250+	10-49	50-249	250+	10-49	50-249	250+	
<b>10-12.</b>	1566	228	54	1782	278	39	1156	86	15	1978	177	15	7374
<b>13.</b>	1503	328	52	557	75	9	983	80	3	273	25	-	3890
<b>14.</b>	1398	128	22	1817	138	26	1217	99	8	1317	86	6	6262
<b>15.</b>	309	45	2	879	117	14	2095	136	9	628	46	3	4283
<b>16-17.</b>	1292	148	20	1524	163	14	898	84	10	780	48	4	4985
<b>18.</b>	952	79	11	739	58	5	507	34	-	298	19	-	2704
<b>19.</b>	31	10	7	17	5	.	21	7	4	74	6	4	186
<b>20-21.</b>	668	291	89	346	115	15	230	63	32	231	33	.	2113
<b>22.</b>	1607	288	41	1003	189	16	553	89	4	447	61	7	4305
<b>23.</b>	919	127	19	1199	229	50	878	103	16	1236	95	-	4872
<b>24.</b>	641	202	42	277	115	16	162	32	8	161	34	5	1695
<b>25.</b>	6428	635	42	4799	443	31	2074	177	9	2086	214	11	16949
<b>26.</b>	738	146	29	430	103	15	277	57	13	122	23	4	1957
<b>27.</b>	1060	204	36	842	162	28	353	60	15	198	23	3	2984
<b>28.</b>	3247	665	88	2823	608	105	750	128	8	521	57	4	9004
<b>29-30.</b>	571	183	79	373	99	31	333	71	15	245	87	19	2106
<b>31.</b>	898	90	5	1659	234	19	925	101	8	475	49	6	4469
<b>32.</b>	598	80	12	692	107	7	492	36	4	194	6	-	2229
<b>33.</b>	1408	87	5	958	43	3	674	27	4	802	63	6	4080
<b>Total</b>	25834	3964	655	22716	3281	443	14578	1470	186	12066	1152	102	86447

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007);

Note: '.' Missing value; '-' less than 3 units.

BTS has a stratified design and the strata are usually defined according to three variables: firm size (generally in terms of employees), economic classification and geographical areas. In the present analysis the width of the classes refers to 3 types of enterprises (according to Eurostat settings, EC 2003): small enterprises (10-49 employees), medium-sized enterprises (50-249 employees) and large enterprises (with at least 250 persons employed). The economic sectors mainly reflect the Nace Rev.2 two digits classification with some few further grouping. The geographical detail refers to Nuts-1 classification that allows for reducing the number of the strata as compared to the Nuts-2 classification that was the usual classification in the past. This choice allows to nearly completely avoid the occurrence of empty strata in the frame and, although the within variance increases, this occurrence has not any substantial impact on sample designs with regards to optimality (Chiodini et al., 2009a).

These stratum definitions mainly derive from administrative settings (Table 1), and often do not respect the statistical and economic principles of stratum definition (see, e.g., Kozac et al., 2007). However, this topic is beyond the scope of this paper, as the involved entities (European Commission, governmental institutions and economic operators) have strong and different level of interest to such domains and greatly support (also financially) the production of detailed results according to the above mentioned stratifications. Table 1 shows the applied frame by firms and workforce, respectively. It is worth noticing that with the selected strata grid only two cells are empty.

## 4. Approaches and Methods

This research has its theoretical background on the combination of two approaches: the one of M. Martini<sup>4</sup> and the one of Magagnoli<sup>5</sup> (Chiodini et al., 2010). From empirical observation new intuitions

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and formal representations follow. These first formal representations are verified by adapting the simulation approach to the context of sampling from finite populations.

### *Martini's Approach*

This is an approach which originates from the observation of real phenomena. In Martini's words (Martini,2004): *Applied Statistics is the privileged place where the dialogue on changing reality between who speaks the language of economic and social sciences and who speaks the language of rigorous procedures takes place, leading to numerical summaries from the reality itself.*

### *Magagnoli's Approach*

In scientific research the empirical evidence is frequently invoked for supporting research hypotheses and developed theories. When the availability of real data is scarce the empirical evidence is supported by computational algorithms to perform simulation. The advantage of this method, through which data are random generated, relies upon (i) not wasting time and resources in finding reliable data for empirical validation, (ii) infinite (at least in theory) replications can be obtained with no additional costs, (iii) different scenarios - from applied to theoretical ones - can be evaluated and finally (iv) the robustness of the proposed method can be checked asymptotically.

This way of working is especially motivated in some particular fields such as quality control and system reliability, where the verification systems frequently lead to the elimination of product units or is time-consuming and entails unaffordable costs<sup>6</sup>

The methodology here proposed can be used when the observation of reality induces to propose a new theoretical method (in our case the ROAUST method) which necessitates some empirical validation. More importantly, in survey sampling from finite populations, simulations allow for the checking of (i) the efficiency of estimators (at a lower level of costs and resources) even with small sampling fractions, (ii) the performance of the unit allocation methods (i.e. in case of stratified sampling) and (iii) the efficacy of the auxiliary information introduced in the sample. These are all issues with no trivial solutions and a purposely built simulation is needed.

## **5. Allocation Methods**

Given a sample of size  $n$  and focusing on strata allocation, the following allocation methods are considered and compared with the classical Proportional, Uniform and Neyman allocation.

### **5.1 ISAE (bounded) Allocation (Neyman on areas, winsorisation of variances, upper bounded)**

It is simply a slight modification of the classical  $x$ -optimal Neyman criterion applied separately on each of the  $k$  ( $k=1\dots K$ ) Nuts\_1 (Nuts\_2 in the past) areas. By doing so, as each area is treated separately, the higher variances of one area work only on this area and do not affect the other ones. The incidence of the major areas is thus reduced while that of the less industrialised ones is conversely increased allowing to increase numerosity also in "weak" strata.

The variability is measured on the stratum workforce upon which, at Nuts-1 level, a winsorisation=5% is applied. For each  $k$ , the upper/lower 5% values of  $\sigma_{hk}$  are set equal to the nearest lower/upper value. This technique is usually applied when dealing with partial frames or incomplete universes, where data on variances can be missing. Also in our case, however, where the complete universe is available, winsorisation is helpful. Some sectors, infact, (e.g. transports) often have very high variances and simply using them for calculating the weights (and consequently the sizes) has the consequence to excessively gather units in these strata despite of in all the others. The stemming

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<sup>6</sup> See Chiodini P.M., Magagnoli U. (2000), Magagnoli U., Chiodini P.M. (2002); Magagnoli U., Chiodini P.M. (2006); Magagnoli U., Chiodini P.M. (2007a); Magagnoli U., Chiodini P.M. (2007b)

sample is often characterized by a higher precision but with an unrealistic concentration of sample units in these high-variances strata. Winsorisation, by smoothing extremes values, allows avoiding this undesirable effect. Then according to Neyman, the  $h^{th}$  stratum size (for  $h=1..H$ ) of the  $k^{th}$  area is:

$$n_{kh} \begin{cases} n_k \frac{N_{kh} \sigma_{kh}^*}{\sum_{h=1}^H N_{kh} \sigma_{kh}^*} & \text{if } N_{kh} \geq n_{kh} \\ N_{kh} & \text{if } N_{kh} < n_{kh} \end{cases} \quad [1]$$

where  $\sigma_{kh}^*$  are the winsorised variances and  $n_k$  is the  $k^{th}$  Nuts-1 sample size, such that :

$$n_h = \sum_{k=1}^K n_{kh} \quad \text{and} \quad n = \sum_{k=1}^K n_k$$

These changes let to overcome the Neyman's drawback to "over"-allocate units in strata with higher variances, leaving others nearly empty and to "under"-allocate units in areas with weak industrial sectors.

This structure proved to be quite satisfactory performing, at sample level, very like to the classical Neyman design<sup>7</sup>, assuring a satisfactory coverage also for less industrialized areas.

A further bound is now however included, due to practical observations: in reality in large firms strata, it is very difficult to achieve a sampling fraction higher than 20% while the Neyman theory often requires also census investigations. While the ISAE methodology without any size bound showed satisfactory results, in this paper we wish to test a more realistic sample by including also this constrain:  $f_h \leq 0.2$ .

## 5.2 The Neyman Domain Algorithm: the (R)OAUST Class

In the context of the domain analysis the most important result has proved to be the (R)OAUST - (Robust) Optimum Allocation with Uniform Stratum Threshold<sup>8</sup> as compared to the classical methods (proportional, univariate, Neyman) usually applied. In this paper we wish to test its efficiency also in comparison of a new version of the ISAE technique as well as against the multivariate allocation (see par 5.3).

We first define the sample size  $n$ , apply the Uniform Allocation by sampling  $n_1$  units ( $n_1 = \alpha n$  with  $\alpha \in [0, 1]$ ) and then the Neyman Allocation for the remaining  $n_2$  units, such that  $n_2 = n - n_1$ :

$$n_s = \frac{n_1}{S} + n_2 \frac{N_s \sigma_s}{\sum_{s=1}^S N_s \sigma_s} \quad [2]$$

In [2],  $n_s$ ,  $N_s$  and  $\sigma_s$  are respectively the sample size, the number of units, the standard deviation in the  $s^{th}$  stratum,  $s=1, \dots, S$ . When  $\alpha=0$  then  $n_2=n$  (obtaining OA); when  $\alpha=1$  then  $n_1=n$  (obtaining UA). Without loss of generality, with small sampling fractions,  $\alpha=0.5$ .

## 5.3 The Neyman Bethel multivariate allocation

A multivariate qualitative allocation is also considered as the BTS investigates various phenomena so that the survey assumes a multipurpose feature and this technique could represent the most suitable one.

<sup>7</sup> See Chiodini, Lima, Manzi, Martelli, Verrecchia (2009a)

<sup>8</sup> See Chiodini, Manzi, Verrecchia (2008a)

The allocation selected represents an extension to the multivariate case of the Neyman allocation, as the variables considered are  $j < 1$ . It is performed according to Bethel (1989) formulation and using the Cromy (1987) iterative algorithm<sup>9</sup> to solve it.

The principles underlying this method are the following: for a sample with  $H$  strata and considering  $J$  variables let :

$n_h$  the sample allocation;  $w_h$  the proportion of population belonging to the  $h^{th}$  stratum;  $\sigma_{hj}^2$  variance of the  $j^{th}$  response variable in the stratum  $h$ ;  $v_j$  arbitrary positive constant;

$$x_h = 1/n_h \text{ if } n_h \geq 1 \\ = \infty \text{ otherwise}$$

and defined the constant:

$$a_{hj} = w_h^2 \sigma_{hj}^2 / v_j^2$$

the problem can be expressed as to minimize a cost function:

$$g_x = \sum_{h=1}^H c_h / x_h \quad c_h > 0, \quad h=1, \dots, H \quad [3]$$

under the constraint:  $a'_j x \leq 1, \quad j=1, \dots, J$   
 $x > 0$

where  $a_j$  is the  $j^{th}$  column vector of the matrix  $A = \{a_{hj}\}$

The solution is obtained by means of the relatively simpler iterative procedure proposed by Chromy.

In this research the variances selected are those of the three qualitative key variables composing the confidence climate, namely: order assessments, production expectations and stock level. It is worth mentioning that, as we are dealing with qualitative variables, the stemming variances are of very limited amount so that their contribution in strata definition would be limited.

## 6. Simulation

In order to empirically evaluate the performance of the various sampling allocation methods, simulation techniques are required. However, a computationally feasible general simulation method is hard to establish, especially when methods need to be compared simultaneously, that is when the sampling experiment has to be performed in a unique way, by separating the selection, the allocation and the inferential processes. This can be achieved via a Sequential Selection-Allocation (SSA) by constructing a new labelled list where population units are re-labelled within each stratum according to their selection rank after performing a Sampling WithOut Replacement (SWOR) of size equal to the stratum size<sup>10</sup>. Then this process is replicated  $N$  times. From this new labelled population, all the allocation algorithms can be performed (Figure 2).

<sup>9</sup> The software used is MAUSS (Multivariate Allocation of Units in Sampling Surveys.) freely available on-line from ISTAT both in SAS and R versions (<http://www.istat.it/strumenti/metodi/software/campione/mauss/>)

<sup>10</sup> Chiodini et al., 2008b; Chiodini et al., 2009b; Chiodini et al., 2009c.



## 7. Results

### 7.1 Overall population results

In order to compare the allocation methods, we use the statistics on the overall employment, as the employment is, in this simulation, the data to be collected (/investigated)<sup>11</sup>. A useful criterion is the well known RMSE (Root Mean Square Error):

$$\text{RMSE} = [\text{Bias}^2 + r\sigma^2]^{1/2} \quad [4]$$

where Bias is equal to  $\mu - r\mu$  ( $\mu$  is the population mean and  $r\mu$  the replication mean) and  $r\sigma$  is the standard error (SE) of the replicates.

Both Bias - that refers to systematic errors - and SE - that refers to the precision of the estimators - are lower in the Neyman allocation when applied to the overall population. In the Neyman allocation, both the Absolute Total Error (|TE|), given by:

$$|\text{TE}| = |\text{Bias}| + r\sigma \quad [5]$$

and the RMSE - that refers in this case to the accuracy of the estimators - are lower than in the other allocation methods (see Table 3).

In order to consider  $\mu$ s of different sizes (e.g. stratum means) and biased and unbiased estimators, a more useful criterion is the so called RRMSE (Relative Root Mean Square Error)

$$\text{RRMSE} = [(\text{Bias} / r\mu)^2 + r\text{CV}^2]^{1/2} \quad [6]$$

where  $r\text{CV}$  is equal to  $r\sigma / r\mu$ .

As it can be noted from Table 4, in this case there are no substantial changes in the allocation methods accuracy ranking. Both the Relative Total Error (|RTE|), given by:

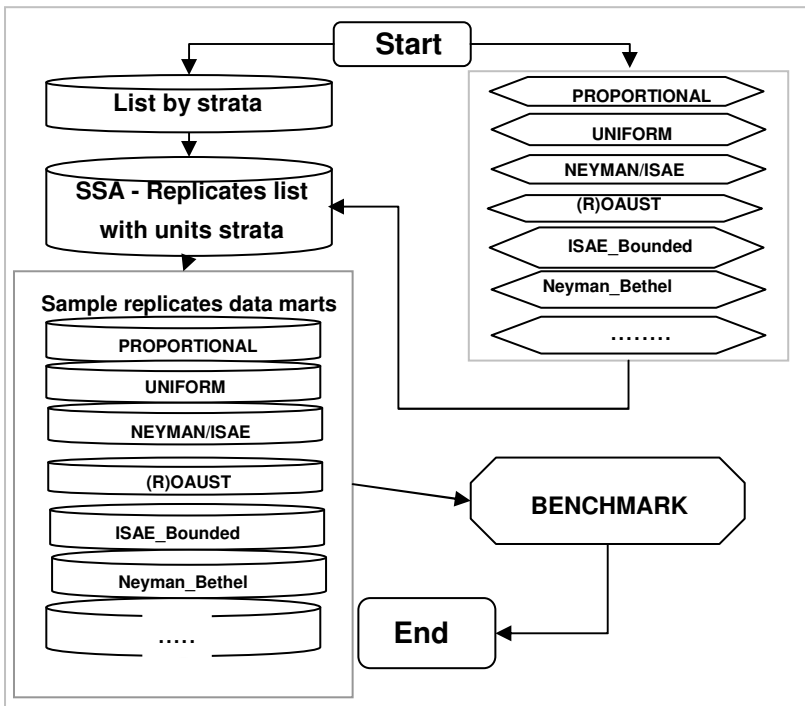
$$|\text{RTE}|: \text{Relative } |\text{TE}| = |\text{Bias} / r\mu| + r\text{CV}, \quad [7]$$

and the RRMSE indicators [6] form the same ranking of allocation methods as well as the |TE| and RMSE indicators.

Figure 3 provides a graphical presentation of accuracy of different methods considered. While the distribution of replications of all the methods based on Neyman appear to be centered on the frame mean (i.e. unbiased), uniform and, at larger extent, proportional result skewed. Furthermore these two latter methods show a remarkable higher volatility.

<sup>11</sup> Also in the case of the multivariate sample, for comparability reasons and taking in mind that the qualitative variables do not have corresponding values in the universe, the employment figures have been utilised.

Figure 2. Simulation flowchart



Source: ESeC-ISAE

Table 3. Errors (Total, 1000 replicates)

	Bias	SE	TE	Bias <sup>2</sup>	SSE	RMSE	Sample
ISAE BOUNDED	1919	84525	86445	3684430	7144533943	84547	3977
NEYMAN / BETHEL	1313	88854	90167	1724426	7894987228	88863	3993
NEYMAN / ISAE	175	21587	21762	30679	465997585	21588	3951
(R)OUST3	265	21832	22097	70228	476614986	21833	3932
(R)OUST9	181	23435	23615	32686	549177982	23435	3946
UNIFORM	1120	60270	61389	1253630	3632422191	60280	3984
PROPORTIONAL	2417	175673	178089	5841141	30860860363	175689	3961

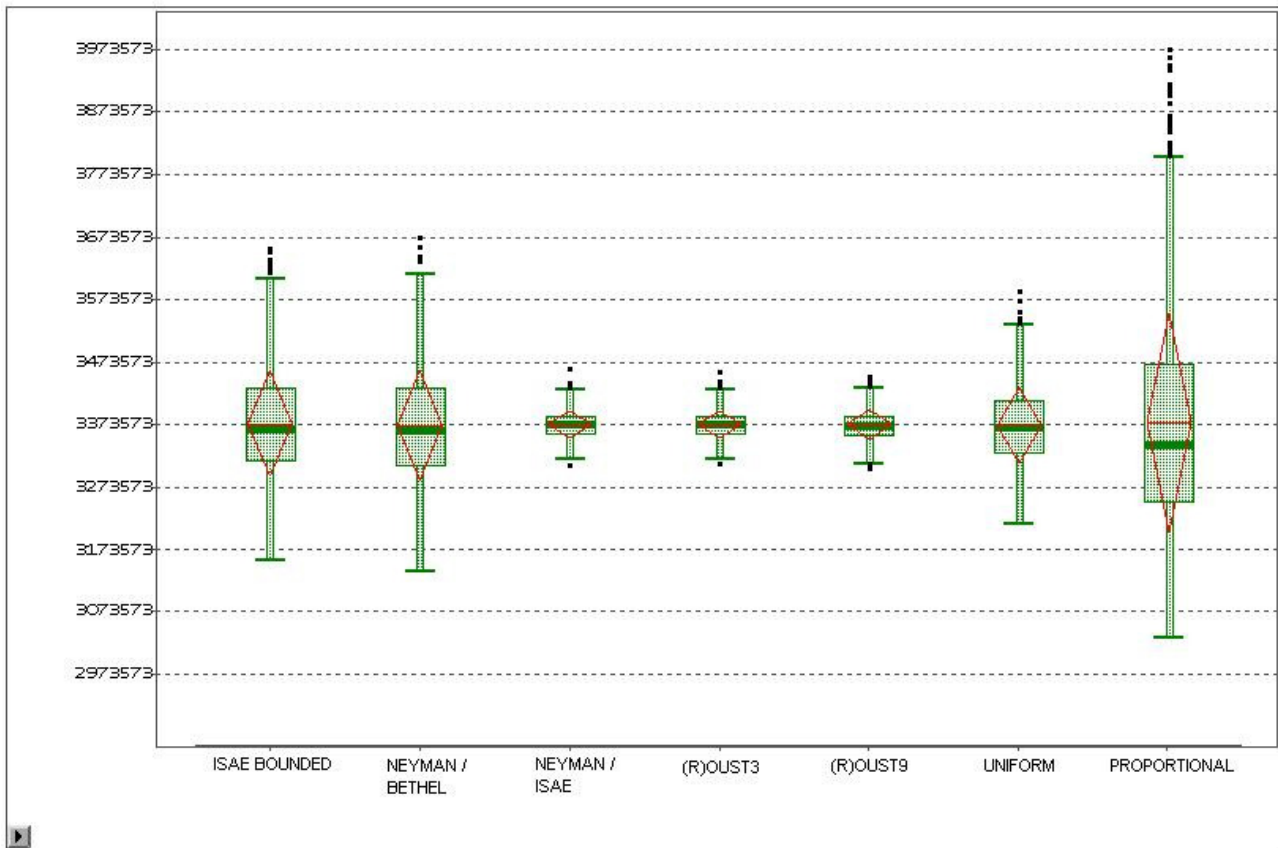
Source: ESeC-ISAE data processing on ISTAT data (ASIA 2006)

**Table 4. Relative errors (Total, 1000 replicates)**

	Bias/ $\mu$	CV	RTE	(Bias/ $\mu$ ) <sup>2</sup>	CV <sup>2</sup>	RRMSE
ISAE BOUNDED	0.0006	0.0250	0.0256	0.0000	0.0006	0.0250
NEYMAN / BETHEL	0.0004	0.0263	0.0267	0.0000	0.0007	0.0264
NEYMAN / ISAE	0.0001	0.0064	0.0065	0.0000	0.0000	0.0064
(R)OUST3	0.0001	0.0065	0.0066	0.0000	0.0000	0.0065
(R)OUST9	0.0001	0.0069	0.0070	0.0000	0.0000	0.0069
UNIFORM	0.0003	0.0179	0.0182	0.0000	0.0003	0.0179
PROPORTIONAL	0.0007	0.0520	0.0528	0.0000	0.0027	0.0520

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2006)

**Figure 3. Total replicates (1000 replicates)**



Source: ESeC-ISAE data processing on ISTAT data (ASIA 2006)

## 7.2 Strata results

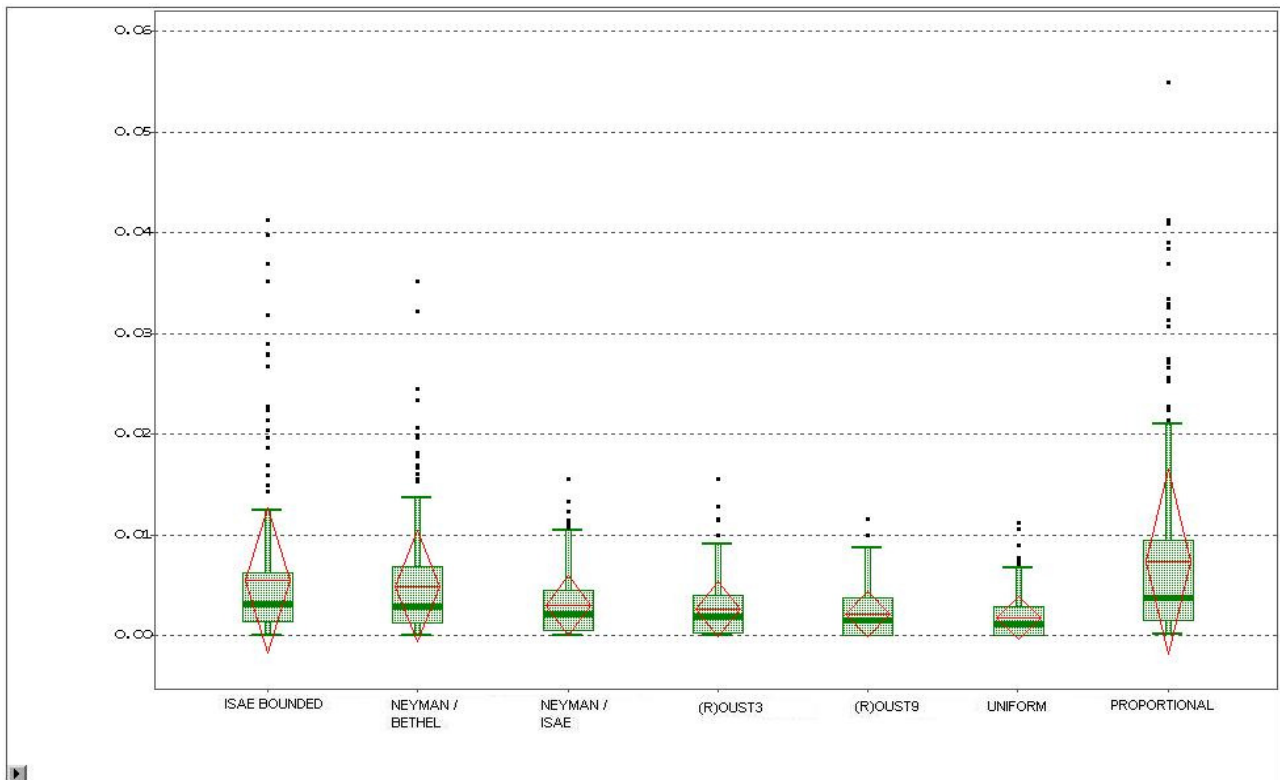
In order to consider the means  $\mu_h$  - that refer to different stratum sizes – we apply formula [7] that gives the relative TE. We can observe (Table 5 and Figures 4-6) that the (R) OUST9 method (although with a little loss in terms of Bias and precision of the overall estimator - i.e. 0.0070 versus Neyman 0.0065), results to have the higher accuracy within the strata (i.e. the maximum of the strata RTEs is equal to 0.1691 versus the maximum of the strata Neyman which is 0.5851).

**Table 5. Maximum errors among strata (Total, 1000 replicates)**

	ISAE BOUNDED	NEYMAN / BETHEL	NEYMAN / ISAE <sup>12</sup>	(R)OUST3	(R)OUST9	UNIFORM	PROPORTIONAL
Max of strata relative  Biases	0.0413	0.0352	0.0155	0.0155	0.0115	0.0112	0.0550
Max of strata CVs	1.2881	1.0115	0.5809	0.2899	0.1670	0.3964	1.6587
Max of strata relative  TEs	1.2982	1.0225	0.5851	0.2919	0.1691	0.4076	1.6657
<b> RTEs </b>	<b>0.0256</b>	<b>0.0267</b>	<b>0.0065</b>	<b>0.0066</b>	<b>0.0070</b>	<b>0.0182</b>	<b>0.0528</b>

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2006)

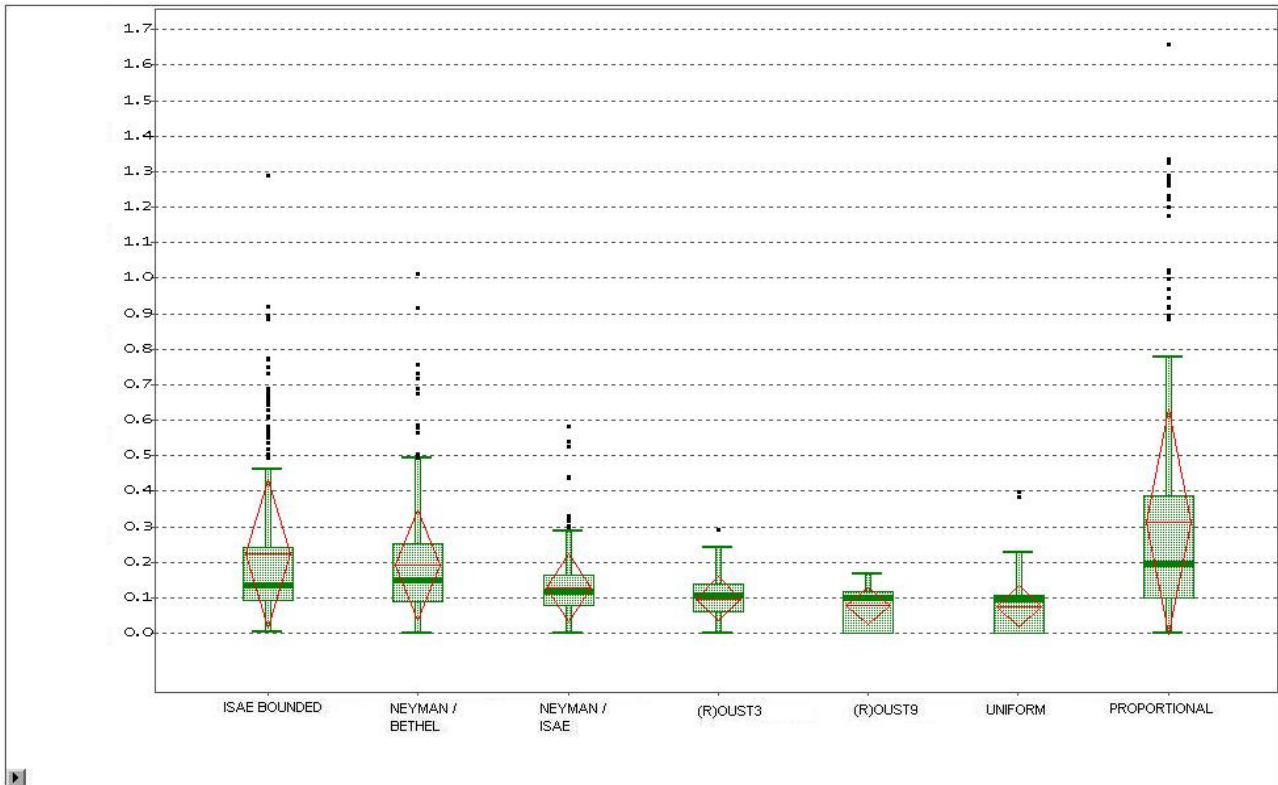
**Figure 4. Relative |Bias| by stratum (# 228, 226 strata populated, 1000 replicates)**



Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

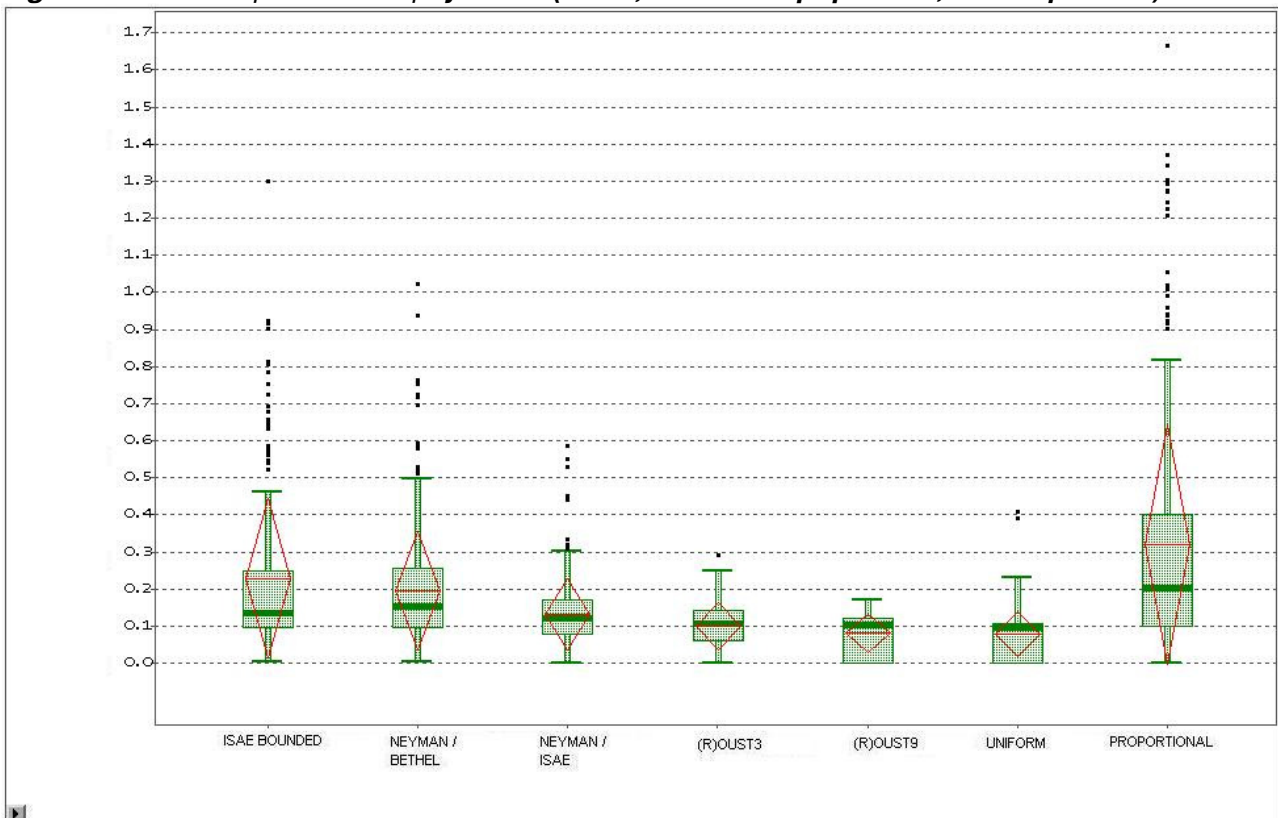
<sup>12</sup> The results for ISAE and Neyman allocations are so similar that they are gathered in an unique column

**Figure 5. CV by stratum (# 228, 226 strata populated, 1000 replicates)**



Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

**Figure 6. Relative |Total Error| by strata (# 228, 226 strata populated, 1000 replicates)**



Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

### 7.3 The ISAE Bounded sample

Given the difficulty to reach all sample units in the small strata (i.e. to apply the so called “take all” strata technique, where  $n_h=N_h$ ), we also tested a very strong operational constrain applied to the ISAE methodology: that is we assume a very sharp upper bound (e.g. 20% of the stratum units for the large sized strata. See above, section 5.1). The results, however, suggest that constrains may be introduced only up to a certain extent. In Chiodini, Lima, Manzi, Martelli and Verrecchia (2009) we proved that, by introducing a sampling fraction not higher than 50% (together with a lower bound of 3 units per stratum), the strata accuracy of the (R)OAUST methods will not be lowered.

In the present ISAE case however, the bound seem to be too tight as the results, even always better than for proportional allocation, are not satisfactory.

## 8. Conclusions

This research points out that some criticalities affect the goodness of the Neyman’s allocation method. Furthermore, the simulation results highlight some points:

1. The best results in terms of robustness are those of (R)OAUST method in domain analyses (regional and sectorial)
2. The Neyman multivariate allocation according to Bethel is not suitable for BTS sampling definition
3. The ISAE allocation with low sampling fraction downgrades its original efficiency
4. The proportional allocation method, although widely used by sectorial operators, is not fit when sample units are enterprises.

Martini explained the sense of the interdisciplinary approach he proposed: “*Statistics can not be used in reality if statisticians are not at the same time economists and sociologists and, above all, are not driven by a problem-solving approach which must start from the entities forming the socioeconomic universes in their work*”.

Sector market surveys often require solutions which are not extensively available in literature. In addition to the usual sample bias connected to the sample lists and the information retrieved via questionnaires, one has to deal with the estimation of population variables which are not normally distributed.

Our proposal comes from the observation of reality with a substantial approach and lead to methodological developments to overcome problems like the problem of imperfect frames and the problem of heterogeneity in the strata. The (R)OAUST class can be considered as a Neyman’s domain allocation, since it allows for an optimal allocation and stratum representativeness. The validation of this proposal is given by computational and formal statistical solutions. From the first findings of our simulation on ISAE survey (see Table 3) the (R)OAUST method is more efficient than other methods and at the same time provides an overall population  $|RTE|$  similar to that of Neyman’s algorithm.

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## Appendix 1

### *Sector (Nace rev.2)*

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#### **CODES AND DESCRIPTION**

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- 10-12. Manufacture of food, beverages and tobacco products**
  - 13. Manufacture of textiles**
  - 14. Manufacture of wearing apparel**
  - 15. Manufacture of leather and related products**
  - 16-17. Manufacture of wood and paper products**
  - 18. Printing and reproduction of recorded media**
  - 19. Manufacture of coke and refined petroleum products**
  - 20-21. Manufacture of chemical and pharmaceutical products**
  - 22. Manufacture of rubber and plastic products**
  - 23. Manufacture of other non-metallic mineral products**
  - 24. Manufacture of basic metals**
  - 25. Manufacture of fabricated metal products, except machinery and equipment**
  - 26. Manufacture of computer, electronic and optical products**
  - 27. Manufacture of electrical equipment**
  - 28. Manufacture of machinery and equipment n.e.c.**
  - 29-30. Manufacture of transport vehicles**
  - 31. Manufacture of furniture**
  - 32. Other manufacturing**
  - 33. Repair and installation of machinery and equipment**
- 

*Source: ISTAT (ASIA 2007)*

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## Appendix 2

### NEYMAN - Weights of sample units (N/n) by strata, Italy, 2007

	North-West			North-East			Centre			South and Islands		
	10 -	50 -	250	10 -	50 -	250	10 -	50 -	250	10 -	50 -	250
	49	249	-	49	249	-	49	249	-	49	249	-
10-12. Manufacture of food, beverages and tobacco products	43.50	8.44	1.00	42.43	7.94	1.00	48.17	8.60	1.50	46.00	10.41	2.14
13. Manufacture of textiles	38.54	9.37	1.79	42.85	9.38	1.13	46.81	11.43	3.00	39.00	8.33	.
14. Manufacture of wearing apparel	46.60	9.14	1.00	51.91	9.86	1.53	46.81	9.90	2.00	45.41	10.75	1.20
15. Manufacture of leather and related products	44.14	11.25	.	43.95	9.00	2.33	46.56	12.36	1.00	48.31	11.50	.
16-17. Manufacture of wood and paper products	44.55	9.25	1.00	44.82	9.06	2.80	47.26	10.50	3.33	52.00	6.86	2.00
18. Printing and reproduction of recorded media	45.33	8.78	3.67	49.27	9.67	1.00	50.70	11.33	.	49.67	19.00	.
19. Manufacture of coke and refined petroleum products	31.00	10.00	1.17	.	.	.	21.00	7.00	1.33	74.00	.	1.00
20-21. Manufacture of chemical and pharmaceutical products	37.11	7.86	1.00	38.44	9.58	1.36	38.33	7.88	1.00	46.20	8.25	.
22. Manufacture of rubber and plastic products	40.18	8.47	1.00	40.12	9.00	2.67	42.54	9.89	4.00	40.64	8.71	1.17
23. Manufacture of other non-metallic mineral products	43.76	8.47	1.00	41.34	7.90	1.09	43.90	10.30	2.00	45.78	10.56	.
24. Manufacture of basic metals	40.06	8.08	1.00	39.57	7.67	1.07	40.50	8.00	1.00	40.25	11.33	1.00
25. Manufacture of fabricated metal products, except machinery and equipment	45.59	9.48	2.21	44.44	9.23	2.58	46.09	10.41	1.29	43.46	9.30	3.67
26. Manufacture of computer, electronic and optical products	43.41	8.11	1.00	39.09	7.92	1.50	46.17	8.14	1.00	40.67	7.67	1.00
27. Manufacture of electrical equipment	42.40	8.50	1.00	40.10	8.10	1.00	44.13	7.50	1.00	39.60	23.00	1.50
28. Manufacture of machinery and equipment n.e.c.	40.59	8.99	1.00	40.33	8.56	1.00	41.67	9.14	1.00	43.42	11.40	4.00
29-30. Manufacture of transport vehicles	38.07	7.96	1.00	41.44	7.62	1.00	41.63	7.89	1.00	40.83	8.70	1.00
31. Manufacture of furniture	49.89	9.00	5.00	42.54	9.75	2.71	46.25	11.22	1.60	39.58	16.33	1.00
32. Other manufacturing	46.00	8.89	6.00	43.25	8.92	1.00	49.20	12.00	2.00	48.50	.	.
33. Repair and installation of machinery and equipment	50.29	9.67	1.00	47.90	8.60	.	51.85	9.00	1.00	47.18	12.60	3.00

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

**ISAE\_Bounded - Weights of sample units (N/n) by strata, Italy, 2007**

	North-West			North-East			Centre			South and Islands		
	10 -	50 -	250	10 -	50 -	250	10 -	50 -	250	10 -	50 -	250
	49	249	-	49	249	-	49	249	-	49	249	-
<b>10-12. Manufacture of food, beverages and tobacco products</b>	47.45	8.14	4.91	36.37	6.62	4.88	37.29	6.14	7.50	19.98	5.06	7.50
<b>13. Manufacture of textiles</b>	37.58	9.11	4.73	34.81	6.82	4.50	31.71	8.00	3.00	17.06	3.57	2.00
<b>14. Manufacture of wearing apparel</b>	43.69	8.53	4.40	34.28	6.27	5.20	33.81	8.25	4.00	18.55	4.30	6.00
<b>15. Manufacture of leather and related products</b>	44.14	9.00	.	33.81	5.85	7.00	34.92	8.50	4.50	19.03	4.60	3.00
<b>16-17. Manufacture of wood and paper products</b>	47.85	8.71	6.67	38.10	7.41	4.67	35.92	7.00	5.00	19.50	5.33	4.00
<b>18. Printing and reproduction of recorded media</b>	45.33	8.78	5.50	35.19	8.29	5.00	33.80	6.80	.	17.53	4.75	.
<b>19. Manufacture of coke and refined petroleum products</b>	10.33	5.00	7.00	5.67	5.00	.	7.00	7.00	4.00	18.50	6.00	4.00
<b>20-21. Manufacture of chemical and pharmaceutical products</b>	39.29	7.46	4.94	31.45	7.19	5.00	32.86	5.25	5.33	17.77	6.60	.
<b>22. Manufacture of rubber and plastic products</b>	43.43	9.00	5.13	34.59	7.00	5.33	32.53	6.36	4.00	16.56	5.08	7.00
<b>23. Manufacture of other non-metallic mineral products</b>	41.77	8.47	4.75	32.41	6.36	5.00	33.77	6.44	5.33	19.02	3.80	.
<b>24. Manufacture of basic metals</b>	40.06	8.08	5.25	34.63	5.75	8.00	32.40	5.33	8.00	17.89	4.86	5.00
<b>25. Manufacture of fabricated metal products, except machinery and equipment</b>	48.33	9.92	5.25	37.20	7.51	5.17	36.39	7.38	4.50	19.87	4.86	5.50
<b>26. Manufacture of computer, electronic and optical products</b>	43.41	8.59	4.83	33.08	6.87	3.75	34.63	7.13	4.33	20.33	4.60	4.00
<b>27. Manufacture of electrical equipment</b>	42.40	8.16	5.14	33.68	6.75	4.67	32.09	6.00	5.00	18.00	3.83	3.00
<b>28. Manufacture of machinery and equipment n.e.c.</b>	42.72	8.64	5.50	33.21	7.24	5.00	31.25	7.11	4.00	18.61	4.38	4.00
<b>29-30. Manufacture of transport vehicles</b>	33.59	8.32	4.65	28.69	6.60	5.17	33.30	5.46	5.00	17.50	5.12	4.75
<b>31. Manufacture of furniture</b>	44.90	8.18	5.00	33.86	7.55	4.75	34.26	8.42	8.00	15.83	3.27	6.00
<b>32. Other manufacturing</b>	46.00	8.00	6.00	32.95	7.13	3.50	32.80	7.20	4.00	19.40	6.00	.
<b>33. Repair and installation of machinery and equipment</b>	45.42	10.88	5.00	34.21	8.60	.	35.47	6.75	4.00	17.43	5.25	6.00

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

**(R)OAUST3 - Weights of sample units (N/n) by strata, Italy, 2007**

	North-West			North-East			Centre			South and Islands		
	10 -	50 -	250	10 -	50 -	250	10 -	50 -	250	10 -	50 -	250
	49	249	-	49	249	-	49	249	-	49	249	-
<b>10-12. Manufacture of food, beverages and tobacco products</b>	48.94	9.12	1.00	48.16	8.69	1.00	50.26	7.82	1.36	52.05	10.41	1.88
<b>13. Manufacture of textiles</b>	42.94	10.58	2.00	42.85	7.50	1.00	49.15	8.89	1.00	30.33	5.00	1.00
<b>14. Manufacture of wearing apparel</b>	51.78	9.14	1.00	56.78	9.86	1.53	50.71	9.00	1.33	50.65	9.56	1.00
<b>15. Manufacture of leather and related products</b>	38.63	7.50	1.00	43.95	8.36	1.75	53.72	11.33	1.00	44.86	6.57	1.00
<b>16-17. Manufacture of wood and paper products</b>	47.85	9.25	1.00	50.80	9.59	2.00	47.26	8.40	2.00	48.75	5.33	1.00
<b>18. Printing and reproduction of recorded media</b>	47.60	7.90	2.20	49.27	7.25	1.00	46.09	5.67	1.00	37.25	4.75	1.00
<b>19. Manufacture of coke and refined petroleum products</b>	7.75	2.50	1.00	5.67	1.67	.	7.00	1.75	1.00	18.50	2.00	1.00
<b>20-21. Manufacture of chemical and pharmaceutical products</b>	39.29	8.82	1.00	34.60	8.85	1.25	28.75	7.00	1.00	33.00	5.50	.
<b>22. Manufacture of rubber and plastic products</b>	45.91	9.60	1.00	43.61	9.45	2.29	39.50	8.09	1.00	37.25	6.78	1.00
<b>23. Manufacture of other non-metallic mineral products</b>	45.95	8.47	1.00	46.12	8.48	1.25	46.21	9.36	1.78	49.44	9.50	1.00
<b>24. Manufacture of basic metals</b>	40.06	8.78	1.00	34.63	7.67	1.07	27.00	5.33	1.00	26.83	5.67	1.00
<b>25. Manufacture of fabricated metal products, except machinery and equipment</b>	54.47	11.14	2.33	52.74	10.55	2.38	53.18	10.41	1.13	49.67	9.73	2.20
<b>26. Manufacture of computer, electronic and optical products</b>	43.41	8.59	1.00	35.83	7.36	1.36	34.63	6.33	1.00	24.40	4.60	1.00
<b>27. Manufacture of electrical equipment</b>	44.17	8.87	1.00	42.10	8.53	1.00	35.30	6.67	1.00	28.29	5.75	1.00
<b>28. Manufacture of machinery and equipment n.e.c.</b>	47.75	10.56	1.07	47.05	9.97	1.00	41.67	8.53	1.00	40.08	8.14	1.00
<b>29-30. Manufacture of transport vehicles</b>	38.07	8.32	1.00	33.91	7.62	1.00	37.00	7.10	1.00	30.63	7.91	1.00
<b>31. Manufacture of furniture</b>	49.89	8.18	1.25	47.40	10.17	2.11	48.68	9.18	1.14	39.58	9.80	1.00
<b>32. Other manufacturing</b>	46.00	7.27	2.40	43.25	8.23	1.00	44.73	6.00	1.00	32.33	2.00	1.00
<b>33. Repair and installation of machinery and equipment</b>	54.15	8.70	1.00	50.42	6.14	1.00	48.14	5.40	1.00	47.18	9.00	1.20

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

**(R)OAUST9 - Weights of sample units (N/n) by strata, Italy, 2007**

	North-West			North-East			Centre			South and Islands		
	10 -	50 -	250	10 -	50 -	250	10 -	50 -	250	10 -	50 -	250
	49	249	-	49	249	-	49	249	-	49	249	-
<b>10-12. Manufacture of food, beverages and tobacco products</b>	58.00	9.91	1.00	59.40	10.30	1.00	55.05	6.14	1.07	65.93	9.83	1.25
<b>13. Manufacture of textiles</b>	53.68	12.62	2.26	37.13	5.77	1.00	51.74	6.15	1.00	22.75	2.50	1.00
<b>14. Manufacture of wearing apparel</b>	58.25	8.00	1.00	69.88	8.63	1.53	55.32	7.07	1.00	57.26	6.62	1.00
<b>15. Manufacture of leather and related products</b>	25.75	4.09	1.00	46.26	7.31	1.17	67.58	9.07	1.00	39.25	4.18	1.00
<b>16-17. Manufacture of wood and paper products</b>	53.83	8.71	1.00	58.62	9.06	1.17	47.26	6.46	1.00	45.88	4.00	1.00
<b>18. Printing and reproduction of recorded media</b>	50.11	6.08	1.10	43.47	4.83	1.00	36.21	3.09	1.00	24.83	2.11	1.00
<b>19. Manufacture of coke and refined petroleum products</b>	3.44	1.00	1.00	1.89	1.00	.	2.33	1.00	1.00	7.40	1.00	1.00
<b>20-21. Manufacture of chemical and pharmaceutical products</b>	37.11	10.78	1.09	24.71	7.67	1.07	19.17	4.85	1.00	19.25	3.00	.
<b>22. Manufacture of rubber and plastic products</b>	55.41	11.08	1.00	47.76	9.95	1.33	34.56	6.36	1.00	29.80	4.69	1.00
<b>23. Manufacture of other non-metallic mineral products</b>	45.95	7.47	1.00	52.13	9.96	1.56	46.21	7.36	1.23	56.18	7.31	1.00
<b>24. Manufacture of basic metals</b>	37.71	9.62	1.00	23.08	7.19	1.00	14.73	2.91	1.00	14.64	3.09	1.00
<b>25. Manufacture of fabricated metal products, except machinery and equipment</b>	81.37	15.12	2.33	76.17	13.42	2.07	66.90	10.41	1.00	63.21	10.70	1.10
<b>26. Manufacture of computer, electronic and optical products</b>	41.00	8.11	1.00	28.67	6.44	1.07	23.08	4.75	1.00	12.20	2.30	1.00
<b>27. Manufacture of electrical equipment</b>	48.18	9.71	1.00	42.10	8.53	1.00	27.15	4.62	1.00	18.00	2.30	1.00
<b>28. Manufacture of machinery and equipment n.e.c.</b>	66.27	14.46	1.52	64.16	13.82	1.36	41.67	8.00	1.00	34.73	5.18	1.00
<b>29-30. Manufacture of transport vehicles</b>	35.69	9.15	1.00	26.64	6.60	1.00	25.62	5.46	1.00	20.42	6.21	1.00
<b>31. Manufacture of furniture</b>	49.89	6.43	1.00	57.21	11.14	1.46	48.68	7.21	1.00	31.67	4.90	1.00
<b>32. Other manufacturing</b>	39.87	5.71	1.20	40.71	7.13	1.00	35.14	3.27	1.00	17.64	1.00	1.00
<b>33. Repair and installation of machinery and equipment</b>	61.22	6.21	1.00	50.42	3.91	1.00	42.13	2.70	1.00	47.18	5.25	1.00

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

**UNIFORM - Weights of sample units (N/n) by strata, Italy, 2007**

	North-West			North-East			Centre			South and Islands		
	10 -	50 -	250	10 -	50 -	250	10 -	50 -	250	10 -	50 -	250
	49	249	-	49	249	-	49	249	-	49	249	-
10-12. Manufacture of food, beverages and tobacco products	74.57	10.86	2.57	84.86	13.24	1.86	55.05	4.10	1.00	94.19	8.43	1.00
13. Manufacture of textiles	71.57	15.62	2.48	26.52	3.57	1.00	46.81	3.81	1.00	13.00	1.19	1.00
14. Manufacture of wearing apparel	66.57	6.10	1.05	86.52	6.57	1.24	57.95	4.71	1.00	62.71	4.10	1.00
15. Manufacture of leather and related products	14.71	2.14	1.00	41.86	5.57	1.00	99.76	6.48	1.00	29.90	2.19	1.00
16-17. Manufacture of wood and paper products	61.52	7.05	1.00	72.57	7.76	1.00	42.76	4.00	1.00	37.14	2.29	1.00
18. Printing and reproduction of recorded media	45.33	3.76	1.00	35.19	2.76	1.00	24.14	1.62	1.00	14.19	1.00	1.00
19. Manufacture of coke and refined petroleum products	1.48	1.00	1.00	1.00	1.00	.	1.00	1.00	1.00	3.52	1.00	1.00
20-21. Manufacture of chemical and pharmaceutical products	31.81	13.86	4.24	16.48	5.48	1.00	10.95	3.00	1.52	11.00	1.57	.
22. Manufacture of rubber and plastic products	76.52	13.71	1.95	47.76	9.00	1.00	26.33	4.24	1.00	21.29	2.90	1.00
23. Manufacture of other non-metallic mineral products	43.76	6.05	1.00	57.10	10.90	2.38	41.81	4.90	1.00	58.86	4.52	1.00
24. Manufacture of basic metals	30.52	9.62	2.00	13.19	5.48	1.00	7.71	1.52	1.00	7.67	1.62	1.00
25. Manufacture of fabricated metal products, except machinery and equipment	306.10	30.24	2.00	228.52	21.10	1.48	98.76	8.43	1.00	99.33	10.19	1.00
26. Manufacture of computer, electronic and optical products	35.14	6.95	1.38	20.48	4.90	1.00	13.19	2.71	1.00	5.81	1.10	1.00
27. Manufacture of electrical equipment	50.48	9.71	1.71	40.10	7.71	1.33	16.81	2.86	1.00	9.43	1.10	1.00
28. Manufacture of machinery and equipment n.e.c.	154.62	31.67	4.19	134.43	28.95	5.00	35.71	6.10	1.00	24.81	2.71	1.00
29-30. Manufacture of transport vehicles	27.19	8.71	3.76	17.76	4.71	1.48	15.86	3.38	1.00	11.67	4.14	1.00
31. Manufacture of furniture	42.76	4.29	1.00	79.00	11.14	1.00	44.05	4.81	1.00	22.62	2.33	1.00
32. Other manufacturing	28.48	3.81	1.00	32.95	5.10	1.00	23.43	1.71	1.00	9.24	1.00	1.00
33. Repair and installation of machinery and equipment	67.05	4.14	1.00	45.62	2.05	1.00	32.10	1.29	1.00	38.19	3.00	1.00

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

**PROPORTIONAL - Weights of sample units (N/n) by strata, Italy, 2007**

	North-West			North-East			Centre			South and Islands		
	10 -	50 -	250	10 -	50 -	250	10 -	50 -	250	10 -	50 -	250
	49	249	-	49	249	-	49	249	-	49	249	-
<b>10-12. Manufacture of food, beverages and tobacco products</b>	22.37	20.73	18.00	22.28	21.38	19.50	22.23	21.50	15.00	22.48	22.13	15.00
<b>13. Manufacture of textiles</b>	22.43	21.87	17.33	22.28	18.75	9.00	22.34	20.00	3.00	21.00	12.50	2.00
<b>14. Manufacture of wearing apparel</b>	22.19	21.33	22.00	22.43	19.71	13.00	22.13	19.80	8.00	22.32	21.50	6.00
<b>15. Manufacture of leather and related products</b>	22.07	22.50	2.00	21.98	19.50	14.00	22.29	19.43	9.00	22.43	15.33	3.00
<b>16-17. Manufacture of wood and paper products</b>	22.28	21.14	20.00	22.41	20.38	14.00	22.45	21.00	10.00	22.29	16.00	4.00
<b>18. Printing and reproduction of recorded media</b>	22.14	19.75	11.00	22.39	19.33	5.00	22.04	17.00	1.00	21.29	19.00	1.00
<b>19. Manufacture of coke and refined petroleum products</b>	15.50	10.00	7.00	17.00	5.00	.	21.00	7.00	4.00	18.50	6.00	4.00
<b>20-21. Manufacture of chemical and pharmaceutical products</b>	22.27	22.38	22.25	21.63	19.17	15.00	20.91	21.00	16.00	21.00	16.50	.
<b>22. Manufacture of rubber and plastic products</b>	22.32	22.15	20.50	22.29	21.00	16.00	22.12	22.25	4.00	22.35	20.33	7.00
<b>23. Manufacture of other non-metallic mineral products</b>	22.41	21.17	19.00	22.20	20.82	16.67	21.95	20.60	16.00	22.47	19.00	1.00
<b>24. Manufacture of basic metals</b>	22.10	22.44	21.00	21.31	19.17	16.00	20.25	16.00	8.00	20.13	17.00	5.00
<b>25. Manufacture of fabricated metal products, except machinery and equipment</b>	22.48	21.90	21.00	22.43	22.15	15.50	22.30	22.13	9.00	22.43	21.40	11.00
<b>26. Manufacture of computer, electronic and optical products</b>	22.36	20.86	14.50	21.50	20.60	15.00	21.31	19.00	13.00	20.33	11.50	4.00
<b>27. Manufacture of electrical equipment</b>	22.08	20.40	18.00	22.16	20.25	14.00	22.06	20.00	15.00	22.00	11.50	3.00
<b>28. Manufacture of machinery and equipment n.e.c.</b>	22.39	22.17	22.00	22.40	21.71	21.00	22.06	21.33	8.00	21.71	19.00	4.00
<b>29-30. Manufacture of transport vehicles</b>	21.96	20.33	19.75	21.94	19.80	15.50	22.20	17.75	15.00	22.27	21.75	19.00
<b>31. Manufacture of furniture</b>	22.45	22.50	5.00	22.42	21.27	19.00	22.02	20.20	8.00	21.59	16.33	6.00
<b>32. Other manufacturing</b>	22.15	20.00	12.00	22.32	21.40	7.00	22.36	18.00	4.00	21.56	6.00	1.00
<b>33. Repair and installation of machinery and equipment</b>	22.35	21.75	5.00	22.28	21.50	3.00	22.47	13.50	4.00	22.28	21.00	6.00

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

**NEYMAN\_BETHEL- Weights of sample units (N/n) by strata, Italy, 2007**

	North-West			North-East			Centre			South and Islands		
	10 -  49	50 -  249	250  -	10 -  49	50 -  249	250  -	10 -  49	50 -  249	250  -	10 -  49	50 -  249	250  -
<b>10-12. Manufacture of food, beverages and tobacco products</b>	34.04	28.50	7.71	25.10	12.64	2.79	18.65	7.82	5.00	17.35	8.43	5.00
<b>13. Manufacture of textiles</b>	42.94	36.44	4.73	21.42	25.00	3.00	17.87	26.67	1.00	18.20	8.33	1.00
<b>14. Manufacture of wearing apparel</b>	32.51	32.00	7.33	30.28	12.55	8.67	20.28	9.90	2.67	21.24	28.67	2.00
<b>15. Manufacture of leather and related products</b>	44.14	15.00	1.00	39.95	29.25	4.67	19.22	11.33	3.00	16.10	15.33	1.00
<b>16-17. Manufacture of wood and paper products</b>	31.51	37.00	6.67	20.32	27.17	4.67	20.88	21.00	3.33	16.96	16.00	1.33
<b>18. Printing and reproduction of recorded media</b>	18.67	26.33	3.67	26.39	11.60	1.67	23.05	11.33	1.00	18.63	6.33	1.00
<b>19. Manufacture of coke and refined petroleum products</b>	10.33	3.33	2.33	3.40	1.67	.	5.25	2.33	1.33	2.96	2.00	1.33
<b>20-21. Manufacture of chemical and pharmaceutical products</b>	20.88	12.13	2.87	14.42	9.58	5.00	16.43	12.60	3.56	15.40	11.00	.
<b>22. Manufacture of rubber and plastic products</b>	32.80	18.00	5.13	35.82	23.63	4.00	29.11	12.71	1.33	27.94	15.25	2.33
<b>23. Manufacture of other non-metallic mineral products</b>	27.85	31.75	6.33	22.20	45.80	8.33	27.44	11.44	5.33	17.66	9.50	1.00
<b>24. Manufacture of basic metals</b>	19.42	15.54	7.00	13.85	14.38	5.33	10.13	6.40	2.67	9.47	11.33	1.67
<b>25. Manufacture of fabricated metal products, except machinery and equipment</b>	48.70	28.86	4.67	36.08	15.28	6.20	23.04	17.70	3.00	24.54	30.57	3.67
<b>26. Manufacture of computer, electronic and optical products</b>	21.09	11.23	9.67	15.36	7.92	5.00	23.08	9.50	4.33	20.33	3.29	1.33
<b>27. Manufacture of electrical equipment</b>	19.63	22.67	4.50	24.06	16.20	5.60	17.65	10.00	3.00	19.80	7.67	1.00
<b>28. Manufacture of machinery and equipment n.e.c.</b>	35.68	26.60	8.00	33.21	14.48	5.00	28.85	18.29	2.67	28.94	5.70	1.33
<b>29-30. Manufacture of transport vehicles</b>	13.60	18.30	5.27	16.95	16.50	2.07	11.48	14.20	5.00	12.25	14.50	6.33
<b>31. Manufacture of furniture</b>	299.33	30.00	1.67	14.30	12.32	6.33	13.21	25.25	2.67	31.67	16.33	2.00
<b>32. Other manufacturing</b>	24.92	26.67	4.00	22.32	17.83	2.33	18.22	12.00	1.33	17.64	2.00	1.00
<b>33. Repair and installation of machinery and equipment</b>	41.41	29.00	1.67	26.61	14.33	1.00	74.89	9.00	1.33	28.64	21.00	2.00

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)



**NEYMAN - relative |Total Error| by strata, Italy, 2007(1000 replicates)**

	North-West			North-East			Centre			South and Islands		
	10 -	50 -	250  -	10 -	50 -	250  -	10 -	50 -	250  -	10 -	50 -	250  -
	49	249		49	249		49	249		49	249	
10-12. Manufacture of food, beverages and tobacco products	0.08	0.09	0.00	0.08	0.08	0.00	0.10	0.15	0.10	0.08	0.10	0.12
13. Manufacture of textiles	0.08	0.07	0.06	0.14	0.16	0.08	0.11	0.17	0.32	0.21	0.26	.
14. Manufacture of wearing apparel	0.09	0.12	0.00	0.08	0.12	0.08	0.10	0.15	0.18	0.09	0.16	0.13
15. Manufacture of leather and related products	0.19	0.19	.	0.12	0.13	0.15	0.07	0.13	0.00	0.14	0.24	.
16-17. Manufacture of wood and paper products	0.10	0.12	0.00	0.09	0.10	0.12	0.11	0.16	0.13	0.12	0.23	0.31
18. Printing and reproduction of recorded media	0.12	0.16	0.14	0.12	0.18	0.00	0.16	0.26	.	0.19	0.27	.
19. Manufacture of coke and refined petroleum products	0.53	0.45	0.09	.	.	.	0.55	0.59	0.21	0.44	.	0.00
20-21. Manufacture of chemical and pharmaceutical products	0.12	0.08	0.00	0.17	0.13	0.09	0.21	0.15	0.00	0.23	0.23	.
22. Manufacture of rubber and plastic products	0.08	0.08	0.00	0.10	0.10	0.13	0.15	0.15	0.17	0.15	0.17	0.11
23. Manufacture of other non-metallic mineral products	0.12	0.12	0.00	0.09	0.10	0.03	0.11	0.14	0.12	0.10	0.14	.
24. Manufacture of basic metals	0.12	0.09	0.00	0.18	0.12	0.05	0.25	0.25	0.00	0.25	0.24	0.00
25. Manufacture of fabricated metal products, except machinery and equipment	0.04	0.06	0.08	0.05	0.07	0.09	0.08	0.10	0.14	0.07	0.09	0.15
26. Manufacture of computer, electronic and optical products	0.12	0.11	0.00	0.16	0.14	0.09	0.21	0.19	0.00	0.31	0.25	0.00
27. Manufacture of electrical equipment	0.10	0.10	0.00	0.11	0.11	0.00	0.18	0.18	0.00	0.22	0.33	0.30
28. Manufacture of machinery and equipment n.e.c.	0.06	0.05	0.00	0.06	0.05	0.00	0.12	0.12	0.00	0.14	0.18	0.25
29-30. Manufacture of transport vehicles	0.13	0.09	0.00	0.16	0.14	0.00	0.18	0.15	0.00	0.21	0.14	0.00
31. Manufacture of furniture	0.11	0.15	0.29	0.08	0.09	0.12	0.11	0.15	0.16	0.14	0.20	0.00
32. Other manufacturing	0.13	0.16	0.18	0.13	0.14	0.00	0.16	0.26	0.24	0.24	.	.
33. Repair and installation of machinery and equipment	0.09	0.15	0.00	0.11	0.23	.	0.13	0.26	0.00	0.12	0.19	0.23

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

**ISAE\_Bounded - relative |Total Error| by strata, Italy, 2007(1000 replicates)**

	North-West			North-East			Centre			South and Islands		
	10 -	50 -	250  -	10 -	50 -	250  -	10 -	50 -	250  -	10 -	50 -	250  -
	49	249		49	249		49	249		49	249	
10-12. Manufacture of food, beverages and tobacco products	0.08	0.09	0.37	0.07	0.07	0.41	0.09	0.12	0.36	0.05	0.07	0.28
13. Manufacture of textiles	0.08	0.07	0.13	0.13	0.13	0.42	0.08	0.14	0.32	0.13	0.16	0.00
14. Manufacture of wearing apparel	0.09	0.12	0.56	0.06	0.09	0.23	0.08	0.13	0.30	0.06	0.09	0.65
15. Manufacture of leather and related products	0.19	0.17		0.10	0.11	0.31	0.06	0.10	0.69	0.09	0.14	0.20
16-17. Manufacture of wood and paper products	0.10	0.11	0.75	0.08	0.09	0.18	0.10	0.13	0.17	0.07	0.20	0.55
18. Printing and reproduction of recorded media	0.12	0.16	0.18	0.10	0.17	0.81	0.13	0.20		0.11	0.13	
19. Manufacture of coke and refined petroleum products	0.29	0.30	0.59	0.24	0.41		0.29	0.59	0.63	0.22	0.37	0.54
20-21. Manufacture of chemical and pharmaceutical products	0.12	0.07	0.23	0.16	0.10	0.29	0.19	0.12	0.38	0.14	0.20	
22. Manufacture of rubber and plastic products	0.08	0.09	0.43	0.10	0.09	0.21	0.13	0.12	0.17	0.09	0.12	0.68
23. Manufacture of other non-metallic mineral products	0.11	0.12	0.45	0.08	0.08	0.21	0.10	0.10	0.25	0.06	0.08	
24. Manufacture of basic metals	0.12	0.09	0.78	0.17	0.10	0.45	0.23	0.20	0.90	0.17	0.15	0.69
25. Manufacture of fabricated metal products, except machinery and equipment	0.04	0.06	0.15	0.04	0.06	0.15	0.07	0.09	0.52	0.05	0.07	0.20
26. Manufacture of computer, electronic and optical products	0.12	0.12	0.66	0.15	0.12	0.22	0.17	0.17	0.52	0.22	0.19	0.75
27. Manufacture of electrical equipment	0.10	0.10	0.39	0.10	0.10	0.65	0.15	0.15	0.69	0.15	0.11	0.64
28. Manufacture of machinery and equipment n.e.c.	0.06	0.05	0.20	0.05	0.05	0.18	0.11	0.11	0.81	0.09	0.10	0.25
29-30. Manufacture of transport vehicles	0.12	0.09	0.46	0.13	0.12	0.58	0.16	0.12	0.72	0.14	0.10	0.57
31. Manufacture of furniture	0.11	0.14	0.29	0.07	0.08	0.18	0.09	0.12	0.56	0.09	0.07	1.30
32. Other manufacturing	0.13	0.15	0.18	0.12	0.12	0.78	0.13	0.18	0.41	0.14	0.25	
33. Repair and installation of machinery and equipment	0.08	0.16	0.92	0.09	0.23		0.11	0.22	0.92	0.07	0.12	0.38

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

**(R)OAUST3 - relative |Total Error| by strata, Italy, 2007(1000 replicates)**

	North-West			North-East			Centre			South and Islands		
	10 -	50 -	250  -	10 -	50 -	250  -	10 -	50 -	250  -	10 -	50 -	250  -
	49	249		49	249		49	249		49	249	
10-12. Manufacture of food, beverages and tobacco products	0.08	0.10	0.00	0.08	0.09	0.00	0.10	0.14	0.08	0.08	0.10	0.11
13. Manufacture of textiles	0.09	0.08	0.07	0.14	0.14	0.00	0.11	0.15	0.00	0.19	0.20	0.00
14. Manufacture of wearing apparel	0.09	0.12	0.00	0.08	0.12	0.08	0.10	0.14	0.11	0.10	0.15	0.00
15. Manufacture of leather and related products	0.18	0.16	0.00	0.12	0.12	0.11	0.08	0.12	0.00	0.13	0.17	0.00
16-17. Manufacture of wood and paper products	0.10	0.12	0.00	0.09	0.10	0.09	0.11	0.14	0.09	0.11	0.20	0.00
18. Printing and reproduction of recorded media	0.12	0.15	0.09	0.12	0.15	0.00	0.15	0.17	0.00	0.16	0.13	0.00
19. Manufacture of coke and refined petroleum products	0.25	0.19	0.00	0.24	0.17		0.29	0.21	0.00	0.22	0.16	0.00
20-21. Manufacture of chemical and pharmaceutical products	0.12	0.08	0.00	0.16	0.12	0.07	0.18	0.14	0.00	0.19	0.18	
22. Manufacture of rubber and plastic products	0.08	0.09	0.00	0.11	0.10	0.12	0.14	0.14	0.00	0.14	0.15	0.00
23. Manufacture of other non-metallic mineral products	0.12	0.12	0.00	0.10	0.10	0.05	0.12	0.13	0.11	0.10	0.13	0.00
24. Manufacture of basic metals	0.12	0.09	0.00	0.17	0.12	0.05	0.21	0.20	0.00	0.22	0.16	0.00
25. Manufacture of fabricated metal products, except machinery and equipment	0.05	0.06	0.08	0.05	0.07	0.08	0.08	0.10	0.10	0.08	0.09	0.10
26. Manufacture of computer, electronic and optical products	0.12	0.12	0.00	0.15	0.13	0.08	0.17	0.16	0.00	0.24	0.19	0.00
27. Manufacture of electrical equipment	0.11	0.10	0.00	0.11	0.11	0.00	0.16	0.16	0.00	0.19	0.15	0.00
28. Manufacture of machinery and equipment n.e.c.	0.06	0.06	0.02	0.06	0.06	0.00	0.12	0.12	0.00	0.13	0.15	0.00
29-30. Manufacture of transport vehicles	0.13	0.09	0.00	0.15	0.14	0.00	0.17	0.14	0.00	0.18	0.13	0.00
31. Manufacture of furniture	0.11	0.14	0.07	0.09	0.09	0.09	0.11	0.13	0.08	0.14	0.15	0.00
32. Other manufacturing	0.13	0.14	0.10	0.13	0.13	0.00	0.15	0.17	0.00	0.19	0.11	0.00
33. Repair and installation of machinery and equipment	0.09	0.14	0.00	0.11	0.18	0.00	0.13	0.19	0.00	0.12	0.16	0.08

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

**(R)OAUST9 - relative |Total Error| by strata, Italy, 2007(1000 replicates)**

	North-West			North-East			Centre			South and Islands		
	10 -	50 -	250  -	10 -	50 -	250  -	10 -	50 -	250  -	10 -	50 -	250  -
	49	249		49	249		49	249		49	249	
10-12. Manufacture of food, beverages and tobacco products	0.09	0.10	0.00	0.09	0.09	0.00	0.11	0.12	0.04	0.09	0.10	0.06
13. Manufacture of textiles	0.10	0.09	0.08	0.13	0.12	0.00	0.11	0.12	0.00	0.16	0.12	0.00
14. Manufacture of wearing apparel	0.10	0.11	0.00	0.09	0.11	0.08	0.11	0.12	0.00	0.11	0.11	0.00
15. Manufacture of leather and related products	0.14	0.11	0.00	0.12	0.12	0.05	0.09	0.11	0.00	0.12	0.13	0.00
16-17. Manufacture of wood and paper products	0.10	0.11	0.00	0.10	0.10	0.04	0.11	0.12	0.00	0.11	0.17	0.00
18. Printing and reproduction of recorded media	0.12	0.13	0.03	0.11	0.12	0.00	0.13	0.12	0.00	0.13	0.07	0.00
19. Manufacture of coke and refined petroleum products	0.16	0.00	0.00	0.10	0.00		0.14	0.00	0.00	0.13	0.00	0.00
20-21. Manufacture of chemical and pharmaceutical products	0.12	0.10	0.03	0.14	0.11	0.04	0.15	0.11	0.00	0.14	0.12	
22. Manufacture of rubber and plastic products	0.09	0.10	0.00	0.11	0.11	0.06	0.13	0.12	0.00	0.13	0.12	0.00
23. Manufacture of other non-metallic mineral products	0.12	0.11	0.00	0.11	0.11	0.08	0.12	0.11	0.06	0.11	0.11	0.00
24. Manufacture of basic metals	0.12	0.10	0.00	0.14	0.12	0.00	0.15	0.13	0.00	0.15	0.11	0.00
25. Manufacture of fabricated metal products, except machinery and equipment	0.06	0.07	0.08	0.06	0.08	0.07	0.09	0.10	0.00	0.09	0.10	0.03
26. Manufacture of computer, electronic and optical products	0.11	0.11	0.00	0.13	0.12	0.04	0.15	0.13	0.00	0.17	0.11	0.00
27. Manufacture of electrical equipment	0.11	0.11	0.00	0.11	0.11	0.00	0.14	0.13	0.00	0.15	0.08	0.00
28. Manufacture of machinery and equipment n.e.c.	0.07	0.07	0.06	0.08	0.07	0.06	0.12	0.11	0.00	0.12	0.12	0.00
29-30. Manufacture of transport vehicles	0.12	0.10	0.00	0.13	0.12	0.00	0.15	0.12	0.00	0.15	0.12	0.00
31. Manufacture of furniture	0.11	0.12	0.00	0.09	0.10	0.06	0.11	0.11	0.00	0.13	0.10	0.00
32. Other manufacturing	0.13	0.13	0.04	0.13	0.12	0.00	0.13	0.11	0.00	0.14	0.00	0.00
33. Repair and installation of machinery and equipment	0.10	0.12	0.00	0.11	0.14	0.00	0.12	0.11	0.00	0.12	0.12	0.00

**Source:** ESeC-ISAE data processing on ISTAT data (ASIA 2007)

**UNIFORM - relative |Total Error| by strata, Italy, 2007(1000 replicates)**

	North-West		North-East			Centre			South and Islands			
	10 - 49  249	50 -  249	250  -  49	10 -  249	50 -  249	250  -  49	10 -  249	50 -  249	250  -  49	10 -  249	50 -  249	250  -  249
10-12. Manufacture of food, beverages and tobacco products	0.11	0.11	0.23	0.11	0.11	0.20	0.11	0.10	0.00	0.11	0.09	0.00
13. Manufacture of textiles	0.11	0.10	0.08	0.11	0.09	0.00	0.11	0.09	0.00	0.12	0.04	0.00
14. Manufacture of wearing apparel	0.11	0.09	0.06	0.10	0.09	0.05	0.11	0.09	0.00	0.11	0.09	0.00
15. Manufacture of leather and related products	0.11	0.06	0.00	0.11	0.10	0.00	0.11	0.09	0.00	0.11	0.07	0.00
16-17. Manufacture of wood and paper products	0.11	0.10	0.00	0.11	0.10	0.00	0.10	0.09	0.00	0.10	0.11	0.00
18. Printing and reproduction of recorded media	0.12	0.09	0.00	0.10	0.08	0.00	0.11	0.06	0.00	0.10	0.00	0.00
19. Manufacture of coke and refined petroleum products	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00
20-21. Manufacture of chemical and pharmaceutical products	0.10	0.11	0.20	0.11	0.09	0.00	0.11	0.08	0.13	0.11	0.06	0.00
22. Manufacture of rubber and plastic products	0.11	0.11	0.21	0.11	0.10	0.00	0.12	0.09	0.00	0.11	0.08	0.00
23. Manufacture of other non-metallic mineral products	0.12	0.10	0.00	0.11	0.12	0.12	0.11	0.09	0.00	0.11	0.08	0.00
24. Manufacture of basic metals	0.10	0.10	0.39	0.10	0.10	0.00	0.11	0.06	0.00	0.11	0.06	0.00
25. Manufacture of fabricated metal products, except machinery and equipment	0.12	0.11	0.07	0.11	0.10	0.05	0.11	0.09	0.00	0.11	0.10	0.00
26. Manufacture of computer, electronic and optical products	0.11	0.10	0.21	0.11	0.10	0.00	0.10	0.09	0.00	0.11	0.03	0.00
27. Manufacture of electrical equipment	0.12	0.11	0.16	0.11	0.10	0.19	0.10	0.09	0.00	0.10	0.02	0.00
28. Manufacture of machinery and equipment n.e.c.	0.11	0.10	0.17	0.11	0.10	0.18	0.11	0.10	0.00	0.11	0.07	0.00
29-30. Manufacture of transport vehicles	0.11	0.10	0.41	0.10	0.10	0.20	0.11	0.09	0.00	0.11	0.09	0.00
31. Manufacture of furniture	0.10	0.09	0.00	0.11	0.10	0.00	0.11	0.09	0.00	0.11	0.06	0.00
32. Other manufacturing	0.11	0.10	0.00	0.12	0.10	0.00	0.11	0.06	0.00	0.10	0.00	0.00
33. Repair and installation of machinery and equipment	0.10	0.09	0.00	0.10	0.08	0.00	0.11	0.05	0.00	0.11	0.08	0.00

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

**PROPORTIONAL - relative |Total Error| by strata, Italy, 2007(1000 replicates)**

	North-West			North-East			Centre			South and Islands		
	10 -	50 -	250  -	10 -	50 -	250  -	10 -	50 -	250  -	10 -	50 -	250  -
	49	249		49	249		49	249		49	249	
10-12. Manufacture of food, beverages and tobacco products	0.06	0.15	0.81	0.05	0.14	0.94	0.07	0.25	0.52	0.05	0.15	0.43
13. Manufacture of textiles	0.07	0.12	0.27	0.10	0.23	0.63	0.07	0.23	0.32	0.15	0.35	0.00
14. Manufacture of wearing apparel	0.06	0.19	1.37	0.05	0.16	0.39	0.07	0.21	0.46	0.07	0.22	0.65
15. Manufacture of leather and related products	0.13	0.29	0.19	0.08	0.20	0.46	0.05	0.17	1.01	0.09	0.29	0.20
16-17. Manufacture of wood and paper products	0.07	0.17	1.30	0.06	0.16	0.34	0.08	0.22	0.26	0.08	0.37	0.55
18. Printing and reproduction of recorded media	0.08	0.26	0.27	0.08	0.26	0.81	0.10	0.32	0.00	0.12	0.27	0.00
19. Manufacture of coke and refined petroleum products	0.37	0.45	0.59	0.46	0.41		0.55	0.59	0.63	0.22	0.37	0.54
20-21. Manufacture of chemical and pharmaceutical products	0.08	0.14	0.53	0.13	0.18	0.55	0.16	0.26	0.71	0.15	0.33	
22. Manufacture of rubber and plastic products	0.06	0.14	0.96	0.08	0.16	0.40	0.10	0.24	0.17	0.11	0.27	0.68
23. Manufacture of other non-metallic mineral products	0.08	0.20	0.94	0.07	0.16	0.40	0.07	0.19	0.49	0.07	0.20	0.00
24. Manufacture of basic metals	0.09	0.16	1.67	0.14	0.20	0.66	0.18	0.36	0.90	0.19	0.29	0.69
25. Manufacture of fabricated metal products, except machinery and equipment	0.03	0.09	0.31	0.03	0.11	0.26	0.05	0.16	0.75	0.05	0.15	0.31
26. Manufacture of computer, electronic and optical products	0.09	0.19	1.27	0.11	0.22	0.50	0.14	0.30	0.99	0.22	0.32	0.75
27. Manufacture of electrical equipment	0.07	0.16	0.78	0.08	0.18	1.21	0.12	0.30	1.34	0.16	0.23	0.64
28. Manufacture of machinery and equipment n.e.c.	0.04	0.08	0.41	0.04	0.09	0.41	0.09	0.20	1.23	0.10	0.23	0.25
29-30. Manufacture of transport vehicles	0.10	0.15	1.02	0.12	0.23	1.05	0.14	0.24	1.29	0.15	0.23	1.24
31. Manufacture of furniture	0.07	0.25	0.29	0.06	0.14	0.41	0.07	0.19	0.56	0.11	0.20	1.30
32. Other manufacturing	0.09	0.25	0.26	0.09	0.22	1.27	0.11	0.31	0.41	0.15	0.25	0.00
33. Repair and installation of machinery and equipment	0.06	0.22	0.92	0.07	0.37	0.15	0.09	0.32	0.92	0.08	0.25	0.38

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)

**NEYMAN\_BETHEL- Relative |Total Error| By Strata, Italy, 2007(1000 Replicates)**

	North-West			North-East			Centre			South and Islands		
	10 -  49	50 -  249	250  -	10 -  49	50 -  249	250  -	10 -  49	50 -  249	250  -	10 -  49	50 -  249	250  -
10-12. Manufacture of food, beverages and tobacco products	0.07	0.17	0.50	0.06	0.10	0.29	0.06	0.14	0.28	0.05	0.09	0.22
13. Manufacture of textiles	0.09	0.15	0.13	0.10	0.27	0.31	0.06	0.27	0.00	0.14	0.26	0.00
14. Manufacture of wearing apparel	0.07	0.24	0.76	0.06	0.13	0.31	0.06	0.15	0.23	0.07	0.26	0.29
15. Manufacture of leather and related products	0.19	0.23	0.00	0.11	0.25	0.23	0.05	0.12	0.53	0.08	0.29	0.00
16-17. Manufacture of wood and paper products	0.08	0.23	0.75	0.05	0.18	0.18	0.08	0.22	0.13	0.07	0.37	0.18
18. Printing and reproduction of recorded media	0.07	0.30	0.14	0.09	0.20	0.34	0.10	0.26	0.00	0.11	0.15	0.00
19. Manufacture of coke and refined petroleum products	0.29	0.24	0.28	0.18	0.17	.	0.25	0.27	0.21	0.07	0.16	0.17
20-21. Manufacture of chemical and pharmaceutical products	0.08	0.10	0.15	0.10	0.13	0.29	0.13	0.20	0.29	0.13	0.26	.
22. Manufacture of rubber and plastic products	0.07	0.13	0.43	0.10	0.16	0.18	0.12	0.17	0.06	0.12	0.24	0.32
23. Manufacture of other non-metallic mineral products	0.09	0.24	0.53	0.07	0.24	0.28	0.09	0.14	0.25	0.06	0.13	0.00
24. Manufacture of basic metals	0.09	0.13	0.94	0.10	0.16	0.36	0.13	0.22	0.43	0.12	0.24	0.27
25. Manufacture of fabricated metal products, except machinery and equipment	0.04	0.10	0.14	0.04	0.09	0.16	0.05	0.14	0.38	0.05	0.19	0.15
26. Manufacture of computer, electronic and optical products	0.08	0.14	1.02	0.10	0.14	0.26	0.15	0.20	0.52	0.22	0.14	0.26
27. Manufacture of electrical equipment	0.07	0.17	0.35	0.08	0.15	0.72	0.11	0.21	0.48	0.15	0.18	0.00
28. Manufacture of machinery and equipment n.e.c.	0.05	0.09	0.24	0.05	0.07	0.18	0.10	0.18	0.59	0.11	0.12	0.08
29-30. Manufacture of transport vehicles	0.07	0.15	0.51	0.10	0.21	0.30	0.09	0.22	0.72	0.11	0.19	0.69
31. Manufacture of furniture	0.27	0.29	0.12	0.04	0.10	0.22	0.05	0.22	0.29	0.13	0.20	0.58
32. Other manufacturing	0.10	0.29	0.14	0.09	0.20	0.58	0.10	0.26	0.14	0.14	0.11	0.00
33. Repair and installation of machinery and equipment	0.08	0.26	0.38	0.08	0.30	0.00	0.16	0.26	0.30	0.09	0.25	0.17

Source: ESeC-ISAE data processing on ISTAT data (ASIA 2007)