**A new approach for Disclosure control - Random Tabular Adjustment**

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**Abstract**

The Government of Canada is investing in making more data available to Canadians. Statistics Canada is supporting this initiative by examining the way that it assesses and treats disclosure risks. Economic / magnitude data has historically been held back from the Canadian public through a process of cell suppression whenever a disclosure risk has been identified. An alternative risk assessment is being proposed that will rely on ensuring that undesirable statistical inferences on individual business entities are prevented while useful statistical inferences on the economy can still be made through tabular perturbation. The Random Tabular Adjustment (RTA) process involves adding random noise to estimates where disclosure risks are apparent. At the same time, we are reassessing what we are comfortable with in terms of risk. The move to releasing more data is not free of cost. In terms of quality, the new approach entails balancing various aspect of quality, such as pertinence, accessibility and accuracy. This presentation will highlight the challenges with disclosure control, the RTA method will be described and the appetite for risk will be discussed.

**Keywords:** Disclosure Control, Random Tabular Adjustment, Confidentiality, Quality

1. **Introduction**

The Government of Canada is striving towards making more data available to Canadians. The Directive on Open Government (Treasury Board of Canada Secretariat, 2014) states:

The objective of the directive is to maximize the release of government information and data of business value to support transparency, accountability, citizen engagement, and socio-economic benefits through reuse, subject to applicable restrictions associated with privacy, confidentiality, and security.

Statistics Canada is supporting this initiative with the way that it assesses and treats disclosure risks. One of the goals of the most recent update of the Statistics Act (Statistics Canada, 2017) was to ensure that it properly addressed data collected through administrative sources. Section 17 (1) (b) states:

(b) no person who has been sworn under section 6 shall disclose or knowingly cause to be disclosed, by any means, any information obtained under this Act in a manner that it is possible from the disclosure to relate the information obtained to any identifiable individual person, business or organization.

Historically, Statistics Canada has committed to this mainly through cell suppression. Information that could be related to an individual business entity was removed from any published table and secondary suppressions were applied to ensure that the primary suppressions could not be undone. This process is typically applied using Statistics Canada’s disclosure control system G-Confid (Wright, 2013), which calculates a linear sensitivity score to identify sensitive cells and then applies a suppression pattern to protect those cells.

The main problem with cell suppression is that often several cells must be suppressed in order to protect the one cell that had a sensitivity issue. The relevance and utility of some tables can be destroyed with little to no information being provided to the user if there are major sensitivity issues.

An alternative risk assessment and treatment methodology is being proposed that will ensure that information is released for all cells while still preventing confidential information from being disclosed. The Random Tabular Adjustment (RTA) (Stinner, 2017) process involves randomly adjusting the estimates where disclosure risks are apparent.

From a methodological and statistical point of view, the RTA method is sound. The advantages in terms of quality seem clear. Relevant, accurate information is accessible to the public that normally would have been suppressed. The challenge with applying the method is user acceptance of the impact that it has on other dimensions of quality. First and foremost, the method is designed to affect the accuracy in terms of the precision of the estimator to ensure that inference on individual values is poor. At the same time, randomly adjusted results can affect the coherence with other sources of information. There are also concerns expressed on the interpretability of RTA results.

This paper aims to clarify and respond to the concerns that the RTA method will have on the quality of tabular data. The paper will describe the method in general with a concentration on how it will affect the accuracy of the survey estimates. The impact that the method will have on other dimensions of quality will also be discussed.

1. **Motivation**

As stated above, the Statistics Act clearly indicates that information about individuals must be protected. This idea is emphasized as the 6th principle of the Fundamental Principles of Official Statistics (United Nations, 2013). At the same time, National Statistical Organizations (NSOs) are under pressure to release more information at a more granular level. These two ideas are clearly in conflict where released information approaches individual information as more detail is provided. At a certain point, the current sensitivity measures and disclosure control processes reach a breaking point. Take for example Statistics Canada’s business surveys where there are attempts to release information at the detailed North American Industrial Classification System[[1]](#footnote-1) (NAICS) 5 and 6-digit level by Province and Territory. Over 1000 cells are available at this level but almost 2/3s of the data can be suppressed because of disclosure control issues. Many of these cells are less important than the aggregate information that is released but, nonetheless, this illustrates the challenge as we attempt to meet user needs while still protecting the confidentiality of information provided from our respondents.

1. **Solutions**

The survey managers are being strongly encouraged to find alternatives to suppression that will allow more information to be provided to Canadians. There are many challenges to this since we are still obligated to protect information under the Statistics Act. Binder in 1995 outlined all of the legal obligations that came under the Act. The Act has not changed considerably since that time and it would seem that the same rules apply until the legal Act is changed. It is also important to take into consideration, aspects that are outside of the Statistics Act. The Statistics Canada’s Quality Assurance Framework (Statistics Canada, 2017) discusses aspects of confidentiality, privacy and security that are the responsibility of Statistics Canada as the data steward including the *Privacy Act* and the *Access to Information Act*.

With the legal obligations that are in place, the solutions to having too much suppression then have to be more subtle. Careful interpretation of what information has to be protected under the Act may allow more flexibility. The Statistics Act Exception to Prohibition states that the Chief Statistician has the power to disclose information under several situations including information where the provider has given consent to release the information or the information is readily available to the public.

Another option for releasing more information is to reconsider the amount of risk that Statistics Canada is willing to accept when conducting a statistical risk assessment. Traditional dominance and prior-posterior assessments including the P% rule, PQ rule and the NK rule (Willenborg, 2001) require a measure of how well the data steward will allow a user to estimate an individual contribution to a table. These rules have been set as fixed factors in the past in order to maintain consistency between programs. However, if the idea of harm is considered, there are some variables that may require less protection than others (publicly available information for example). Statistics Canada is currently reassessing risk thresholds to be able to release more information while still protecting confidentiality. Unfortunately, this method does very little for when there are only 1 or 2 respondents in a cell.

1. **The Random Tabular Adjustment Solution**

The common aspect of all disclosure control processes is that they have a negative impact on data quality when compared to doing nothing to the dataset. In the case of suppression, it is clear that less information is accessible to the user. At the same time, even with the limited information provided, the user is able to construct a rough estimate for the suppressed cell. If the disclosure control process was applied correctly, this would only be an estimate and would have a value of accuracy associated with it.

The Random Tabular Adjustment method is described in detail by Stinner, 2017. The technical details of the approach are out of scope for this paper but the general idea can be summarized as follows. The process formalizes the idea of controlling the risk of precise inference on individual contributions through the addition of random noise to the survey estimate. More specifically, a random value ∆ is added to the cell total where ∆~*N*(0*,σ2*). The end effect of this adjustment is that, when required, the variances, standard errors or coefficients of variation used to measure the precision of a survey estimate are increased. The process will negatively affect any user’s ability to make statistical inference on an individual’s contribution to a cell.

The simplest illustration of this method is considering a single unit cell which clearly has a confidentiality issue for the provided total *yi*=*T.* The data custodian decides on a level of protection in terms of the appropriate variance measure *σ2* required on T. This would be based on a precision threshold where the custodian is comfortable that the value *yi* is protected. Once the variance is determined, the random noise ∆ is added to T to determine $\hat{T}$. The value $\hat{T}$ is published with a variance measure *σ2*. Aggregate values are affected respectively. A similar process can be extended to cells with several units.

*RTA Example*

An example of the differences between suppression and RTA is found below. In the example, information for 3 industries for 2 regions is desired for publication (Table 1). Estimates (Est) are based on a census with corresponding variation measures in terms of coefficients of variation (CV) equal to 0. Assuming that the cell for Industry C / Region 2 (highlighted) is sensitive, the cell would be suppressed. At the same time, because of the aggregates being release, secondary cells would have to be suppressed. The process results in a table with 4 of the 6 internal cells being suppressed (Table 2).

**Table 1: Example - Table Desired for Dissemination**



**Table 2: Example - Table after suppression methods applied**



The RTA alternative would add noise onto the sensitive cell (Industry C / Region 2). The noise is illustrated in a more variable (larger) CV measure and an updated estimate. Aggregate cells are affected while the accompanying internal cells are unaffected (Table 3).

**Table 3: Example - Table after RTA method applied**



*Advantages of the RTA*

The main advantage of the RTA is that estimates that would have normally been suppressed are released to the user community. A complete table including all values is disseminated to the user. Clear quality measures will allow the user to appropriately interpret the estimates.

Unlike the suppression method, only the primary cells where there is a confidentiality issue are affected. No secondary noise is required.

The method will not add noise if there is enough sample variance to be considered as protection for the units contributing to the cell. The cell will be published with its original variance measure.

The method is less sensitive to small changes in its assessment and treatment than suppression. Small changes in the microdata may cause a cell to be suppressed in the traditional approach. The RTA will simply add extra noise.

*Disadvantages of the RTA*

The main disadvantage of the approach is the inherent effect it has on the estimates. A feature is that it changes the estimates from what was collected from the survey respondents. The accuracy of the sensitive cells is reduced in order to publish a value for the cell.

Aggregate estimates are affected depending on how the noise added to the sensitive cell relates to the total for the aggregate. This can be a challenge if aggregate estimates are more valued to the user community than detailed estimates.

Like suppression, there are challenges in application. The method adds independent noise which causes challenges with revision strategies, trend analysis and seasonal adjustment. Modern solutions, specific to this method, will have to be sought out.

Finally, this method requires a strong presentation and understanding of the statistical accuracy of the survey estimate since this is the basis for the disclosure control method. In some surveys, these indicators are not directly presented to the user and this method will require a culture shift where the uncertainty of the estimates should be made clear to both the users and respondents. There is a risk of perceived disclosure if this information is not made aware to the user.

1. **Quality and the RTA**

At Statistics Canada, there are several initiatives that are in place to put quality at the forefront of the information we produce. The Quality Assurance Framework has already been mentioned but along with that there are the Quality Guidelines (Statistics Canada, 2009) where ‘the main purpose of the Quality Guidelines is to provide a comprehensive list of guiding principles and good practices in survey design’. The Policy on Informing Users of Data Quality and Methodology (Statistics Canada, 2000) requires that all statistical products include or refer to documentation on data quality and methodology.

In the Quality Assurance Framework and the Quality Guidelines, statistical quality is broken down into six dimensions:

1. Relevance
2. Accuracy and Reliability
3. Timeliness and punctuality
4. Accessibility and clarity
5. Coherence and comparability
6. Interpretability and management of metadata

The RTA as a perturbative method has many advantages over a suppression approach but, nonetheless, does have an impact on several aspects of quality. The balance of the dimensions of quality is seen in Figure 1 with the impacts described in more detail below.

**Figure 1: The balance of the dimensions of quality**

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*Relevance*

In terms of relevance, it is clear that the RTA will put more information in the hands of the users of the survey information. The dissemination approach suggests that the detailed cells that are typically suppressed are needed by some users. The first point to recall is that the secondary suppressions are released without any additional noise added to them. Only the cells with a sensitivity issue and their aggregates are affected. The estimates produced for sensitive cells are disseminated as estimates in the sense that, like any survey estimate, they do not precisely reflect the population. In addition to the sampling and non-sampling errors, a disclosure control noise is added. It is thought that these estimates, although not perfect, should be relevant to the users. All forms of statistical inference are still possible and the amount of noise added to an estimate can be controlled to ensure that the estimate is relevant while still considering the risk of disclosure.

*Accuracy and Reliability*

An inherent characteristic of the RTA method is that it decreases the accuracy of inferences on individual contributions through increasing the variability on the point estimate. No survey estimate reflects reality with 100% accuracy. In addition to the sampling errors, there are non-sampling errors such as recall error, nonresponse, reporting errors, etc. The RTA is simply an additional, controlled and quantifiable noise on the survey estimates. The accuracy of the estimates will depend on the amount of noise added. Some noise is required for sensitive information while less noise may be required for information that may be considered less sensitive (either already publicly available or for which inference on individual value is already imprecise). The accuracy of an estimate from RTA will generally be good enough for publication and the level of accuracy will depend on the amount of risk the survey is willing to take.

*Accessibility and Clarity*

The RTA makes more information available to the survey users than would have been made available through a suppression approach. One of the challenges will be to ensure that the effects of RTA on the estimates should be made clear to the user. In some situations, quality measures are not readily accessible, while elsewhere, only metadata descriptions or quality descriptions that are somewhat vague in nature are available. The RTA relies on the users realizing that the information provided is not perfect. An apparent disclosure of individual’s values can easily be dismissed through an illustration that the estimate is not precise. The challenge then is to how to illustrate the quality measures without giving too much information to an attacker.

*Coherence and Comparability*

One of the main challenges that has been noted by data providers investigating the RTA is around the fact that the method introduced independent noise on survey estimates. This independent noise could be between correlated variables, between consecutive months on the same variable, or even recalculating the RTA tables. This feature of the method can cause issues when using the survey estimates to interpret month to month movements or correlation studies. Larger month to month movements will be observed than in the original estimate but with proper inference the two results would come to similar conclusions.

The other challenge is due to the fact that there are often other sources of information that are used to corroborate the information coming from the survey. These data sources may be available to the general public or to a specific user. The RTA could cause a comparability issue where the two sets of information do not agree.

For both these issues, these are design features of the process that prevents an attacker from being able to get detailed information on an individual. To fix the estimate in any way will give additional information that could be used to get a more precise measure on an individual contribution. Statistics Canada will consider to research this area since it becomes a vital point of consideration for several survey areas.

1. **Conclusion**

This paper illustrates a new method that allows the publication of statistical information that has traditionally been suppressed for magnitude data. The method continues to support the Statistics Act and the fundamental principle of ensuring that confidential individual information is not released into the public. The challenge is that the ability to release more comes with a cost. The method has several advantages for some of the quality dimensions but disadvantages in others.

The method has attracted many potential users but there is still some reluctance to adopt the method. There is a clear trade-off between the different aspects of quality. In order to move forward, more consultation with users, stakeholders and analysts is required with the hope to find the right application of the method. It is hoped that in the near future that data stewards will see past the negative aspects of the method and make the cultural shift to using this method.

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