

HOW TO DEAL WITH INSUFFICIENT SAMPLE SIZE DUE TO NON-RESPONSE IN SURVEYS?

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(Received 05th February 2024; accepted 06th April 2024)

Abstract. Surveys have become indispensable approach for gathering input from diverse people in several fields, including social research, marketing, healthcare, and public opinion polls. However, non-response in surveys is a complex issue that is impacted by a variety of factors. The aim of this study is to enhance approaches to dealing with insufficient sample size resulting from non-response in surveys. This study revealed that there are several approaches in dealing with insufficient sample size due to non-response in surveys, namely: (a) resizing the population by dividing into specific category; (b) ethical and practical constraints as justification; (c) using different sampling techniques in determining sample size; and (d) repositioning the sample of a pilot study and real study. Conclusively, the proposed approaches in this study for addressing non-response and insufficient sample sizes in surveys are anticipated to significantly influence novel methodologies in sampling techniques across a variety of populations. Additional investigation is required to assess the efficacy of several approaches in augmenting the rate of response, including reminders, follow-ups, monetary or non-monetary incentives, and utilisation of online platforms for responding.

Keywords: *non-response, survey, sample size, population*

Introduction

Surveys have become an indispensable approach for gathering input from diverse people in several fields, including social research, marketing, healthcare, and public opinion polls. Surveys are a useful method for collecting large volumes of numerical data. Depending on how they are designed, surveys can provide both descriptive and inferential analyses, which can help improve our understanding of research questions. Surveys can be carried out using several methods of administration, including in-person interviews, internet surveys, telephone surveys, and postal surveys. The initial section of a survey offers a chance to give a brief summary of the survey's objective, justification, and approach while also educating participants about the ethical factors that are pertinent to their involvement. This section further offers guidance on how to effectively complete the survey and elucidates the purpose and use of the gathered data. An expertly constructed introduction has the capacity to increase response rates, boost data accuracy, and promote more meaningful interaction with survey participants.

However, non-response in surveys is a complex issue that is influenced by a variety of factors. These factors include different elements of a survey, such as the creation of survey questions, the organisation and duration of the survey, the characteristics of the surveyed population, the method used for data collection, the provision of incentives to encourage participation, and the individual choices made regarding participation. Comprehensive research has shown that non-response rates tend to be elevated when dealing with sensitive topics, such as sexual conduct, drug use, or mental health. Furthermore, it has been discovered that demographic factors such as age, gender, level of education, and geographical location have been discovered to influence the rates at which individuals respond. In addition, the timing and manner of delivering the survey

can also have an impact on response rates. For instance, specific time periods such as weekends or holidays, as well as survey administration modalities including internet platforms, phone, or postal surveys, may be less successful. Hence, understanding the fundamental factors related to non-response is crucial for survey researchers since it allows them to create surveys that are customised to their intended audiences, leading to increased response rates and more precise conclusions.

The aim of this study is to enhance approaches to dealing with insufficient sample size resulting from non-response in surveys. This study provides valuable insights into the influence of non-response on survey outcomes, emphasising its possible ramifications and offering recommendations for mitigating the problem. It assists survey researchers in assessing the magnitude of non-response bias and in developing methods to alleviate or compensate for it. Researchers may improve their understanding of the missing components in the sample and apply corrective actions to account for any selection bias through the analysis of non-respondents' characteristics. This study provides a valid rationale for implementing minimum response rates in surveys to guarantee the representativeness of the sample. Furthermore, understanding the frequency of non-response and its root causes may assist researchers in adapting the survey structure or method of delivery, ultimately leading to superior data quality and more precise study conclusions. In summary, studying the issue of inadequate sample size caused by non-response in surveys may enhance the quality of surveys and guarantee that public policies and practices are grounded in solid data and trustworthy.

The significance of surveys in large sample size

Surveys are an invaluable approach for collecting data on a variety of topics, ranging from public opinion to consumer behaviour (Gideon, 2021). They prove particularly advantageous in the field of health humanities, as they can provide perspectives that are generalizable (Klugman, 2019). Surveys have the ability to uncover hidden factors that would otherwise remain unseen and allow for the creation of controlled variation (Stantcheva, 2023). Nonetheless, they do have certain limitations, such as the inability to elucidate the reasons behind respondents' answers (Klugman, 2019). The survey methodology is guided by statistical principles, encompassing every aspect from sample creation to data analysis (Koning, 2020). Despite practical challenges, such as dwindling response rates and data integration, surveys continue to be a vital approach in the realm of statistics (Saigo, 2020). The success of surveys hinges on meticulous questionnaire and sample design, as well as the minimization of sources of error (Goodfellow, 2023; Halperin and Heath, 2020).

Surveys are a cost-effective method for gathering data, especially when conducted through online platforms, and can yield valuable insights into public services (Clifton et al., 2022; Goodfellow, 2023; Menon and Muraleedharan, 2020). They are particularly valuable for evaluating public services from the perspective of citizens (Clifton et al., 2022). However, there are certain limitations associated with surveys, including low response rates and the inability to provide explanations for respondents' answers (Goodfellow, 2023; Klugman, 2019). While the use of online surveys can expedite data collection, complex surveys may necessitate direct interaction (Putranto, 2019). Internet-based surveys have gained popularity due to their ability to reach a larger pool of participants and their efficiency in managing data (Menon and Muraleedharan, 2020). Respondent-driven sampling, though valuable, has the potential for bias and requires a methodologically rigorous approach (Navarrete et al., 2022). Surveys can uncover

otherwise hidden factors and provide opportunities for studying specific groups (Stantcheva, 2023).

Recent research has indicated an ongoing and even escalating use of surveys within the realm of social sciences, specifically in the domains of organisational change, management control systems, and political science (Church and Waclawski, 2020; Mutz and Kim, 2020; Speklé and Widener, 2020; Sturgis and Luff, 2021). Nevertheless, the response rates in police surveys have experienced a decline over time, with in-person surveys attaining higher rates (Nix et al., 2019). Furthermore, the use of internet-based surveys has gained popularity, particularly during the COVID-19 pandemic, due to their capacity to reach a larger pool of participants and their efficacy in data management (Menon and Muraleedharan, 2020). Despite these advancements, concerns persist regarding the limitations of surveys, such as their inability to elucidate the reasons behind individuals' responses (Klugman, 2019).

The dealing approaches

This study revealed that there are several approaches to dealing with insufficient sample size due to non-response in surveys, namely: (a) resizing the population by dividing it into specific categories; (b) using ethical and practical constraints as justification; (c) using different sampling techniques in determining sample size; and (d) repositioning the sample from a pilot study and a real study.

Resizing the population by dividing into specific category

By dividing the population into certain categories, the non-response surveys can be used to adjust it to a smaller size. By implementing this approach, it is possible to decrease the population to a more compact magnitude, consequently reducing the sample size as well. However, a recalculation is necessary to determine the appropriate sample size. For example, the total number of individuals in the parent population is approximately 1500. According to Krejcie and Morgan (1970), the recommended sample size should be approximately 306. Additionally, the parent population can be subdivided into various categories, such as races, types of occupation, residential locations, or departments within an institution. Select the category that aligns best with the study's scope, ascertain the reduced population, and generate a new sample size that is guaranteed to be smaller than the previous one. Inexperienced researchers are expected to benefit from this methodology by reducing their research expenses. Nevertheless, the researcher must ensure that the newly chosen category remains within the scope of the research. The suggestion for dividing the parent population into focused, specific, and categorised populations has been simplified into the framework below (*Figure 1*).

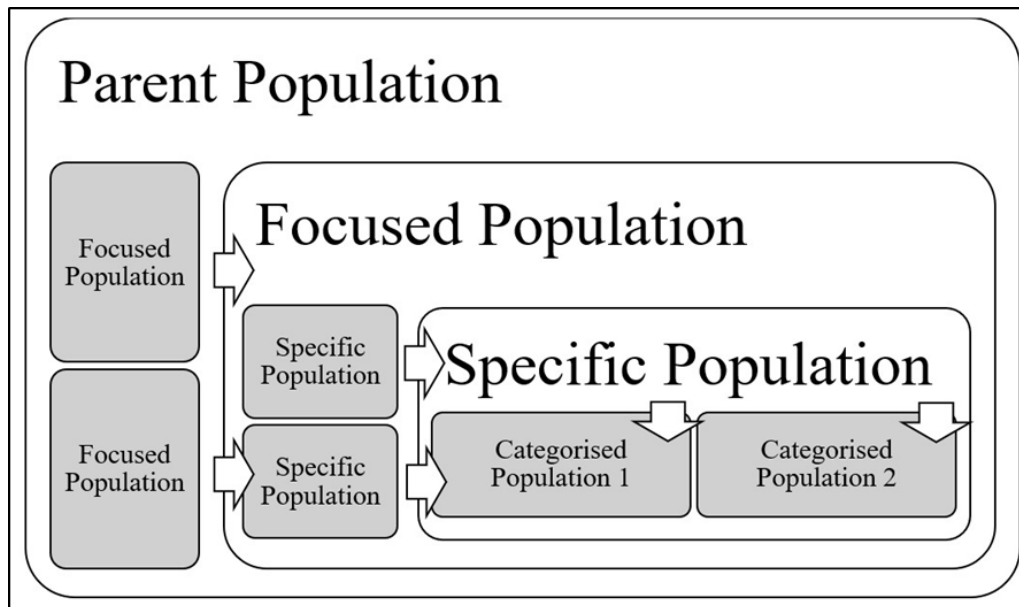


Figure 1. Suggestion for dividing the parent population into focused, specific, and categorised populations.

Recent studies have investigated different approaches to categorising populations based on their size. Wan et al. (2022) devised a technique for reducing the scale of population data that demonstrated superior accuracy for categories characterised by low and medium density. Nishizaka (2021) illustrated the process by which individuals divide populations in order to regulate rights, while Bongaarts (2020) emphasised the projected increase in population in underdeveloped areas. Aleshin-Guendel et al. (2021) examined the difficulties associated with determining the size of a population, whereas Li et al. (2019) put out a technique for calculating the size of populations that exhibit heterogeneity. Anson et al. (2019) investigated the consequences of population growth, while Qader et al. (2020) and Shang et al. (2021) introduced techniques for achieving more uniformity in sample units and estimating populations at the level of individual buildings, respectively.

On top of that, several studies have investigated the benefits of resizing populations by dividing them into specific categories. Fennell (2021) emphasises the significance of categories in streamlining information while also acknowledging the possibility of inaccuracies and deliberate manipulation. The study proposes that the use of bigger, more resilient, and more diverse categories can help alleviate these problems. In this context, Conti et al. (2022) suggest a resampling method for probability-proportional-to-size sampling designs, which can be beneficial. Stoica et al. (2019) and Nishizaka (2021) both examine the subject of biased partitions. Stoica et al. (2019) suggests a solution to achieve fair districting, while Nishizaka demonstrates how individuals divide populations to control entitlements. Boldin et al. (2023) and Stevens (2023) offer mathematical and practical viewpoints, respectively, on the difficulties and advantages of adjusting population sizes. In Mazari and Ruiz-Balet's (2021) study, a fragmentation issue is discussed in relation to the optimisation of total population size. The author suggests that the dispersion rate of a species might have an impact on the optimal distribution of resources.

Using ethical and practical constraints as justification

Two primary factors influence survey research: ethical and practical constraints. Ethical constraints refer to factors that ensure the welfare and entitlements of survey participants. These ethical constraints may encompass the requirement of acquiring informed consent prior to survey involvement, safeguarding the privacy and confidentiality of survey participants, ensuring the precision of survey data, and preventing any potential damage or discomfort to respondents (Roberts and Allen, 2015). Practical constraints pertain to the practicability of carrying out surveys, encompassing tasks such as formulating unambiguous and pertinent questions, upholding data integrity, and following ethical protocols (Dillman et al., 2014). Furthermore, practical constraints include factors such as the survey's intended audience's presence and reach of the survey's intended audience, the resources available for conducting the survey, and the desired method of administering it. It is essential to consider and overcome these ethical and practical constraints to ensure the accuracy and consistency of survey responses and to preserve confidence between researchers and survey participants.

There are several important ethical constraints to consider in surveys, namely (McNamara, 1993):

(a) Informed consent: Participants must get comprehensive information regarding the objective, methodologies, potential hazards, and advantages of the survey before providing their agreement to participate. Researchers should obtain informed consent voluntarily and without coercion.

(b) Confidentiality and anonymity: Researchers must ensure the confidentiality and anonymity of participants' responses and personal data, unless they have obtained specific authorization to disclose or share such information.

(c) Determining the objective and sponsor: Survey researchers are required to disclose to potential respondents both the survey's objective and the specific organisation that is funding it.

(d) Mitigation of adverse effects: Researchers should take steps to minimise any potential injury or discomfort to participants. This may entail refraining from asking questions that are sensitive or intrusive, offering options for help, and ensuring that involvement does not result in excessive stress or harm.

(e) Optional participation: Survey participation must be optional, and participants must have the prerogative to withdraw from the survey at any point without incurring any penalties or consequences.

(f) Equity and impartiality: When conducting surveys, it is essential to ensure a fair and impartial approach, free from any discrimination or bias based on race, gender, religion, or socioeconomic status.

(g) Analysis and reporting: Survey researchers are also responsible for providing precise and truthful accounts of their surveys' methodologies and findings of their surveys to fellow professionals in the scientific community. The reports should include all of the investigation's issues, deficiencies, and both positive and negative discoveries of the investigation.

Complying with these ethical constraints safeguards the rights and welfare of survey respondents and guarantees the integrity and accuracy of the study results. Before conducting surveys involving human participants, researchers must acquire ethical approval from the appropriate institutional review boards or ethics committees. In addition to ethical constraints, there are common practical constraints in surveys (Jackson, 1988):

(a) Temporal limitations: Restricted periods for data collection may impose constraints on the number of participants or the duration of the survey instrument. To achieve deadlines, researchers may have to prioritise specific inquiries or decrease the sample size.

(b) Budget constraints: Financial limitations might affect the extent of the survey, including the size of the sample, methods of data collection, and incentives for participants. Researchers may be required to make compromises and identify cost-efficient resolutions.

(c) Resource availability: The presence and accessibility of staff, machinery, and technology can impact the practicality and effectiveness of data gathering. Researchers may be required to operate within the limitations of the resources at their disposal or explore alternative possibilities.

(d) Participant accessibility: Overcoming barriers to contacting and involving the desired demographic can provide practical hurdles. These challenges may include poor response rates, difficult-to-reach people who are difficult to reach, or restricted access to specific groups.

(e) Language and cultural factors: To ensure precise and significant results, surveys conducted in diverse environments may necessitate translations, modifications, or cultural awareness to guarantee precise and significant results. These factors can introduce complexity and prolong the survey process.

Researchers must adeptly traverse these practical constraints to ensure the integrity and reliability of survey results. This may entail formulating strategic choices, pursuing partnerships, or modifying survey methodologies to maximise data acquisition within the existing resources and limitations. Therefore, ethical and practical limitations can be valid reasons for non-response surveys, especially when considering optional participation due to ethical constraints and participant accessibility due to practical constraints. Respondent-reflected behaviour resulting from an excessive number of items included in the questionnaire consistently causes these two specific limitations in an online survey conducted on an uncontrolled set of participants. Researchers can use this technique to validate non-response surveys observed without needing to resampling. However, they have to ensure that the data is sufficient to be analysed. The figure below simplifies the ethical and practical constraints (*Figure 2*).

Ethical		Practical	
✓	Informed Consent	✓	Temporal Limitations
✓	Confidentiality and Anonymity	✓	Budget Constraints
✓	Determining the Objective and Sponsor	✓	Resource Availability
✓	Mitigation of Adverse Effects	✓	Participant Accessibility
✓	Optional Participation	✓	Language and Cultural Factors
✓	Equity and Impartiality		
✓	Analysis and Reporting		

Figure 2. *The ethical and practical constraints.*
 Source: McNamara (1993); Jackson (1988).

Various studies have examined the ethical and practical constraints of justifying appropriate sample sizes. Karim et al. (2019) and Andrade (2020) both highlight the significance of having a sufficient sample size. Karim et al. (2019) offer statistical formulas for various research methods, while Andrade explores the connection between sample size and ethical issues. Lakens (2022) provides pragmatic methodologies for justifying sample sizes, encompassing power analysis, desired precision, and the use of heuristics. Serdar et al. (2021) and Stevenson (2021) examine the correlation between sample size, power, and effect size, with Stevenson explicitly discussing the distinct factors involved in veterinary epidemiology. Stamatopoulos (2022) proposes a comprehensive method for calculating sample sizes in statistical surveys, taking into account the variability within limited populations. These studies emphasise the need to find a middle ground between ethical and practical factors when determining sample sizes.

Additionally, the importance of ethical and practical constraints in determining the size of a survey sample is a critical factor in research. Serdar et al. (2021) and Andrade (2020) both stress the need for determining an acceptable sample size, with Serdar et al. (2021) underscoring the possibility of obtaining insufficient findings and encountering ethical dilemmas when employing a statistically inaccurate sample size. Tripathi et al. (2020) and Karim et al. (2019) emphasise the need for precise sample size calculations in clinical research. Tripathi et al. (2020) also point out that clinical research journals do not properly report sample size and sampling factors in clinical research journals. Chaudhuri (2020) and Althubaiti (2023) present realistic methodologies for determining sample sizes. Chaudhuri specifically tackles the difficulties encountered in sensitive circumstances, while Althubaiti offers a comprehensive manual tailored to health researchers. Akinrata et al. (2019) and Adam (2020) examine the consequences of unethical behaviours in the construction sector and suggest modifications to the process of determining sample size in survey research, respectively. These studies emphasise the ethical and practical importance of sample size in research, as well as the necessity for precise and clear reporting.

Using different sampling techniques in determining sample size

A range of studies have explored the determination of sample size in survey research. Besides the famous Krejcie and Morgan (1970), Chuan (2006) compared the Krejcie & Morgan and Cohen Statistical Power Analysis methods, with the latter being recommended for higher accuracy. Bartlett et al. (2001) provided procedures for determining sample size for continuous and categorical variables, while Adam (2020) proposed an adjustment to Yamane's formula for both types of variables. Cohen (2005) discussed sample size considerations for multilevel surveys, and Peel and Skipworth (1970) proposed an alternative to traditional sampling techniques. Taherdoost (2017) summarised the calculation of the survey sample size using several statistical formulas, which were based on desired accuracy with confidence levels of 95 and 99 percent. However, according to Weisberg et al. (1989), it is often realised too late, after completing the study, that the sample size was insufficient or not properly representative. Therefore, a few techniques suggested can be applied (Hill, 1998), with justification for the smaller sample size after the non-response surveys appear. The techniques that can be taken into consideration are Gill et al. (2010), Frankfort-Nachmias and Nachmias (1996), Isaac and Michael (1995), Gay and Diehl (1992), Roscoe (1975) and Krejcie and Morgan (1970) (Table 1).

Table 1. Recommended alternative sampling techniques for resizing the sample size.

Reference	Techniques	Recommendation for sample size
Krejcie and Morgan (1970)	Suggested a distinctive calculation table for determining sample size.	-By utilising the calculation table, one may estimate the sample size that will accurately represent the population. -The table is suitable for any population with a specified (limited) size. -As the population grows, the sample size also increases, but at a decreasing pace until it reaches a point where it remains constant at little over 380 cases. -Sampling beyond around 380 cases is not worthwhile in terms of the benefits obtained compared to the cost and effort involved.
Gay and Diehl (1992)	Sample size depends upon the type of research involved-descriptive, correlational, or experimental	-Descriptive research: the sample size should ideally be 10 percent of the total population. However, if the population is of a diminutive size, then a minimum of 20 percent may be necessary. -Correlational research: to establish a relationship, a minimum of 30 subjects is necessary. -Experimental research: a minimum of 30 people per group is frequently applied.
Isaac and Michael (1995)	Essential of large size sample and justifiable of small size sample.	Large samples are essential as: -Numerous uncontrollable variables interact unpredictably, and it is preferable to reduce their impacts. This can be achieved by randomly combining the effects, so neutralising any imbalances. -The entire sample will be partitioned into many sub-samples for comparison. -The larger group or population encompasses a diverse array of factors and features, which increases the likelihood of overlooking or distorting these distinctions. This risk is particularly relevant in the context of an e-survey, given that the parent population is now global. -Minimal disparities in the outcomes are anticipated. Small sample sizes are justifiable: -When dealing with situations involving a limited number of observations or a small-scale economy. That is when it is not financially viable to gather a substantial sample. -During computer monitoring. There are two possible forms that this may take: (i) The input of large quantities of data can potentially introduce errors, specifically

		<p>through key punch blunders. (ii) To further ensure the dependability of the computer programme, a small subset of the primary data is chosen and manually examined. The objective of this analysis is to assess the congruity of outcomes between the small sample data and the large sample data.</p> <p>-For instance, involving exploratory research and pilot projects. Sample sizes ranging from 10 to 30 are adequate for these situations. The sample size is sufficiently adequate to conduct hypothesis testing, while also being small enough to potentially disregard subtle treatment effects. Obtaining statistical significance is improbable with this sample size.</p> <p>-When conducting research that requires a comprehensive analysis of a specific case.</p> <p>-Specifically, this occurs when the research necessitates the use of methodologies like interviews and when a substantial volume of qualitative data is obtained from each participant.</p>
Weisberg et al. (1989)	Sampling based on acceptable margin or error level.	<p>-The acceptable margin of error for anticipating, for instance, election survey outcomes, is approximately 3 to 4 percent.</p> <p>-Attempting to achieve an error rate as low as 1 percent is seldom worthwhile.</p> <p>-Once the precision exceeds 3 to 4 percent, the additional 1 percent is deemed unworthy of the resources and expenses needed to appropriately raise the sample size.</p> <p>-To tolerate a margin of error of 5 percent in a survey, a sample size of 400 observations is necessary.</p> <p>-If a 10 percent margin of error is deemed acceptable, then a sample size of 100 can be considered acceptable when employing simple random sampling.</p>
Frankfort-Nachmias and Nachmias (1996)	Sampling based on confidence level.	<p>-A probability level of 0.05, often known as a significance level, is widely accepted as a reliable level of confidence in the field of behavioural sciences.</p>
Roscoe (1975)	Sampling based on acceptable error level and confidence level.	<p>-Consider utilising a 10 percent level as a generally accepted benchmark for a probability (or significance) level.</p>
Gill et al. (2010)	Sampling based on confidence level.	<p>-Sample size determination based on: (a) a confidence level of 95 percent; and (b) a confidence level of 99 percent.</p>

Usually, the most popular sampling technique in survey research is Krejcie and Morgan (1970), which can be considered a primary sampling technique, and the others can be considered alternatives. Based on the review above, researchers suggest the Gay and Diehl (1992) as well as Isaac and Michael (1995) sampling techniques as sensible alternatives to Krejcie and Morgan (1970) for dealing with non-response surveys. Gay and Diehl (1992) provide a solution to different types of statistical analysis, so researchers can make some adjustments to the analysis as long as they are congruent with the research objectives. While Isaac and Michael (1995) present a solution depending on the current events of the sample within the population, it can either be a large response or a justifiable small response. When dealing with non-response surveys, these two solutions are considered appropriate. Otherwise, Weisberg et al. (1989), Frankfort-Nachmias and Nachmias (1996), and Roscoe (1975) used sampling based on acceptable margin or error level, confidence level, and acceptable error level, respectively. The figure below (*Figure 3*) simplifies these approaches.

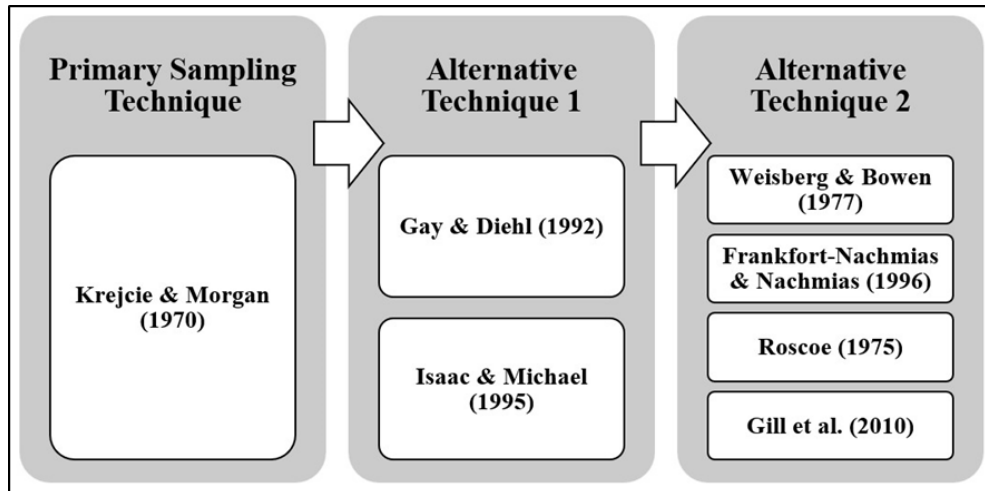


Figure 3. Alternative sampling techniques replacement for the primary sampling technique.

Besides, Gill et al. (2010) used sample size determination based on confidence levels of 95 percent and 99 percent (Table 2). Various studies have investigated diverse sampling techniques to tackle the difficulties posed by limited sample sizes in surveys. The studies conducted by Siswantining et al. (2020) and Guadarrama et al. (2019) both emphasise the significance of small area estimation techniques. Siswantining et al. (2020) specifically examine spatial correlation, while Guadarrama et al. (2019) focus on cut-off sampling. Nandram et al. (2021) suggest the incorporation of both nonprobability and probability samples through the use of survey weights, while Amir et al. (2020) present a thorough examination of sampling methods across several fields. Coelho et al. (2022) and Nanjundeswaraswamy and Divakar (2021) both analyse the integration of several sampling techniques, with Coelho et al. (2022) explicitly investigating the utilisation of quota and probability sub-sampling. Zacks (2020) and Logan et al. (2020) offer a comprehensive examination of sample surveys. Zacks delves into the strategies and techniques used in designing and modelling these surveys, while Logan et al. (2020) specifically explore the estimate of data for limited geographic areas such as census tracts. These studies emphasise the need to utilise various sampling approaches to tackle the difficulties posed by limited sample sizes in surveys.

Table 2. Sample size determination based on: (a) a confidence level of 95 percent; and (b) a confidence level of 99 percent.

Category	Population size	Variance of the population P=50%		
		5	3	1
(a)	100	79	91	99
	300	168	234	291
	500	217	340	475
	1000	278	516	906
	5000	357	879	3288
	10000	370	964	4899
(b)	100	87	95	99
	300	206	258	295
	500	285	393	485
	1000	398	647	943
	5000	583	1342	3838
	10000	620	1550	6228

Source: Gill et al. (2010).

Furthermore, multiple studies have examined the advantages of various sampling methods for surveys with small sample sizes. Vergara-Hernández et al. (2021) and Parker et al. (2019) both highlight the significance of taking into account spatial interdependence and informative sampling in the estimation of tiny areas. Parker et al. (2019) specifically focus on models that operate at the level of individual units. Chaudhuri (2020) and Finch and French (2019) discuss the difficulties associated with sensitive instances and the limited accuracy of parameter estimation in small samples. Finch and French (2019) specifically recommend the use of the pairwise technique for estimating item difficulty parameters in item response theory models. Amir et al. (2020) present an extensive analysis of sampling methodologies across several disciplines, whereas Dickson et al. (2019) evaluate the effectiveness and practicality of sample strategies in surveys conducted at establishments. These studies emphasise the importance of a detailed and precise method of selecting participants in small-scale surveys. This method should include criteria such as location, information, and the unique traits of the community under study.

Repositioning the sample from a pilot study and a real study

Typically, the optimal sample size for a pilot study in surveys varies depending on the context and aims of the study. The recommended sample size for a pilot or preliminary study is usually 30 (Johanson and Brooks, 2010). Nevertheless, during a pilot study, researchers should gather a sample size that exceeds the optimal size (>30) to ensure an adequate amount of data and to account for potential non-response surveys, which represent the worst-case scenario. If the sample size is sufficiently large for a pilot study, it is reasonable to consider the first 30 responses as the pilot study sample. The remaining responses might be set aside as a reserve or used for further cases to be analysed later. It is suggested to transition the pilot study to the actual study if the real study receives a small response below the required minimum sample size and needs recalculation for a smaller population as the first 30 become a sample for the pilot study. Although this technique slightly deviates from the typical academic procedure, it can be considered a prudent decision for research projects that have invested significant time, resources, and effort. This approach is crucial for inexperienced researchers who may not have adequately organised their research, and it has been simplified into the figure below (*Figure 4*).

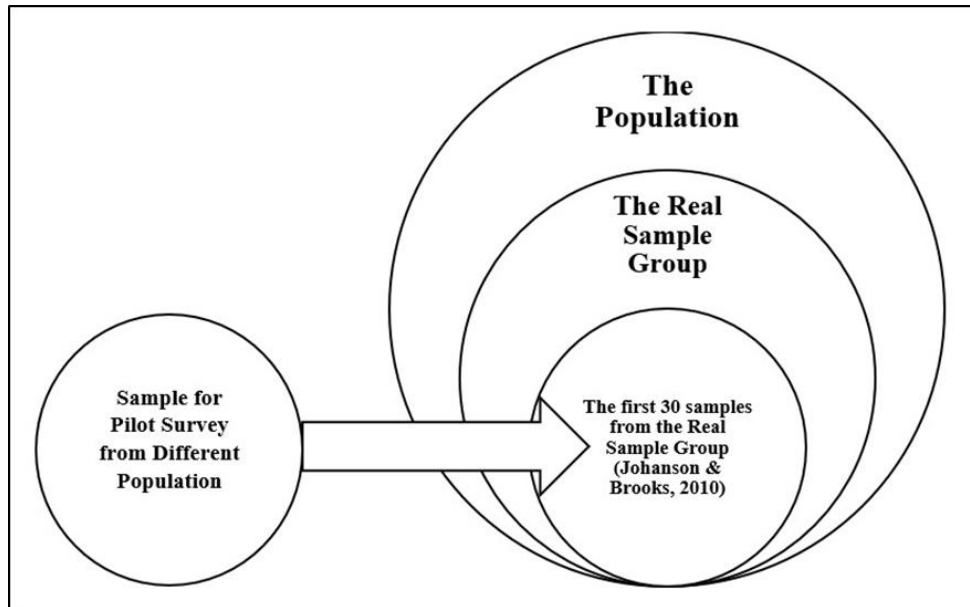


Figure 4. *Repositioning the sample for the pilot survey from different populations and the first 30 samples from the real sample group.*

Recent studies have put forth different approaches to address issues presented by limited sample sizes in surveys. Tseng and Sim (2021) and Konietschke et al. (2020) examine the correlation between the sample size of pilot studies and the design of major investigations. Tseng and Sim (2021) offers techniques for calculating sample size, while Konietschke et al. (2020) concentrate on the analysis of high-dimensional data. Cuntrera et al. (2022) and Cole (2020) provide pragmatic remedies, with Cuntrera et al. (2022) investigating the application of inverse sampling and Cole offering instructions for scrutinising and presenting outcomes in impact evaluations. Mastrangelo et al. (2020) highlight the significance of sample size in workplace surveys, whereas van de Schoot and Miočević (2020) present statistical techniques for applying remedies in studies with limited sample sizes. Muggleton (2020) and Santomauro and Sanderson (2019) emphasise the importance of targeted reporting and meticulous preparation in pilot studies. Muggleton warns against the improper utilisation of preliminary effects, while Santomauro and Sanderson (2019) address the dangers and potential reduction in sample size in intricate applied research.

Moreover, recent studies have emphasised the significance of repositioning the sample in both pilot and real studies conducted in surveys. Tseng and Sim (2021) and Malmqvist et al. (2019) both stress the need for proper sample size planning in pilot studies. Tseng and Sim (2021) offer methodologies for achieving this, while Malmqvist et al. (2019) highlight the significance of pilot studies in enhancing research quality. Aikens et al. (2020) advocate for the use of a “pilot design” in observational research, wherein observations are utilised to enhance the overall study design. Olsen (2022) and Nilsson et al. (2021) examine the utilisation of survey data to get site samples that are more representative, as well as the process of reweighting survey participants to restore representativeness. Finally, Lewis et al. (2021) examine the process of determining the sample size for progression criteria in pilot randomised controlled trials (RCTs), with the latter presenting a structured framework for hypothesis testing and indicating the appropriate sample size. These studies emphasise the need for repositioning the sample

in both pilot and actual studies in surveys to guarantee proper planning, enhance research design, and restore representativeness.

Conclusion

Conclusively, the proposed approaches in this study for addressing non-response and insufficient sample sizes in surveys are anticipated to significantly influence novel methodologies in sampling techniques across a variety of populations. However, it must be consistent with the main concept of the study if there is a handy method to adjust to. Researchers must document all modifications made to the thesis or research paper, providing suitable justifications. The methods for dealing with insufficient sample size due to non-response in surveys are simplified into the framework below (*Figure 5*).

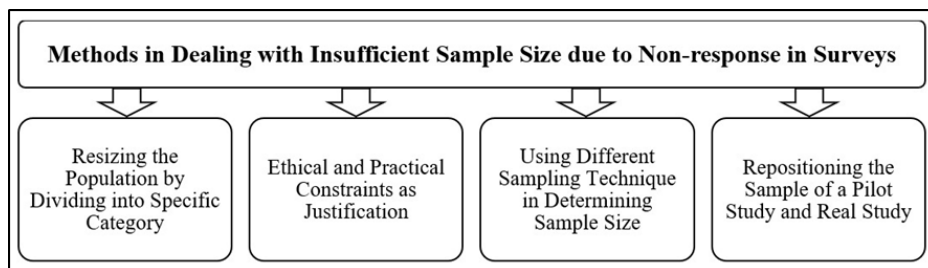


Figure 5. Framework on addressing non-response and insufficient sample sizes in surveys.

Additional investigation is required to assess the efficacy of several approaches in augmenting the rate of response, including reminders, follow-ups, monetary or non-monetary incentives, and the utilisation of online platforms for responding. Furthermore, future studies might explore the use of incentives that are more customised to particular target demographics, as well as evaluate the ethical implications and any compromises associated with providing incentives. It is necessary to undertake comprehensive investigations that evaluate the accuracy of the obtained data with and without corrective weighting on a large scale. Future research might also prioritise the identification of variables that impact non-response and the creation of models that elucidate non-response trends, including the social, economic, and demographic attributes of the community. Examining research opportunities pertaining to non-response is crucial for enhancing the calibre of survey research and yielding useful insights on techniques.

Acknowledgement

The author thanks the Academy of Contemporary Islamic Studies, Universiti Teknologi MARA, for technical support.

Conflict of interest

The author confirms that there is no conflict of interest involved with any parties in this research study.

REFERENCES

- [1] Adam, A.M. (2020): Sample size determination in survey research. – *Journal of Scientific Research and Reports* 26(5): 90-97.
- [2] Aikens, R.C., Greaves, D., Baiocchi, M. (2020): A pilot design for observational studies: Using abundant data thoughtfully. – *Statistics in Medicine* 39(30): 4821-4840.
- [3] Akinrata, E.B., Ogunsemi, D.R., Akinradewo, O.F. (2019): Outcomes of unethical practices by quantity surveyors in Nigerian construction industry. – *International Journal of Applied Research in Social Sciences* 1(3): 84-94.
- [4] Aleshin-Guendel, S., Sadinle, M., Wakefield, J. (2021): Revisiting identifying assumptions for population size estimation. – *Cornell University* 58p.
- [5] Althubaiti, A. (2023): Sample size determination: A practical guide for health researchers. – *Journal of General and Family Medicine* 24(2): 72-78.
- [6] Amir, N., Jabeen, F., Niaz, S. (2020): A brief review of conditions, circumstances and applicability of sampling techniques in computer science domain. – *IEEE 23rd International Multitopic Conference 2021*: 1-6.
- [7] Andrade, C. (2020): Sample size and its importance in research. – *Indian Journal of Psychological Medicine* 42(1): 102-103.
- [8] Anson, J., Bartl, W., Kulczycki, A. (2019): Roots and Fruits of Population Growth and Social Structures: Demographic and Sociological Vistas. – In: J. Anson, W. Bartl, A. Kulczycki (eds.) *Studies in the Sociology of Population*, Springer 24p.
- [9] Bartlett, J.E., Kotrlik, J.W., Higgins, C.C. (2001): Organizational research: Determining appropriate sample size in survey research appropriate sample size in survey research. – *Information Technology, Learning, and Performance Journal* 19(1): 43-50.
- [10] Boldin, B., Diekmann, O., Metz, J.A.J. (2023): Population growth in discrete time: a renewal equation oriented survey. – *Journal of Difference Equations and Applications* 29p.
- [11] Bongaarts, J. (2020): *World Family Planning 2020 Highlights*. – United Nations Department of Economic and Social Affairs, Population Division *World Family Planning 2020: Highlights*, United Nations Publications 46p.
- [12] Chaudhuri, A. (2020): A review on issues of settling the sample-size in surveys: Two approaches-equal and varying probability sampling-crises in sensitive cases. – *Calcutta Statistical Association Bulletin* 72(1): 7-16.
- [13] Chuan, C.L. (2006): Sample size estimation using Krejcie and Morgan and Cohen statistical power analysis: A comparison. – *Jurnal Penyelidikan IPBL* 7: 78-86.
- [14] Church, A.H., Waclawski, J. (2020): Rediscovering the Art of Surveys for Organization Change. – In: W. H. Macey, A. A. Fink (eds.) *Employee Surveys and Sensing: Challenges and Opportunities*, Oxford University Press 16p.
- [15] Clifton, J., Fernández-Gutiérrez, M., Howlett, M. (2022): Assessing public services from the citizen perspective: what can we learn from surveys? – *Journal of Economic Policy Reform* 25(1): 1-8.
- [16] Coelho, I.B., Pitta, M.T., do Nascimento Silva, P.L. (2022): Combining quota and probability sub-sampling within enumeration areas to produce more reliable estimates. – *Statistical Journal of the IAOS* 38(4): 1399-1410.
- [17] Cohen, M.P. (2005): Sample size considerations for multilevel surveys. – *International Statistical Review* 73(3): 279-287.
- [18] Cole, R. (2020): Small samples due to lower-than-planned enrollment in impact evaluations: What to do? – *Mathematica Policy Research* 5: 1-8.
- [19] Conti, P.L., Mecatti, F., Nicolussi, F. (2022): Efficient unequal probability resampling from finite populations. – *Computational Statistics & Data Analysis* 167: 15p.
- [20] Cuntrera, D., Falco, V., Giambalvo, O. (2022): On the sampling size for inverse sampling. – *Stats* 5(4): 1130-1144.
- [21] Dickson, M.M., Grafström, A., Giuliani, D., Espa, G. (2019): Efficiency and feasibility of sampling schemes in establishment surveys. – *Mathematical Population Studies* 26(2): 114-122.

- [22] Dillman, D.A., Smyth, J.D., Christian, L.M. (2014): *Internet, Phone, Mail, and Mixed Mode Surveys: The Tailored Design Method* (4th ed.). – John Wiley & Sons Inc. 528p.
- [23] Fennell, L.A. (2021): Sizing up categories. – *Theoretical Inquiries in Law* 22(1): 1-30.
- [24] Finch, H., French, B.F. (2019): A comparison of estimation techniques for IRT models with small samples. – *Applied Measurement in Education* 32(2): 77-96.
- [25] Frankfort-Nachmias, C., Nachmias, D. (1996): *Research Methods in the Social Sciences* (5th ed.). – Arnold 617p.
- [26] Gay, L.R., Diehl, P.L. (1992): *Research Methods for Business and Management*. – Macmillan Publishing 679p.
- [27] Gideon, L. (2021): Survey Research. – In: J. Morin, C. Olsson, E.O. Atikcan (eds.) *Research Methods in the Social Sciences: An A-Z of Key Concepts*, Oxford University Press 336p.
- [28] Gill, J., Johnson, P., Clark, M. (2010): *Research Methods for Managers*. – SAGE Publications 288p.
- [29] Goodfellow, L.T. (2023): An overview of survey research. – *Respiratory Care* September 68(9): 1309-1313.
- [30] Guadarrama, M., Molina, I., Tillé, Y. (2019): Small area estimation methods under cut-off sampling. – Luxembourg Institute of Socio-Economic Research (LISER) Working Paper Series 27p.
- [31] Halperin, S., Heath, O. (2020): Surveys. – In: S. Halperin, O. Heath (eds.) *Political Research: Methods and Practical Skills* (3rd ed.), Oxford University Press 60p.
- [32] Hill, R. (1998): What sample size is “enough” in internet survey research. – *Interpersonal Computing and Technology* 6(3-4): 1-12.
- [33] Isaac, S., Michael, W.B. (1995): *Handbook in Research and Evaluation: A collection of principles, methods and strategies useful in the planning, design and evaluation of studies in education and the behavioral sciences*. – Edits Pub 262p.
- [34] Jackson, E.L. (1988): Leisure Constraints: A Survey of Past Research. – *Leisure Sciences* 10(3): 203-215.
- [35] Johanson, G.A., Brooks, G.P. (2010): Initial scale development: Sample size for pilot studies. – *Educational and Psychological Measurement* 70(3): 394-400.
- [36] Karim, M., Furnaz, S., Buksh, A.R., Beg, M.A., Khan, M.S., Moiz, B. (2019): Sample size calculation in medical research. – 13th International Conference on Mathematics, Actuarial Science, Computer Science and Statistics (MACS) 5p.
- [37] Klugman, C.M. (2019): Surveys. – In: C. M. Klugman, E. G. Lamb (eds.) *Research Methods in Health Humanities*, Oxford Academic 10p.
- [38] Konietschke, F., Schwab, K., Pauly, M. (2021): Small sample sizes: A big data problem in high-dimensional data analysis. – *Statistical Methods in Medical Research* 30(3): 687-701.
- [39] Koning, A. (2020): A survey researcher’s many decisions. – In: W. R. Thompson (ed.) *Oxford Research Encyclopedia of Politics*, Oxford University Press 2000p.
- [40] Krejcie, R.V., Morgan, D.W. (1970): Determining sample size for research activities. – *Educational and Psychological Measurement* 30(3): 607-610
- [41] Lakens, D. (2022): Sample size justification. – *Collabra: Psychology* 8(1): 28p.
- [42] Lewis, M., Bromley, K., Sutton, C.J., McCray, G., Myers, H.L., Lancaster, G.A. (2021): Determining sample size for progression criteria for pragmatic pilot RCTs: The hypothesis test strikes back! – *Pilot and Feasibility Studies* 7(1): 1-14.
- [43] Li, H., Lin, H., Yip, P.S., Li, Y. (2019): Estimating population size of heterogeneous populations with large data sets and a large number of parameters. – *Computational Statistics & Data Analysis* 139: 34-44.
- [44] Logan, J.R., Bauer, C., Ke, J., Xu, H., Li, F. (2020): Models for small area estimation for census tracts. – *Geographical Analysis* 52(3): 325-350.
- [45] McNamara, J.F. (1993): Ethical guidelines in survey research. – *International Journal of Educational Reform* 2(1): 96-101.

- [46] Malmqvist, J., Hellberg, K., Möllås, G., Rose, R., Shevlin, M. (2019): Conducting the pilot study: A neglected part of the research process? Methodological findings supporting the importance of piloting in qualitative research studies. – *International Journal of Qualitative Methods* 18: 1-11.
- [47] Mastrangelo, P.M., Macey, W.H., Fink, A.A. (2020): Improving the design and interpretation of sample surveys in the workplace. – In: W. H. Macey, A. A. Fink (eds.) *Employee Surveys and Sensing: Challenges and Opportunities*, Oxford University Press 14p.
- [48] Mazari, I., Ruiz-Balet, D. (2021): A fragmentation phenomenon for a nonenergetic optimal control problem: Optimization of the total population size in logistic diffusive models. – *SIAM Journal on Applied Mathematics* 81(1): 153-172.
- [49] Menon, V., Muraleedharan, A. (2020): Internet-based surveys: relevance, methodological considerations and troubleshooting strategies. – *General Psychiatry* 33(5): 3p.
- [50] Muggleton, E. (2020): Pilot randomised controlled trial reporting should be focused. – *Anaesthesia* 75(11): 1550-1550.
- [51] Mutz, D.C., Kim, E. (2020): The progress and pitfalls of using survey experiments in political science. – In: W. R. Thompson (ed.) *Oxford Research Encyclopedia of Politics*, Oxford University Press 2000p.
- [52] Nandram, B., Choi, J.W., Liu, Y. (2021): Integration of nonprobability and probability samples via survey weights. – *International Journal of Statistics and Probability* 10(6): 1-5.
- [53] Nanjundeswaraswamy, T.S., Divakar, S. (2021): Determination of sample size and sampling methods in applied research. – *Proceedings on Engineering Sciences* 3(1): 25-32.
- [54] Navarrete, M.S., Adrian, C., Bachelet, V.C. (2022): Respondent-driven sampling: Advantages and disadvantages from a sampling method. – *Medwave* 21(11): 17p.
- [55] Nilsson, A., Bonander, C., Strömberg, U., Canivet, C., Östergren, P.O., Björk, J. (2021): Reweighting a Swedish health questionnaire survey using extensive population register and self-reported data for assessing and improving the validity of longitudinal associations. – *Plos ONE* 16(7): 15p.
- [56] Nishizaka, A. (2021): Partitioning a population in agreement and disagreement. – *Journal of Pragmatics* 172: 225-238.
- [57] Nix, J., Pickett, J.T., Baek, H., Alpert, G.P. (2019): Police research, officer surveys, and response rates. – *Policing and Society* 29(5): 530-550.
- [58] Olsen, R.B. (2022): Using survey data to obtain more representative site samples for impact studies. – *Cornell University* 16p.
- [59] Parker, P.A., Janicki, R., Holan, S.H. (2019): Unit level modeling of survey data for small area estimation under informative sampling: A comprehensive overview with extensions. – *Cornell University* 48p.
- [60] Peel, J., Skipworth, G. (1970): Sample size: An innovatory procedure in survey analysis. – *Sociology* 4(3): 385-393.
- [61] Putranto, L. S. (2019): The use of an online survey to speed up the data collection process. – *IOP Conference Series: Materials Science and Engineering* 508(1): 5p.
- [62] Qader, S.H., Lefebvre, V., Tatem, A.J., Pape, U., Jochem, W., Himelein, K., Ninneman, A., Wolburg, P., Nunez-Chaim, G., Bengtsson, L., Bird, T. (2020): Using gridded population and quadtree sampling units to support survey sample design in low-income settings. – *International Journal of Health Geographics* 19(10): 1-16.
- [63] Roberts, L.D., Allen, P.J. (2015): Exploring ethical issues associated with using online surveys in educational research. – *Educational Research and Evaluation* 21(2): 95-108.
- [64] Roscoe, J.T. (1975): *Fundamental Research Statistics for the Behavioural Sciences* (2nd ed.). – Holt Rinehart & Winston 483p.
- [65] Saigo, H. (2020): Special feature: Theory and practice of surveys. – *Japanese Journal of Statistics and Data Science* 3: 563-564.

- [66] Santomauro, C.M., Sanderson, P.M. (2020): From bartending interruptions to medication delivery interruptions: Managing the risks of a high-fidelity simulation study with pilot research. – *Journal of Experimental Psychology: Applied* 26(3): 522-537.
- [67] Serdar, C.C., Cihan, M., Yücel, D., Serdar, M.A. (2021): Sample size, power and effect size revisited: Simplified and practical approaches in pre-clinical, clinical and laboratory studies. – *Biochemia Medica* 31(1): 27-53.
- [68] Shang, S., Du, S., Du, S., Zhu, S. (2021): Estimating building-scale population using multi-source spatial data. – *Cities* 111: 13p.
- [69] Siswantining, T., Naima, M.G., Soemartojo, S.M. (2020): Estimation of variance of random effect in small area model with Spatial Empirical Best Linear Unbiased Prediction (SEBLUP). – *Journal of Physics: Conference Series* 1442(1): 6p.
- [70] Speklé, R.F., Widener, S.K. (2020): Insights on the use of surveys to study management control systems. – *Accounting, Organizations and Society* 86: 6p.
- [71] Stamatopoulos, C. (2022): A holistic view of finite populations for determining an appropriate sample size. – *International Journal of Marine Science and Environment* 6(1): 36-54.
- [72] Stantcheva, S. (2023): How to run surveys: A guide to creating your own identifying variation and revealing the invisible. – *Annual Review of Economics* 15: 205-234.
- [73] Stevens, K.B. (2023): From top to bottom: Gridded human population estimates in data-poor situations. – *Revue Scientifique et Technique* 42: 111-119.
- [74] Stevenson, M.A. (2021): Sample size estimation in veterinary epidemiologic research. – *Frontiers in Veterinary Science* 7: 16p.
- [75] Stoica, A.A., Chakraborty, A., Dey, P., Gummadi, K.P. (2019): Minimizing margin of victory for fair political and educational districting. – *AAMAS* 9p.
- [76] Sturgis, P., Luff, R. (2021): The demise of the survey? A research note on trends in the use of survey data in the social sciences, 1939 to 2015. – *International Journal of Social Research Methodology* 24(6): 691-696.
- [77] Taherdoost, H. (2017): Determining sample size; How to calculate survey sample size. – *International Journal of Economics and Management Systems* 2: 237-239.
- [78] Tripathi, R., Khatri, N., Mamde, A. (2020): Sample size and sampling considerations in published clinical research articles. – *Journal of The Association of Physicians of India* 68(3): 14-18.
- [79] Tseng, C.H., Sim, D. (2021): Sample size planning for pilot studies. – *Cornell University* 15p.
- [80] van de Schoot, R., Miočević, M. (eds.) (2020): *Small sample size solutions: A guide for applied researchers and practitioners* (1st ed.). – *Routledge* 284p.
- [81] Vergara-Hernández, C., Marí-DellOlmo, M., Oliveras, L., Martínez-Beneito, M.A. (2021): Taking advantage of sampling designs in Bayesian spatial small area survey studies. – *Cornell University* 14p.
- [82] Wan, H., Yoon, J., Srikrishnan, V., Daniel, B., Judi, D. (2022): Population downscaling using high-resolution, temporally-rich US property data. – *Cartography and Geographic Information Science* 49(1): 18-31.
- [83] Weisberg, H.F., Krosnick, J.A., Bowen, B.D. (1989): *An introduction to survey research and data analysis*. – *Scott, Foresman & Co.* 332p.
- [84] Zacks, S. (2020): Foundation of sampling surveys. - In: S. Zacks (ed.) *The Career of a Research Statistician*. – *Statistics for Industry, Technology, and Engineering*, *Birkhäuser* 16p.