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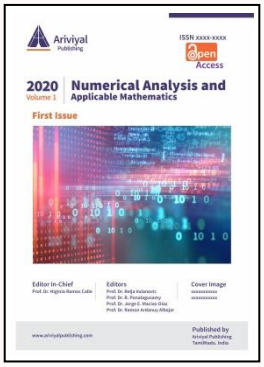

A Study of Estimation of Sexual Harassment by Direct Questionnaire Method and Methods of Randomised Response Technique

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Abstract: It has been observed that males commonly harass women. Sometimes males are also harassed by females, but this happens rarely. In both cases, men and women do not speak directly. Most of the time, they avoid it when the problem becomes severe and take any action. In this paper, we discuss how to collect information about these sensitive questions by randomize response techniques. Also, we show that these techniques are better than a direct questionnaire method.

Keywords: sexual harassment; randomized response technique; Warner's method; Simmon's method; direct questionnaire method

1. Introduction

Sexual harassment at the workplace is a widespread problem globally, whether it is a developed nation or a developing nation or an underdeveloped nation. It is a crime against women, which are considered the most vulnerable section of society. The other problems against women in society are female feticide, female trafficking, stalking, rape, sexual abuse, etc. In a general sense, it is known as "unwelcome sexual favor and other verbal or physical conduct of a sexual nature that tends to create a hostile or offensive work environment."

The Supreme Court of India defined Sexual Harassment as any unwelcome sexually determined behavior (whether directly or by implication) such as;

1. Physical contact and advances,
2. A demand or request for sexual favors,
3. Sexually colored remarks,
4. Showing pornography,
5. Any other unwelcome physical, verbal or non-verbal conduct of sexual nature.

The most important words of the above paragraph are unwanted and unwelcome, which completely specify the maximum part of sexual harassment. Such unwelcome or uninvited conduct/act is totally prohibited. Sexual or romantic interaction between consenting people at work may be offensive to observers or may also lead to a violation of the workplace's policy, but it is not sexual harassment. Two types of sexual harassment exist in the workplace. One is "quid pro quo," in which a person in a higher position forces his/her junior for sexual relations in exchange for a job promotion. The other is a "hostile environment' in which an unwelcome behavior unreasonably interferes with the work performance or overall comfort.

Another definition of sexual harassment which the World Bank gave in 1994 is as follows: "Sexual Harassment is any unwelcome sexual advance, request for sexual favor or other verbal, non-verbal or physical conduct of a sexual nature which unreasonably interferes with work, is made a condition of employment, or creates an intimidating, hostile or offensive environment".[17]

In India, sexual harassment violates women's fundamental rights under Articles 14 and 21 of the Indian Constitution. Legislations that try to prevent sexual harassment of women at the workplace are the Indian Penal Code, the Indecent Representation of Women (Prohibition) Act

(1987), the Industrial Dispute Act (1947), The Factories Act (1948), and the Protection of Human Rights Act, 1993. Other than these remedies from the above mentioned Acts, the victims of sexual harassment can approach Civil Courts for tortious actions (mental anguish, physical harassment, depression, loss of employment).

When harassment occurs at home by family members, then it is known as violence, but if it happens outside the home or public place by unknown peoples or some times by colleagues, then known as sexual harassment. It has been observed that males commonly harass women. Sometimes males are also harassed by females, but this happens rarely. In both cases, men and women both don't speak directly. Most of the time, they avoid it when the problem becomes severe, then they take any action. Many types of research have been done on Sexual Harassment, but it is limited for women respondents only. In recent research, it became important to include men's thoughts also in the research related to sexual harassment. So in this paper, we also include thoughts of men on Sexual Harassment.

Sexual Harassment is a susceptible issue, so in this paper, we use statistical techniques applicable for randomize response. Surveys for collecting information on sensitive or stigmatizing attributes are plagued by the problem of un- truthful responses or non-cooperation by respondents, both of which lead to biased estimates. To avoid this ''evasive answer bias,'' and to preserve the privacy of the respondent, Warner (1965) introduced an innovative technique commonly referred to as a randomized response technique (RRT).[16]

Most of the work on Randomized Response techniques is restricted to the study of a single sensitive attribute. Very often, however, social researchers are interested in studying several sensitive attributes together. Thus the researchers are interested in estimating and testing hypotheses concerning the proportions of the population possessing the individual sensitive attributes under study and the degree of association between the different attributes. Suitable statistical techniques for collecting and analyzing data for surveys dealing with such multiple sensitive attributes do not appear available.

Some literature reviews done by different authors are as follows: Clark (1980) explained another perspective to the accessibility of opportunity and information for happening of a crime. He used conscious decision-making assumptions and the human nature of the coherence of the classical theory of criminology.[1] Cornish and Clarke (1987) suggested, "Where there are suitable targets, victimization can be minimized if proactive measures are taken to make opportunities harder for offenders to act".[2] Menon and Kanekar (1992) have taken a sample of 720 undergraduate students to study the incidence of sexual harassment at the workplace.[10] Thompson (1994) studied that men also face sexual harassment, but most of the research focuses on women.[14] Stockdale (1996) studied that harassment occurs due to a strong need for power or dominance or if somebody wants to control over others.[12] Lenton, Smith, et al. (1999) studied and found that the problem of Sexual Harassment is faced by women worldwide.[7] According to Macmillan, Nierobisz, and Welsh (2000), most of the time, women are victims, and men are culprit.[8] Sitaram and Leach (2007) studied that sexual harassment occurs not only in public transport but also in educational institutions. For this study, they had taken data from two South Indian Schools.[6] According to Manjoo and McRaith (2011), Media coverage of crime against women and International identification of victimization played the main role in making people much aware and sensitive about the issues of sexual harassment.[9] Dhillon and Bakaya (2014) had done a qualitative study using snowball sampling in which data has been taken from 20 upper-middle-class women and 20 lower-middle-class women (aged 18-30 years).[3] Sur (2014) studied that women aged 20-55 years have a high risk of facing sexual harassment at public transport.[13] Mushtaq, Sultana, and (2015)[11] and Gekoski et al. (2015) studied that mostly sexual harassment against women takes place at workplaces.[4]

2. Objectives of the study

1. To study the association between gender and thinking of people about sexual harassment.
2. To compare the proportions of responses by direct questionnaire method and Warner method of Randomised response technique.
3. To show that the Simmons method is better than Warner's method in case of data collected for sexual harassment.

3. Database and Methodology

3.1. Data collection

The data is collected by a cross-sectional method from three colleges, Vivekananda college of Nursing and Dayanand Anglo Vedic Post Graduate College (DAV PG College), and Lucknow University. We have collected the data by Simons and Warner methods of Randomized response Technique (RRT) and noted the respondents' responses.

3.2. Sample size determination

For our study, we calculated sample size from the following formula:

$$n = \frac{z_\alpha^2\, p(1-p)}{d^2}$$

where, n = required sample size, $z\alpha$ = confidence level, p = Rate of sexual harassment in India, d = margin of error.

3.3. Warner's method

If a query in a questionnaire is very personal and sensitive, it becomes the reason for nonresponse or wrong response. For example, if we ask a boy or a girl in front of his/her parents who had taken alcohol before, it will definitely become sensitive for them. For solving these types of problems, first, take the estimation of binomial proportion π_A of respondents who belong to a group or had done some specific work. In 1965 Warner showed that this proportion π_A could easily be calculated by randomized response techniques even if the respondents do not reveal their personal status for this sensitive question. Thus, the Randomized Response Technique (RRT)'s main objective is to keep confidentiality and get truthful answers. In other words, we can say that Randomized Response Techniques (RRT) is the methods that can be used precisely for the Structured Survey Questionnaire. The term Randomized Response Techniques (RRT) was first used by S.L. Warner (1965).[16] Later on, it was modified B.G. Greenberg (1969).[5] Randomized Response Techniques (RRT) provides a confidential atmosphere to the respondents for sensitive questions.

According to Warner (1965), for the randomization process, we can use a box with white and red balls or a spinning arrow as a randomizing device; each provides only two responses as "Yes" or "No" for respondents. Here the interviewer is completely unaware of the question answered by the respondent but knows the probabilities associated with two responses as "p" and "1-p" for "Yes" and "No" response. The success of the randomized response technique depends on the respondent's being convinced that his/her participation in this method will not be revealed.

Warner, in 1965 proposed two statements as:

"I belong to group A." (With probability p)
"I do not belong to group A." (With probability 1-p)

According to Warner (1965), If an interviewer collects information from n respondents and gets a binomial estimate as $\hat{\varphi}$=m/n, Where φ is the proportion of "yes" answers. If the respondents answered all sensitive questions truthfully, then we get a relation between π_A and φ in the population as,

$$\varphi = p\pi_A+(1- p)(1- \pi_A) = (2p -1) \pi_A + (1- p) \quad (1)$$

For known probability (p) of success or "Yes," the above equation provides the estimate of π_A as,

$$\hat{\pi}_{AW}= \frac{[\hat{\varphi}-(1-p)]}{(2p-1)} \qquad (p \neq \frac{1}{2}) \quad (2)$$

The variance of unbiased estimate $\hat{\pi}_{AW}$ is given by,

$$V(\hat{\pi}_{AW})=\frac{\varphi(1-\varphi)}{n(2p-1)^2} \quad (3)$$

We can also write $(1-\varphi)$ as,

$$(1-\varphi) = (2p-1)(1-\pi_A) + (1-p) \quad (4)$$

Using equation (4), we can also write equation (3) as,

$$V(\hat{\pi}_{AW}) = \frac{\pi_A(1-\pi_A)}{n} + \frac{p(1-p)}{n(2p-1)^2} \quad (5)$$

The first part of equation (5) shows the variance of the estimate of A that is $\mathbf{V}(\hat{\boldsymbol{\pi}}_{\mathbf{A}})$. Here $\mathbf{V}(\hat{\boldsymbol{\pi}}_{\mathbf{A}})$ is obtained if the respondents responded to a direct question truthfully that he is a class A member. Now for $\boldsymbol{\pi}_{\mathbf{A}}$ near ½ and p>0.85, we see that the second part of equation (5) is greater than the first part or often much greater because the interviewer has no idea whether a" Yes" answer by respondents implies that the respondents belong to a class A or opposite class. As the Mean Square Error obtained by Warner's method has less value than a direct questionnaire method.

3.4. Simmon's method: The unrelated second question

Simmons suggested that if the second question is not sensitive, then the information related to respondents can be improved. So it can be said that if the second question is unrelated to the first question, then the results can be improved. For instance, let us take two statements as

"I belong to group A." (With probability p)
"I was born in December."

Here we see that the first statement is unchanged. In this case, if respondents answer truthfully, the population proportion of "yes" answers is given as,

$$\varphi = p\pi_A+(1- p)(1- \pi_U) \quad (6)$$

Where π_U is the sample proportion of respondents, who were born in December. Now, if π_U is known, then the Maximum Likelihood Estimate (MLE) of $\pi_A$is given by,

$$\hat{\pi}_{AU} = \frac{[\hat{\varphi}-(1-p)]\pi_U}{p} \quad (7)$$

The variance of the estimate given by equation (4) is given by,

$$V(\hat{\pi}_{AU}) = \frac{\varphi(1-\varphi)}{np^2} \quad (8)$$

Morton used the reference of Greenberg et al.(1969)[5] and suggested the case in which π_U known can always be achieved. Let us take a bag contains white, red and blue balls. The proportions of white, red, and blue balls are p1, p2, and p3, respectively. Drawing a white ball gives an indication of the sensitive question. While the drawing of a red and blue ball indicates an unrelated question as "The drawn ball is of red color." Thus we get,

$$\pi_A = p_1/(p_2 + p_3) \quad (9)$$

The variance of the estimate of unrelated question method is always less than that of the Warner method, i.e., $V(\hat{\pi}_{AU}) < V(\hat{\pi}_{AW})$ for all π_A,π_U, with the condition that p should be greater than 1/3. It was also observed that the variance of $\hat{\pi}_{AW}$ is symmetrical about p=1/2, and the small value of p gives few responses on the sensitive question with the Warner method. It is compulsory to calculate both $\pi_A$andπ_U. We may take two random samples having sizes n1 and n2 with proportions p1 and p2 for sensitive questions. If φ_1 and φ_2 represents the proportions of "Yes" responses in the population, then they may be defines as,

$$\varphi_1 = p_1\pi_A + (1 - p_1)\pi_U \quad (10)$$

$$\varphi_2 = p_2\pi_A + (1 - p_2)\pi_U \quad (11)$$

By solving the above two equations, we get the estimate as

$$\hat{\pi}_{AU} = \frac{\hat{\varphi}_1(1-p_2)-\hat{\varphi}_2(1-p_1)}{(p_1-p_2)} \quad (12)$$

The variance of the above estimate is given by,

$$V(\hat{\pi}_{AU}) = \frac{1}{(p_1-p_2)^2}\left[\frac{\varphi_1(1-\varphi_1)(1-p_2)^2}{n_1} + \frac{\varphi_2(1-\varphi_2)(1-p_1)^2}{n_2}\right] \quad (13)$$

The variance $V(\hat{\pi}_{AU})$ is minimum If p1>0.5 and p2=0, when all in the second (n2) sample are asked the unrelated π_U question. Greenberg et al. (1969)[5] has suggested that p1+p2 =1. Now let n = n1 + n2 then for optimal value of n1, n2 we use Cauchy- Schwartz inequality.

According to which the minimum value of $V(\hat{\pi}_{AU})$ is given by,

$$V_{min}(\hat{\pi}_{AU}) = \frac{1}{n(p_1-p_2)^2}\left[(1-p_2)\sqrt{\varphi_1(1-\varphi_1)} + (1-p_1)\sqrt{\varphi_2(1-\varphi_2)}\right]^2 \quad (14)$$

Now the minimal ratio of (n_1/n_2) is given by,

$$\frac{n_1}{n_2} = \frac{(1-p_2)}{(1-p_1)}\sqrt{\frac{\varphi_1(1-\varphi_1)}{\varphi_2(1-\varphi_2)}} \quad (15)$$

Greenberg et al. (1969) suggested that to preserve the confidentiality of respondents' π_A should be equal to π_U. Greenberg et al. (1971)[5] used two-sample technique to estimate the mean μ_A for a sensitive continuous or discrete variable. The term μ_U estimates the mean for a non-sensitive variable. Let us take the two random groups of sizes n1 and n2 having probability pi (i=1, 2) for sensitive question and probability

(1- p_i) the non-sensitive question. The combination of these two-variable is now represented by zi. Thus zi is the combination of two distributions having proportions pi and (1-pi). One distribution has to mean μ_A and variance$\sigma_A{}^2$; the other distribution has mean μ_U and variance $\sigma_U{}^2$. Thus we can write,

$$E(z_i) = p_i\mu_A + (1 - p_i)\,\mu_U \tag{16}$$

$$V(z_i) = p_i\sigma_A{}^2 + (1 - p_i)\sigma_U{}^2 + p_i(1 - p_i)(\mu_A - \mu_U)^2 \tag{17}$$

Similar as equation (12), we get the estimate of μ_A as,

$$\hat{\mu}_{AU} = \frac{[(1-p_2)\bar{z}_1 - (1-p_1)\bar{z}_2]}{(p_1-p_2)} \tag{18}$$

It has also been observed that the conditions for maximum efficiency are μ_U=μ_A, $\sigma_U{}^2$=0. While for preservation of anonymity, $\mu_U = \mu_A$, $\sigma_U{}^2 = \sigma_A{}^2$ are best.

4. Analysis

4.1. Sample size

For our study, we take p = 0.45, d = 0.05 and z_α=1.96 at 95% confidence Interval.
[As per National Crime Records Bureau (NCRB)-2016, the Sexual harassment rate is 45%.]

$n = \frac{(1.96)^2(0.45)*(1-0.45)}{(0.05)^2}$ = 380.3184 = 380 Approximately.

Since the topic is quite sensitive, we used such a method that could give us answers to sensitive questions, keeping the respondents ensured that their confidentiality would be maintained and preserved. So we have collected the data by Both Simons method and Warner method of Randomized Response Technique.

4.2. Warner's method calculation

In Warner Method were assured respondents that their responses would be confidential to give truthful responses. For the Warner method, we have used two decks of cards (21 red cards and 7 black cards), where we had taken two complementary questions for each card.

P (drawing a red card) = 0.75 =3/4
P (drawing a black card) = 0.25 =1/4

We have associated the question "Have you ever being sexually abused?" with red cards and "Have you never sexually abused?" with black cards. The respondents have to choose one card from the properly shuffled deck of cards and answer according to the card chosen. Suppose a person responds "YES or "NO." We have to estimate the proportion of people responding "YES. We had assumed that these "YES" and "NO" responses are made truthfully.

The number of people responded "yes" = 266
Total number of respondents = 380

Let φ = the true probability of "YES" responses by respondents = 266/380 = 0.7
p =the probability that Red card is drawn =3/4

Xi = 1 if the ith respondent says "yes"
0 if the ith respondent says "no"

Then $\varphi = p\pi_A + (1- p)(1- \pi_A)$

$= (2p -1)\,\pi_A + (1- p)$
$\pi_A = 0.90$

for p≠1/2,

$\hat{\pi}_{AW}=\frac{[\hat{\varphi}-(1-p)]}{(2p-1)}$

$E(\hat{\pi}_{AW}) = \pi_A$

$V(\hat{\pi}_{AW})=\frac{\varphi(1-\varphi)}{n(2p-1)^2}$

P (Drawing a Black card) = p =3/4
P (Drawing a Red card) = (1-p) =1/4

Xi = { 1 Respondent responds “yes”
0 Respondent responds “no”

By the survey, we get that 266 persons have responded “yes” and 114 responds “no”.

Therefore,
φ = 266/380=0.7
$\varphi = p\pi_A + (1- p) (1- \pi_A)$
$= (2p -1) \pi_A + (1- p)$
$\pi_A = 0.90$
for $p \neq 1/2$,

Now we have to show that $E(\hat{\pi}_{AW}) = \pi_A$
as we know that

$\hat{\pi}_{AW}=\frac{[\hat{\varphi}-(1-p)]}{(2p-1)} = 0.9$

This shows that the estimator is unbiased.

$V(\hat{\pi}_{AW})=\frac{\varphi(1-\varphi)}{n(2p-1)^2} \quad = 0.002211$

4.3. Simmons method calculation

For the SIMMONS method, we used a deck of cards. We made all the respondents choose one card randomly from the pack of 52 cards and answer the required question accordingly:

1. If the chosen card comes out to be a non-spade, the respondent has to answer the sensitive question, Sensitive Question: Have you ever been sexually abused?
2. If the chosen card comes out to be a spade, then the respondent has to answer the unrelated question,

Unrelated Question: Do you like music?

So we get the Probability of answering a sensitive question = 3/4 and
Probability of answering a non-sensitive question = 1/4
Number of yes respondents = 228
Total number of Responses = 380
Proportion of yes responses = 228/380 = 0.60 = 60 %

$\hat{\varphi}$ = The true probability of yes responses in the sample =228/380 = 0.6
π_U= The probability of answering the non-sensitive question with "Yes."
= 50/228 = 0.22

Now $\hat{\pi}_{AU} = \frac{[\hat{\varphi}-(1-p)]\pi_U}{p}$ = 0.73
$Var(\hat{\pi}_{AU}) = \frac{\hat{\varphi}-(1-p)}{n.p^2}$ = 0.001122

Table 1. Showing association between gender and Questions

QUESTIONS	RESPONSE	GENDER		TOTAL	P- VALUE
		MALE	FEMALE		
Have you ever heard the term sexual harassment?	Yes	177	145	322	0.002
	No	19	39	58	
Total		196	184	380	
Have you ever been sexually harassed?	Yes	8	42	50	<0.001
	No	188	142	380	
Total		196	184	380	
Was the culprit a family member?	Yes	5	7	12	0.455
	No	191	177	368	
Total		196	184	380	
Were you aware that you were sexually harassed?	Yes	23	34	57	0.066
	No	173	150	323	
Total		196	184	380	
Did you tell about this to anybody or lodge a complaint?	Yes	14	11	25	0.647
	No	182	173	355	
Total		196	184	380	
Do you know about the initiative like 1090, Nirbhaya App, etc.?	Yes	163	155	318	0.777
	No	33	29	62	
Total		196	184	380	
Does a person's job affect his/her chance of becoming a victim?	Yes	99	83	182	0.292
	No	97	101	198	
Total		196	184	380	
Do people who use public transport suffer more than others?	Yes	130	154	284	<0.001
	No	66	30	96	
Total		196	184	380	
Do people around you openly talk about sexual harassment?	Yes	85	62	147	0.053
	No	111	122	233	
Total		196	184	380	
Is gender affects someone's chance of being sexually harassed?	Yes	117	111	228	0.900
	No	79	73	152	
Total		196	184	380	
Do the provocative clothes are responsible for being sexually harassed?	Yes	126	106	232	0.182
	No	70	78	148	
Total		196	184	380	
Does a person's Social and Economic status affect their chance of being a victim?	Yes	119	111	230	0.930
	No	77	73	150	
Total		196	184	380	
Is there any role of education in increasing activities of sexual harassment?	Yes	80	77	157	0.838
	No	116	107	223	
Total		196	184	380	
Are the molesters mentally ill?	Yes	132	140	272	0.059
	No	64	44	108	
Total		196	184	380	

5. Conclusion

From the data obtained by a direct questionnaire on Sexual harassment, we found that knowledge about sexual harassment depends on gender. In other words, males are much aware of sexual harassment than females. Also, females are more sexually harassed than males. Maybe the reason is that sometimes women do not talk about it because of societal pressure. According to the data, either men or women both got sexually harassed when they used public transport. Some other conclusions are:

1. It has been observed that for the Warner method $\hat{\pi}_{AW} = \hat{\pi}_A$ = 0.9.
2. The variance of $\hat{\pi}_{AW}$ by the Warner method is 0.002211.
3. For Simmons Method, the estimate of unrelated question $\hat{\pi}_{AU}$= 0.73
4. The variance of $\hat{\pi}_{AU}$ by Simmons Method is 0.001122.
5. We can conclude that $V(\hat{\pi}_{AU}) < V(\hat{\pi}_{AW})$.

Comparison between the proportion of being sexually harassed by Direct Questionnaire Method and Warner method of Randomised response technique:
Proportion of people being sexually harassed by direct questionnaire method =50/380 = 0.14 = 14%

The proportion of people being sexually harassed by the Warner method of RRT = 266/380 = 0.70 =70%
Proportion of people being sexually harassed by Simmons method of RRT = 228/380 = 0.60 =60%

We found that Randomised Response Technique increases respondents' confidence for truthful reporting; thus, it should be used for sensitive surveys, which is reflected in the increased value of proportion estimate of the sensitive category "Sexual Harassment."

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Conflict of interests

The authors declare that they have no conflict of interests.

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