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RESEARCH ARTICLE

ON EFFECTIVE ARRANGEMENT OF POSTERS IN ADVERTISING

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ABSTRACT

In this paper, an alternate method is suggested to put up the posters, which achieve more improvements in reaching the people. The efficiency of the proposed method of arrangement compared to Bhatt and Jaiswal method has been assessed in terms of reach and frequency. Further we have also presented the values of reach and frequency for these two methods for various values of m and p, where m is the number of posters and p is the probability of seeing the poster.

INTRODUCTION

Poster advertising is one of the important media of advertising in most of the countries. Bhatt and Jaiswal (1985) have studied the effectiveness of poster advertisement in terms of statistical models. They introduced two types of arrangements of posters advertising for the same product, same location and same number of posters. They also introduced two measures namely reach and frequency to study the effectiveness of advertisements. The present paper deals with the effective arrangement of posters in advertising to achieve more improvements in reaching the people. Consequently an alternative method has been suggested to put up the posters. The explicit expressions for the probability density function, reach and frequency of the proposed method are also presented. The efficiency of the proposed method compared to Bhatt and Jaiswal method has been assessed in terms of reach and frequency.

PRELIMINARY RESULTS

For the sake of convenience we have presented some definitions and results discussed by Bhatt and Jaiswal (1985). Let m be the number of similar posters displayed in a particular location and X be the random variable, denotes the number of posters seen by a person passing by that location. Then P (X = x) denotes the probability that a person will see x posters out of m same type of posters.

Let p be the probability of seeing a poster. Further it is assumed, throughout this paper that 0 < p < 1, unless otherwise stated.

Definition 2.1: Reach is defined as proportion of the people in the target audience who will see at least one poster of a given product (when there are m similar posters) in a specific location. That is $\mathrm{Re}ach = P(X \geq 1)$.

Definition 2.2: Frequency is defined as the average number of posters (ANP) seen by a person (when there are m similar posters) in a specified location.

That is Frequency = ANP = E (X).

Bhatt and Jaiswal Method : A series of similar posters (same copy) is arranged one after the other for a specified number of times (say, m). Hereafter this method is called as method 1. The explicit expressions for the probability density function, reach and frequency for method 1 are obtained as follows:

$$P(X = x) = \frac{(1-p)p^x}{(1-p^{m+1})} \qquad x = 0, 1, 2, \cdots, m \qquad (1)$$

$$\text{Reach1} = \frac{p(1-p^m)}{(1-p^{m+1})} \qquad (2)$$

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$$\text{ANP1} = \frac{\left(p + mp^{m+2} - (m+1)p^{m+1}\right)}{(1-p)\left(1-p^{m+1}\right)} \qquad (3)$$

For more details regarding the assumptions and the derivation of probability density function, reach, and frequency one may refer to Bhatt and Jaiswal (1985).

MAIN RESULTS

Let m be the number of posters available to be displayed in particular location. The proposed method of arranging the posters is given below:

Proposed Method: In this method the m posters are put up in two different locations, say m_1 posters in location 1 and m_2 posters in location 2, such that $m_1 + m_2 = m$ and $m_1 \le m_2$.

PROBABILITY DENSITY FUNCTION, REACH AND FREQUENCY

Let the random variable X_1 denotes the number of posters seen by a person passing through the location 1. Then

$$P(X_1 = x_1) = \frac{(1-p)p^{x_1}}{\left(1-p^{m_1+1}\right)}$$
$$x_1 = 0,1,2,\cdots,m_1.$$

Let the random variable X_2 denotes the number of posters seen by a person passing through the location 2. Then

$$P(X_2 = x_2) = \frac{(1-p)p^{x_2}}{\left(1-p^{m_2+1}\right)}$$
$$x_2 = 0,1,2,\cdots,m_2.$$

Let the random variable X denotes the number of posters seen by a person passing through the location 1 and location 2.

Then

$$P(X = x) = \sum_{x_1=0}^{x}\left(P(X_1 = x_1).P(X_2 = x - x_1)\right).$$

After a little algebra the probability density function reach and frequency for the proposed method are obtained as

$$P(X = x) = \begin{cases} c(x+1)p^x & x = 0,1,2,\cdots,m_1 \\ c(m_1+1)p^x & x = m_1+1, m_1+2,\cdots,m_2 \\ c(m+1-x)p^x & x = m_2+1, m_2+2,\cdots,m \end{cases} \qquad (4)$$

where $c = \dfrac{(1-p)^2}{\left(1-p^{m_1+1}\right)\left(1-p^{m_2+1}\right)}$

Reach2

$$= 1 - \frac{(1-p)^2}{\left(1-p^{m_1+1}\right)\left(1-p^{m_2+1}\right)} = \frac{p\left(2 - p^{m_1} - p^{m_2} - p\left(1-p^m\right)\right)}{\left(1-p^{m_1+1}\right)\left(1-p^{m_2+1}\right)} \qquad (5)$$

ANP2

$$= E(x) = c\left[\sum_{x=0}^{m_1} x(x+1)p^x + \sum_{x=m_1+1}^{m_2} x(m_1+1)p^x + \sum_{x=m_2+1}^{m} x(m-x+1)p^x\right] \qquad (6)$$

OPTIMUM VALUE OF m_1 AND m_2

The Reach2 obtained in (5) is a function of m_1 and m_2. The optimum value of m_1 and m_2 are determined by maximizing (5). Since $m = m_1 + m_2$, the equation (5) can be written as a function of m_1 only. Further maximizing (5) with respect to m_1 is the same as maximizing the function

$$\left(1-p^{m_1+1}\right)\left(1-p^{m-m_1+1}\right).$$

Let $f(m_1) = \left(1-p^{m_1+1}\right)\left(1-p^{m-m_1+1}\right)$.

Differentiating $f(m_1)$ with respect to m_1 we get

$$\frac{df(m_1)}{dm_1} = \left(p^{m-m_1+1} - p^{m_1+1}\right)\log p \qquad (7)$$

By equating (7) to 0 and solving the resulting equation, one may get $m_1 = m/2$.

Differentiating (7) again with respect to m_1 one may get

$$\frac{d^2 f(m_1)}{dm_1^2} = -(\log p)^2\left(p^{m-m_1+1} + p^{m_1+1}\right) \qquad (8)$$

By substituting $m_1 = m/2$ in (8), one can get

$\dfrac{d^2 f(m_1)}{dm_1^2} < 0$. Hence the optimum values of m_1 and m_2

are obtained as $m_1 = m_2 = m/2$ (since $m = m_1 + m_2$), which maximize the value of Reach2.

It is to be noted that the values taken by m, m_1 and m_2 are integers, since they represent the number of posters to be displayed. Hence the optimum value of $m_1 = m/2$ is valid only if m is an even number. However there are situations where one can have odd number of posters to be displayed. In such situations the optimum value of m_1 is to be taken as (m-1)/2 or (m+1)/2. This can be easily proved, by considering the following:

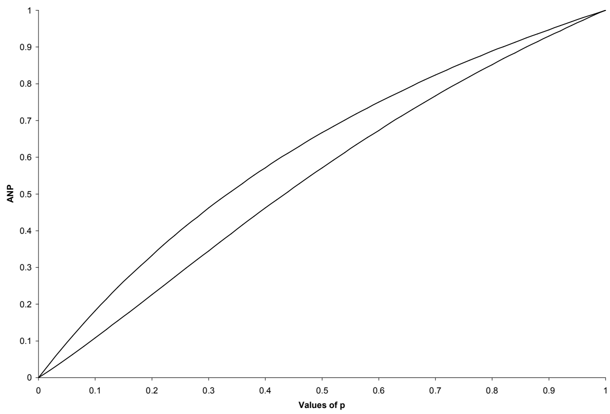

Fig.1. Comparison of ANP_1 and ANP_2 for given Value M=2

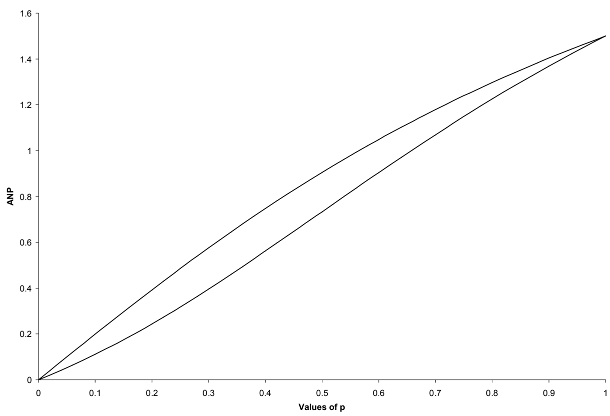

Fig.2. Comparison of ANP_1 and ANP_2 for given Value M= 3

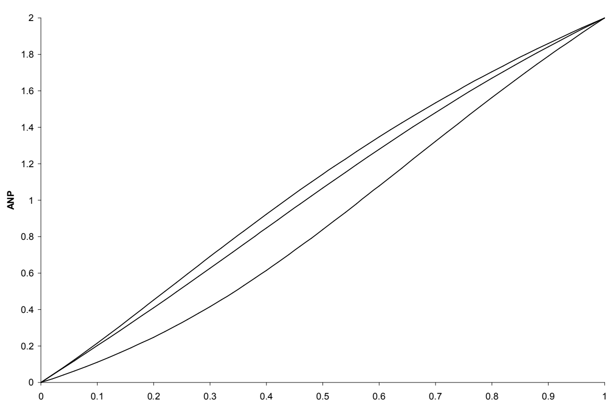

Fig.3. Comparison of ANP_1 and ANP_2 for given Value M= 4

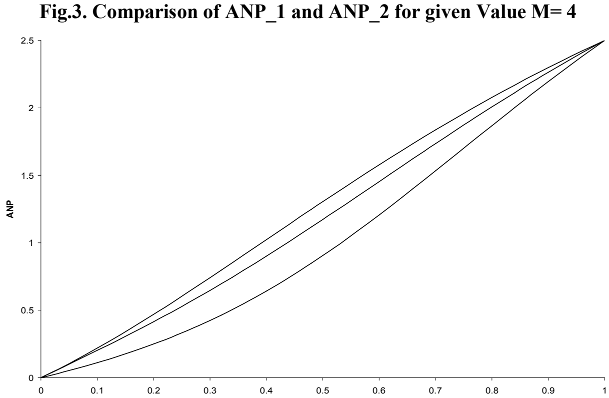

Fig.4. Comparison of ANP_1 and ANP_2 for given Value M= 4

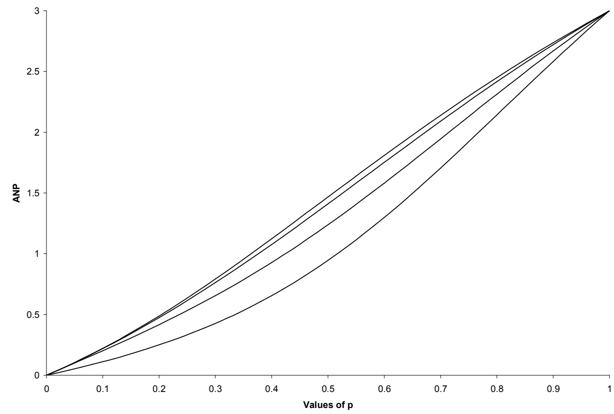

Fig.5. Comparison of ANP_1 and ANP_2 for given Value M= 6

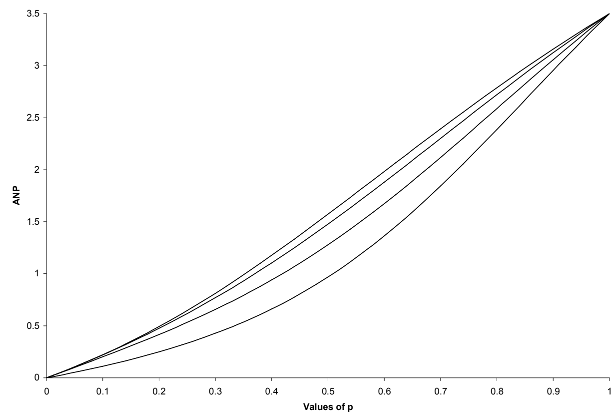

Fig.6. Comparison of ANP_1 and ANP_2 for given Value M= 7

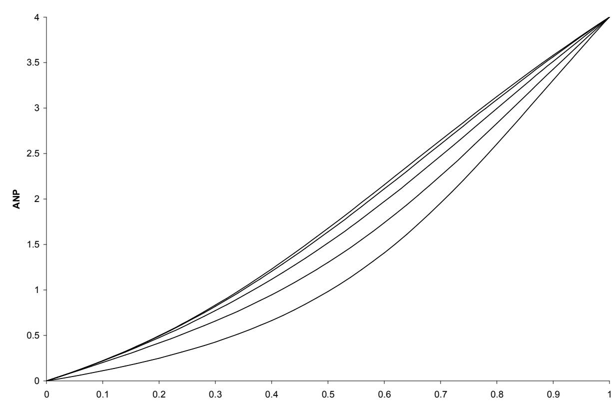

Fig.7. Comparison of ANP_1 and ANP_2 for given Value M= 8

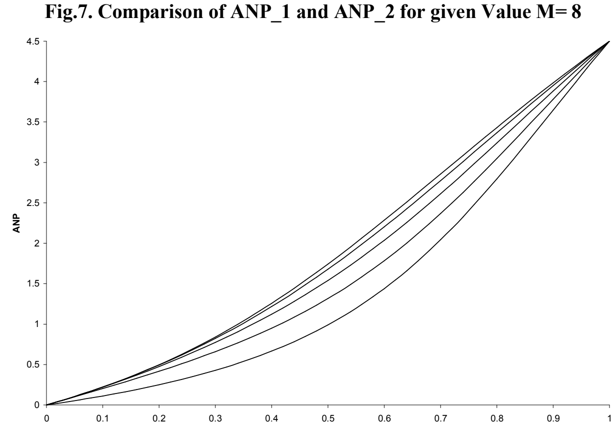

Fig.8. Comparison of ANP_1 and ANP_2 for given Value M= 9

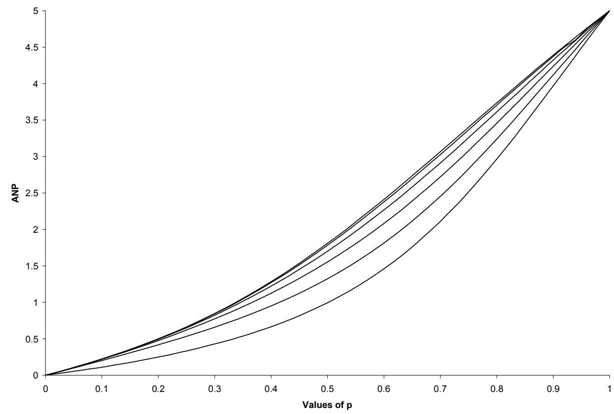

Fig.9. Comparison of ANP_1 and ANP_2 for given Value M= 10

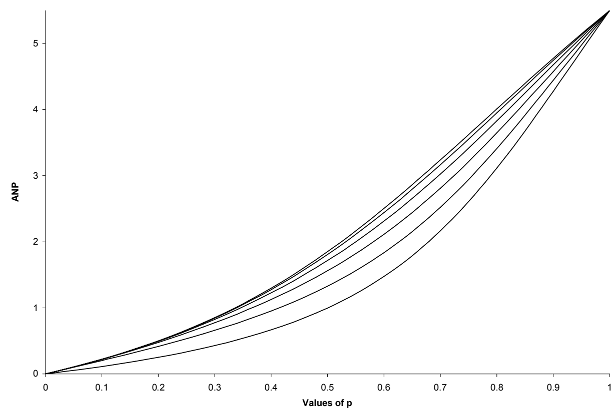

Fig.10. Comparison of ANP_1 and ANP_2 for given Value M= 11

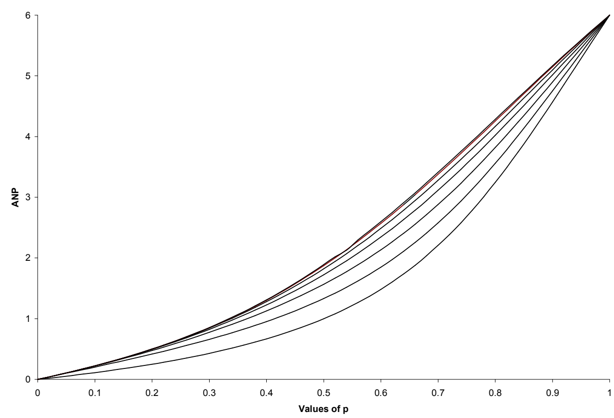

Fig.11. Comparison of ANP_1 and ANP_2 for given Value M= 12

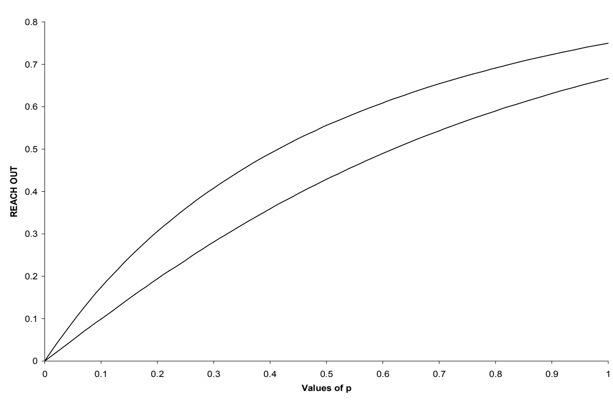

Fig.12. Comparison of REACH_1 and REACH_2 for given Value M=2

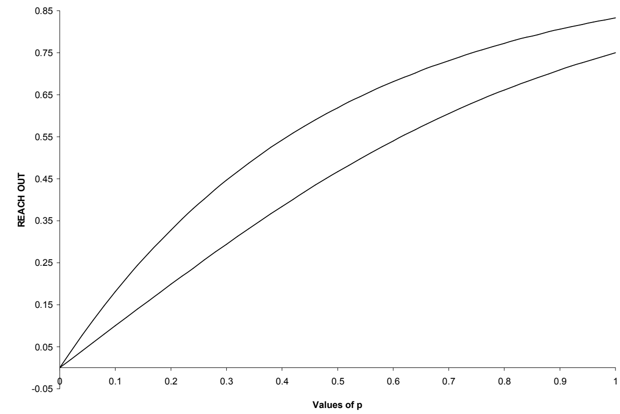

Fig.13. Comparison of REACH_1 and REACH_2 for given Value M=3

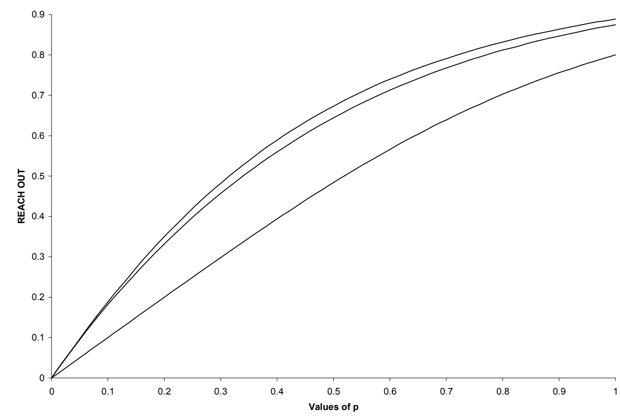

Fig.14. Comparison of REACH_1 and REACH_2 for given Value M=4

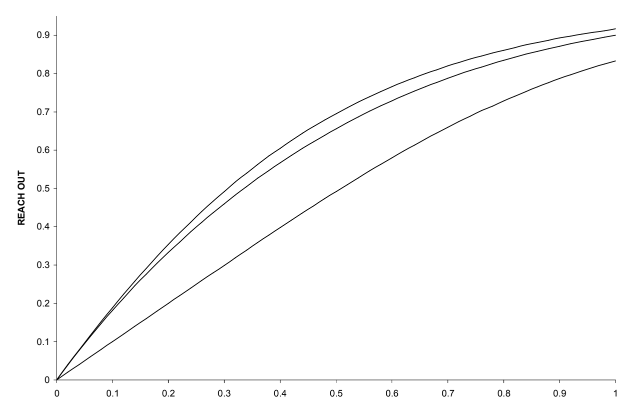

Fig.15. Comparison of REACH_1 and REACH_2 for given Value M=5

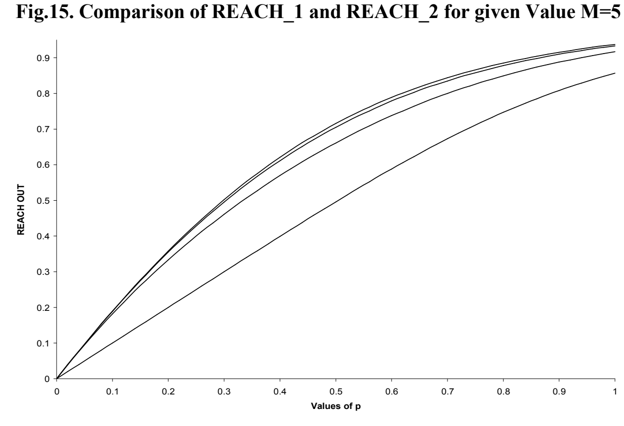

Fig. 16. Comparison of REACH_1 and REACH_2 for given Value M=6

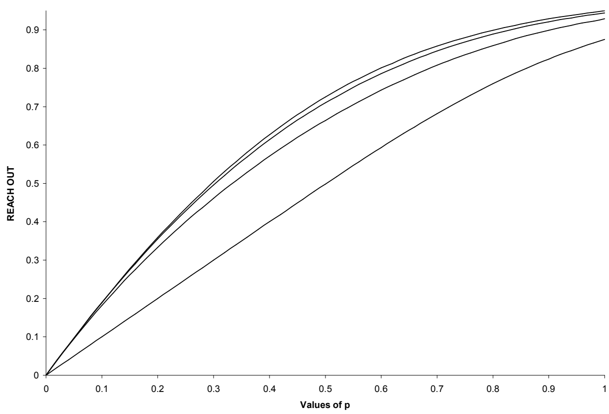

Fig. 17. Comparison of REACH_1 and REACH_2 for given Value M=7

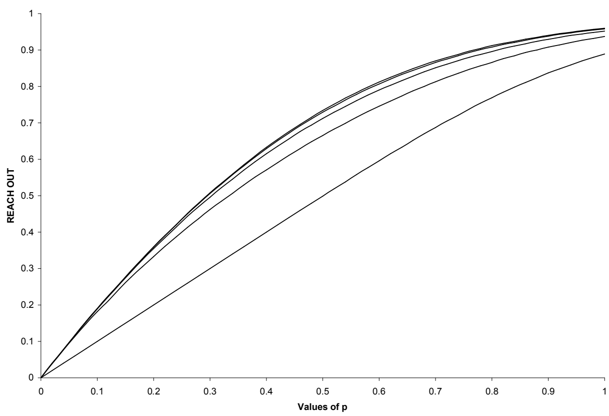

Fig. 18. Comparison of REACH_1 and REACH_2 for given Value M=8

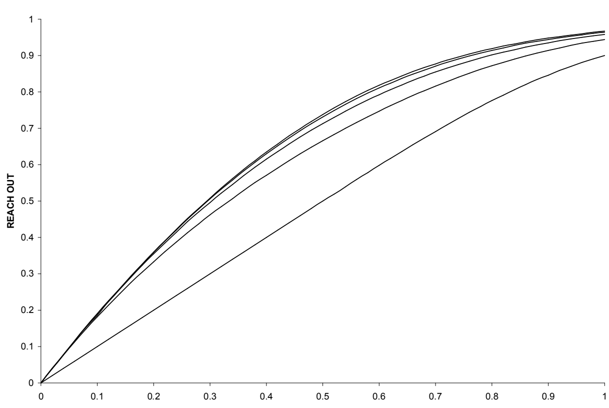

Fig. 19. Comparison of REACH_1 and REACH_2 for given Value M=9

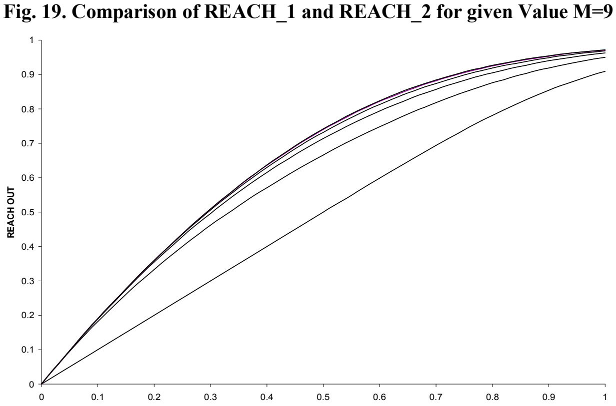

Fig. 20. Comparison of REACH_1 and REACH_2 for given Value M=10

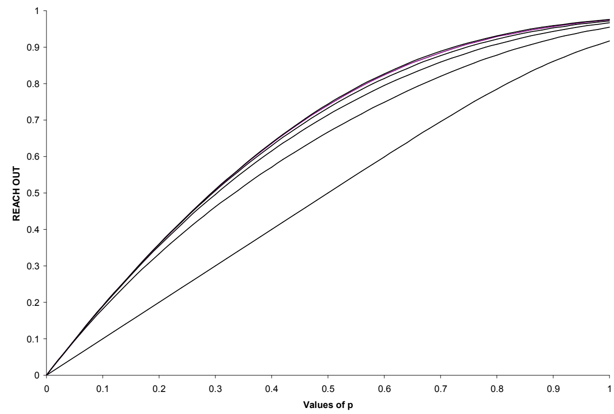

Fig. 21. Comparison of REACH_1 and REACH_2 for given Value M=11

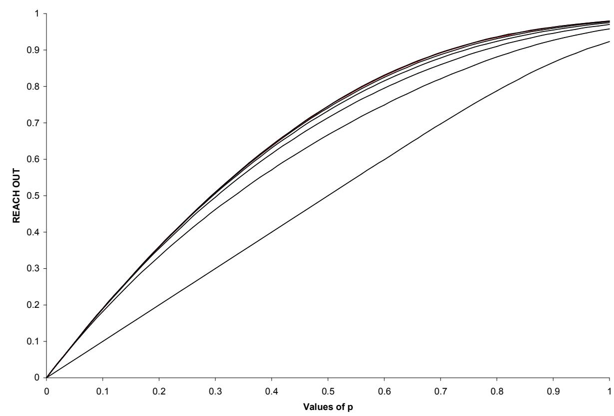

Fig. 22. Comparison of REACH_1 and REACH_2 for given Value M=12

$$f(m_1) = \left(1 - p^{m_1+1}\right)\left(1 - p^{m-m_1+1}\right)$$

$$f\left(\frac{m-1}{2}\right) - f\left(\frac{m-3}{2}\right) = (1+p)(1-p)^2 p^{(m-1)/2} > 0$$

$$f\left(\frac{m-1}{2}\right) - f\left(\frac{m+1}{2}\right) = 0$$

$$f\left(\frac{m+1}{2}\right) - f\left(\frac{m+3}{2}\right) = (1+p)(1-p)^2 p^{(m-1)/2} > 0$$

That is $f(m_1)$ attains maximum at $m_1 = (m-1)/2$ or $m_1 = (m+1)/2$ when m is an odd number. Hence it is concluded that the optimum value for m_1 is $m/2$ for even m and $(m-1)/2$ or $(m+1)/2$ for odd m, which maximize Reach2 given in (5).

Further the optimum value of Reach2 is obtained as

Reach2 =

$$\begin{cases} \dfrac{p\left(1-p^{m/2}\right)\left(2-p-p^{m/2+1}\right)}{\left(1-p^{m/2+1}\right)} & \text{for even } m \\[2ex] \dfrac{p\left(2-(1+p)p^{(m-1)/2}-p\left(1-p^{m}\right)\right)}{\left(1-p^{(m+1)/2}\right)\left(1-p^{(m+3)/2}\right)} & \text{for odd } m \end{cases}$$

COMPARISON OF REACH 1 AND REACH 2

From (2) and (5) one can have

Reach 2 - Reach 1 =

$$1-\frac{(1-p)^2}{\left(1-p^{m_1+1}\right)\left(1-p^{m_2+1}\right)}-1+\frac{(1-p)}{\left(1-p^{m+1}\right)}.$$

After simplification one may get

$$\text{Reach2 - Reach1} = \frac{p(1-p)\left(1-p^{m_1}\right)\left(1-p^{m_2}\right)}{\left(1-p^{m_1+1}\right)\left(1-p^{m_2+1}\right)\left(1-p^{m+1}\right)} \qquad (9)$$

Since $0<p<1$ the expression given in (9) is always greater than 0 for any value of m_1 and m_2 and hence it is concluded that the proposed method is more powerful than Bhatt and Jaiswal method for poster advertising.

That is, if m posters are available to display for advertising then m posters should be displayed in two different locations instead of displaying all the posters in a particular location. However to reach the maximum target audience the posters should be displayed according to the combinations discussed earlier.

COMPARISON OF ANP1 AND ANP2

From (3) and (6) one cannot compare the efficiency of method 1 and method 2 of poster advertising in terms of frequency (ANP) due to non–availability of simplified expression for ANP 2. Hence the performance is assessed in terms of numerical comparisons. Consequently the values of Reach 1, Reach 2, ANP 1 and ANP 2 have been computed for various combinations of m_1 and m_2 and for $p = 0.1,\ 0.2,\cdots,\ 0.9$. Using these values, graphs of ANP 1 and ANP 2 are drawn for the values of M and presented in Fig.1 to Fig.11. Similarly the graphs of Reach 1 and Reach 2 are drawn for different values of M and given in Fig.12 to Fig.22. From these graphs, it is clearly observed that the proposed method is more powerful than the method of Bhatt and Jaiswal for poster advertising.

REFERENCE

Rajshri Bhatt and M.C.Jaiswal (1985): An Effective Arrangement of Posters in Advertising, Gujarat Statistical Review, Vol.12, 33 – 43.

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