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Direct Marketing: The Mathematics of Tests

by H. Neil Lund

Editor's Note: This article is a reprint from the Fall 1993 NewsDirect *issue and is the second in a four-part series. Another article in an upcoming issue of* NewsDirect *will discuss some pragmatic approaches in testing. Various "rules of thumb" will provide an interesting contrast to the classic approach presented in this article.*

Direct marketing literature devotes a great deal of space to test mailings. This article covers the classic mathematics of testing and hopefully clarifies a few aspects of testing.

Some experts advocate including at least one test cell in every marketing effort. Such a maxim may well apply where large-scale mailings are the norm but may be impossible for small-scale mailings. Regardless of the size of an organization's mailing, some level of testing must take place. New products, product changes, new creative, or new lists certainly call for testing. Testing may also be necessary as a result of observing competitors, new technologies or regulatory change or experiencing some spark of creative genius.

Testing is used to confirm or deny hypotheses about markets, products, media, or promotions. Testing can take many forms: focus groups, surveys, simulations, or single- or multiple-cell tests. However, because this series of articles covers the analysis of solicitation, only single- and multiple-cell tests are examined. Single-cell tests are used, for example, when trying a new product, a new marker, and the like. Multiple-cell tests are used when comparing, for example, a new creative package against the standard or control package or comparing the effectiveness or a credit card list against a savers' list. Testing involves not only the analysis discussed in the June 1993 issue of *NewsDirect*, but also two other questions: How many pieces must be mailed to be confident that the test will provide meaningful information? And how

(continued on page 3, column 1)

Chairperson's Corner

New NTM Mission

by Edward F. McKernan

I expect this will be my last Chairperson's Corner article for the Nontraditional Marketing (NTM) Section. I have never considered myself an author by any means—as you have probably surmised during the past year. So, consider it a blessing that this is my last one. Coincidental with the Annual SOA Meeting, the gavel will pass on to Carl Meier, who I expect will serve the Section well in his new role as chairperson.

During this last year, the (NTM) Section Council has been very active with a variety of endeavors, many of which will have come to fruition as this newsletter goes to press. These have included:

- The "Bancassurance—Before Today, Beyond Tomorrow" and "Emerging Markets for the New Senior Citizen" seminars
- Programs and recruitment of speakers for the Annual and Spring SOA meetings
- Several *NewsDirect* editions, which have included excellent contributions

(continued on page 2, column 1)

In This Issue

Direct Marketing: The Mathematics of Tests
from page 1

confident are we that the test worked?

Appropriate testing is critical to the long-term success of any endeavor because the needs and desires of the market place are ever-changing. For example, suppose your company offers an AD product with a choice of $25,000 or $50,000 face amounts. Recently, 90% of the buyers have purchased the $50,000 option. Should the $25,000 option be dropped? The answer based on the given information is *not* obvious. The structure and cost differential between the two benefit levels may be pushing purchasers upward the higher amount where a $50,000 and $75,000 option may result in lower total responses and effectiveness. Should the normal offer be replaced? With what? Testing is clearly needed.

Single-Cell Test

For a single-cell test, the formula for the number of pieces to be mailed using the normal approximation to the binomial is:

$$n = \frac{r(1 - r)c^2}{e^2}$$

where

- n = number of pieces to be mailed
- r = estimated response rate
- e = error rate in responses
- c = normal factor for the desired degree of certainty (1.64 for 90% confidence)

For example, if the expected response rate is 0.5%, the accepted error range is 0.05%, and 90% confidence is desired, then:

$$n = \frac{(0.005)\,(0.995)\,(1.64)^2}{(0.0005)^2} = 53{,}523$$

That, for some companies, is an extremely large mailing. The required number of pieces can be lowered by a lower expected response rate, lower confidence (80% confidence as opposed to 90% reduces the number of pieces required by nearly 40%) or a larger error range.

Multiple-Cell Test

Similarly, if we wish to compare two solicitations, the number of pieces required for each test cell is:

$$n = \frac{[r_a\,(1 - r_b) + r_b\,(1 - r_b)]\,c^2}{(r_a - r_b^{2})}$$

where

- n = number of mailing pieces required for each cell
- r_a = estimated response rate for cell *a*
- r_b = estimated response rate for cell *b*
- c = normal factor for the desired degree of certainty.

For example, if the expected response rate for cell *a* is 0.50% and for cell *b* is 0.55% and we desire 90% confidence, then

$$n = \frac{[(0.005)\,(0.995) + (0.0055)\,(0.9945)]\,(1.64)^2}{(0.0005)^2}$$

= 112,369 for each cell

Again, this is a large number of pieces. This number can be reduced by using a lower confidence level or by testing for a larger difference in response rates.

Solving for Confidence Level

When the available mailing universe is small, testing will have to be done on the entire universe and the question is reversed to "How confident am I in the results given that *n* pieces were mailed?"

For example, assume that a new creative package is mailed to all 12,200 mortgage holders of a bank. The response rate is an encouraging 1.10%. "How confident can we be that the result is better or at least as good as the expected 1% response? Again, using a normal approximation where r_e is the expected response rate:

$$c = \frac{r - r_e}{\sqrt{\dfrac{r\,(1 - r)}{n}}} = \frac{0.011 - 0.01}{\sqrt{\dfrac{(0.011)\,(0.989)}{12{,}200}}}$$

= 1.054 or about 85% confident.

Knowledge of the appropriate mailing size and confidence level is critical to confirming or denying hypothesis.

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