

## ESTIMATION OF TURNOVER IN READERSHIP SURVEYS

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Prior to the late 1930's, U. S. advertisers seeking quantitative measures of potential magazine advertising exposure were forced to rely on "circulation" statistics. In 1938<sup>1</sup> Life Magazine began a series of reports that produced estimates of the "audience" of a magazine. It was not always easy to convince advertisers that two magazines with the same average issue circulation might have very different average issue audiences, but by the end of the 1940's the concept of average audience was reaching the position of general acceptance as "a vital component of sound media evaluation"<sup>2</sup>

Of course, once advertisers began to think in terms of audience rather than circulation, a number of important questions emerged. One of these question areas involved the issue of "what is a reader" and what is an "ad exposure." Another question area involved the fact that audience was not distinct or independent, but accumulative. Two magazines with exactly the same "average issue audiences" will have the same two issue "gross" audience, but not the same two issue "net" or accumulative audience. Thus, it is possible that even if single issues of magazines A and B are each seen by 1,000,000 persons, a second issue of magazine A might add 500,000 new persons to the accumulative audience while a second issue of magazine B might add only 200,000 new persons to the accumulative audience.

Throughout the 1940's the nature and extent of audience accumulation was left to speculation and hypothesizing. But, this lack of knowledge did not last very long.

In 1950, Alfred Politz undertook a study that provided a direct measurement of the "accumulation" of audience over 13 successive issues of Life Magazine<sup>3</sup>. Apparently, the concept and measurement of accumulative (and repeat) audience proved to be useful in magazine ad sales. The 1950 Politz study was followed up by a series of studies of audience accumulation. This study of accumulation was extended to other media as well. In 1953 Politz conducted a landmark study of audience accumulation among four different media (magazines, newspapers, television and radio) on behalf of Life magazine. One of the important features of the 1953 study is the fact that magazine audience accumulation past the 6th issue was estimated on the basis of a "model."

In the 1950 Politz study, audience accumulation and repeat readership of 13 issues of Life Magazine was determined from respondent reporting of exposure (via issue recognition) to 13 actual issues of Life. Each respondent was visited on three successive occasions. In the first visit, respondents were asked the "recognition" question in conjunction with an examination of the articles in four issues of LIFE magazine. At the second visit, recognition measures were obtained for 4 additional issues. Finally, at the last visit, recognition was used to determine the issue specific audience of three additional issues.

In the 1953 study, respondents were visited six times. At each visit the recognition method was used to obtain readership for one issue of 5 magazines. Thus it was possible to obtain direct estimates of audience accumulation of from 1 to 6 issues. The 1950 Study had established a precedent, however. In order to produce estimates of accumulative readership for 13 issues of both LIFE and other competitive magazines, a mathematical model was used in the 1953 Study. The model, which is described in Chapter H of the study report made use of the "BINOMIAL" probability distribution in order to extrapolate the estimates of

1 In the preface of *A Study of Four Media: Their Accumulative and Repeat Audiences*, conduct for Life by Alfred Politz Research and published in 1953, A. Edward Miller (Director of Research) and Herb Breseman (Advertising Research Director) note that "Fifteen years ago, with its first report of the Continuing Study of Magazine Audiences, Life embarked on what was then a revolutionary piece of research. But now, many studies later, the advertising profession has come to count on audience research as a vital component of sound media evaluation. Audited circulation is still the primary basis of printed media appraisal, but it is now generally recognized that net paid circulation is not the only important measurement of a medium's impact or influence."

2 Alfred Politz Research Inc., *A Study of Four Media: Their Accumulative and Repeat Audiences*, New York, Time Incorporated, 1953.

3 Alfred Politz Research, Inc., *A Study of the Accumulative Audience of Life*, New York: Time, Incorporated, 1950.

accumulative audience from 6 issues to 13 issues. It is interesting to note that the authors<sup>4</sup> of this model produced one half of the generally accepted model for audience accumulation. Specifically they hypothesized that readership behavior for individuals could be approximated by the binomial distribution under the assumption that each potential reader is exposed to issues on an independent basis from issue to issue with a specific single issue probability  $p$ . The developers of the 1953 Politz model were uncertain about the underlying form of the distribution in the single issue probabilities, so they used an iterative algorithm to approximate this distribution.

In 1958 George P. Hyett read a paper to the Statistics Seminar and the London School of Economics.<sup>5</sup> In this paper Hyett made use of the same binomial formula for individual readership, but he "postulated" the use of the "BETA" distribution to provide the shape of distribution of individual reading probabilities in the population of potential readers.<sup>6</sup> The paper does not mention the Politz data but, rather, makes use of 3 issue audience accumulation for six English Newspapers.

Hyett's suggested use of the beta distribution which he described as "...the beginning - and it is only a beginning..." provided the missing link for what is now considered the standard mathematical model for print media accumulation, i.e. the Beta-Binomial Distribution Model. Once this paper made its way to the United States, American magazine researcher found that it provided a very close fit to the observed 13 issue accumulation found in the 1950 Politz study and the 6 issue data found in the 1953 Politz study. It also preformed well against other accumulation data in the US.

One important feature of the Beta-Binomial Distribution Model is the fact that it is uniquely determined by two parameters.<sup>7</sup> If one accepts the assumptions of the model, then it is possible to predict a multi-issue accumulation curve from any two points on the curve. Under various assumptions about error structure, maximum reliability is obtained when the observed audiences consist of the single issue audience and the  $n$ th issue audience, where  $n$  is as large as possible. It should be noted however, that under the basic assumptions of the beta-binomial model, the two required parameters may be estimated from any two points on the curve, including the single issue audience and the two issue net (accumulated) audience.

While the Politz multi-issue, multi-interview procedure provided the basic empirical measure of multi-issue accumulation of audience, the routine use of this methodology for a large set of titles proved to be both impractical and uneconomical. As a result, researchers wishing to make use of the Beta Binomial and other similar two parameter models have searched for various methods by which the two parameters of the Beta binomial might be estimated.

The original Simmons Study, which was begun in the United States in 1963, made use of a single interview conducted with two issues of each magazine. Theoretically this should have provided sufficient data for modeling accumulation, but it met with resistance in the user community. In the 1960s other methods were proposed and used for obtaining the two basic parameters required by the beta binomial model. These methods included, direct single issue probability measures using a 10 point scale, direct probability measures using a 4 point scale (1/4, 2/4, 3/4 and 4/4). In 1966, the Simmons service switched from a single interview involving two issues of each magazine to a two interview approach (one issue of each magazine per interview).

The 1966 Simmons approach was carried out as follows. At the first interview, readership was obtained for a specific issue of a magazine. After some period of time, say 5-6 months, a second interview was conducted. The respondent was not asked about readership for the successive issue of the magazine (i.e. the issue immediately following the issue addressed in the first interview). Rather, the respondent was asked about an issue that was (in the case of weeklies) between 16 to 24 issues later and in the case of monthlies 4 to 6 issues later. The cross tabulation of the two interviews was used to establish something called the "turnover" rate. The turnover rate ( $T$ ) is obtained by first subtracting ( $A$ ) the average issue audience (over two issues) from ( $N_2$ ) the "net" audience of the magazine obtained in interviews about two (non-successive) issues of the

4 The model was developed by Lester Frankel (then the Technical Director of Alfred Politz Research) with the assistance of Charles Jacobson.

5 Hyett, G. P., "The Measurement of Readership," Statistics Seminar, London School of Economics, February 1958.

6 "For every adult, there is a personal parameter ( $p$ ), defined as the adult's mean probability of reading any particular newspaper over the next  $n$  days of issue, (weekdays or Sundays as the case may be). It is postulated that  $p$  is a Beta variable of the first kind with parameter  $l$  and  $m$ .  $f(p) = p^{l-1} (1-p)^{m-1} / B(l,m)$ ,  $0 < p < 1$ "

7 It should be noted that other formulas for audience accumulation were suggested that also depended on only two observed points in the accumulation curve. Most notable of these is the model suggested by J. M. Agostini. "Analysis of Magazine Accumulative Audience," *Journal of Advertising Research*, Vol 2, No.4, December, 1962 pp. 24-27.

magazine. This difference is then divided by the average issue audience (over the two issues). Thus  $T = (N_2 - A)/A$

The beta-binomial model for producing multi issue reach (and frequency) was applied to the Simmons data by using the Average issue audience (averaged over two interviews) and a synthetic two issue cumulative audience derived as the average issue audience times the turnover rate.

When the Beta Binomial distribution was validated against the 1950 Politz data, this validation was based on issue accumulation obtained from averaging over the various pairs of magazine issues that were shown. In other words, the two issue audience obtained by the Politz study was the derived from "all possible combinations of issues"<sup>8</sup>. Thus the average two issue net audience is actually an average of all possible pairs of two issues. The use of a 4 to 5 month lag to obtain a single observation of the two issue net audience would seem a reasonable attempt to follow the spirit of "all possible pairs," but it is unclear whether or not this was ever subjected to empirical testing. This testing would, of course, require the raw respondent level data from the original Politz survey.

Of course, if turnover were "constant" over time then any possible pair would provide an unbiased estimate of the two issue net audience required for estimation of the parameters of the beta-binomial. However, there is some indication that turnover may not be constant. In 1974, Robert J. Schreiber,<sup>9</sup> noted that the assumption "...that each person has a fixed probability of exposure to each media vehicle." might subject to varying degrees of violation. In this case, the spacing of issues used for the turnover rate might influence the resulting turnover and beta binomial extrapolation.

Over the years a variety of approaches have been taken to obtaining the two mathematical parameters required by the Beta Binomial distribution. In the 1980 Simmons Study information was obtained which allowed for the comparison of several of these methods. The results of this study were presented at the International Symposium in Montreal.<sup>10</sup>

In the 1993 Simmons study, the addition of the frequency question allows us the opportunity to compare the results of 5 possible method of obtaining turnover rates and thus, the subsequent parameters of the beta binomial distribution. These methods are:

**METHOD 1:** Two interviews are used to obtain a non-successive issue turnover rate by direct computation.

**METHOD 2:** The first interview is used to establish the single issue audience. A five category frequency question is used to subdivide the screened in audience into 5 groups. The actual reported reading is used to establish the overall single issue probability of reading for each group. The binomial distribution is used to obtain the two issue net audience. This two issue net audience is used in conjunction with the single issue audience to obtain a turnover rate.

**METHOD 3:** The frequency distribution of x or 4 issue reported behavior is used assuming direct probabilities 1/4 = probability .25, etc. This probability distribution is used to obtain a single issue and two issue net audience. This in turn is used to develop the turnover rate. The less than 1 or 4 frequency category is assigned a probability of 0.05.

**METHOD 4:** The frequency distribution of x of 4 issue reported behavior is used using the "70% solution" initially suggested by Val Appel. Specifically the probability within each frequency group is taken as 70% of the probability implied by x of 4. For example, the probability associated with the 3 issues out of 4 frequency group is taken as  $3/4 * .7 = .525$  rather than .75 in method 3.

**METHOD 5:** The first interview (issue recognition) is used to establish the single issue audience and the screen (logo identification) is used to obtain the x issue accumulative audience (where x is 6 in the case of monthlies, x is 26 in the case of weeklies, etc)

8 "The number of ways in which 13 issues can be arranged is, of course very great. Each order determines a different combination of issues to be used for tabulating cumulative audiences up to 12 issues. Since the survey's objectives is to report average cumulative audiences of average issues, none of the orders is superior to another." Politz (1950) p. 128.

9 Schreiber, Robert J., "Instability in Media Exposure Habits", *Journal of Advertising Research*, Vol. 14, No. 2, April, 1974. pp. 13-17.

10 Richard, Adam and Frankel, Martin, "A Comparison of Reach and Frequency Estimates: Single Versus Dual Interview Approaches," in Henry, H., Ed., *Readership Research: Montreal 1983*. Amsterdam: Elsevier Science Publishers B.V. pp. 384-392.

Estimates of turnover shown in this paper are based on approximately 6,000 interviews. While this may appear to be a "large" sample, this represent approximately 25% of the total sample used in the annual Simmons Survey of Media. Furthermore because of the scheduling of fieldwork, these 6,000 interviews do not represent a completely random subset of the overall Simmons sample. In order to provide appropriate compensation for differential sampling by income strata the sample has been weighted. However, the results should be considered preliminary and subject to change. Furthermore, in order to avoid instability among smaller magazines (due to relatively small sample size), this analysis has been restricted to 55 magazines with a rating or coverage of 1.5% or more.

TABLE I shows average and median turnover rate obtained from each of the five estimation methods.

**TABLE 1  
OVERALL MEAN AND MEDIAN TURNOVER RATES  
USING 5 METHODS**

METHOD	MEAN	MEDIAN
M-1	37.2	36.5
M-2	34.3	33.7
M-3	20.2	20.3
M-4	44.1	44.2
M-5	29.2	28.3

This table shows closest agreement between methods 1 and 2. The use of screens (M-5) seems to produce a substantially lower turnover rate.

Table II shows average and median turnover rates obtained from each of the five estimation methods by publication interval (weekly vs monthly).

**TABLE 2  
OVERALL MEAN AND MEDIAN TURNOVER RATES  
FOR WEEKLIES AND MONTHLIES  
USING 5 METHODS**

METHOD	MONTHLIES		WEEKLIES	
	AVERAGE	MEDIAN	AVERAGE	MEDIAN
M-1	37.5	36.4	36.8	36.7
M-2	33.9	33.6	35.8	35.5
M-3	20.2	20.1	21.0	21.2
M-4	44.2	44.0	44.7	44.9
M-5	32.1	33.1	20.4	20.6

Table III shows average and median turnover rates obtained from each of the five estimation methods by circulation size (under 1 million vs 1 million or more)

**TABLE 3  
OVERALL MEAN AND MEDIAN TURNOVER RATES  
BY CIRCULATION SIZE  
USING 5 METHODS**

METHOD	UNDER 1 MILLION		1 MILLION OR MORE	
	AVERAGE	MEDIAN	AVERAGE	MEDIAN
M-1	38.8	39.2	36.6	36.4
M-2	37.4	37.1	37.4	33.1
M-3	21.6	21.9	21.6	20.1
M-4	45.1	45.3	45.1	44.0
M-5	29.0	27.3	29.2	28.7

Finally Table IV shows average and median turnover rates obtained from each of the five estimation methods by audience skew (single sex versus dual-sex)

**TABLE 4**  
**OVERALL MEAN AND MEDIAN TURNOVER RATES**  
**BY AUDIENCE SKEW**  
**USING 5 METHODS**

METHOD	DUAL SEX		SINGLE SEX	
	AVERAGE	MEDIAN	AVERAGE	MEDIAN
M-1	35.2	35.5	39.1	39.4
M-2	33.5	33.5	35.1	33.7
M-3	18.8	19.3	21.5	21.0
M-4	43.1	43.5	45.1	44.7
M-5	27.1	26.2	31.2	32.7

These results show a close agreement between Method 1 (Two issue-two interview) and Method 2 (Single interview with frequency as classification). Method 3 which uses the frequency question and the direct probabilities generally produces appreciably lower turnover rates. Method 4 which uses the frequency question probabilities subject to the 70% solution generally produces turnovers that are higher than any of the methods. Turnover rates based on the six month screening question produce turnover rates that are lower than those produced by either method 1 or 2. The differential by publication interval for Method 5 is consistent with that found in previous work.

### Post-Script

#### What turnover rate is the "right one"

At the present time the various models that are commonly used for the extrapolation of reach and frequency, involve the assumption of "constant" turnover. However, there is both evidence and conjecture that this assumption is subject to some degree of violation. In general the conjectures assume that as the time span increases, turnover will also increase.

In 1950 the first Politz Study of the Accumulative Audience of Life found an average issue coverage of 20.3% and a turnover rate of 43.6. In the 1953 study of Four Media, Life magazine had an average issue of coverage equal to 22.1% and a turnover of 46.7%. It is not surprising that the average issue audience grew during this period. It is somewhat surprising that the turnover rate grew as well.

In the 1950 study, respondents (or more correctly a subset of all respondents) were interviewed about each of 13 issues (over 3 waves). In the 1953 study, a subset of respondents were interviewed about each of 6 issues (over 6 waves). Since more actual issues were involved in the earlier study, it would seem logical that the turnover rate should have been somewhat lower in a study of 6 issues than one which studied 13 issues. However, the first Politz study involving 13 issues, made use of issues of Life from June 6, 1949 to November 14, 1949. (approximately 5 months). The 1953 Politz study made use of issues from February 4, 1952 to December 15, 1952 (approximately 10 months). Thus, it would appear that the Politz data supports the following:

**Hypothesis:** the greater the issue spread (i.e. calendar time between the first and last issue under consideration) the higher the "turnover."

Of course, which is the most appropriate "turnover" for models would appear to depend upon the calendar time covered by the schedule. Schedules that are being placed in "consecutive issues" should be evaluated using a somewhat lower turnover rate than schedules that do not involve consecutive issues. If one were to accept Method 1 as a benchmark, Method 2 would appear to be a reasonable proxy.

