INTERSTAT
Conseil en Marketing Research

Simulated Market Test

by Alain Pioche, Associate Director, INTERSTAT.

Part I - Modeling consumer panel data

1. The classical exponential growth
2. The Fourt-Woodlock model
3. The Parfitt & Collins model
4. The "Depth-of-repeat" model

Part II - Estimating the parameters

1. ASSESSOR
2. BASES
3. QUARTZ
4. MARKET MIND

Sept 2006

This paper cannot be seen as a complete and exhaustive description of all available models on the market, simply because most of them very rarely publish the way they handle essential questions arising in the field of new product introduction.

The author focuses on the models he has been deeply involved with, namely BASES, QUARTZ and MARKET MIND.

ASSESSOR is a significant exception: as the authors were Professors of Marketing at M.I.T., they published all the theoretical foundations as well as the practical methods they used within their model. These famous papers have been used as sources of inspiration for many other models, both in Europe and in the US, and in some cases outright copies were made. This is the reason why a good description of the early version of the model is possible.

Part I - Modeling Household panel data.

1. The basic exponential growth.

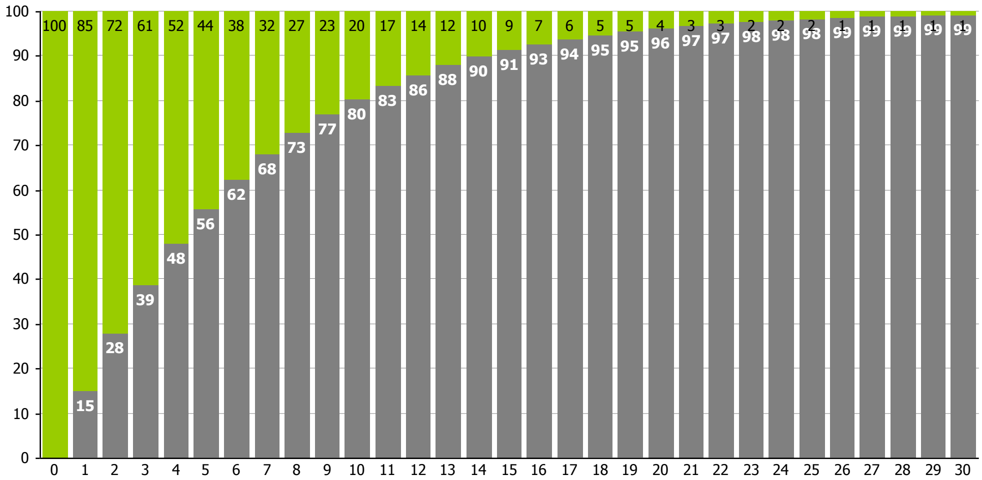
This is probably the simplest model underlying penetration curves as published from a consumer panel. At each period of time (a week, for instance), a constant fraction of remaining "non consumers" are converted into consumers. Hereafter, an example with a constant fraction of 15%: at each period of time, 15% of the remaining non-consumers are converted into consumers.

The simple exponential model.

At each period "t", a constant fraction of remaining people is converted into buyers.

Fraction converted at each period : 15%

Total number of people : 100



t	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Remaining people to be converted at time "t"	100	85	72	61	52	44	38	32	27	23	20	17	14	12	10	9	7	6	5	5	4	3	3	2	2	2	1	1	1	1	1
Buyers (penetration at time "t")	0	15	28	39	48	56	62	68	73	77	80	83	86	88	90	91	93	94	95	95	96	97	97	98	98	98	99	99	99	99	99

The cumulative number of "converted" consumers is the penetration of the product at period "t": this is the number of people having bought the product at least once at period "t" since the beginning (i.e. period *t = 0*).

Computations may be stated as follows:

	Remaining people coming from (t – 1)	Converted into buyers (fraction "r"): penetration at period "t"	Remaining people at period "t"
t = 1	a	$a(1-r)$	$a(1-r)$
t = 2	$a(1-r)$	$a\cdot r(1-r)$	$a(1-r)^2$
t = 3	$a(1-r)^2$	$a\cdot r(1-r)^2$	$a(1-r)^3$
t = 4	$a(1-r)^3$	$a\cdot r(1-r)^3$	
t		$P_t = a\cdot r(1-r)^{t-1}$	
t = n	$a(1-r)^{n-1}$	$a\cdot r(1-r)^{n-1}$	$a(1-r)^{n-1}$ $a(1-r)^n$

a = total number of consumers
r = constant fraction (conversion rate)

This curve is a basic element in New-Product Forecasting, in that it may be applied to a large range of products, including durable goods[1].

2. The Fourt-Woodlock model (1960).

It has been very well known for many years that when the long-run performance of a product depends on repurchase, a first-purchase (trial) model should be supplemented with a repeat-purchase model[2]. The separation of trial sales and repeat sales is critical, given that the same level of sales can be reached by various combinations of trial and repeat.

The focus on repeat should not be limited to the number of first purchasers. Most repeat-purchase models recognize the need to model "depth of repeat" (i.e. the repeat purchase of one-time buyers, two-time buyers, and so on).

The attempt made by Fourt-Woodlock was based on the concept of repeat ratios. For instance, the first repeat ratio is the fraction of triers who make a second purchase. Second, third and other repeat ratios are similarly defined and can be interpreted as the probability that a first- or second- or third-time buyer will buy again.

The total sales equation used in this model is:

$$S_t = Q_{Tt} N_{Tt} \left[1 + \frac{N_{1t}}{N_{Tt}} + \frac{N_{1t}}{N_{Tt}} \cdot \frac{N_{2t}}{N_{1t}} + \frac{N_{1t}}{N_{Tt}} \cdot \frac{N_{2t}}{N_{1t}} \cdot \frac{N_{3t}}{N_{2t}} + \cdots \right]$$

with Q_{Tt}: average quantities per period per first-time buyer
N_{Tt}: number of first-time buyers
N_{1t} / N_{Tt}: first repeat ratio (fraction of triers who made a second purchase)
N_{2t} / N_{1t}: second repeat ratio (fraction of first repeaters who made a second repeat purchase)

The number of first-time buyers at time "t" (the triers) is usually modeled using the previous exponential curve, with $P(t) = N_{Tt} / a$, "a" being the total number of potential buyers during the first year (sometimes referred as "potential triers").

This model is still used by the National Purchase Diary, Inc. (NPD) to predict first-year volume. However, because their experience with it is not always satisfactory, they also use the Parfitt & Collins model.

[1] This curve is an application of more general diffusion models, including some parts on the theory of adoption of new ideas or new products. A good overview on this subject may be found in the following book: Rogers, E.M., *Diffusion of Innovation*, New York: The Free Press, 1962.
[2] The first mention of this point may be found in Stanley Womer, "Some applications of continuous consumer panel", *Journal of Marketing*, Oct. 1944.

3. The Parfitt & Collins model (1968).

The aim of this model is to use consumer panels for brand-share prediction. In brief, Parfitt & Collins described in 1968 a method of predicting the market share for newly launched brands and the future equilibrium share of established brands after major promotional activity.

This method is based on three main elements:

(1) The ultimate cumulative penetration P

(2) The repeat-purchasing rate R after stabilization

(3) The buying-level index I

The method suggested by Parfitt & Collins is to multiply these three numbers together in order to achieve the market share prediction:

$$\text{market share} = P \times R \times I$$

Example. If the ultimate penetration is 34%, the repeat-purchasing rate 25% after stabilization and the buying index 1.00, the market share is given by: $34\% \times 25\% \times 1.00 = 8.5\%$

The two basic underlying assumptions are:

(1) The retail distribution is "uniformly high" (or is not substantially worse than it is likely to be in the foreseeable future)

(2) Besides the advertising and promotional activity during the brand's launch, the circumstances of the market will remain much the same in the future as they have been during the prediction measurement.

3.1. Cumulative penetration model.

Defining "t" as a discrete variable ("t" in weeks after launch of the new product), the cumulative penetration P(t) is defined as:

$$P(t) = K\ (1 - e^{-a.t})$$

K: ultimate penetration
a: rate of growth parameter

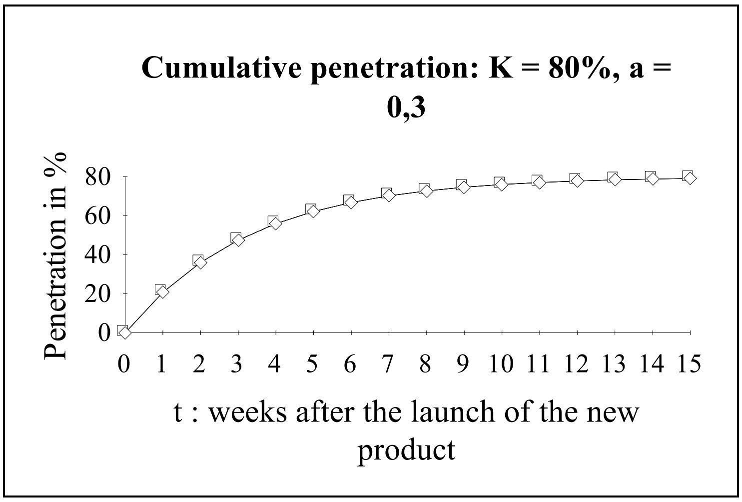
This model implies that the rate of increase of penetration at time "t" is proportional to the expected number of new buyers:

$$\Delta P(t) = a\ (K - P(t)) + \varepsilon(t)$$

$\varepsilon(t)$ being the random error associated with the measurement at time "t".

The deterministic part of this stochastic model may be summed up as previously indicated by the classic exponential growth curve.

A numerical example of this type of curve may be obtained with an ultimate penetration of 80% and a rate of growth of 0.3 (meaning that at each period of time, 30% of the remaining non-buyers will be converted into new buyers: this is the same basic assumption that Fourt and Woodlock made 10 years before[3]):



Estimation of the parameters has been described by Anscombe in 1961, based on least-squares procedures applied to consumer panel data.

3. 2. Repeat-purchasing rate.

This is the first time a correct approach of the repeat buying question has been published. This approach will be introduced through an example:

T: new brand launched in week 1
O: an existing brand (whatever the name is)

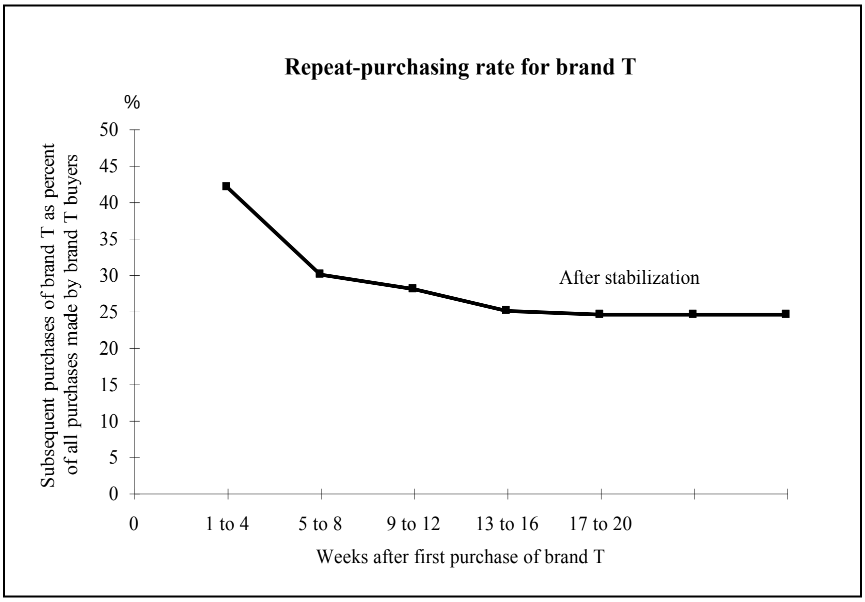
Week	1	2	3	4	5	6	7	8	9	10	11
Buyer 1	**T**	T	O	T	O	O	O	O	T	O	O
2	**T**		O		O		O		O		O
3		**T**	T	T	T	T	T	T	T	T	T
4		**T**		T		O		T		O	
5			**T**		T		T		T		T
6			**T**	T	O	T	O	O	O	O	O
7			**T**	O		O		O		O	
Number of cumulative buyers	2	4	7	7	7	7	7	7	7	7	7
Repeat-purchasing rate				6/10		5/10		4/10		4/10	

The repeat purchasing rate is calculated from the period after the first purchase of brand T, here in two-week intervals, every consumer having different opportunities for repeat purchasing according to their date of entry into the market.

At this point in time, Parfitt & Collins observe that the pattern of a declining repeat-purchasing rate is normal because "second, third, fourth etc. purchases of a new brand still tend to be exploratory and are also often still a benefit from promotional activity of the launch".

Such a pattern may be described as follows:

[3] Louis A. Fourt and Joseph W.Woodlock, "Early prediction of Market Success for New Grocery Products", *Journal of Marketing*, 25 (October 1960), 31-8.



Such a "repeat-decay" function has become very well-known since that date, the concept of "market stabilization" having been taken as such by ASSESSOR some years later.

An additional observation made by Parfitt & Collins is that "the sooner a buyer enters the market for a particular brand, the higher that buyer's repeat-purchasing rate will be". In other words, buying behavior partly depends on the date of entry, early buyers being more important than late buyers (i.e. having a larger repeat-purchasing rate).

This point may be illustrated by the following example from the Attwood Consumer Panel (Great Britain) where the 4.9% market share of a brand **X** is the result of a cumulative penetration of 30.0%, an average repeat-rate of 15.5% and an average buying index of 1.05.

Date of entry	Contribution to cumulative penetration	Repeat-purchasing rate	Buying rate index	Contribution to brand share
Before official launch	1.9%	40.0%	1.21	0.9%
During the first 6 weeks	13.2%	17.0%	1.00	2.2%
During the second 6 weeks	5.0%	15.5%	1.12	0.9%
During 13-24 weeks period	5.5%	8.5%	1.08	0.5%
After 24 weeks	4.4%	8.5%	1.00	0.4%
Total (or average)	30.0%	15.5%	1.05	4.9%

This point has a lot of marketing implications, and has probably been underestimated by the authors.

3. 3. Buying level index.

The buying level of buyers of brand T could be an important element in the calculation because if the households who tried brand T were particularly heavy buyers of the product class (maybe an index of 1.2 compared with the average), or were particularly light buyers (maybe an index of 0.8) then it would considerably influence the calculation of the ultimate share of brand T.

This point may be illustrated by the following example:

> Assuming a penetration rate of 34% of the target, and a repeat-purchasing rate of 25% after stabilization, a buying level index varying between 0.8 and 1.2 would produce the following values:
>
> > Heavy buyers of the product class: 34% × 25% × 1.20 = 10.2%
> > Average buyers of the product class: 34% × 25% × 1.00 = 8.5%
> > Light buyers of the product class: 34% × 25% × 0.80 = 6.8%

This example shows the importance of such an index: however, nothing is said about its measurement, except that it has to be carefully observed in a consumer panel.

4. The "depth-of-repeat" model.

This model is the next development stage of the previous Fourt-Woodlock model.

Furthermore, it has been demonstrated that the continuous analog of the discrete depth-of-repeat model is the familiar NBD model (Ehrenberg 1959), which assumes exponentially distributed interpurchase times (or equivalently, a Poisson distribution of purchase events across successive time periods of equal length).

The discrete "depth-of-repeat" model underlies the BASES procedure, while the continuous NBD model underlies QUARTZ.

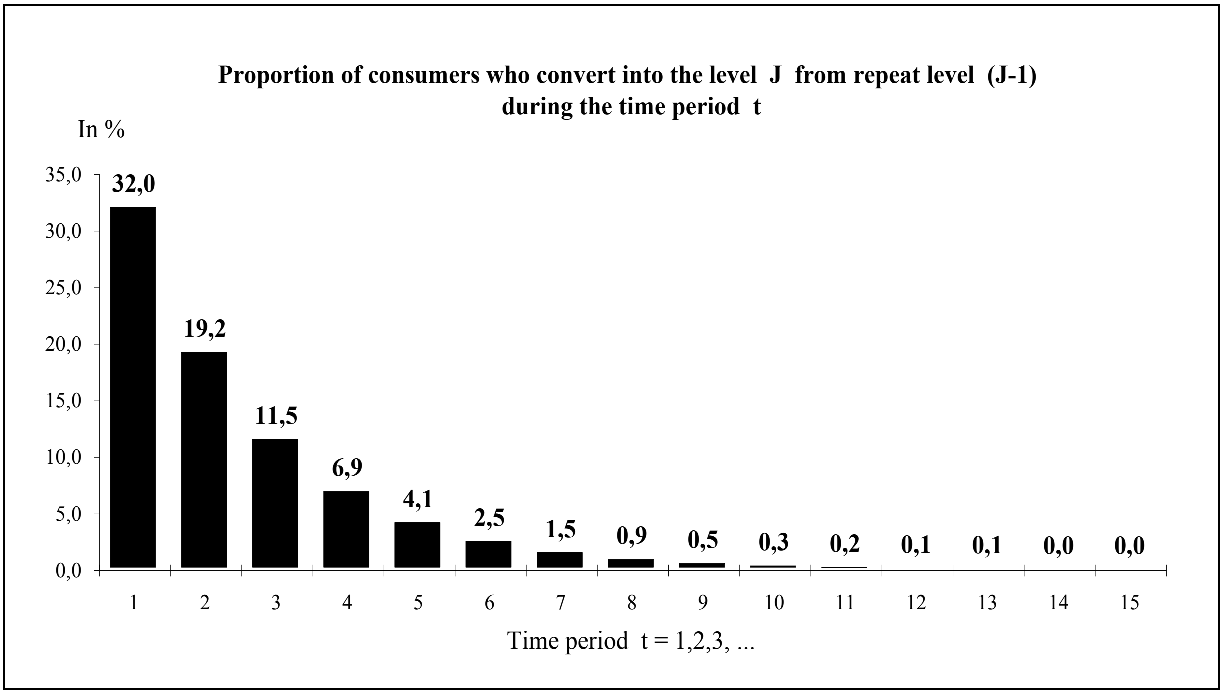
The main idea is to model **in the same way** not only the penetration level (trial) but also all the further repeat levels (repeat purchases 1, 2, 3, ...). This means for instance that the cumulative distribution of the people having bought at least two times may be represented by an exponential function, the ceiling being 100% of the initial triers.

Following the work of Fourt-Woodlock, the proportion $\pi(t)$ who converts into the modeled repeat level J during the t-th time period is given by:

$$\pi(t) = P(t) - P(t-1) = a\,(1-r^t)$$

P(t) being the cumulative value of $\pi(t)$.

Example. Assuming that 80% of the triers have made (J-1) repeat purchases, the proportion of this group who will convert into the J-th repeat level at a given point of time may be illustrated by this graph:



The main question is to estimate "r", the constant fraction always present in the exponential growth curve. It has been demonstrated[4] that the average interpurchase time “c” of these consumer who will convert into some repeat level J is given by:

$$c = 1 / (1-r)$$

"r" being the value of this constant fraction.

This allows an easy way of estimating "r", based on the observation of "c" in a consumer panel, the previous relationship being rearranged as $r = (c-1) / c$

This expression for interpurchase time is based on the assumption that data on conversions into the J-th repeat level are available over an infinite period of time.

In practice, however, the period over which conversion into the J-th repeat class is observed is bound to be limited. If we assume that the conversion into the J-th repeat class is observed only for T periods, the average interpurchase time “c^T” for truncated data is smaller than the theoretical average interpurchase time “c”.

$$c^T = 1 / (1-r) \; - \; T.r^T / (1-r^T)$$

Up to this point, the consumers entering a particular repeat level have been assumed to be homogeneous. Empirical evidence, however, indicates that the early entrants into a repeat class tend to be heavier buyers of the product than later entrants: this point has been successively observed by Fourt and Woodlock (1960), Parfitt and Collins (1968) and Eskin (1973).

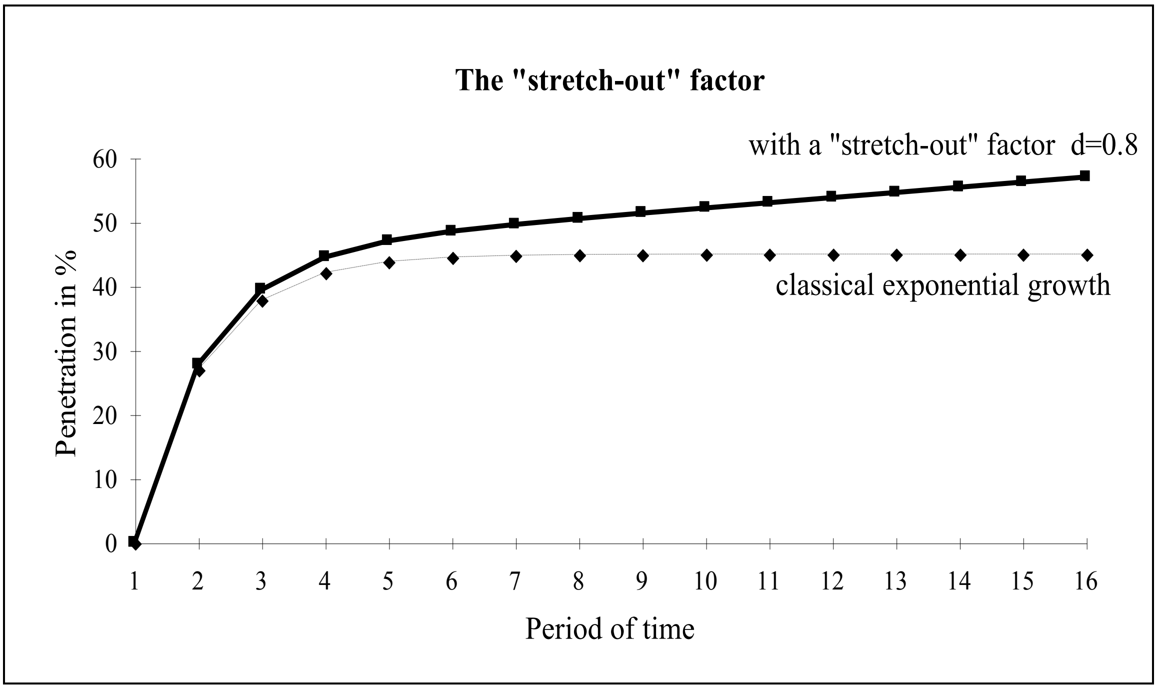
The addition of a trend factor “d” provides this “stretch out” of penetration[5], which leads to the following adjustments:

[4] The full demonstration may be found in M.U.Kalwani and A.J. Silk, "Structure of Repeat Buying for New Packaged Goods", *Journal of marketing Research* 17 (August 1980): 316-322.

$\pi(t) = a\, r^{t-1}\,(1-r) + d$

$P(t) = a\,(1-r^{t}) + dt$ (cumulative distribution)

This modification allows the ceiling to be a linear function of time instead of a fixed quantity, as illustrated by the following graph:



For the depth of repeat model, the cumulative proportion of consumers who convert into the J-th repeat level within T periods of previous purchase is given by:

$F_J(t) = a_J(1-r_J t) + d_J t \qquad t = 1,2,3, \ldots$

where the suffix J denotes the repeat class and the time variable t is measured in time periods since last purchase. As indicated before, one purpose here is to compare the penetration curves across various repeat levels. How do the parameters a_J, r_J and d_J vary with J ? Eskin (1973)[6] proposed three hypotheses about the patterns in a_J, r_J and d_J across repeat levels, and tested them with purchase data for six established products.

(a) For a new product, the parameter r_J has approximately the same value across all repeat levels. This implies that the average interpurchase times are approximately equal across all repeat classes.

(b) d_J takes on the same value across all repeat levels. In this case, Eskin found that d_J's "vary in a relatively small range but do tend to exhibit a negative trend over J".

(c) In a third hypothesis, Eskin postulated that a_J's could be obtained from a geometric distribution of the form:

---

[5] This is the key difference between the discrete and continuous models. In the discrete case, the "stretch out" factor is used to allow for the heterogeneity between early and late entrants into a repeat class. The use of the gamma distribution in the continuous case allows more flexibility in describing consumer heterogeneity.
[6] The basic article is Eskin, Gerald J., (1973), "Dynamic Forecasts of New Product Demand Using a Depth of Repeat Model", *Journal of Marketing Research*, 10 (May), 115-29.

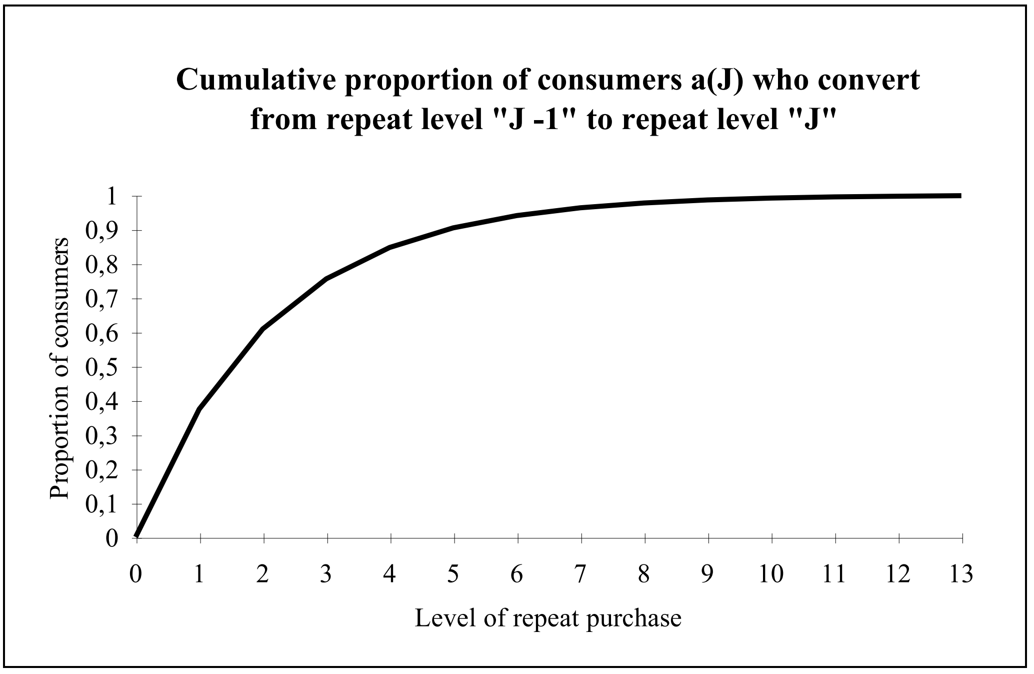
$$a_J = a_\infty(1-\gamma^J) \qquad J = 1,2,3, \ldots$$

where the limit a_∞ is usually unity or slightly less than unity.

The following values were obtained with the numbers indicated by Eskin and Malec (1973) in their paper:

$$a_\infty = 1 \text{ and } \gamma = 0.626$$

In other words, distribution of purchases is similar for every level of repeat, except maybe for the initial trial.



With this definition, the distribution of the purchases over the time may be estimated for each level of repeat: final sales will be computed assuming a constant average quantity bought at each purchase.

Total sales S_t may be broken down along all different repeat levels:

$$S_t = \sum_{J=0}^{\infty} R_t(J) \cdot U_t(J) \qquad J=0,1,2, \ldots$$

with $R_t(J)$: number of consumers having repeated "J" times
$U_t(J)$: average quantity bought per repeat purchase

Therefore, being able to model each repeat level $R_t(J)$, it is easy to derive total sales S_t at the period "t".

Part II - Estimating the parameters.

In the first part, consumer panel data was used to estimate the key parameters on which most models are based, such as repeat-purchasing rate after stabilization or average interpurchase time.

This way of tracking consumer buying behavior through a consumer panel leads to traditional market-tests procedures, the most technically advanced being BehaviourScan in the US. Many attempts have been made in Europe in the same direction: ERIM in France and in Germany, SCANNEL in France, BehaviourScan in Germany, StatScan in the UK.

However, the total European market seems to be too small to support several competitive techniques. Furthermore, one of the main interests of these techniques is to measure individual media exposure (this is the "single-source" concept, measuring multi-media exposure and purchase behavior for the **same respondent**), which is not so easy to implement in Europe where cable TV is not the technical standard.

The aim of the following part is to describe how these parameters may be estimated for new products based on consumer claims in traditional surveys (concept-use tests mainly). In these methods, consumer panels are no longer used to estimate the key parameters: they are replaced by consumer ad-hoc surveys.

Main strengths and weaknesses:

Strengths

- Relatively good accuracy
- Only winners go to test market
- Costly failures are avoided
- Risk reduction in predicting failures
- Reading time is shortened
- Confidentiality
- Rapid competitive new products forecasts
- Indicate source of business
- Predicted winners can build confidence
- Smaller product requirement
- Does not necessarily need finished packaging / finished commercial
- Allows for marketing simulations

Weaknesses

- Only assumptions on marketing variables: distribution build, awareness build
- Competitive reactions are almost impossible to assess correctly
- Impact of external variables is impossible to evaluate objectively
- Deviations of pre-test stimuli and product vs. actual execution may create differences
- Trade acceptance is not available
- Need a "model" for converting GRP's into awareness

The advantages being much more important than the potential disadvantages, Pre-Test Market models are presently very successful in developed countries, such as the USA, Europe and Japan.

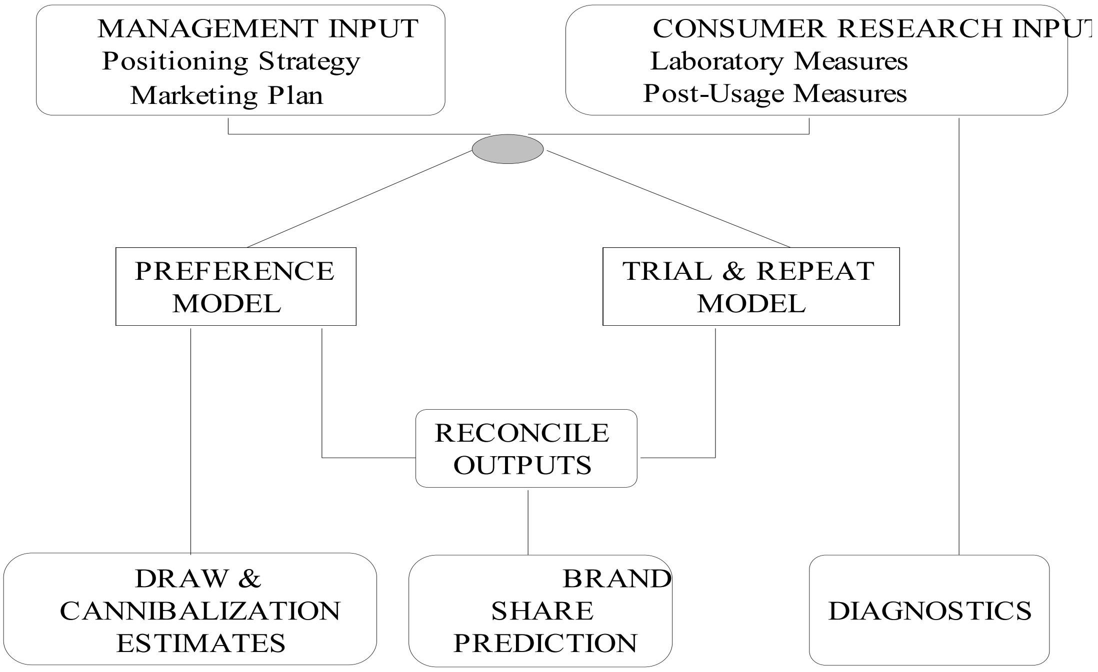
1. ASSESSOR[7].

The main purpose of ASSESSOR is to estimate the sales potential of new packaged goods before they are test-marketed.

ASSESSOR is a set of measurement procedures and models designed to help management in evaluating new packaged goods before test marketing when a positioning strategy has been developed and executed to the point where the product, packaging and advertising copy are available and an introductory marketing plan (price, promotion and advertising) has been formulated. Given these inputs, the system is designed to:

1. Predict the new brand's equilibrium or long-run market share.
2. Estimate the sources of the new brand's share --"cannibalization" of the firm's existing brand(s) and "draw" from competitor's brands.
3. Produce actionable diagnostic information for product improvement and the development of advertising copy and other creative material.
4. Permit low cost screening of selected elements of alternative marketing plans (advertising copy, price, and packaged design).

The general structure of the ASSESSOR system may be summarized as follows:



The task of predicting the brand's market share is approached through **two** models --one relates preference to purchase probability and the other is a straightforward flow representation of the trial-repeat process.

[7] The version presented here was first published by A.Silk and G.Urban, "Pre-Test-Market Evaluation of New Packaged Goods: A Model and Measurement Methodology", *Journal of Marketing Research* 15 (May 1978), 171-191.

A general overview of the ASSESSOR design is shown in the following flow-chart:

Design	*Procedure*	*Measurement*
Q1	Respondent screening and recruitment (personal interview)	Criteria for target-group identification (for example, product-class use)
Q2	Premeasurement for established brands (self-administered questionnaire)	Composition of "relevant set" of established brands, attribute weights and ratings, and preferences
X1	Exposure to advertising for established brands **and** new brand	
[Q3]	Measurement of reactions to the advertising materials	Optional: for example, likeability and believability of advertising materials
X2	Simulated shopping trip and exposure to display of new and established brands	
Q4	Purchase opportunity (choice recorded by research personnel)	Brand(s) purchased
X3	Home use / Consumption of new brand	
Q5	Post-use measurement (telephone interview)	New brand use rate, satisfaction ratings and repeat purchase propensity: attribute ratings and preferences for "relevant set" of established brands plus new brand.

X = advertising or product exposure
Q = measurement

Relevant set = subset of available brands which are familiar to the respondent regardless of whether they are judged favorably or unfavorably as choice alternatives. This concept is somewhat different from the "evoked set" concept, which has been interpreted to include only "acceptable" alternative.

One of the key features of ASSESSOR is that two different models are used to generate separate predictions of market share for a new brand, a "preference model" and a "trial & repeat model": convergent results should strengthen confidence in the prediction, whereas divergent outcomes signal the need for further analysis to identify sources of discrepancies and potential solutions.

2.1. Preference model.

The authors postulate that the observed measurements of preference, obtained by the constant sum, paired comparison procedure[8], are related to brand choice probabilities by:

$$P_i(j) = \frac{V_i(j)^{\beta}}{\sum_{k=1}^{m_i} V_i(k)^{\beta}}$$

where $V_i(j)$ = the estimated preference of consumer "*i*" for brand "*j*",

β = parameter to be estimated.

This formulation may be also related to McFadden's "random utility model".

The parameter β is estimated using the preference scale values for the established brands derived from data obtained in the pre-exposure questionnaire (Q2). Assuming β to be a stable parameter whose values will remain unchanged after introduction of the new brand, and given measurements of consumers' preference for the new brand plus the established brand obtained after a period of trial usage of the new brand, each individual's probability of purchasing the new brand is given by:

$$L_i(t) = \frac{A_i(t)^{\beta}}{A_i(t)^{\beta} + \sum_{k=1}^{m_i} A_i(k)^{\beta}}$$

where

$L_i(t)$: probability that consumer "*i*" chooses the brand "*t*" after having tried the new brand

t: index for the new brand

k: index for established brands

$A_i(t)$: estimated preference of consumer "*i*" for the new brand "*t*" after having tried the new brand

$A_i(k)$: estimated preference of consumer "*i*" for established brand "*k*" after having tried the new brand.

This predicted probability is conditional on the brand being an element of each consumer's relevant set: to calculate an expected market share for the new brand, one must take into account that the new brand will not necessarily become an element of the relevant set.

Therefore, this market share M(*t*) is given by:

[8] The method of least-squares suggested by Torgerson (*Theory and Method of Scaling*. New York: John Wiley & Sons, Inc., 1958) is used by ASSESSOR: it is a method for estimating ratio scale values from judgments of paired comparisons between stimuli.

$$M(t) = E(t)\frac{\sum_{i=1}^{N} L_i(t)}{N}$$

where

M(*t*) = expected market share for the brand "*t*"

E(*t*) = proportion of consumers who include brand "*t*" in their relevant set of alternatives

$L_i(t)$ = predicted probability of purchase of brand "*t*" by consumer "*i*", *i* = 1, ... , N.

How to estimate E(*t*). This is done using the following equation (the "arcsin" transformation is applied as a mean of stabilizing the error variance):
Arcsin E(*j*) = -.599 + .901 Arcsin B(*j*) + e(*j*)
Numerical coefficients have been obtained from 18 observations (i.e. brands of deodorants).

2.2. The Trial-Repeat model.

According to Parfitt & Collins, market share M(*t*) may be expressed as:

M(*t*) = TS

where

T = ultimate cumulative trial rate for the new brand "*t*" (proportion of all buyers in the target group who ever try the new brand)

S = ultimate repeat purchase rate for the new brand "*t*" (new brand's share of subsequent purchases in the product category made by buyers who have made a trial purchase of the new brand).

Assuming that incidence of the first purchase is dependent on the level of awareness induced by advertising (or other forms of promotions) and the extent of its retail availability, the ultimate trial T may be expressed as:

T = FKD

where

F = long-run probability of a consumer making a first purchase given awareness and availability (i.e. proportion of consumers making a trial purchase in the long run given that all consumers were aware of it and distribution was complete). The proportion of respondents who purchased the new brand in the simulated shopping trip is used as an estimator of F.

K = long-run probability that a consumer becomes aware of the new brand.

D = long-run probability that the new brand is available to a consumer (i.e. proportion of retail outlets that will ultimately carry the new brand weighted by their sales volume in the product category).

The translation of marketing plan into estimates of K and D is accomplished by informal means, drawing upon managerial judgment as well as results and experience obtained with similar products.

The other quantity S has been defined by Urban as the equilibrium share of a first order, two-state Markov process:

$$S = \frac{R(k,t)}{1 + R(k,t) - R(t,t)}$$

where the transition probabilities are defined as follows:

$R(k,t)$ = probability that a consumer who last purchased any of the established brands (*k*) will switch to the new brand (*t*) on the next buying occasion

$R(t,t)$ = probability that a consumer who last purchased the new brand (*t*) will repurchase it on the next buying occasion.

Estimates of $R(k,t)$ and $R(t,t)$ are derived from measurements obtained in the post-usage survey, based either on repurchase intentions (or mail order repurchase) or preferences for the new and relevant established brands.

It is clear that "this trial-repeat is a very simplified representation of the new product response process".

An important assumption implicit in the model is that the frequency of purchase of the new brand will be the same as that for established brands. This assumption can be relaxed somewhat by weighting the ultimate repeat rate S by an index that reflects the new brand's usage rate in relation to that for established brands, but this can be seen at best as a crude adjustment.

If the adoption process has to be represented in greater detail, it could be eventually desirable to use one of the other available models.

2. BASES[9].

BASES is presently the most widely used model throughout the world. Several stages are defined by Burke when promoting this method: BASES I for concept test (in the US, two additional services are offered prior to BASES I: ConceptCast and Concept Designer), BASES II for concept-product test, BASES LX for line extension, BASES III for in-store test, Starter (a syndicated tracking service of awareness), Restager, SOVA (Source of Volume Analysis), PASS (Position Analysis & Segmentation Summary), etc.

Because only part of this range of services is available in Europe, we will focus only on the BASES II model, which represents the "core business" of BASES and is probably the most important system in the BASES world.

The basic principles underlying this model are apparently very simple and straightforward, and may be summarized as follows:

1. The product is presented in a "monadic" way (i.e. alone, without any competitive environment), through a "concept-board" mentioning the main features of the product, consumer benefits and price per consumer unit.

2. An intention to buy is asked before use.

3. Product is given to people having a "positive" intention to buy (i.e. both claims "certainly" and "probably") for regular in-home use.

4. A second intention to buy is asked after use, to determine the "repeat process". In addition, questions on price value and hedonic value are asked.

Sales volume is computed using a "Depth-of-Repeat" model (see below for a more detailed description), input parameters being "adjusted" in order to fit with model requirements.

These adjustments are made using a "database" to translate claims obtained in a consumer survey into behavior probabilities, the large size of this database being the main guarantee of the ability of BASES to translate correctly.

Such a brief description must be expanded in order to have a fair understanding of BASES's place among the other competitive Pre-Test Market techniques.

2.1. The sales volume calculating model..

By definition, the model used by BASES in order to compute sales volume can be expressed as the following:

(1) $S_t = T_t + R_t$ $\qquad t = 1,2,3, \ldots$

[9] Because there is a very limited of number scientific publications fully describing this procedure (some partial descriptions are published here und there), it is somewhat difficult to put back together all the pieces of information coming from different sources. Therefore, the following description of BASES may be regarded as the only technical summary available in Europe.

where

S_t	total sales volume up to time period (week) "t"
T_t	trial volume up to time period (week) "t"
R_t	repeat volume up to time period (week) "t"

In addition, trial volume T_t and repeat volume R_t can be further defined as:

$$(2) \qquad T_t = TM \times P_t \times U_0$$

where

TM	target market size (i.e. number of households in the target market area)
P_t	cumulative trial (or penetration) rate up to week "t"
U_0	average units purchased at trial

$$(3) \qquad R_t = \sum_{i=1}^{\infty} N_{i-1,t} \times Y_{it} \times U_i \qquad t = 1,2,3, ...$$

where

i	repeat level 1,2,3, ...
$N_{i-1,t}$	cumulative number of consumers repeating at least (i-1) times by week "t" (defining $N_{0,t} = TM \times P_t$)
Y_{it}	conditional cumulative i-th repeat rate at week "t" given that (i-1) repeat purchase was made up to week "t"
U_i	average units at repeat level "i"

The mathematical equation used for expressing the shape of all conditional cumulative repeat curves is a geometric function with a linear stretch factor over time. This equation is similar to the trial function proposed by Fourt-Woodlock in 1960, and is also used by Eskin in his own "Depth-of-Repeat" model.

$$(4) \qquad Y_{it} = \alpha_i (1 - \gamma_i^{\,t}) + \delta_i.t$$

where the parameters α_i , γ_i and δ_i are restricted by:

$0 < \alpha_i \leq 100 - \delta_i.t$
$0 < \gamma_i < 1$
$0 < \delta_i < 1$

It has been shown (Lin 1979, Kalwani and Silk 1980) that γ_i is functionally related to the average time between purchases among core repeaters buyers.

N.B. It has to be remembered that a constant value is assumed for all repeat levels. This means that only three values need to be determined: α , γ and δ as being the constant values of α_i , γ_i and δ_i for all repeat levels "i".

Similar to the other models, the BASES questionnaire has been designed mainly to provide the previous "Depth-of-Repeat" computational system with the right inputs:

- Penetration at the end of year 1 (in %), providing P_t for t=52
- Penetration after 13 weeks (in %), providing P_t for t=13

  These two values are required to determine the trial curve: this curve is **not** determined by the three parameters α, γ and δ, (only the further repeat purchases are) and must be estimated separately. BASES assumes that most of the time, P_{13} is approximately equal to 0.255 * P_{52} , this last value being the most important for determining the trial curve.

- % repeating at least once within 52 weeks from initial purchase, leading to "α"
- "w", average number of weeks between consecutive purchases, leading to "γ" by: $\gamma = w / (1+w)$.
- Average penetration transaction size, U_0
- Average repeat transaction size, U_i , constant for each repeat level "i".
- Seasonality input (if any).

With these parameters, the "Depth-of-Repeat" model is able to determine a final sales volume in the first year, according to all the assumptions previously described.

Therefore, the main goal of BASES is to derive values for these parameters based on ad-hoc consumer surveys.

Two additional comments must be made before explaining how these values are obtained:

- These values are aggregated values, necessarily obtained at the total (representative) sample level.

- Marketing plans are not explicitly introduced in these parameter values: distribution and awareness are supposed to influence firstly trial curve, and secondly repeat purchases (because they are themselves influenced by the trial).

2.2. Estimating the trial curve.

The key measurement tool is the well-known buying intention scale in 5 points, used before and after use of the product:

1. Certainly
2. Probably
3. May or may not
4. Probably not
5. Certainly not

BASES uses a weighting procedure in order to compute an "eventual trial" score (i.e. a trial assuming 100% ACV and 100% awareness). According to Burke, "the weighting scheme differs by country, product category and unit price level. Such a procedure is obtained based on empirical validation of concept respondent's purchase behavior after product availability".

In other words, the weighting scheme (or equivalently the "database") is obtained through a regression done at the aggregated level, as shown in the following table:

	The dependent variable: observed trial rate[a]	The explanatory variables: the 5 steps of the buying intention scale as given by the BASES questionnaire for the new product				
		certainly	probably	may or may not	probably not	certainly not
Product 1	29%	25%	34%	17%	13%	11%
Product 2	17%	19%	24%	44%	9%	4%
etc ...						

[a] This is the observed trial rate (i.e. the % which may be read in a consumer panel) after adjustment for 100% ACV and 100% awareness. Usually, adjustments are made in a multiplicative way.

The regression equation is as usual:

$$(\text{trial}) = a_1\,(\text{certainly}) + a_2\,(\text{probably}) + a_3\,(\text{may or may not}) + a_4\,(\text{probably not}) + a_5\,(\text{certainly not}) + (\text{constant})$$

The coefficients "a_k" (k = 1, 2, 3, 4, 5) are the weights used in order to derive the eventual trial: these weights are the "norms" BASES keeps secret for commercial reasons.

However, it would be necessary to know at least how many **validations** (and not how many tests, such a number not being a relevant statistic) are used in order to build such a database for a given country (with the necessary breakdown in terms of product category, price level and date --only the most recent validations must be used), as well as the level of accuracy currently associated with the weights obtained at the end of the regression.

Afterwards, this "eventual trial" is adjusted for marketing inputs (i.e. awareness build and ACV distribution build over time):

$$P_{52} = (\text{Ev. Trial}) \times (\text{Adjusted Dist.}) \times (\text{Adjusted Awar.}) \times (\text{CDI --if available})$$

where:

(Adjusted Dist.) is the weighted average value of the distribution build as given by the manufacturer, assuming that early "points" are slightly more important than further points

(Adjusted Awar.) is the weighted average value of the planned awareness, this awareness coming either directly from the manufacturer or from a "model" converting GRPs into awareness.

CDI (Category Development Index): indicates to what extent the total category is growing.

The "awareness model". In brief, this "model" is simply a regression equation, with the following assumptions:

1 GRP Press = 1/2 GRP TV and 1 GRP Radio = 1/2 GRP TV

All GRPs are converted into "TV equivalent GRPs" for the remaining computations. The main equation is:

$$\text{Awareness} = b\,(\text{GRP}) + 0.18\,(\text{Max. Dist.})$$

the value of "b" varying according to "the quality of the advertising". Its value lies between 0.012 and 0.024, the "true" value being defined on judgment. Influence on final sales volumes estimate is obviously very high.

(Max. Dist) is the maximum level of distribution achieved at the end of year 1: it means that without advertising and with 100% distribution, any new product will "automatically" achieve 18% awareness.

2.3. Estimating the remaining parameters.

The remaining parameters are estimated in a similar way, i.e. the aggregated figures obtained at the sample level are adjusted for over-claiming using a "database" based on past validations:

(a) The "first true repeat rate" (percentage of triers who will make a repeat purchase within one year of initial purchase) is based on purchase intention (5-point scale) after in-home product use weighted by its proper category and unit price class, and on a price value score after use.

(b) "Repeat decay" (repeat stabilization point) is estimated through a regression sub-model using mainly the price value score after use.

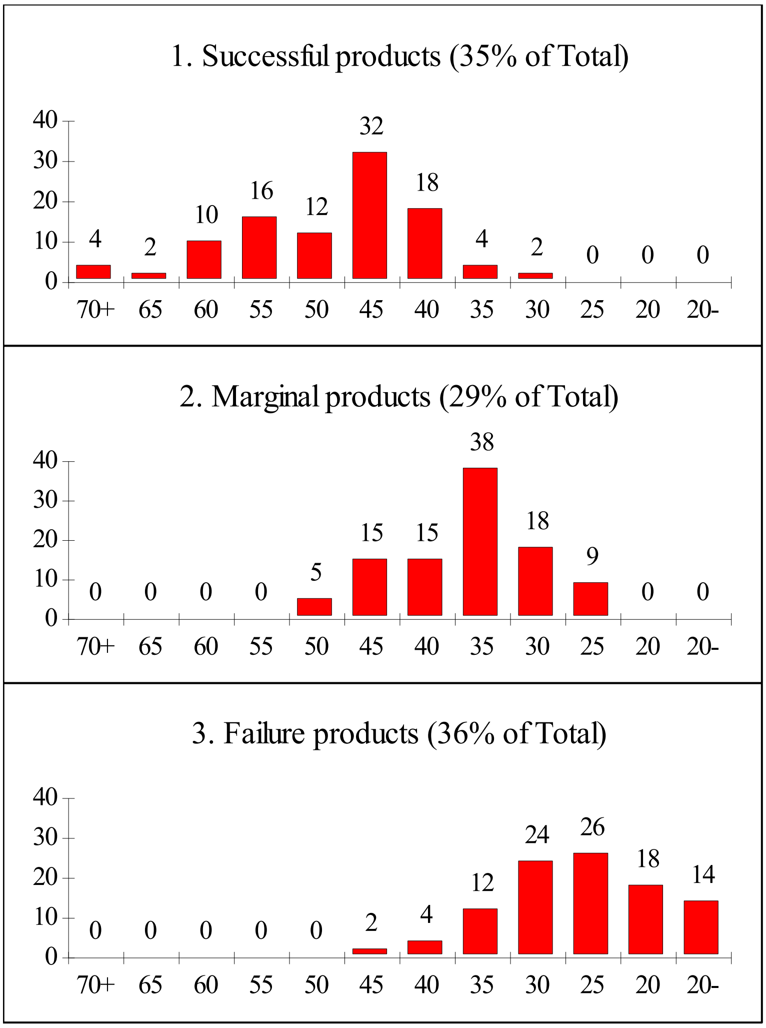
(c) "Buying rate" (average purchase units), is based on intended before- and after-use purchase units among positive purchase intent respondents.

(d) Average purchase cycle is estimated, based on validation experience, on actual purchase cycle and claimed intended purchase frequency after product use (positive people only).

Past validations are critical for BASES: they are at the origin of the "database", in that they are used to adjust all ad-hoc results for over-claiming. This is probably the reason why these validations have been as carefully studied as possible, and have always left the marketing research community quite unsatisfied.

From late 1977 to October 1984, BASES claimed for 157 validation cases all over the world: in 80% of the cases, forecasted results were in a ±20% confidence range from actual sales (after a posteriori adjustments for awareness and distribution).

However, it must be pointed out that a larger number of cases do not improve the accuracy of a "norm": such an accuracy (or discriminant power) is only based on the **variance** of the norm. The large number of validations allows estimating this norm's variance with more accuracy, but not the norm itself. This discriminant power may be illustrated by the following graphs, showing the distribution --according to the measured repeat rate-- of 134 new products introduced nationally, classified by the manufacturers into three groups (successful, marginal or failure):



The discriminant power of the BASES norm. This may be appreciated with the two following decision rules, according to the measured repeat rate as observed for the new product:

Decision rule: $x_{obs} \le x_c \Rightarrow$ failure $x_{obs} > x_c \Rightarrow$ success	Probability of rejecting a "good" product (successful) if $x_{obs} \le x_c$	Probability of accepting a "wrong" product (marginal or failure) if $x_{obs} > x_c$
x_c = 45%	55%	5%
	x_c = 40%	x_c = 23%

The main criticisms of BASES involves the purchase frequency measurement[10]:

(a) The purchase frequency of a new product can hardly be estimated by a direct question, such as "How often would you buy this product?". Answers are most often very unreliable, and must be corrected for significant over-claiming. It is doubtful that the BASES past validations can be used for such adjustments.

(b) Being a monadic and aggregated model, BASES does not take into account the frequency of purchase of the product category to which the new product belongs. This point may be important, as illustrated by the following example for two products in the same product category:

Buying intention (in %)	Product A	Product B
Definitely Buy	26	16
Probably Buy	39	36
Might, Might Not	20	33
Probably Not	11	9
Definitely Not	4	6
TRIAL TRANSLATION[a]	11.4	8.8

[a]Assuming that category norms and marketing plans are identical, Buying Intentions are the only difference between the two products.

Based on this data, it would have been forecasted that Product A is better than Product B.

However, taking into account the underlying dynamics with heavy buyers recorded via scanner leads to very different results:

	Product A	Product B
Total Trial	11.4	8.8
Trial among		
• Heavy users	11.0	17.0
• Light Users	13.1	8.4
• Previous Non-Users	9.0	1.0
1st Year volume	39.0	41.0

It is readily apparent that while Product A had greater overall trial appeal (11.4% versus 8.8%), its appeal is relatively more to the light user and previous non-user segments. Product B, in contrast, substantially out-performs Product A among the important heavy users segment, giving Product B the overall volume advantage.

[10] These points come from IRI's brochure, presenting "The Next Generation: ASSESSOR$_{FT}$" in the US market, just before selling ASSESSOR to M/A/R/C/ and signing a "strategic agreement" with BASES.

3. QUARTZ[11]: a first attempt made by Nielsen in the 80's.

QUARTZ may be seen as the "continuous" version of BASES (i.e. this model being seen as "discrete", as previously mentioned) with three major improvements:

1. Heterogeneity (i.e. differences between consumer's buying habits) is introduced through the "Gamma" distribution, which allows more flexibility than the "stretch out" factor.
2. The claimed purchase frequency for the new product is corrected in a much better way, using the Nielsen database (consumer panel).
3. QUARTZ estimates are based on two types of consumers: the "switchers" --consumers deciding to buy the new product instead of one of their usual products-- and the "new buyers", buying the new product "in addition". This makes it possible to introduce competition, and estimate a preference between the new product and the usual products: from this standpoint, QUARTZ is more similar to ASSESSOR.

A classic QUARTZ test follows the traditional concept-use test procedure:

- Presentation of a concept-board with no competition (similar to BASES), indicating the main features of the product, consumer benefits and price per consumer unit.
- Immediately after, an open-ended question determines for each consumer the set of potential competitive products.
- Based on this competitive set, measurement of preferences between the new product and existing products, using a "ranking" process.
- The new product is given to any consumer having a non-zero probability of trying it, for in-home test under regular conditions.
- After use, the same set of questions is asked, i.e. competitive set and preferences through a rank order.

The data is input into the sales computing module, after having been adjusted for overestimations.

3.1. The sales volume calculation model.

For each consumer, the purchases made in the product category to which the new product belongs are distributed over the time according to a Poisson process:

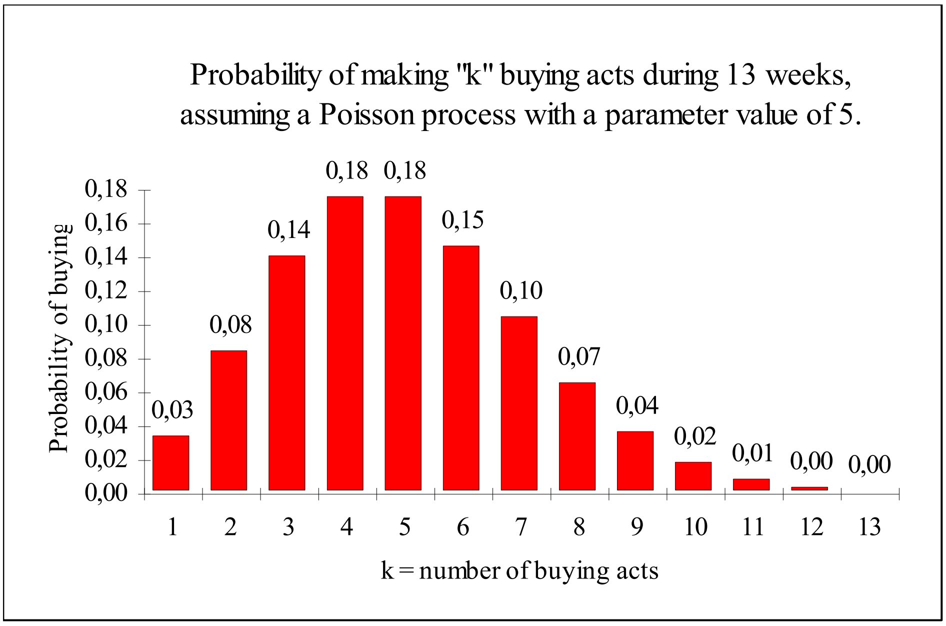
$$P(k,\lambda) = e^{-\lambda} \frac{\lambda^k}{k!}$$

with

k: number of purchases
λ: parameter of the Poisson process. This is the average number of purchases made by the consumer in a given period of time.

[11] QUARTZ was built by Nielsen, with the help of Abel Jeuland, Professor of Marketing at the University of Chicago and Albert Bemmaor, Professor of Marketing at ESSEC (Paris, France).

Such an assumption makes it possible to determine the full sequence of consumer purchases in the PC during a given period of time, as shown in the following graph, knowing only the average number of purchases made during a period of time:



There is a probability of 0.18 of making 5 purchases during this 13-week period.

The most important advantage of such a Poisson process is that further computations are relatively easier to make with a single parameter "λ".

However, it must be pointed out that the behavioral assumptions underlying this process are not very realistic. In brief, this process assumes that the consumer has no "memory"[12]: even if he usually buys once a month, having made a purchase at week "t" means he still has a non-zero probability of buying the week immediately after.

QUARTZ relies on two main figures:

Θ_T: measurement of the probability of trying the product among a set of competitive products (first purchase).

Θ_R: measurement of the probability of repeat buying after having tested the product in-home (further purchases), among a set of competitive products.

Independence between Θ_T and Θ_R. This assumption made by QUARTZ means (1) that trial and repeat are two nested events (one cannot repeat purchase without first trying the product) and (2) that knowledge of a trial by a consumer will provide no information on his/her propensity to repurchase the product. Both events (trial and repeat) are the outcome of separate consumer information processing.

Knowing on the one hand for a consumer "j" the full sequence of the purchases in the product category to which the new product belongs, and on the other hand the probability of choosing the new product at every purchase, then it is possible to estimate the number of times a new product will be bought by this consumer "j". This number is simply, at the individual level "j", given by:

$$n_j = \lambda_j \Theta_{jR}$$

[12] This is why the NBD model does not apply to products "bought regularly" (such as bread, cigarettes, etc.).

The main question is now to aggregate consumers, in order to produce final sales volume figures, taking into account marketing inputs such as distribution build or media plan.

This aggregation is done according to the following rules, integrating heterogeneity among consumers with marketing inputs:

1. There is an "availability" function, depending both on media exposure and distribution level, such a function being a continuous function:

   $$A(t) = r\,(1 - e^{-kt})$$

   "r" is a parameter to be estimated based on the distribution build given by the manufacturer as well as the media plan.

2. The individual λ parameters are distributed in the population according to a Gamma function.

3. The individual probabilities Θ_T and Θ_R are distributed in the population according to two different Beta functions.

Using these assumptions, it is possible to determine the distribution of the total purchases for a given period of time (usually two years), based on the computation of the probability of making a purchase at successive moments, "t_1" (time before the first purchase), "t_2", "t_3", etc.:

$$g(t_1) = \int_0^{t_1} a(u).f(t_1 - u).du$$

$$h(t_2) = \int_0^{t_2} g(u).f(t_2 - u).du$$

$$l(t_3) = \int_0^{t_3} h(u).f(t_3 - u).du$$

etc.

with $a(t) = r.k.e^{-k.t}$ and $f(t_i) = \lambda.\Theta_R.e^{-\lambda\Theta_R t_i}$

With such a procedure, it is possible to compute the total purchases that will be made for the new product, these purchases coming from different "sources" (i.e. the product classes to which the new product belongs).

Similar to the other models, QUARTZ primarily computes the distribution of the purchases over the time, quantities being estimated at the end with an assumption on the average quantity bought at every purchase.

3.2. Estimating procedures.

One of the main objectives is to estimate the preference between the new product and the potential competitive products given by the open-ended question.

This preference is estimated at the individual level through the following steps:

- Buying intention of the new product: only the "positive" respondents (i.e. the top two boxes) are retained for the rest of the interview, assuming that for the other respondents, the probability of buying (i.e. try or repeat) is near zero.

- The preference is deduced from a complete ranking of the competitive brands and the new product. The rank "*r*" obtained is transformed into a probability *P* by:

$$P = \frac{p(1-p)^{r-1}}{1-(1-p)^{n}}$$

where

P = probability of buying the new product (which is simply Θ_T before use and Θ_R after use of the product).

r = rank order obtained by the new product in the respondent's complete ranking.

n = total number of brands mentioned by the respondent in a given product class (a particular respondent may mention several product classes)

p = parameter to be estimated for every product class. This parameter describes how easy it is for a new product to enter the product class.

Estimation of "*p*". The estimation of "*p*" is based on the Nielsen consumer panel, the most frequently bought brand at the individual level being assumed to be ranked first in a complete ranking. A least-square procedure is used to derive "*p*" from the panel data.

The frequency of buying the new product is **deduced** from (1) the purchase frequency of the product class to which the new product belongs and (2) the preference between the new product and existing products. Knowing Θ_T before use and Θ_R after use of the product is sufficient to compute sales, according to the previous assumptions about the heterogeneity in the total population.

This model has been abandoned by Nielsen. Today (September 2006), Nielsen has bought BASES and is running it all over the world.

4. MARKET MIND[13] ®, a model made in France by INTERSTAT in connection with IN VIVO.

This model was designed in the late 1990s, when technology had improved and computer memory had achieved huge capacities, much larger than in the 1970s when BASES and ASSESSOR were built. The main result is that probability functions generating statistical distributions are no longer necessary, as it is possible to anticipate every individual respondent's buying behavior in a sample of potential users.

Two assumptions are made by MARKET MIND:

a) This is a "substitution model", similar to ASSESSOR. A new product will replace, partially or totally, existing products used by a consumer (the "relevant set"). Therefore, it is necessary to define in advance a product category (PC) to which the

[13] MARKET MIND ® was written by Alain Marechal, Associate Director of INTERSTAT.

new product belongs as the set of potential products to be substituted.

b) Potential users of the new product are present buyers of the PC[14]. This point may be a source of questions about the "non-buyers", when it can be reasonably assumed they may be potential buyers as well (see hereafter § 4.3.4. The non-buyers question).

The main principle of MARKET MIND is to "frame" a micro-modeling approach with aggregated data coming from two different sources:

a) Households panel and Retail Audit for the PC
b) IN VIVO experimental store for the new product.

Before describing the adjustment procedures, we must explain why these two sources are systematically in disagreement.

4.1. Household panel and retail audit: inconsistencies.

In a "perfect world", the following equation holds:

(Total volume) = (Number of households) × (Penetration in %) × (Average purchase frequency) × (Average quantity per purchase).

Retail Audit directly measures total volume (left side), other sales components (right side) being measured by a household panel. And because these two instruments are not perfect, many discrepancies occur between the volume given by Retail Audit and the volume given by household panel.[15]

The first objective of MARKET MIND is to "reconcile" Retail Audit with household panel, to avoid having two different volumes for a common PC. The following assumptions are made:

a) Retail Audit provides the most accurate volume. Some exceptions may arise, but this assumption can be considered as acceptable in 95% of the cases.

b) Household panel usually misses purchases, for many well-known reasons. It is first considered that, at the PC level and for a period of at least 12 months, average quantities are correctly measured by the household panel.

c) Adjustment factors can be related either to penetration[16] or to the average number of purchases (average purchase frequency). Adjustments are made for every case in particular, after careful examination of all available data provided by a manufacturer.

At the end of the process the previous basic equation holds, allowing full use of adjusted sales components to determine the right volume of the PC. This is necessary because the model determines what share of the PC the new product will take as a result of estimating its sales components.

4.2. IN VIVO experimental stores.

The main principle of these experimental stores is to place a consumer in a "natural" environment (i.e. similar to the usual environment in a super-market in France), and to

[14] In a PC, "Private Labels" have to be treated differently: experience says that people buying Private Labels are less inclined to buy branded products made by manufacturers.
[15] Household panel does not give a volume directly: volume has to be deduced from a "volumetric index", a way to disguise the lack of accuracy of a household panel from this standpoint.
[16] The number of households in a country is assumed to be known.

observe his/her behavior when "buying"[17] a product from the PC to which the new product belongs.

A respondent is asked to "shop as usual" using a shopping cart and a large "shopping list" which includes products in the PC under investigation.

Apart from behavioral elements (duration of the purchase, hesitation, etc.), two main indicators are derived:

a) The "shelf impact": proportion of people having seen the product on the shelf when buying a product in the PC. This indicator is obtained through a direct question: every respondent is required to look at a photo of the shelf and point out which products they saw when shopping.

b) The "buying rate": proportion of people having "bought" (i.e. put in the shopping cart) the product during the shopping trip in the experimental store.

These two elements are theoretically more reliable than usual declarations of intent, as they are closer to purchase behavior in real conditions when the new product is launched. Measuring the first purchase in a "real" environment means focusing on the trial act, implicitly assuming than repeat purchase is not a big issue when the initial purchase has been made under normal conditions (i.e. not under special offers, sampling, etc.). However, a phone call is necessary after a period of home use, when repeat may be subject to some variations depending on the quality of the product.

4.3. Adjustment procedures.

4.3.1. PC adjustment: sample representativeness.

Obtaining a full representative sample is absolutely necessary: sample sizes are usually quite small (less than 300 for a basic cell), and the model is supposed to be able to project sales volumes two years hence. The meaning of "representativeness" is that the sample must be able to reproduce the present volume of the PC only with usual questions adjusted as described hereafter.

The model is based on a sample of PC users. Non-users may be also interviewed, but separately with another questionnaire (see below § 4.3.4. The non-buyers question). A "user" is defined as a household (in general, a housewife) having bought one of the PC products at least once in the past 12 months.

PC purchase frequency is asked of each respondent, leading to a number of purchases per year, as follows:

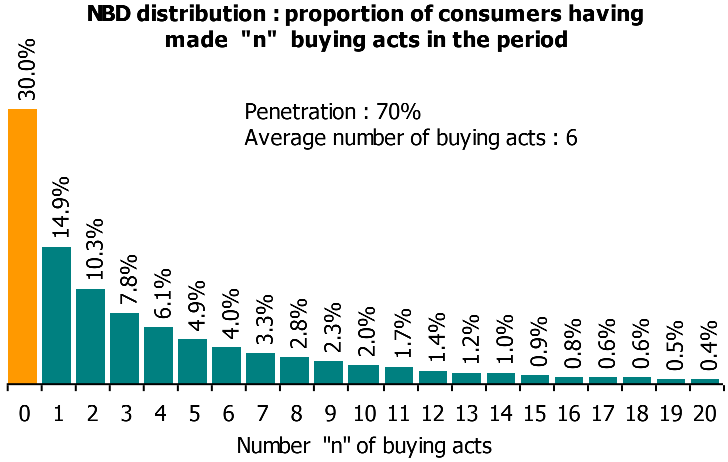
Purchase frequency scale	Number of purchases per year
Once every week or more	52
2 or 3 times a month	24
Once a month	12
2 or 3 times a year	2
Once a year	1

The distribution of this number of purchases per year in the sample must be equal to the distribution from a household panel, after adjustment. When the household panel does not

[17] There is no real purchase, in that the respondents do not have to pay for any products. The assumption is that it is sufficient to place a consumer in his/her usual "shopping environment" to obtain natural buying behavior.

give the same distribution directly, the NBD approximation[18] is used to build the distribution knowing only penetration and average frequency per year.

More precisely, the NBD gives the proportion of consumers having bought the PC exactly 1, 2, 3, times during the period.



Using such a distribution as a benchmark, the sample distribution is adjusted in order to fit with the benchmark. This adjustment leads to a change of the number of purchases associated with a claimed purchase frequency. For instance, "once every week" will mean 17.6 purchases for the sample of respondents after adjustment, instead of the theoretical number 52, which is simply the direct translation of the scale level into an equivalent number of purchases per year.

4.3.2. Adjustment for the buying rate: probability of buying.

A first value of the probability of choosing the new product among a set of competitive products is given by a "propensity scale", mixing both purchase intent and intended purchase frequency. This 5-point scale is labeled as follows:

1. Every time (8, 9 or 10 times out of 10)
2. Often (5, 6 or 7 times out of 10)
3. From time to time (3, 4 or 5 times out of 10)
4. Rarely (1 or 2 times out of 10)
5. Never (0 out of 10)

As a starting point, initial probabilities are attached to each level of this scale:

80% / 60% /30% /10% / 0%.

With these two sets of values, it is possible to derive a "weighted average value" as the average probability of buying at the sample level. If the respondents used exactly the same probabilities as those initially attached to the 5 scale levels, this "weighted average value" should be equal to the number of people having bought the product during the shopping trip.

Due to usual overestimation, this average value is almost always larger than the number of buyers observed in the shopping trip. Taking the proportion of buyers as the "true" average value of the probability scale, probabilities attached to each of the 4 levels are "revised" in order to adjust the two average values.

---

[18] This point has been largely developed by A.S.C. Ehrenberg, *Repeat-Buying: Facts, theory and applications*. (1972), Second Edition, Charles Griffith & Co. Ltd, London.

4.3.3. Building individual buying sequences.

An individual buying sequence is the result of combining 4 conditional probabilities:

a) P1: probability of buying the PC. This is given at any point in time by the respondent's adjusted purchase frequency, according to his/her declared purchase frequency in the questionnaire. (see above § 4.3.1. PC adjustment).

b) P2: probability of finding the product. This is given by the WD at any point in time. A distribution of $x\%$ means a probability of $x\%$ of finding the product when shopping.

c) P3: probability of seeing the product on the shelf. This is given by the impact on the shelf, as defined after the IN VIVO shopping trip. It is assumed that this probability is the same for every respondent. It can be modulated according to the rank of the purchase, using different probabilities for the initial purchase (trial) and further repeat purchases.

d) P4: probability of choosing the new product among a set of competitive alternatives, after adjustment of the propensity scale based on the buying rate. (See § 4.3.2 above).

These probabilities are conditional: for instance, P2 can be $\neq 0$ only if P1 is $\neq 0$.

4.3.4. The non-buyers question.

More and more, a new product is expected to attract current non-buyers of a PC, thus extending the whole category. Distributors also increasing ask for this information.

Assuming no further question on the precise definition of exactly what is a "non-buyer", two assumptions are made regarding this population:

a) They will not try the product without being exposed to prior advertising.

b) Non-buyers purchase intent obtained with the propensity scale has to be adjusted in the same way as for buyers (see § 4.3.2. above. Adjustment for the buying rate: the probability of buying): over-claiming is not related to the buying behavior for a given PC.

4.4. Final aggregation leading to usual indicators.

The main objective is to achieve the same table as for the households panel (see § 3.2.above: Repeat-purchasing rate) with all purchases for a sample of respondents over a two-year period, allowing a simple and straightforward computation of indicators traditionally used in the new product area, such as penetration, repeat-purchase rates, purchase frequency, etc.

These usual indicators result from an aggregation process of individual purchase sequences. Building these individual sequences means that every variable able to influence purchase behavior is automatically taken into account. This is the case for PC purchase frequencies, leading to "heavy" or "light" buyers, which are fully taken into account by individual purchase frequencies (see p. 27 above, "criticism of BASES").

Other variables, maybe of less importance, are also taken into account: gender, age of children and more generally the family size, total income, etc. Usually, these variables are taken into account by the representativeness of the sample, leading to sampling both PC users and PC non-users, which is less cost effective.

4.5. The advertising model (cf. Appendix below for more technical details).

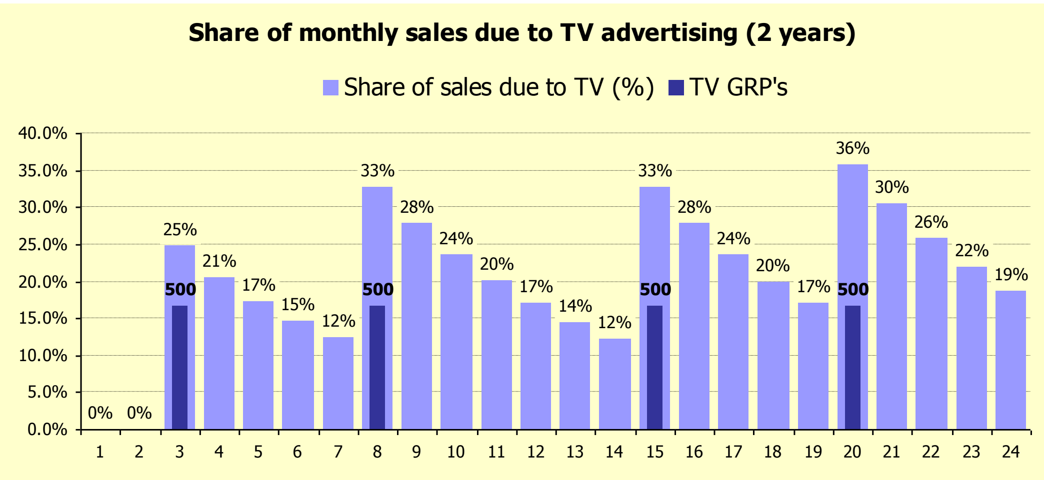
A sub-model has been set up for advertising, taking into account the two aspects of advertising in a new product launch:

1. The "exposure" effect as the effect of being exposed to an advertisement concerning the new product (also called "copy effect"). This effect is measured by comparing two sub samples, one being exposed and one being non exposed to advertising, on all the parameters driving sales volume such as buying rates, shelf impact, propensity scales, quantities per purchase, etc.

2. The "media effect": this is the number of people exposed to advertising according to the media schedule associated with the new product introduction on the market. This media effect takes into account a decreasing cumulative effect of advertising, as mentioned by several authors having worked in this area.

By combining these two effects over the 2-year period we can compute an advertising effect on sales for each of the 24 months.

Hereafter is an example of a very successful advertising campaign for a new product launch in the food area.



In month 3, when spending 500 TV GRPs, 25% of total sales are due to advertising. This proportion rises to 36% in month 20, when the cumulative effects of previous investments are added to the 500 GRPs invested this month.

This sub-model has been repeatedly validated with sales data from manufacturers.

4.6. Validations.

Making a decision to introduce a new product on the market carries an uncertainty factor and is subject to error:

	The new product is a success one year later	The new product does not meet sales objectives one year later
Decision (1): introduce the new product on the market	OK	Type I error
Decision (2): stop the new product launch process.	Type II error	OK

Decision (2): there are only potential outputs. The new product would have been a success one year later, or would not have met sales objectives (i.e. if it had been introduced on the market). Type II error can sometimes be appreciated when a competitor has taken the risk to introduce a similar product with success.

Type I error is easily observable, simply by reading the Retail Audit one year later.

At this point in time (September 2006), 184 cases have been validated by Clients since the introduction of this model in 1993. Among theses cases, 91% forecasted a volume within ± 9% of the observed volume[19].

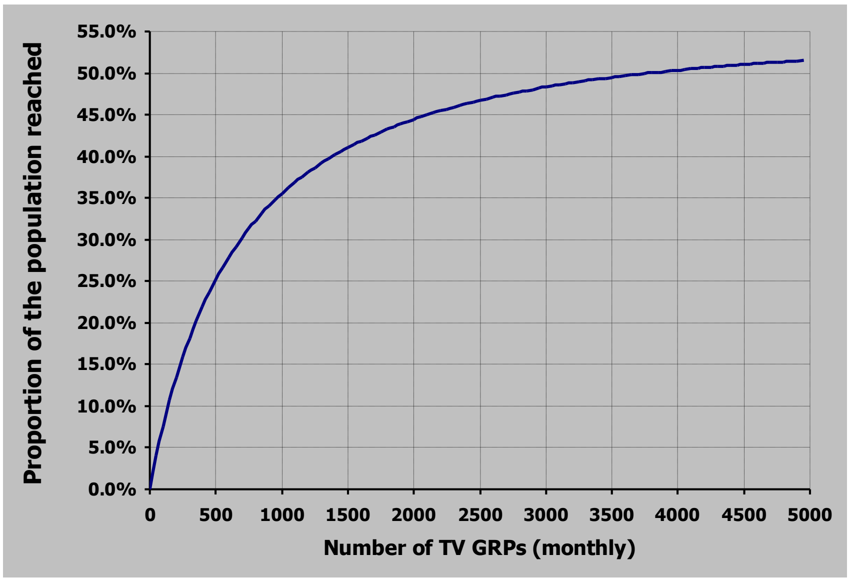
Some technical aspects of the "advertising" sub-model used in MARKET-MIND: the "media" effect.

The "media" effect requires a combination of two different pieces of information:

a) A first part defining a correspondence between the amount of TV GRPs (or equivalent monetary units) spent in a given month and the proportion of the population reached by advertising. For instance, it is necessary to know that 25% of the population will be reached with a 500 GRPs TV campaign in a given month[20].

   This correspondence is given by the following mathematical function, *X* being the amount of monthly TV GRPs, *a*, *b* and *c* constant parameters and *Y* the proportion of the population reached by a TV advertising campaign:

$$Y = \frac{c\left(1 - e^{bX}\right)}{1 - a \cdot e^{bX}}$$



[19] This has been obtained after having "re-run" the model with the observed values for marketing activities (distribution build, advertising, promotions, etc.)

[20] Such a number is for instance the typical result of advertising tracking used as a post-test of a monthly advertising campaign. This proportion is different from traditional criteria provided by "reach and frequency" type models: this has to be considered as a measurement of the recall of a recent advertising campaign.

b) A second part taking into account the lag effects of a monthly investment (sometimes called "ad-stock" effect). This part has been inspired by numerous authors having developed this theory in advertising research. The basic idea is an investment made at month t continues to have an effect at months $t + 1$, $t + 2$, etc. This can be illustrated as follows: