Statistical Quantification of Gain Analysis in Strategic Management

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Summary- In this paper we have pointed out gain matching based on probabilistic approach. Gain prediction based on plotting is also depicted. We have also cited an idea of pattern analysis of arrival of related gain estimate with reliability justification at specific instants of time. Testing of randomness of sequence of gain pattern is also shown. Artificial intelligence based pattern matching has also been applied.

I. Introduction

Gain analysis plays a pivotal role in case of optimum business planning. Quantification of gain prediction is the pillar of success in terms of risk reduction as well as throughput upgradation. In forecast based strategic planning, randomization of gain is to be sensed and its relative decision support system is to be generated accordingly.

II. Sensing Randomized Gain Pattern

Let mapping function \( y_i \rightarrow g_i \) for \( i=1 \) to \( n \) be sensed for consecutive \( n \) years where \( y_i \) is \( i \)th year and \( g_i \) be its relative gain. Aim is to achieve \( g_{opt} \) such that \( |g_i - g_{opt}| \) tends to zero after \( g_k \) onwards, \( k \) being the year of successful pattern sensing. Let in a particular time slot, \( I = (I_1, I_2, I_3, \ldots, I_n) \) be the set of matched gain estimates. We observe all possible sequences consisting of \( x \) number of elements and \( y \) number of different estimates. Hence, \( x+y = n \). The collection of the various sequence of patterns of information element leads to the observation process in the light of sampling distribution\[1\]. Hence, mean = \( M = \frac{2xy(x+y)}{x+y} + 1 \) and variance = \( V = \frac{[(2xy(2xy-x-y))}{((x+y)^2(x+y-1))} \).

A. Statistical analysis of prediction

Let the time-stamp of gain sensing be at \( t_1 \). We want to concentrate on only those gain estimates which will be matched. The recognition is continued till timing instant \( t_2 \).

Case I : No information is matched:

Let \( X(t) \) be the probability of no matching in time \( t \) to \( X(t+t') \) will be that in time \( (t+t') \). Hence, \( X(t+t') = X(t)[1- \varepsilon \ t'] \) where \( \varepsilon \) is the constant of proportionality.

\[ \lim_{t\rightarrow 0} \frac{X(t+t')-X(t)}{t'} = - \varepsilon \ X(t) \]

or, \( X(t) = a e^{-\varepsilon t} \), where \( a \) is a constant of proportionality.

Case II : If only one or many gain estimate is matched:

Let \( X_1(t) \) be the probability that one gain estimate is recognized successfully. So \( X_1(t+t') \) id that in time \( t+1 \). It may happen that in time \( t \) no matching occurs while it occurs in \( t' \). The reverse may also occur.

Hence, \( X_{M}(t) = X_{M}(t') = 0.5 \) = equally probable.

where \( X_M(t) \) is probability of successful match in \( t \) and \( X_M(t') \) is that in \( t' \).

\[ X_{M}(t) = a e^{-\varepsilon t} + b e^{-\varepsilon t} \]

where \( b \) is another constant of proportionality.

If \( b = 0 \), \( X_{M}(t) = a e^{-\varepsilon t} \)

In generalized form, if \( n \) number of successful gain patterns are observed in time \( t \), then

\[ X_{M}(t) = \frac{(\varepsilon t)^n e^{-\varepsilon t}}{n!} \]

III. Gain Prediction in The Light of Graphical Plotting

If the matched gain estimates are arranged in random order or haphazardly then there is some method for prediction based on some curvical nature \[2\]. We assume that the estimates follow the equation of some normal curve. Hence the position can be calculated by changing the variables of the equation of the curve at different timing instant. We can even do clustering, so that, instead...
of element detection we can concentrate on cluster detection, thereby minimizing search overhead.

We can predict the position of a particular gain estimate if there is a relation between the position of a particular timing instant and the value of the timing instant. If we have the idea of position of estimate at two timing intervals then we can predict value of the position of the estimate both at the midway position and also the extreme position, provided the matched estimates are in equidistant form. If they are not in equidistant form, in that case the incoming estimate is examined with respect to the curve fitting between the earlier estimates in accordance with exponential curve form. N’s represent the gain estimates while cv’s represent the curves.

![Diagram of curve fitting between estimates](image)

**Fig.1. Curvical nature in the light of exponential form.**

**Theorem 1:** If there bears a relation between positions of an estimate with a particular timing instant, then the same relation is valid, if the estimate is present in the midway position.

**Proof:** Let the equation for determination of estimate is 
\[ P_{N,t} = M e^{at} \]
where \( P_{N,t} \) is position of element at a time instant \( t \).

‘M’ and ‘a’ are constants.

We further assume that estimates are \( N_1, N_2, N_3, \ldots \) and so on.

Therefore, \( P_{N_1,t_1} = M e^{at_1} \) and \( P_{N_2,t_2} = M e^{at_2} \)

So, the midway interval time is \( (t_1+t_2)/2 \).

Now, 
\[
\begin{align*}
(P_{N_1,t_1} \cdot P_{N_2,t_2})^{1/2} &= \left( (Me^{at_1} \cdot Me^{at_2}) \right)^{1/2} \\
&= [Me^{a(t_1+t_2)}]^{1/2} \\
&= Me^{a(t_1-t_2)/2} = P_{N_1(t_1-t_2)/2}
\end{align*}
\]

Hence, we conclude that the same relation is valid in midway position, in this case \( S_1 \) indicates the midway position of the curve connecting \( N_1 \) and \( N_2 \) gain estimates.

**Theorem 2:** To determine the position of a gain estimate in respect of first curve, concept of exponential growth or decay is valid.

**Proof:** Let the first curve \( CV_1 \) passing through estimates \( N_1 \) and \( N_2 \) is exponential curve satisfying equation,
\[ P_{N_1} = M e^{at} \]

Now estimate \( N_3 \) has to be examined with respect to curve \( CV_1 \), whether it is exponential growth (charging curve) or decay (discharging curve) curve emanating from \( N_1 \). 

In Fig. 1, \( N_1 \) is connected to \( N_3 \) and the curve is exponential decay type, satisfying the equation, \( P_{N_3,t} = M e^{-at} \).

Therefore the curve fitting between the estimates \( N_1 \) and \( N_3 \) is \( CV_2 \) exponential decay curve consisting of new estimate \( N_3 \).

Similarly, in case of estimate \( N_4 \), it is exponential growth type, satisfying \( P_{N_4,t} = M e^{at} \) equation.

**Theorem 3:** If a particular timing instant the position of gain estimate is in form of arithmetic mean of two intervals and position of another estimate is in the form of their harmonic mean, then square root of the product of these two means reveals the geometric mean of the two timing instants.

**Proof:** We assume that \( t_1 \) and \( t_2 \) are two timing instants. Let at \( t \) arithmetic mean is valid act at \( t' \), harmonic mean is valid.
\[ P_{N,t'} = (t_1+t_2)/2 \quad \text{and} \quad P_{N,t''} = 2/(1/t_1 + 1/t_2) \]

Hence, 
\[ P_{N,t'} \cdot P_{N,t''} = t_1 \cdot t_2 \]

\[ (P_{N,t'} \cdot P_{N,t''})^{1/2} = (t_1 \cdot t_2)^{1/2}, \quad \text{which is geometric mean of} \ t_1 \text{and} t_2. \]

**IV. Gain Analysis With Reliability Justification and Likelihood Estimate**

**A. Concept**

Let the gain patterns be \( G_1,G_2,\ldots, G_n \). The business transactions by involving the patterns be \( A_1,A_2,\ldots, A_n \) show the reliability of condition assuming that some of the patterns are optimum among the set of all the patterns. We assume the following business transactions are dependent on the respective patterns. We further assume that out of the patterns \( G_1, G_2 \) and \( G_5 \) jointly can generate optimized gain of \( A_1 \). Similarly \( G_3, G_4 \) can deliver optimized gain estimate for \( A_2 \). While \( G_6, G_7 \) for \( A_3 \).

<table>
<thead>
<tr>
<th>Business transactions</th>
<th>Gain Patterns</th>
</tr>
</thead>
<tbody>
<tr>
<td>( A_1 )</td>
<td>( G_1, G_2, G_3 )</td>
</tr>
<tr>
<td>( A_2 )</td>
<td>( G_3, G_4 )</td>
</tr>
<tr>
<td>( A_3 )</td>
<td>( G_6, G_7 )</td>
</tr>
</tbody>
</table>
B. Estimation in series form

**Corollary 1:** Let, in a given set there are n₁ and n₂ reability factors, and G₁, G₂ are their respective geometric means, then the geometric mean (G) of the combined set of reability measure is given by \( G = (G₁^{n₁} \cdot G₂^{n₂})^{1/(n₁ + n₂)} \)

**Proof**

Let, \( r_{11}, r_{12}, \ldots, r_{n₁} \) be the values of reability factor of the first gain pattern set, while \( r_{21}, r_{22}, \ldots, r_{n₂} \) be those of second one. Then,

\[
G₁ = (r_{11} \cdot r_{12} \cdot \ldots \cdot r_{n₁}) \quad \text{or} \quad r_{11} \cdot r_{12} \cdot \ldots \cdot r_{n₁} = G₁^{n₁}
\]

In the similar way, \( r_{21} \cdot r_{22} \cdot \ldots \cdot r_{n₂} = G₂^{n₂} \)

Hence the product of \((n₁+n₂)\) values in the combined set is equal to \( G₁^{n₁} \cdot G₂^{n₂} \). It’s therefore, evident that the geometric mean \( G \) of the combined set is given by,

\[
G = (G₁^{n₁} \cdot G₂^{n₂})^{1/(n₁ + n₂)}
\]

C. Estimation over time in exponential form

**Corollary 2:** If reability factor \( r \) exchanges over time \((t)\) exponentially, then the value of the variable at the midpoint of an interval \((t₁,t₂)\) i.e at \((t₁+t₂)/2\) is the geometric mean of its values at \( t₁ \) and \( t₂ \).

**Proof**

Suppose \( rt = ab^2 \)

Also, the value of \( r \) at \((t₁+t₂)/2\) is,

\[
ab^{(t₁+t₂)/2} = (ab^{t₁})^{1/2} = (ab₁)(ab₂)^{1/2} = (r₁ \cdot r₂)
\]

D. Estimation in terms of likelihood

Suppose the gain distribution \( f(g; g_{opt}) \) of a random variable \( g \) involves a parameter \( g_{opt} \) whose value is unknown, and we want to make a guess about (or to estimate) the value of \( g_{opt} \) on the basis of a random sample \( r₁, r₂, r₃, \ldots, rₙ \) of size \( n \) drawn on from the various gain patterns[3]. For this, we use a suitably chosen statistic \( t = g(r₁, r₂, \ldots, rₙ) \), i.e. a function of the sample observations. It’s a random variable whose value is completely determined by the sample values. Now, for a given sample \( r₁, r₂, \ldots, rₙ \), the value of \( t \) is \( g(r₁, r₂, \ldots, rₙ) \); it’s simply a number and it’s taken as the guess for the value of \( g_{opt} \). The statistic \( t \) is called an estimator of \( g_{opt} \) while the value of \( t \) is obtained from a given sample and is called an estimate of \( g_{opt} \). Naturally, for \( t \) to be a satisfactory estimator of \( g_{opt} \), the difference \( |t - g_{opt}| \) should be as small as possible. \( E(t) = g_{opt} \), whatever the true value of \( g_{opt} \) may be i.e. \( Var(t) ≤ Var(t') \), whatever the true value of \( g_{opt} \) may be, where \( t' \) is any other estimator. This reveals minimum deviation towards achieving optimum gain pattern \( g_{opt} \).

V. Gain Pattern Matching in Artificial Intelligence Domain

We assume that the parameters required for delivering gain estimate \( G₁ \) be \( P₁, P₂ \), that for \( G₂ \) be \( P₃ \) and \( P₄ \), and for \( G₃ \) be \( P₅ \) and \( P₆ \). Let the computed or predicted efficiency is \( Ec \), while the optimum preknown efficiency is \( Ep \). So, as I \( Ep - Ec \) is large, it implies that the deviation of the computed value from the biased values (optimum value is termed as bias value). Hence the model for this particular estimate[4,5] is as follows:

VI. Conclusion

The paper deals with several gain estimates which play a crucial role in strategic business planning thereby reducing risk estimate. We have given statistical modeling of gain estimate sensing and related equation based pattern matching has also been cited. In this context gain analysis with reliability justification and likelihood estimate is also pointed out in the paper. Finally artificial intelligence based gain computation has been realized.
References

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