DYNAMICS OF BUSINESS TOOLS

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Businesses thrive on the basis of good decision making. Decisions require a logical and rational approach to process business intelligence. Whereas genius is the uncanny ability to intuitively hit upon the best solution, the rest of us need analytic tools. Business managers deploy both qualitative and quantitative tools backed with past experience. To achieve its objectives of tracking, forecasting and decision-making, a business entity relies on some form of business analytics (BA).

Business Analytics

The three main categories of BA are descriptive, predictive and prescriptive. Descriptive analytics is the use of data to figure out what happened in the past. Predictive analytics uses data to find out what could happen in the future. Prescriptive analytics evaluates new ways to operate, balances constraints and targets to determine the best course of action. These three frequently overlapping methods produce reports that analyze trends, models for forecasting and design of business processes.

Another class of quantitative methods is operations research (OR). It is a toolbox of highly mathematical techniques, the application of which requires computers. In a business, OR is used to solve the problem of choosing the best solution from a given set of alternatives, under special circumstances or constraints. Optimization and simulation methods belong to this specialization.

In what follows, we present a selective review of business applications, illustrative studies and dynamic business tools.

Market Analysis

Market analysis describes structure, growth prospects, trends and volumes. At the macro level, one studies economy-wide or industry-level trends, fluctuations and makes projections. For an individual business entity, market research and analysis

help define business prospects, establish pricing, distribution and promotional strategies. Potential market share is a benchmark that tells the manager how well his business is doing *vis-a-vis* market-planning projections.

Financial Ratios

Financial ratios are mathematical numbers that break down the information on a company's financial statements. Reports of financial ratios are descriptive: they measure the company's ability to meet short-term obligations, profitability on sales, assets which generate revenues and so on. Not only can financial ratios provide indicators for internal reviews, but they also enable comparison to other companies. Ratios below the industry standards or benchmarks allow business owners and managers to focus on areas to make improvements in their business. In short, financial ratios are useful in tracking (a) snapshots of a company such as its strength and performance and (b) comparisons with a benchmark – be it the company's own past performance, another company, the industry or a pre-set target.

A series of financial indicators covering a suitably lengthy period of time, find use in business forecasting. Forecasts provide estimates for future production, output or sales revenue. Predictive BA helps to make plans for purchasing economic resources and other inputs needed to produce goods and services. Financial analysts use the data series for risk management and portfolio allocation.

Sales Performance

A common forecast method is the "percent-of-sales." Percent-of-sales calculates an estimate for the cost of goods sold and expenses for a specific time period. Business owners and managers base these percentages on a sales figure, which can represent a previous time period or an average trend of gross sales.

Case Study 1

Consider a FMCG company with nation-wide reach and a large sales force. Sales personnel are allotted specific regions and monthly sales targets. Every month-end the sales manager receives this information: Three sets of monthly sales data are

recorded for (1) individual salespersons (2) each region (3) country-wide. The sales manager is hard put to elicit a clear picture or to evaluate performances directly from this stream of raw sales data. However it is imperative to detect substandard performers and to pinpoint trouble spots as quickly as possible. He sets up, in consultation with the business analyst, a simple yet efficient sales performance tracking system:

Quarterly moving averages are computed and updated for the 3 sales data every month end. With these 3 smoothed time series several types of useful analyses become possible:

For example, every salesperson who falls below the target level appears on the Underperformers List, reverse ordered according to the shortfall. Automatically the worst performing individuals are identified for remedial action. The best performers too are highlighted, for rewards and emulation. A similar classification of the second series allows comparative analysis of regional performances. The third series indicates the trend in aggregate sales of the company as well as a quick sales forecast for the forthcoming month.

Thus, even a simple quantitative method like moving averages becomes a handy business tool.

Dynamic Economic Theory

When economists talk about dynamics, they mean changes in an economic system over time, particularly those reflected in the behavior of markets, businesses or the general environment.

Because there are modifying forces always at work, economic phenomena are intrinsically dynamic – that is, subject to change over time. Hence a dynamic approach to the analysis of business information is more realistic rather than static methods. The dynamic characteristic of economic phenomena was recognized in the late 19th century by Cournot and others. Economists of the 20th century made great contributions to dynamic economic theory, which is essentially a study of changing economic relationships.

Application of Dynamic Methods

Notwithstanding advances in dynamic theory, static equilibrium continued to rule the roost in practice. Henry Moore, a contemporary of Irving Fisher, was among the pioneers who broke new ground. His quantitative work on business cycles and trend analysis via trend ratios was perhaps one of the early attempts to model the concept of dynamic equilibrium. Since then, mathematical methods have become indispensable tools for the development of dynamic economic models. After the advent of IT, dynamic methods that integrate economic theory, mathematical tools and information technology (IT) are the norm to make business sense out of information.

In today's corporate world the collection, storage, transmission and presentation of voluminous data involves complex dynamic processes. Collectively labelled Business Intelligence (BI), they are computer-based techniques to spot, digout, and process 'hard' business data. These reports are dynamic too, changing to reflect changes in the business environment.

Models

Models are quantitative tools built on a foundation of economic theory. They are capable of analyzing internal and external business information and can be put to multiple uses: combine many factors in a single integrated picture, forecast business indicators, compare alternate business plans. Tools like decision trees, game theory and supply-demand functions calculate how the company will operate under specific conditions. They may take into account competitors, probability of success and consumer behavior. Models are also used to study multiple outcomes (what-if analysis). Different information can be fed into the model to simulate a best-case, average and worst-case scenario.

Whether the business analyst uses time series, regression functions or other methods to analyze business information, the underlying task is the same: given that quantitative relationships change through time, how best to incorporate dynamism and flexibility into the model framework.

Ripple Effects

Since cause and effect do not necessarily occur in the same time period, outcome at time t may be affected by what happened one or more periods earlier in time - that is, at time t-1, t-2 and so on. Such a behavioural relationship requires dynamic models with lagged variables.

Case Study 2

Take the case of the price of milk (Y) which is affected by consumer demand (X) so that Y=f(X). On a particular day, there is a rumour that the milk supply may stop due to a transport strike. On day 1, only a few people hear the rumour and decide to buy more milk. The increased demand results in a hike in the price of milk. On day 2, more consumers come to know and react similarly. On day 3, the news percolates throughout the market and the ripple effect raises the price even higher. Thus consumer demand (X) impacts the price (Y) in 3 successive ripples X(t), X(t-1) and X(t-2) so that we have a single-equation dynamic model

$Y(t) = b0 + b1X(t) + b2X(t-1) + b3\ X(t-2)$ where $0<b1<b2<b3$

It postulates that the price of milk varies dynamically due to consumer demand during 3 consecutive time periods. The parameters b1, b2 & b3 measure the individual influence of demand on day t, t-1 and t-2. The *a priori* hypothesis regarding the retail market for milk suggests that b2 and b3 will have a greater impact than b1.

Case Study 3

Contrary-wise, consider a model for the weekly retail price of onions P, where X is the supply of onions from the farmers.

$P(t) = b0 - b1X(t) - b2X(t-1) + b3\ P(t-1)$

This model postulates that the current and last week's market arrivals influence the retail price of onions to go down. Unlike Case Study 2, here b1 is hypothesized to have a stronger influence than b2. Moreover, because prices tend to be sticky downward, last week's price will have a positive influence on current price.

Structural breaks

Unlike short run fluctuations, a structural break is a one-time, sudden change in the environment which has a lasting effect.

Case Study 4

Company X uses its weekly sales and the retail market price as a guide to the quantity of the product to keep in stock. They use a demand curve based on price P which has a negative impact on sales Q. At a particular point in time, say at t=k, a major competitor entered the market with an imported product. In company X, demand began to fall. Its sales forecasts based on the existing demand curve, overshot the mark. Consequently inventories piled up. The company suspects that its demand curve is no longer valid. Apparently the market structure has altered due to the arrival of the new competitor.

Has the event changed the demand curve? If so, in what manner? Is the change transient or long-term? How can the company obtain a reliable demand forecast? Standard statistical methods are available to seek answers to the above questions.

In a longitudinal model, a structural break shows up as a sudden, unexpected shift from the historic pattern at a particular time point t=k. In the presence of a structural break, prediction errors tend to become huge and persistent, unlike random errors which cancel out over time. Therefore a structural break renders the time series model unreliable for predictive purposes beyond t=k.

In such a situation, one wants to confirm that there is indeed a structural break. If we have a regression model, Chow's F-test for the equality of two sets of beta-coefficients is a logical place to begin the investigation. If the test confirms it, one option is to modify the regression function by introducing a suitable dummy variable in the regression to factor in the structural break. If the data series, post-break, is sufficiently long, fitting two separate regressions is a better alternative.

Case Study 5

Consider the linear regression line $Q=f(P) = A - BP$. Now suppose that we suspect a structural break at point t=k. We want to test whether the data supports this supposition.

A) The longitudinal data series is split at t=k, to give us 2 series. Two regression fits are obtained to represent the relationship before and after the point k.

With k-1 observations: $Q = A1 - B1(P)$ .... (1)

With n-k +1observations: $Q = A2 - B2(P)$ .... (2)

We could conduct different statistical tests of significance, depending on the hypothesis we postulate. Four possible hypotheses and corresponding statistical analysis are indicated below:

- It is a lateral shift in the relationship → A (intercept) has changed...Test of significance under the Null A1=A2.
- The force of impact has changed →B (slope) has changed ... Test of significance under the Null B1=B2.
- Both of the above → A and B have changed ... Joint test of significance for both the regression coefficients.
- The relationship itself has broken down → Q<> A-BP... Look for a new relationship Plot a scatter diagram for the period t>=k and. Is it non-linear? Is there another explanatory factor that has emerged?

B) Suppose there is insufficient data to fit regression (2). In this situation, one could introduce a dummy variable d in the original regression, to catch the impact of the supposed structural break at t=k.

With all n observations: $Q = A+BP+Cd$ ...(3)

A test of significance of the coefficient C will show whether the data supports the structural break hypothesis.

Time Series

Time series has been described as a sort of one-way train that never comes back. Change in a time series has several characteristics – magnitude, direction, shape and velocity. Tracking its path, discerning meaningful patterns such as cyclical or

temporal; and lastly, predicting where it is headed – this is the aim of time series analysis. How effectively can an analyst depict changes in business data over time?

Static Approach

Trend-adjusted smoothing of a time series is a standard analytic procedure. By way of illustration, suppose that a business analyst has a sufficiently long quarterly data series on industry demand for a product. Applying trend-adjusted smoothing, he is able to obtain reliable quarterly forecasts.

Now suppose that a new event occurs in the industry, affecting demand. Is it possible to measure the effect in the subsequent quarter, using the same trend-adjusted time series model? Compare the actual demand with the forecast; the difference may be attributed to the new event. But is it a structural change which has shifted the demand curve or is it a temporary blimp which will soon subside? Observe this difference for a few quarters. If it continues to seem substantial, a statistical test of significance on the difference of means will throw light on the question.

The above analysis relies on *post facto* snapshots, which is essentially a static approach to a dynamic situation.

Dynamic Approach

Business and macroeconomic time series often show strong relationship with their own past values. One may posit that all the past causal effects of the explanatory variable X, as well as that of any other omitted variables, are contained in Y(t-1). The following time series model does that.

$$Y(t) = b0 + b1X(t) + b2Y(t-1)$$

By changing X(t) to X(t-1), we get a model that relies only on the immediate past information that is more readily available to the business analyst.

$$Y(t) = b0 + b1X(t-1) + b2Y(t-1)$$

The above are the most basic forms of a lagged-variable model. Such a model may be used for quick business forecasting, where time is of the essence. They perform well only in a stable environment.

Time series analysis offers us sophisticated tools such as random walk, time-varying parameters, and co-integration to build complex dynamic models. Advanced applications include modelling movements of business cycles, dynamics of business failures and stock price fluctuations.

Caveats

- An intricate model specification is not necessarily the best choice.
- A good understanding of economic theory and market behavior are pre-requisites for a dynamic quantitative model to be effective as a business tool.
- Resource constraints preclude the use of complex models for day-to-day business analytics.
- Obtaining a statistically robust model is an ongoing process.
- Predictive BA is fraught with danger: not only are markets volatile by nature, they are known to spring nasty surprises. Past performance is no guarantee for the future!

Dynamic Business Models

A business model is a road map that specifies how an enterprise plans to achieve its goals. To enable strategic advantage and to focus on differentiation are key aspects of a good business model. This, in turn, drives the design of business processes in finance, marketing and operations.

Dynamic business modelling (DBM) recognizes that businesses are not static; they evolve and change over time. DBM achieves strategic advantage by focused differentiation. An open mechanism allows the business model to dynamically re-invent itself. The underlying business processes too are automatically enabled to adapt. The capital resources of the enterprise must get

suitably re-allocated to exploit its physical, human and technical capabilities. In short,

strategy → models → design of processes → re-allocation of resources

The core principles of DBM are the following:

1. Business strategy drives selection of business models.
2. Business models drive the design of underlying processes
3. Enterprise software automates these services and processes.
4. DBM enables innovation: tuning and re-defining the present business model.

BA is critical to the successful implementation of DBM. Enterprise software such as CRM and ERP dynamically automate and advance the business processes and services that lie behind business models.

Business model innovation is a powerful tool for DBM. One way to bring in dynamism into a business model is hypothesis testing with experimentation. In this approach, you establish a hypothesis about what you should be doing and design a way to test it. Having measured the appropriate metrics, you will follow the "learn and adapt" process thereby integrating the dynamic element into the business model.

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