Statistical applications in enterprise management

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Fishery based enterprises

Enterprises in fisheries sector are many and support the fishing, processing and marketing activities. They are ancillary industries which are mostly run either as small or medium scale enterprises. Fishing activities requires hardware inputs like fishing craft, gear, engine, etc. which are supplied by small and medium scale enterprises. The commercial construction of fishing boats is carried out along the coastal belt as a cottage industry. Likewise engine, ottor boards, sinkers, floats and other accessories are manufactured by small and medium production units.

Fish has been distributed all along in a traditional way to the consumer as fresh fish through its domestic marketing network all over the country. When we talk of processed fish in the domestic market it is the dry fish which is sold in retail fish market as well as in grocery and petty shops. Changing lifestyles and increasing number of working women has aided the fast food and convenience products market in a big way. Food business, per se, both snack food and convenient food products is industry a well established sector which has grown manifold during the past three decades. Fish based food industry is in its initial years and is yet to establish though certain companies are producing and marketing branded convenience and snack foods through super markets. R & D initiatives in this area has opened up opportunities for potential entrepreneurs in the area of fish value addition.

Statistics and Enterprise management

Micro, small and medium enterprises play a major role in the economy of our country. They generate considerable employment and sustain livelihood of millions. They have demonstrated considerable strength and resilience in maintaining a consistent rate of growth and employment generation during the recent global recession and economic slowdown. The typical small dimension of firms operating in traditional fields has both positive aspects as well as points of weakness. Though small dimension implies more flexibility and a faster ability to adapt to changing environments, there may be bottlenecks while adopting innovations and performing R & D activities.

Statistics plays a major role in decision making and management of enterprises. Suppose a production unit for sale of fish based products is planned in a particular location. Baseline data on the fish production, species of fish available locally, their prices and seasonality has to be analysed for sustaining the production in the long run. The cost of production has to be ascertained for deciding product prices and price analysis of similar products in the market has to be carried out to compete in the market. Consumer preferences have to be evaluated to decide upon the type of products to be promoted.

To determine the volume or quantity of production, the entrepreneur has to assess the market potential for his products. Once the production unit is established and business has picked up momentum, for expanding it, time to time sales forecasts has to be computed which is again by analyzing the data on sales and revenue. For effective management of the enterprise, benefit-cost analysis has to be carried out.

Big data and analytics can play a major role in Enterprise Information Management. Globally, the volume of available data in all the sectors has continued to double every three years as information pours in from transactions, social media, sensors in the physical world, and billions of mobile phones. Data storage capacity has increased, while its cost has plummeted. Data scientists now have unprecedented computing power at their disposal, and they are devising ever more sophisticated algorithms that can instantly sift through troves of data to find patterns and reveal insights. The upshot of all this innovation is that decisions no longer have to be based on gut instinct, or subject to human error. Algorithms can make them instantly and consistently, drawing on a mountain of evidence. Systems enabled by machine learning can provide customer service, manage logistics, analyse medical records, or even write news stories. Few applications of statistical techniques in enterprise management are discussed below.

1. Market potential

While introducing new innovative products into a market across a segment of consumers, it is imperative that market potential for such products is studied in advance. One common failure, quite often found in new business ventures, is the failure to assess the overall market potential.

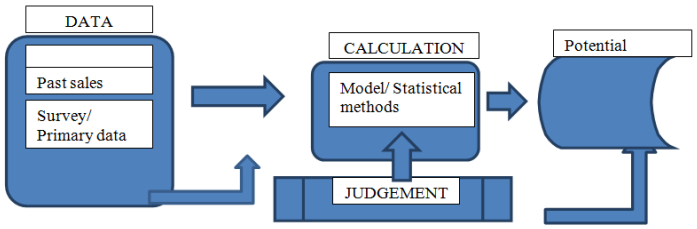
Market potential is the entire size of the market for a product at a specific time. It represents the upper limits of the market for a product. Market potential is usually measured either by sales value or sales volume. For example, the market potential for sports bicycles may be worth Rs.50,00,000 in sales each year. On the other hand, the market potential for motorcycles may be 500,000 units each year, which is a measure of sales volume rather

than sales value. It has to be kept in mind that market potential is just a snapshot in time. It's a fluid number that changes with the economic environment. For example, rising and falling interest rates will affect the demand for products that are typically financed, like cars and houses.

Market potential estimates serve to

- Make entry/exit level decisions
- Resource level decisions
- Make location & other resource level decisions
- Set objectives and evaluate performance
- Use as an input to forecasts

Determining the market potential of a product is part of a successful marketing process and requires marketing research. First step is to examine at least three factors that will determine whether the market potential of the product is worth the investment. Analysis of the potential customer base, competition and current environmental conditions that may affect market potential has to be carried out.



The second step is to assess the size and demographic characteristics of potential consumers, population size of target market, their product preferences and their median annual household income. This step will tell the number of potential customers and whether they can actually afford the product.

Regression analysis, which is used to predict the value of one variable from the value of another variable, is one method used to arrive at a market potential estimate. Multiple regression is used when there are two or more independent variables that can affect the estimated results of a dependent variable.

For example, in real estate business, suppose the market potential for building new homes in a city has to be assessed. Market for new homes is basically dependent upon how well the overall economy is doing. Suppose it is assumed that new home construction and sales will increase proportionally as the overall gross domestic product (GDP) goes up. The overall market for new homes can then be forecast using historical data

related to new home completions and estimated GDP numbers. The following table shows the number of new home completions, in thousands, over an 8-year period starting in 2009. In addition, it shows the GDP and the average employment rate for those years.

Table 1 : No. of home completions versus GDP & Employment

Year	Units (no. in '000)	GDP	Employment rate
2009	794	14.42	90.1
2010	651	14.96	90.7
2011	584	15.52	91.5
2012	649	16.16	92.1
2013	764	16.69	93.3
2013	883	17.43	94.4
2015	966	18.12	95.0
2016	1059	18.62	95.3

It should be noted that the analysis of market potential does not attempt to estimate the percentage of a market that a company can expect to obtain. The market potential is an estimate of the entire market under consideration though it may be focused on a particular country or region where the company expects to do business.

If we use only the GDP numbers, then the single regression formula for new home sales, in thousands, can be derived as:
Units = -663.7 + (88.4 * GDP)
However, we can also incorporate the overall employment numbers, in which case the associated multiple regression formula is:
Units = -2239.9 + (59.2 * GDP) + (22.1 * Employment)

Multiple regressions allow any number of independent variables to be added to the equation. For example, we could add individual savings rates as another term in the analysis if we thought that savings were an important predictor of new home sales. Using the appropriate or most relevant prediction factors is an important consideration, and will ensure that the model used for prediction purposes is not underspecified.

To know how much the Company will actually sell the demand for the product should be estimated. Then the Company can be geared up to meet the demand by making the basic infrastructure and production set up. If executives overestimate the demand for a product, the company could end up spending money on manufacturing, distribution, and servicing activities

it won't need. Especially when it comes to fish and fishery products where storage time is a matter of concern estimating the market demand should be precise.

Underestimating the demand can also be just as devastating. When a company introduces a new product, it launches marketing and sales campaigns to create demand for it. But if the company isn't ready to deliver the amount of the product the market demands, then other competitors can steal sales the firm might otherwise have captured. Sony's inability to deliver the e-Reader in sufficient numbers made Amazon's Kindle more readily accepted in the market; other features then gave the Kindle an advantage that Sony is finding difficult to overcome.

2. Forecasting sales

Once the marketing executive has an idea of the market potential, the company's sales potential can be estimated. A firm's sales potential is the maximum total revenue it hopes to generate from a product or the number of units of it the company can hope to sell. The sales potential for the product is typically represented as a percentage of its market potential and equivalent to the company's estimated maximum market share for the time period.

Simple regression trends including non-linear fail to capture the variability inherent in a market. This is often true when one is looking at a seasonal data. A time series analysis is a tool which attempts to account for any internal structure such as seasonal fluctuations that may be inherent in the data.

A common first step is to determine market potential, or total industry-wide sales expected in a particular product category for the time period of interest. (The time period of interest might be the coming year, quarter, month, or some other time period.)

Time series techniques examine sales patterns in the past in order to predict sales in the future. For example, with a trend analysis, the marketing executive identifies the rate at which a company's sales have grown in the past and uses that rate to estimate future sales. For example, if sales have grown 3 percent per year over the past five years, trend analysis would assume a similar 3 percent growth rate next year.

3. Cost Control

For expanding the company's market share of an enterprise, cost management and cost control are effective ways to obtain benefits. Statistics

has important significance and role in enterprise development, therefore, statistics of cost control need to be paid more attention during the process of enterprise development. Statistics applications in business management and cost control, will change the company's cost control system, build statistical indicators system to improve quality control.

For example, while running a small scale fish production unit, overhead costs generated is treated with statistical analysis, statistical mathematics table is formed as below:

Table 2 Cost Analysis for a small scale production unit (inputs)

Month	Cost of Fish purchased (Rs.)	Cost of other ingredients (Rs.)	Cooking Fuel cost (Rs.)	Maintenance cost (Rs.)	Rent (Rs.)	Loan repayment (Rs.)	Transportation cost (Rs.)
January 2016	30000	13500	15500	2000	6000	9500	2400
February 2016	35000	14200	18000	2100	6000	9500	2800
March 2016	32000	12900	16500	3200	6000	9500	2400
April 2016	29000	11600	13500	2000	6000	9500	2600
May 2016	34500	15000	17500	2500	6000	9500	3000
June 2016	36000	16500	18400	2000	6000	9500	2400

Statistics in management cost control of enterprise development can summarize the company's cost information and provide the enterprise management department with detailed cost statistics information, so as to help business managers and leaders to make the right decisions for the development of enterprises based on the statistical information of cost.

As the competition among enterprises continue to increase, in order to enhance their market competitiveness, boost economic efficiency of enterprises, enterprises need to strengthen internal management and cost control. The statistics applied to business management and cost control, can provide a detailed cost balance sheet for the business managers, realize

effective implementation of cost control, reduce costs and provide economic efficiency of enterprises, so as to promote the development of enterprises.

4. Investment Decision-Making Criteria

The Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return are certain criteria which tell the profitability of the enterprise and enable the entrepreneur to make management decisions.

Net present value (NPV) is determined by calculating the costs (negative cash flows) and benefits (positive cash flows) for each period of an investment. The period is typically one year, but could be measured in quarter-years, half-years or months. After the cash flow for each period is calculated, the present value (PV) of each one is achieved by discounting its future value (see Formula) at a periodic rate of return (the rate of return dictated by the market). NPV is the sum of all the discounted future cash flows. Because of its simplicity, NPV is a useful tool to determine whether a project or investment will result in a net profit or a loss. A positive NPV results in profit, while a negative NPV results in a loss. NPV is used in capital budgeting to analyze the profitability of a projected investment or project. NPV is the difference between the discounted present value of future benefits and the discounted present value of future costs.

NPV = PV (Benefits) – PV (Costs), *(if NPV ≥ 0, accept if NPV < 0, reject)*

Benefit/cost ratio (BCR) A benefit-cost ratio (BCR) is an indicator, used in cost-benefit analysis, that attempts to summarize the overall value for money of a project or proposal. A BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. All benefits and costs should be expressed in discounted present values. A BCR can be a profitability index in for-profit contexts. Benefit cost ratio (BCR) takes into account the amount of monetary gain realized by performing a project versus the amount it costs to execute the project. The higher the BCR the better the investment. General rule of thumb is that if the benefit is higher than the cost the project is a good investment.

BCR = PV (Benefits) / PV (Costs), *(if BCR ≥ 1, accept if BCR < 1, reject)*

Internal rate of return (IRR) is a method of calculating rate of return. The term *internal* refers to the fact that its calculation does not involve external factors, such as inflation or the cost of capital.Normal investment cash flows the NPV curve slopes downwards from left to right. At some point the curve intersects the horizontal axis. That is, it becomes "0". The discount rate at which the NPV becomes "0" is called the Internal Rate of Return (IRR).

when IRR ≥ r, then accept

and when IRR < r, then reject
where r = the interest rate (cost of financing the project)

Corporations use IRR in capital budgeting to compare the profitability of capital projects in terms of the rate of return. For example, a corporation will compare an investment in a new plant versus an extension of an existing plant based on the IRR of each project. To maximize returns, the higher a project's IRR, the more desirable it is to undertake the project. If all projects require the same amount of up-front investment, the project with the highest IRR would be considered the best and undertaken first.

5. Evaluating consumer preferences

The emerging fast food culture among the young and affordable has brought focus on processed food and its demand in the domestic food market in India. Domestically, spending on food and food products constitutes the largest portion of the Indian consumer's spending – more than a 31% share of wallet. Evaluation of consumer preferences before introducing a new product will help the marketer to refine the product for better reach.

Conjoint analysis is a popular technique used in marketing research to study the features a product should possess to have a wide consumer reach. Conjoint analysis was initially conceptualized by Luce and Tukey (1964) and further developed by Green and Rao (1971) for marketing research. It employs a decompositional method to estimate the structure of consumer preferences and consumer utility values of different attributes of a product or service. It is a decompositional method that disaggregates the structure of consumer preferences into utility values. The relative importance of a product can also be estimated using this method.

Products possess attributes such as price, color, ingredients, guarantee, environmental impact, predicted reliability, and so on. Consumers typically do not have the option of buying the product that is best in every attribute, particularly when one of those attributes is price. Consumers are forced to make trade-offs as they decide which products to purchase. Consider the decision to purchase a car. Increased size generally means increased safety and comfort. The trade off is an increase in cost and environmental impact and a decrease in gas mileage and maneuverability. Conjoint analysis is used to study these trade-offs.

If products are composed of attributes, conjoint analysis determines which combination of attribute levels are most preferred by consumers. Consumers indicate their preferences by ranking a number of different combinations of

attribute levels. Conjoint analysis assumes that consumers make purchases by simultaneously considering several attributes of a product. The ability to analyze several attributes at once distinguishes conjoint analysis from traditional market research methods where each attribute is studied separately. Usually, conjoint analysis consists of a main-effects analysis of variance with ordinally scaled dependent variables. Consumer preferences are the dependent variables, and product attributes are the independent variables. The following are some of the questions that can be answered with a conjoint analysis.

- How important is each product attribute to consumers?
- Which existing products do consumers prefer?
- What combination of product attributes do consumers prefer most?
- How well will my product do in the current market?

Conjoint analysis is based on a main effects analysis-of-variance model. Subjects provide data about their preferences for hypothetical products defined by attribute combinations. Conjoint analysis decomposes the judgment data into components, based on qualitative attributes of the products. A numerical part-worth utility value is computed for each level of each attribute. Large part-worth utilities are assigned to the most preferred levels, and small part-worth utilities are assigned to the least preferred levels. The attributes with the largest part-worth utility range are considered the most important in predicting preference. Conjoint analysis is a statistical model with an error term and a loss function.

Metric conjoint analysis models the judgments directly. When all of the attributes are nominal, the metric conjoint analysis is a simple main-effects ANOVA with some specialized output. The attributes are the independent variables, the judgments comprise the dependent variable, and the part-worth utilities are the β's, the parameter estimates from the ANOVA model. The following formula shows a metric conjoint analysis model for three factors:

$y_{ijk} = \mu + \beta_{1i} + \beta_{2j} + \beta_{3k} + {}_{ijk}$

where $X\beta_{1i} = X\beta_{2j} = X\beta_{3k} = 0$

This model could be used, for example, to investigate preferences for cars that differ on three attributes: mileage, expected reliability, and price. The y_{ijk} term is one subject's stated preference for a car with the ith level of mileage, the jth level of expected reliab ility, and the kth level of price. The grand mean is μ, and the error is e_{ijk}. The predicted utility for the ijk product is:

$\hat{y}_{ijk} = \hat{\mu} + \hat{\beta}_{1i} + \hat{\beta}_{2j} + \hat{\beta}_{3k}$

Nonmetric conjoint analysis finds a monotonic transformation of the preference judgments. The model, which follows directly from conjoint measurement, iteratively fits the ANOVA model until the transformation stabilizes. The R square increases during every iteration until convergence, when the change in R square is essentially zero. The following formula shows a nonmetric conjoint analysis model for three factors:

$\Phi(y_{ijk}) = \mu + \beta_{1i} + \beta_{2j} + \beta_{3k} + e_{ijk}$

where Φ(yijk) designates a monotonic transformation of the variable y.

The R square for a nonmetric conjoint analysis model is always greater than or equal to the R square from a metric analysis of the same data. The smaller R square in metric conjoint analysis is not necessarily a disadvantage, since results should be more stable and reproducible with the metric model.

Metric conjoint analysis was derived from nonmetric conjoint analysis as a special case. Today, metric conjoint analysis is probably used more often than nonmetric conjoint analysis.

In the SAS System, conjoint analysis is performed with the SAS/STAT procedure TRANSREG (transformation regression). Metric conjoint analysis models are fit using ordinary least squares, and nonmetric conjoint analysis models are fit using an alternating least squares algorithm (Young 1981; Gifi 1990).

6. **Big Data for Enterprise Management**

The technology revolutions that has happened over the several years now in the area of communication has led to the extensive use of mobile and internet. This has created huge volumes of data which are indicators of consumer behaviour and their interests. Entertainment, transport, banking, information technology, medical services, e-commerce, hospitality are few sectors which have undergone tremendous transformation by utilising big data to expand their customer base.

For example, ride-sharing services such as Uber has cashed on geospatial mapping technology efficiently to match passengers with the nearest available driver in real time and maintains its database of customers in cities around the world.

Handling and evaluating data with the right analytical tools will generate value. Granular data about individual characteristics and behaviour can be used to customize products and services. Above all, data and analytics can improve the accuracy and transparency of decision making, a capability with

far-ranging potential in everything from managing complex urban environments to making public policy decisions. Data Scientists, now armed with superior computing power and vast amounts of omni-channel data, are in a position to deliver business insights at lightning speed.

Big data in sales & marketing With Big Data enabled customer analytics, marketing and sales departments are well positioned to derive insights from omni-channel customer experiences. Price optimization is possible because of Big Data algorithms and Advanced Analytics techniques.

Big data in supply chain management Traditional supply chain systems were driven by statistics and measurable performance indicators. The slow and gradual integration of Big Data technologies in supply chain Data Management has aided effective decision making in times of emergencies. Efficient management of warehouses and distribution centers is possible when data-centric Enterprise Information Management is implemented.