The Relative Efficiency for Benchmarking Advertising Expenditure-An Alternative Approach

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Abstract

Efficient use of advertising expenditure is critical in determining the profitability of many companies because advertising leads to increase in sales volume. If the sales volume is not proportional to advertising expenditure, it may be viewed that a good share of advertising expenditure goes waste. Therefore, challenges before today's advertisers are to identify and eliminate the sources of advertising inefficiency. In order to identify advertising inefficiencies, it is absolutely necessary on the part of advertisers to measure the advertising efficiency. However, in the process of measuring advertising efficiency, managers face extreme difficulties in defining an efficiency score as it involves multiple inputs and outputs. This paper uses a non-parametric technique known as Data Envelopment Analysis (DEA) to measure the technical efficiency of advertising expenditure. A sample of leading forty-eight companies is taken for the analysis. The methodological demonstration is made by using the data for two consecutive years i.e. 2003 and 2004, collected from the secondary source. A comparative analysis is also made between the results. The paper also aims to find the best practices and benchmark for each company in context of advertising expenditure.

Key Words : Advertising Expenditure; Data Envelopment Analysis (DEA); Efficiency; Benchmark; DMUs

Introduction

The efficient use of advertising expenditure is critical element in determining the profitability of many companies. The right media mix and proper budget allocation to each of these mixes can lead to increased sales and profits. The recent trend shows a general decline in the manufacturing expenditure whereas the marketing cost is going up (Sheth and Sisodia, 1995). However, in difficult economic climate and budget constraints among the first expenses to be reduced are marketing spending (Weber, 2002). From marketing perspective, marketing cost usually refer to advertising and promotion (Ambler, 2000). Some empirical

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evidence suggests that in long term, advertising has a positive effect on differentiation and brand equity, while this is not the case for promotion (Boulding et al., 1994; Jedidi et al., 1999). So from the marketer's perspective advertising is more important. It is a known fact that a good pie of the advertising expenditure goes waste and for some companies, the level of waste can go up to 407% of the net income (Bass and Frank, 1979). It is rightly said by famous retailer, John Wanamaker, that "Half of every dollar spent on advertising is wasted; the problem is I just don't know which half" (Cheong and Leckenby, 2006). The statement shows the need for measuring the advertising efficiency and identification of sources of inefficiency. The previous study shows that advertising works, but problem is on overspending in advertising. MPA (Magazine Publishers of America) and Hudson River Group ***(www.magazine.org)*** in their release about media mix measurement study found that the brands that spent a higher percent of their marketing budgets on advertising, as evidenced by their media spending, received a higher return on their overall marketing investment. So the scenario is, consumers are becoming more demanding seeking quality products at lower prices, thus placing emphasis on efficiency in marketing; on the other hand, marketing managers are usually evaluated in relation to the efficiency/productivity of their functional area (Bush et al., 2002).

As huge amount of money is spent on advertising and advertising has long term impact on brand establishment marketers are concerned about the inefficiency in advertising expenditure. Companies are interested to know the effectiveness of each media used for advertising, identifying the possible sources of inefficiencies, setting the benchmarks for performance improvements. This paper uses a non-parametric method known as Data Envelopment Analysis (DEA) to find the technical efficiency of advertising expenditure made by top forty-eight U.S. companies. The purpose of the paper is to demonstrate DEA as a methodology for measuring the advertising efficiency. DEA has been chosen as appropriate technique for the analysis because it can deal with the concern in the marketing literature that advertising expenditure decisions are often made with competitors in mind (Rust et al., 2004). Sheth and Sisodia (2002) call for a design for a marketing system that covers both efficiency ("doing things right") and effectiveness ("doing the right things"). Moreover, they claim, the efficiency of marketing expenditures must be measured relative to competitors in the industry as well as benchmarks established in similar industries. The result also shows the sources of inefficiencies and benchmark unit for each of the company.

Literature Review

The starting point of the efficiency is Farrell's (1957) paper on the concepts of efficiency and their computations (Farrell, 1957; Forsund and Sarafoglou, 2000). Michael James Farrell's paper gave insight to two issues i.e. how to calculate the benchmark technology & efficiency measures. The story of data Envelopment Analysis began with Edwardo Rhodes Ph.D dissertation research at Carnegie Mellon University School of urban and public affairs (Now the H. J. Heinz III School of public policy and management) under the supervision of W. W. Cooper (Despotis and Smirlis, 2002). This work was on estimating the relative efficiency of schools involving multiple inputs and outputs. This paper leads to formulation of a model now popularly known as CCR model (Charnes, Cooper & Rhodes, 1978). Charnes et al. used the developments made in the linear programming techniques to generalise the Farell single output/input technical efficiency measure to the multiple input-output cases by constructing a single virtual output to a single virtual input relative efficiency measure. The advantage is, CCR model is readily computable using the standard LPP. The literature review on the applications of DEA suggests many applications in efficiency analysis in service organization but not many applications were found in measuring the advertising efficiency. Luo and Donthu (Luo and Donthu, 2001) had used Data Envelopment Analysis (DEA), to measure and benchmark advertising efficiency. The paper also highlights on, how the ranking of the advertising campaigns can differ based on the output. Slack analysis was also presented to show the diagnostic power of DEA. Cheong et al. (Cheong and Leckenby, 2006), analyze the efficiency of advertising expenditures on six media Magazines, Newspapers, Outdoor, TV, Radio and the Internet, using DEA. The results reveal inefficiencies with each medium, relative to the advertisers' expenditures, and also indicate less efficiency for Radio and Outdoor advertising for these advertisers than for expenditures on Magazines, Newspapers, TV and the Internet. Stewart and Koslow (Stewart and Koslow, 1989) in their paper replicated the study of the influence of executional factors on advertising performance. Jin et.al. (Jin, Zhao and Soontae , 2006) have used a field study to investigate the effects of publicity messages related to the commercials aired during three Super Bowl games. The paper found that publicity had a positive impact on the memory of subsequent advertisements for both recall and recognition, but publicity effects were more evident in recall than in recognition. Sheth (Sheth, 1974) has examined three aspects of effectiveness of advertising communication, first how a specific advertising

communication get distorted in consumers mind, second how the advertising influence consumer choice process and third how does the advertising influence the consumption behaviour. Dertouzos and Garber (2006) have taken U.S. army data from 1981 to 1984 and found that army advertising was very productive in producing enlistments; response functions for television, radio, and magazines are consistent with widespread advertising practice; lag patterns differ substantially over media; and the army's allocation of spending across media was nearly optimal. Stankey. J.Michael (1988), observed that over advertising represents major misallocation of resources and contributes to lower profit margins for companies that engage in it. The paper recommends for increasing advertising media efficiency, and provides the suggestions for reducing the advertising expenditures, increase advertising efficiency, and subsequently-increases the financial health of their organizations.

Among the major suggestions for future research found in the above-mentioned literature survey points towards: to focus on specific industry (or product category); to use longitudinal data to measure advertising efficiency since advertising effects wear out over time. Overall, more research on benchmarking advertising efficiency is needed in order to gain better knowledge of possible ways of improving the efficiency of advertising expenditures.

Data Envelopment Analysis

Data Envelopment Analysis is a non parametric method for evaluating the relative efficiency of Decision Making Units (DMUs) on the basis of multiple inputs and outputs (Charnes, Cooper & Rhodes, 1978). The Data Envelopment Analysis approach to measure efficiency is based on Farrell's seminal paper (Farrell, 1957). The discussion and application in the name of Data Envelopment Analysis (DEA) were initiated after the work of Charnes et al and subsequent evidence can be found in the works of Banker and Cooper (Banker et.al. 1984; Cooper et.al.1999). The application of DEA is increasing day by day; a useful review is done by Luo (Luo, 2004) on three important books on DEA.

DEA is a multi factor productivity analysis model for measuring the relative efficiencies of a homogeneous set of DMUs (Talluri, 2000). DEA becomes very important when it comes to the performance evaluation of a unit in presence of multiple inputs and outputs. The problem becomes more difficult if there is complex relationship between the inputs and outputs and unknown tradeoff between them. In real life problems in such situations are common and usual statistical methods like regression analysis, central tendency etc does not provide satisfactory solutions. The efficiency score in presence of multiple input and output can be calculated using the "weighted cost approach" given by

$$\text{Efficiency} = \frac{\text{weighted sum of outputs}}{\text{weighted sum of inputs}}$$

The problem with this is that it assumes that all the weights are uniform, but DEA allows the DMUs to choose weights, which show them in most favorable light. The basic DEA model for n DMUs each with m inputs and s outputs is given by Charnes et.al. as follows

$$Max \quad \frac{\sum_{k=1}^{s} v_k y_{kp}}{\sum_{j=1}^{m} u_j x_{jp}}$$

$$s.t. \quad \frac{\sum_{k=1}^{s} v_k y_{kp}}{\sum_{j=1}^{m} u_j x_{jp}} \leq 1 \qquad \forall\ i$$

$$v_k, u_j \geq 0 \qquad \forall\ k, j$$

v_k = Weight of the given output k

u_j = Weight of the given input j

y_{ki} = Amount of output k produced by the DMU I

x_{ji} = Amount input j utilized by the DMU i

The above problem is a fractional programming problem, which can be formulated as the Linear Programming Problem and can be solved.

DEA can give very useful results to the user by providing insight to the problem and its solution like efficiency score of each of the DMUs, slack of each input and output, benchmarks for each of the DMUs. So the results from DEA can provide the advertisers useful information about how to adjust their inputs and outputs to make it efficient. In contrast to this parametric approach optimizes a single regression plane through the data, DEA offers a reference for each unit comparing it to the efficient frontier.

Data Definitions and Descriptive Analysis

Advertising expenditure data for the fifty leading advertisers during the year 2003 and 2004 was obtained from Advertising Age as given in their website

(http://adage.com/dataplace). Company profiles include advertising expenses by media-such as magazine, television, internet, outdoor and sales and operating earnings reports for 2003 and 2004.

We have taken top 50 companies for our DEA application but since there are two companies with missing information about sales so we have omitted it from the analysis. Thus the effective sample size for our analysis is 48. The data considered for analysis is given in Appendix.

Though various media are used for advertising, we have the current study has considered four media Print, Broadcast, Outdoor and Internet, which is considered to be important based on the expenditure made by companies included in the sample on these media. The print media includes advertisement made in newspaper, magazines, special issues etc., the outdoor media includes advertisement through billboard, posters, banners, hoarding etc., the broadcast includes usage of television, radio etc for advertisement and any web based advertisement is included in internet media. The parameters and the abbreviations used in the paper are shown below.

The Parameters Used and There Abbreviations.

PRT	:	Expenditure in Print media
BCT	:	Expenditure in Broadcast
ODR	:	Expenditure in Outdoor
INT	:	Expenditure in Internet
SLS	:	Annual Sales of the company

The correlation between the variables is calculated for both the year 2003 and 2004. The value of correlation gives a fair idea about the relationship between the variables. The correlation matrix for the year 2003 & 2004 is shown in Table–I and Table-II respectively.

Table I :Correlation Matrix for the year -2003

2003	PRT	BCT	ODR	INT	SLS
PRT	1	0.49*	0.22	0.45*	0.17
BCT		1	0.27	0.18	0.35*
ODR			1	0.23	0.06
INT				1	0.23
SLS					1

** Significant at 0.05% level*

Table II :Correlation Matrix for the year -2004

2004	PRT	BCT	ODR	INT	SLS
PRT	1	0.58*	0.34*	0.34*	0.29*
BCT		1	0.27*	0.16	0.35*
ODR			1	0.33*	0.14
INT				1	0.24
SLS					1

** Significant at 0.05% level*

It is interesting to note that for both years, there is average or less than average degree of correlation between the variables. For the year 2003 the highest value of correlation is 0.49, which is between PRT & BCT, the same is repeated for the year 2004. This may be a reflection to the fact that spending of companies in print media and broadcast media are in proportion. The most important factor for the advertisers is sales, for the year 2003 the highest value of correlation under SLS column is 0.35 which is between SLS and BCT, interestingly the same is repeated for the year 2004. This shows that expenditure in Broadcast has highest impact on sales figure. The lowest value in the correlation matrix for the year 2003 is 0.06, which is between SLS and ODR; similarly the lowest value of correlation for the year 2004 is again between SLS and ODR. This shows that expenditure in outdoor advertising has least impact on sales figure.

Next the Descriptive Statistics of the variables under consideration is calculated. The descriptive statistics for the variables is tabulated in Table- III

Table III : Descriptive Statistics

	2003				2004			
	MEAN	MEDIAN	IQR	SD	MEAN	MEDIAN	IQR	SD
PRT	273032.708	219364.00	225796.25	209283.7	301426.417	237754.500	283694.000	222373.5
BCT	518578.938	416760.00	403716.50	399967.7	576515.625	445610.000	407239.000	433492.9
ODR	9530.958	2706.000	13718.750	13552.86	12611.000	4042.500	19180.000	16985.5
INT	24198.208	15950.500	30904.250	28270.55	35320.292	19893.500	40893.500	39585.14
SLS	53295.917	40031.500	48432.750	52200.18	58918.063	41438.000	56513.750	58500.11

The descriptive statistics gives a fair idea about the data distribution; it is interesting to note here that there is fair amount of increase in all modes of the advertising expenditure. Considering the MEAN column it is seen that there is 10.3 % increase in expenditure on PRT, 11.1% increase in BCT, 32.3% increase ODR, 45.9% increase in INT, 10.5% increase in SLS over 2003 to 2004. It is observed that the largest increase is on advertising expenditure on Internet, which is the medium gaining popularity. The interquartile range (IQR) and Standard deviation gives an idea about the spreadness of data. The large value of IQR and SD, shows that the data is more dispersed and presence of heterogeneity in the values of variables.

Input-Output Definition

The most important consideration in DEA application is the selection of input and related output variables. The criteria of selection of inputs and outputs are quite subjective; there is no specific rule for determining the procedure for selection of inputs and outputs (Ramanathan, 2001). However to give a broad outline any factor used as the resources by the DMUs for producing something of value & also, any

environmental factor that bears a strong effect on how the resources are consumed can be considered as the input. Similarly any factor, which describes the amount of goods, services, or any other outcomes obtained as a result of the processing of resources can be taken as output. Also, any factor, which describes the qualitative nature of the resulting outcome, can be considered as the output.

So for our study we have taken all the expenditure PRT, BCT, ODR, INT as input and SLS as the output.

Analysis and Results

The analysis in this application consists of running the DEA software for calculation of efficiency score for both the years 2003 & 2004. Based on the efficiency score the new ranks are assigned to each of the DMUs. A comparison is made between ranks of 2003 and 2004.

The general output maximization CCR DEA model is used to solve the problem and get the efficiency score. We have used DEAP (Data Envelopment Analysis Programme) version 2.1 to solve the model.

The result for the year 2003 is tabulated in Table-IV and for the year 2004 is tabulated in Table- V. The first column "DMU" refers to the various companies which is considered for analysis, Column 2"Eff." lists the technical efficiency score of the DMU, Column 3 refers to the new rank through DEA analysis, the fourth column "Peers" gives the bench mark or the DMU that shall be referred by that particular DMU for improvement, the fifth column "Peer Weight" gives the weightage or importance that shall be given to these benchmarked companies, the sixth column "Peer Count" gives the peer count i.e. the number of institutes referring that particular DMU for improvement

Table-IV :Results from DEAP Version 2.1
(Output orientated DEA, Scale assumption: CRS) 2003

DMU	Eff.	New Rank	Peers	Peer Weight	Peer Count	DMU	Eff.	New Rank	Peers	Peer Weight	Peer Count
1	0.062	43	39	11.722	0	32	0.195	25	47 39	0.211 0.610	0
2	0.034	46	47, 39	2.559 4.573	0	33	0.237	18	39 47	0.272 0.582	0
3	0.062	44	47 39	2.679 2.066	0	34	0.030	47	47 39	0.164 1.326	0
4	0.644	6	21 24 39	2.334 0.277 0.020	0	35	0.253	13	47 39	0.849 0.511	0
5	0.068	41	47 39	3.869 1.703	0	36	0.562	7	47 39	1.308 0.296	0
6	0.249	16	47 39	1.059 2.272	0	37	0.083	38	47 39	0.789 0.773	0
7	0.276	11	47 39	1.714 2.044	0	38	0.074	40	24 39	0.437 0.402	0
8	0.047	45	47 39	1.633 1.960	0	39	1.000	3	39	1.000	44
9	0.203	22	39	1.296	0	40	0.205	21	47 39	0.195 0.640	0
10	0.084	37	24 39	0.486 1.910	0	41	0.019	48	47 39	0.016 0.657	0
11	0.206	20	47 39	0.697 1.273	0	42	0.065	42	47 39	0.048 0.846	0
12	0.197	24	47 39	0.513 1.194	0	43	0.968	5	47 39	0.480 0.234	0
13	0.326	8	47 39	1.190 1.395	0	44	0.112	35	47 39	2.218 0.108	0
14	0.239	17	47 39	0.914 2.038	0	45	0.252	14	39	0.130	0
15	0.155	29	47 39	0.894 1.468	0	46	0.257	12	47 39	0.007 0.282	0
16	0.151	30	47 39	0.900 1.498	0	47	1.000	4	47	1.000	34
17	0.299	9	39	1.062	0	48	0.127	32	47 39	2.291 0.098	0
18	0.118	34	39	0.566	0						
19	0.190	26	24 39	1.359 0.221	0						
20	0.173	27	47 39	0.542 1.016	0						
21	1.000	1	21	1.000	2						
22	0.099	36	21 39	0.795 0.982	0						
23	0.251	15	47 39	0.481 0.929	0						
24	1.000	2	24	1.000	4						
25	0.074	39	47 39	1.137 0.907	0						
26	0.199	23	47 39	0.386 1.275	0						
27	0.137	31	47 39	0.343 0.689	0						
28	0.123	33	47 39	0.083 0.550	0						
29	0.159	28	47 39	0.575 0.032	0						
30	0.287	10	47 39	0.500 0.807	0						
31	0.223	19	47 39	0.480 0.238	0						
Mean Efficiency = 0.266											

Table V :Results from DEAP Version 2.1
(Output Orientated DEA, Scale Assumption: CRS) 2004

DMU	Eff.	New Rank	Peers	Peer Weight	Peer Count	DMU	Eff.	New Rank	Peers	Peer Weight	Peer Count
1	0.363	20	29 23 39	0.067 1.133 0.387	0	32	0.407	17	39	0.129	0
2	0.261	30	23 39	0.680 0.006	0	33	0.240	34	39	0.086	0
3	0.072	45	23 39	0.148	0	34	0.162	39	23 39	0.001 0.039	0
4	0.341	22	23 39	0.115 0.155	0	35	0.288	27	39	0.164	0
5	0.109	41	29 23 39	0.521 0.075 0.113	0	36	0.785	3	39	0.280	0
6	0.548	12	29 23 39	2.006 1.184 0.330	0	37	0.103	42	29 23 39	0.119 0.009 0.072	0
7	0.420	15	29 23 39	1.023 0.407 0.477	0	38	0.519	13	39 24	0.020 0.107	0
8	0.086	44	29 23 39	0.140 0.079 0.085	0	39	1.000	1	39	1.000	41
9	0.178	38	39	0.250	0	40	0.662	8	23	0.512	0
10	0.251	31	39 23	0.140 0.101	0	41	0.286	28	23	0.050	0
11	0.784	4	29 23 39	0.573 0.530 0.133	0	42	0.420	16	23 39	0.118 0.022	0
12	0.383	18	12 39 23	0.062 0.520	0	43	0.466	14	39	0.302	0
13	0.549	11	13 29 23 39	0.641 0.410 0.446	0	44	0.357	21	39 23	0.014 0.142	0
14	0.746	6	29 23 39	0.956 0.547 0.375	0	45	0.857	2	23 39	0.031 0.024	0
15	0.229	36	29 23 39	0.064 0.357 0.152	0	46	0.312	23	29 23 39	0.107 0.088 0.043	0
16	0.767	5	23	1.092	0	47	0.092	43	24 39	0.047 0.169	0
17	0.307	24	39 23 29	0.289 0.063 0.415	0	48	0.278	29	39	0.055	0
18	0.296	26	23 39	0.207 0.014	0						
19	0.729	7	39 23	0.014 0.186	0						
20	0.382	19	29 23 39	0.255 0.220 0.115	0						
21	0.245	33	23 39	0.144 0.062	0						
22	0.301	25	23 39	0.269 0.034	0						
23	1.000	1	23	1.000	32						
24	1.000	1	24	1.000	3						
25	0.149	40	29 23 39	0.210 0.063 0.059	0						
26	0.619	9	23 39	0.639 0.107	0						
27	0.248	32	29 23 39	0.652 0.136 0.048	0						
28	0.183	37	39 24	0.062 0.030	0						
29	1.000	1	29	1.000	16						
30	0.553	10	29 23 39	0.216 0.246 0.178	0						
31	0.231	35	39	0.069	0						
Mean Efficiency = 0.428											

The table –IV, shows that DMU-21, 24, 39 & 47 has efficiency score of unity and comes in the first place in the year 2003. All the DMUs with efficiency score of unity brings in a tie situation, the tie breaking can be done based on the numbers of DMUs refereeing that particular DMU for improvement. Based on this DMU34 which is referred by maximum number DMUs i.e. DMU44 can be rated as best. The mean efficiency score is 0.266 which is 26.6 percent which means that, based on the DEA analysis, there seems to be a lot of capital resources wasted on advertising by the top advertisers during the 2003. The least efficiency score is .019 which is for DMU41. DMU41shall make DMU47 and DMU39 as its benchmark and shall attach a weightage of 0.016 & 0.657 respectively to these two units for improvement.

The efficiency score distribution for the year 2003 is shown in Figure – I below. There are only four DMUs which is operating efficiently. DMU43 is coming close behind with 96.8 percent efficiency. The other companies which are crossing 50 percent efficiency are DMU4 and DMU36. Rest of the companies are operating at less than 50 percent of technical efficiency.

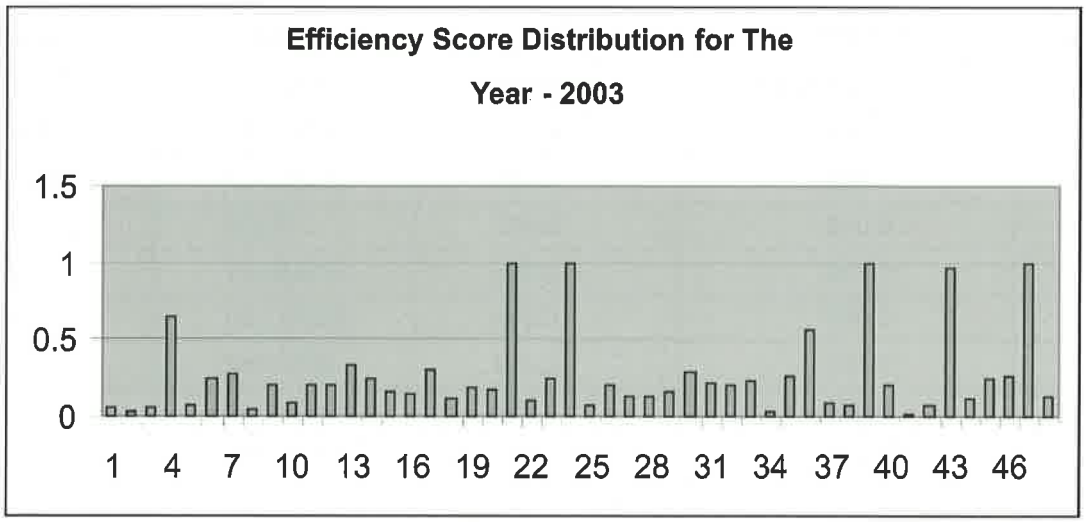


Figure I : Efficiency Score Distribution- Year 2003

An average degree of correlation is observed between the new ranks for the year 2003 and 2004. The correlation value is found to be r = 0.45 and is significant ($p < 0.005$).

To know whether there is any significant difference between the ranks assigned based on the efficiency scores of the DMUs over two years, both paired sample t-test and sign test is conducted. The result is as shown below

H_{01}: *DEARANK-2004 = DEARANK-2003*
H_{11}: *DEARANK-2004≠DEARANK-2003* E_2

	t - Value	Sig.(two tailed)	Sign statistic	Sig.(two tailed)
Comparison between Rank of 2003 and 2004	-1.37	0.1782	18	0.1839

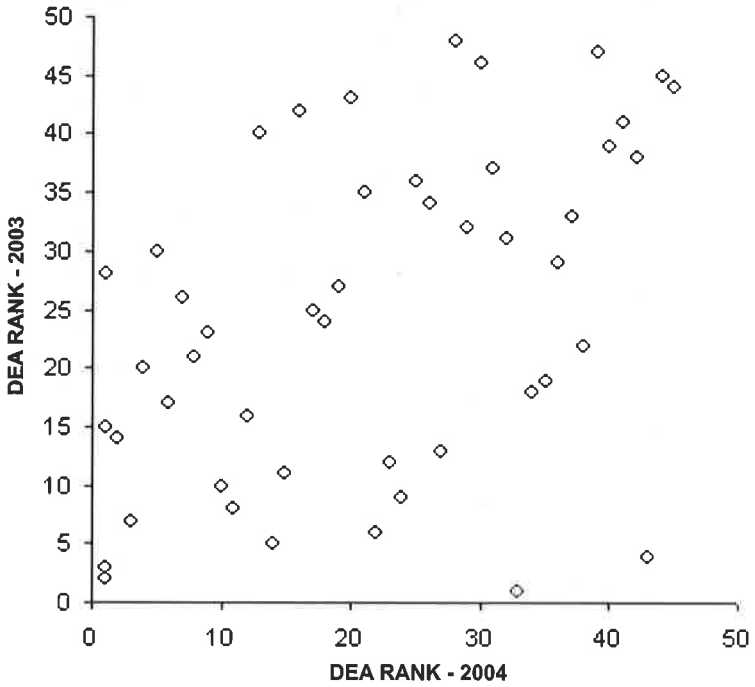


Figure II : Average Degree of Correlation Year 2008-2009

Next the slack analysis for the year 2004 is done and is shown in Table – VI. The output slack for all the companies is zero indicating that all the DMUs shall concentrate on reducing the advertising expenditure rather than increasing the sales. The slack entries in the Table implies that advertising spending in various media is in excess compared to the efficient advertisers. The slack values suggest that the management could have reduced a lot of the advertising expenditures to obtain the same output—sales thus improving the advertising efficiency.

Table VI : Slack Analysis for The Year 2004

Firm/ Input	1 (PRT)	2(BCT)	3 (ODR)	4(INT)
1	0.00010067	118.538	27566.107	40167.107
2	0.000	0.000	1799.281	8923.281
3	0.000	0.000	34498.893	149850.893
4	0.000	0.000	0.000	11412.000
5	0.000	0.000	17954.076	41635.076
6	0.000	0.000	13015.710	19782.710
7	0.000	0.000	8536.987	23051.987
8	0.000	0.000	26622.190	42769.190
9	0.000	33202.594	27681.417	31928.417
10	191198.209	0.000	0.000	8903.000
11	0.000	0.000	1794.437	12593.437
12	170064.729	0.000	0.000	24477.000
13	0.000	0.000	12236.247	46382.247
14	0.000	0.000	15171.618	68399.618
15	28593.213	0.000	0.000	44265.000
16	0.000	0.000	31068.649	31068.649
17	0.000	117875.757	3139.360	35139.360
18	0.000	330270.392	41362.415	41362.415
19	84099.848	0.000	0.000	0.000
20	0.000	0.000	28.614	28.614
21	0.000	0.000	0.000	0.000
22	0.000	831833.195	0.000	0.000
23	0.000	0.000	1695.564	1695.564
24	0.000	0.000	0.000	0.000
25	0.000	0.000	18189.138	18189.138
26	0.000	0.000	1881.246	1881.246
27	0.000	0.000	2482.746	2482.746
28	122782.421	0.000	0.000	0.000
29	0.000	0.000	262.210	262.210
30	0.000	0.000	150.199	150.199
31	0.000	0.000	25089.646	25089.646
32	182667.860	0.000	0.000	0.000
33	43090.520	0.000	0.000	0.000
34	0.000	0.000	370.787	370.787
35	0.000	0.000	1577.233	1587.23
36	0.000	0.000	490.166	490.166

Firm/ Input	1 (PRT)	2(BCT)	3 (ODR)	4(INT)
37	0.000	0.000	11768.830	11768.830
38	15812.147	0.000	0.000	0.000
39	0.000	0.000	0.000	0.000
40	0.000	0.000	249.754	249.754
41	0.000	0.000	6741.911	6741.911
42	0.000	0.000	58752.963	58752.963
43	0.000	0.000	9026.357	9026.357
44	0.000	0.000	2033.926	2033.926
45	0.000	589880.693	5657.634	5657.634
46	97598.074	0.000	0.000	0.000
47	0.000	0.000	0.000	0.000
48	0.000	0.000	353.984	353.984
Mean	19498.063	249378.774	8526.048	17269.256

It is clear from the above table that all the efficient DMUs have input slacks zero i.e. the four efficient advertisers have not wasted their advertising budget and hence all their slack is zero for each of the four parameters.

DMU18 would have to reduce $1,000 in print, $2,190,000 in broadcast, and $26,419,000 in outdoor spending and still obtain the same net sales and operating income in order to be called an efficient advertiser when compared to the 63 advertisers in the sample.

Regression Analysis

To have a deeper understanding of the relationship between the sales of the company and the various heads of advertising expenditure, regression analysis has been conducted. The results are summarized in Table- VII and VIII. In the regression equation there are two variables, namely, independent variable and dependent variables.

Independent Variables: The various medium of advertising is taken as the independent variables for the regression equation. The medium are 'Print' (X_1), 'Broad Cast' (X_2), 'Outdoor' (X_3), 'Internet' (X_4).

Dependent Variable (Y): The overall sale is taken as dependent variable.

The mathematical representation of the regression equation can be written as follows :

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 \quad \ldots\ldots\ldots\ldots (1)$$

Where,

b_0 = Constant, Value of dependent variable when value of independent variables are zero

= Also called intercepts, because it determines where the regression line meets the Y-axis.

$b_1 \ldots\ldots b_4$ = Coefficients, that represents the estimated change in mean value of dependent variable for each unit change in the independent variable values.

Table VII :Relationship Between Overall Sales and Various medium of Expenditure- 2004

Independent Variables	Coefficients	Std. Error Coefficient	P
Constant	22636.6716	15328.3795	0.1470
X_1	0.0169	0.0479	0.7258
X_2	0.0395	0.0233	0.0968
X_3	-0.0867	0.5306	0.8710
X_4	0.2691	0.2268	0.2420

Note: R-Sq = 0.16% R-Sq (adj) = 0.08%

Table VIII :Relationship Between Overall Sales and Various Medium of Expenditure- 2003

Independent Variables	Coefficients	Std. Error Coefficient	P
Constant	27144.5020	13459.2338	0.0500
X_1	-0.0275	0.0441	0.5359
X_2	0.0501	0.0214	0.0239
X_3	-0.2556	0.5681	0.6551
X_4	0.4191	0.2926	0.1594

Note: R-Sq = 0.16% R-Sq (adj) = 0.09%

Now, considering the values from the Table VII ,the regression equation for the year 2004 will be in the following form

$$Y = 22636.6716 + 0.0169X_1 + 0.0395X_2 - 0.0867X_3 + 0.2691X_4 \quad \text{.....(2)}$$

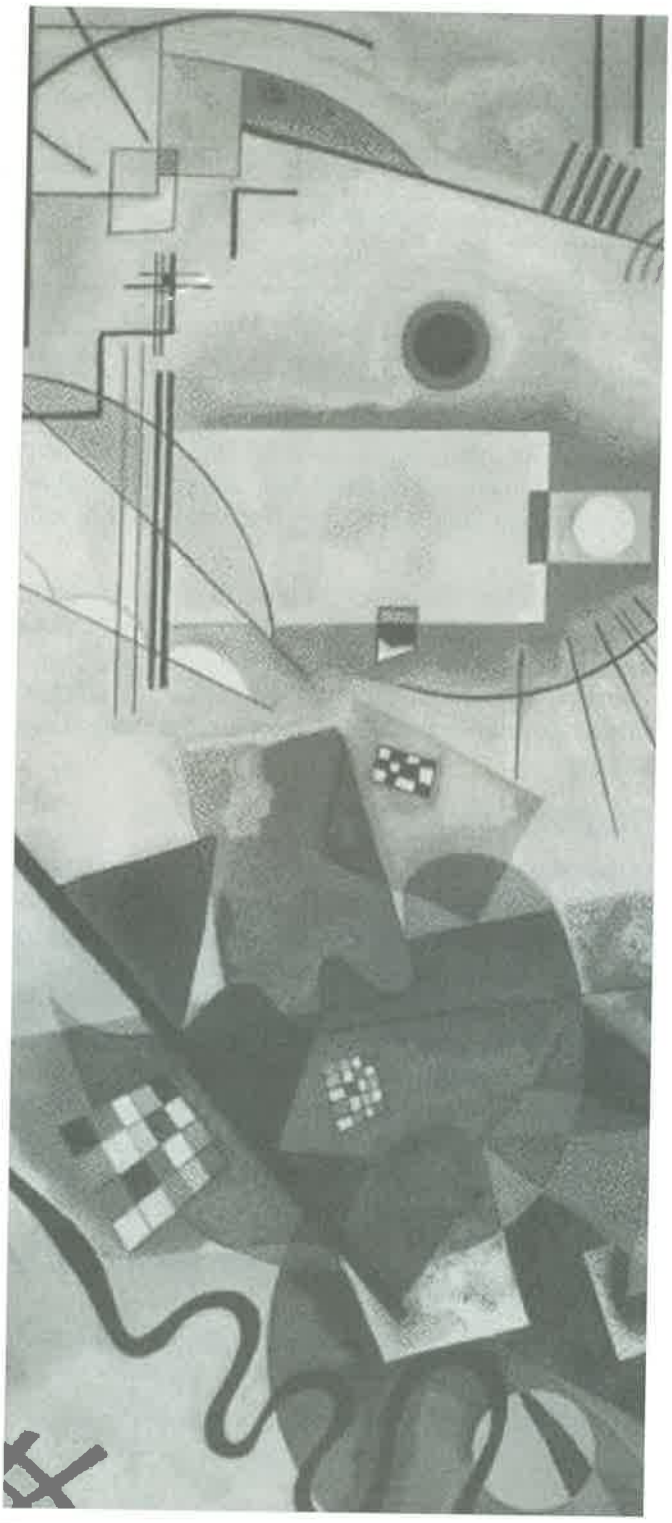
Similarly the regression equation for the year 2003 will be in the following form

$$Y = 27144.5020 - 0.0275X_1 + 0.0501X_2 - 0.2556X_3 + 0.4191X_4 \quad \text{.....(3)}$$

It is observed from both the above Table VII and VIII that only the variable X_2 is statistically significant at 95% confidence level ($p<0.05$). This is an indication that broadcast is the medium which contributes most to the output i.e. sales.

Conclusion

A company goes for the advertising is to improve on its sales and profits. The recent study shows that large number of companies tends to over advertise, the reason may be numerous – inability to identify the media which may be effective, tendency to remain on the safe side by port foiling with various media etc. Many marketers base their media plans on minor adjustments from last year's plan, which in turn are based on minor adjustment from the previous year. Such approach lacks analytic rigor to justify media budgets. The only defense to such an approach is that "it's worked for us in the past," but such appeal to tradition would not succeed in many areas of business decision-making. Instead, a careful analytic study of marketing success drivers and media allocation decisions should be the guiding light for budget allocations. Many of the marketing scholars have pointed towards the inefficiency in advertising expenditures. This paper uses Data Envelopment Analysis a non parametric method to calculate the efficiency of advertising expenditure relative to each other and setting the benchmark for each company. The study analyzes the advertising expenditures of 48 leading advertisers in four mediums 'Print', 'Broad Cast', 'Outdoor', and 'Internet' for two consecutive years 2003 and 2004, and determines the capability of each of the advertisers to generate sales, relative to their expenditures. The data is subjected to basic statistical analysis to know the characteristics of the data. This study has several limitations. DEA is sensitive to missing observation and in our analysis not all the companies in the industry are included. It is recommendable therefore to replicate the models for all companies. Moreover, the results of our study could be country-specific and therefore, it is desirable to do comparative studies across countries. Another possible extension is the estimation of cost efficiency. In this paper we outline one way for benchmarking company's operations to those of other companies (successful or "best performers") in the industry. This could be a useful tool for managers and an appropriate methodology for researchers in the field of marketing.



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APPENDIX

DMU No.	Media Spending for Two Years									
	2004					2003				
	Print	B' Cast	Outdoor	Internet	Sales	PrintB'	Cast	Outdoor	Internet	Sales
1	564112	1681748	48307	66093	193517	533649	1506192	32384	44985	185837
2	790370	2199422	3650	12185	51407	799947	1995273	5306	12430	43377
3	742130	979890	70858	145304	42089	713722	929467	37052	152404	39565
4	287893	1469673	846	23851	52516	268080	749353	90	11502	44736
5	864647	885485	20535	56326	40787	972473	796776	21115	44796	40498
6	884963	1194817	23805	40302	192319	348329	987535	14623	21390	155719
7	574609	968727	17771	61193	171600	489417	902328	10467	24982	164300
8	440433	856649	39659	53264	30752	466818	864972	28466	44613	27061
9	684430	665746	41391	124576	71283	589914	585272	28214	32461	67468
10	382259	979886	1026	29375	47348	360243	904762	797	9700	41862
11	216379	353720	1995	11525	79905	219176	555200	2761	13560	73061
12	315956	626631	2028	13817	55800	343040	518244	817	25294	64377
13	336977	698536	18132	43863	160959	338617	616053	13566	47712	132791
14	328043	548255	24039	28454	152363	304302	885248	16591	69819	134187
15	317485	905321	12104	39484	69767	302213	641888	1172	45437	64021
16	332103	726206	28977	6038	79818	276412	654928	32257	5020	63641
17	495471	562710	1830	48106	89610	448364	570492	3576	25594	81320
18	106510	539836	38444	5273	19065	25762	571365	41595	1035	17140
19	370595	392249	372	2017	17522	323895	349466	125	1112	16589
20	202348	377040	5696	17599	50417	171624	442913	791	5218	48997
21	105237	458299	1652	15052	28247	94398	295061	32	3370	24864
22	139815	703841	8398	9349	29261	119742	1484720	4290	24136	26971
23	147140	374886	1396	4241	73094	153442	404589	2383	2842	64813
24	267875	205037	12	8283	22939	169086	187773	25	3071	22486
25	292512	383000	27060	21789	22526	304208	407482	19285	17248	20828
26	164734	603515	1990	12947	77232	147420	550243	2651	7136	68286
27	470750	369012	4685	12923	27428	110660	299890	2984	7544	26197
28	191457	194881	284	46657	18424	167101	235754	279	35857	17786
29	142989	27225	560	372	5790	134382	24375	641	180	5096
30	144945	330597	4435	17998	70114	152378	353206	800	16373	65301
31	58193	142538	28451	51903	19785	121927	110307	25493	12140	18015
32	176029	150746	3004	153674	36835	259223	263967	385	62977	32187
33	185639	170697	628	32735	24616	190138	126447	482	27749	22225
34	116703	502865	203	11865	11070	98315	567753	1020	1348	10506
35	220576	270400	6179	29075	46839	219552	233292	2327	19542	42025
36	239059	169409	2163	137453	79905	316112	150141	1444	69625	73061
37	230226	395246	20329	35337	21761	217590	343682	12588	26399	19250
38	58359	329163	35	6714	8272	107935	253121	176	4404	8334
39	73618	474861	829	49495	285222	45524	426038	411	17595	256329
40	126488	432921	3247	3282	37437	74336	276128	637	989	35275
41	38519	315089	7349	737	3635	33546	280287	7022	1465	3149
42	45326	398799	58811	3785	14934	49521	361395	59131	3497	14147
43	236450	308236	11203	54479	86190	121700	108683	9428	52910	77442
44	470494	198092	588	3670	14441	517956	86685	3489	4168	13343
45	7313	643134	5704	1521	9011	5911	645199	5711	717	8380
46	101110	181298	855	8168	19380	111946	120182	120	3911	18653
47	271145	1232870	1528	119507	49205	231289	183853	636	79729	41444
48	508054	93546	2285	13718	15630	534235	83809	1851	15528	15264