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Multi-attribute Decision Making: An Application of the Brown-Gibson Model of Weighted Evaluation

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Abstract: This study applies Brown-Gibson model of weighted evaluation of both objective and subjective parameters for automobile selection. In addition to the input from the NPV calculations, we set 15 subjective attributes and estimate the best investment strategy based on the objective and subjective factors. Results obtained from NPV and Brown-Gibson model are inconsistent. Further evidence suggests that mileage is the most sensitive influencing factor while making the investment decision and even a small change in this factor changes the decision completely from one alternative to another.

Key words: Multi-attribute decision making, Brown-Gibson model, Net Present Value (NPV)

INTRODUCTION

The purpose of this study was to adapt the best investment strategy in investing automobiles. As the Net Present Value (NPV) reflects the absolute magnitude of the investment proposals, it is insufficient in terms of multi-objective decision-making that incorporates non-monetary objectives[1]. This study applies Brown-Gibson Model of weighted evaluation of both subjective and objective parameters for automobile selection. In order to evaluate the impact of different factors and explore their interactions we assign weights to the attributes and set up a preference table based on the assumption that all the automobiles to be purchased are brand new.

Methodology

NPV Analysis: In this study, the alternative automobile models are mutually exclusive. We considered 1600 and 2000 cc automobiles with gasoline and diesel options with 11 alternatives 7 of which have gasoline and 4 have diesel engines. Factors that are taken into consideration are

Table 1: Sensitivity analysis

Monetary values	A	B	C	D	E	F
Initial cost	21600.00	22250.00	20750.00	22250.00	21350.00	21500.00
Fuel cost (yearly)	3921.75	3378.38	3945.375	3661.88	3685.50	3638.25
Maintenance and service cost (yearly)	270.00	220.00	350.00	270.00	180.00	240.00
Insurance cost (yearly)	756.00	778.75	726.25	778.75	747.25	752.50
Road tax cost (yearly)	118.00	118.00	118.00	118.00	118.00	118.00
Salvage value at 1st year	15984.00	16465.00	15355.00	16465.00	15799.00	15910.00
Salvage value at 2nd year	13824.00	14240.00	13280.00	14240.00	13664.00	13760.00
Salvage value at 3rd year	12312.00	12682.50	11827.50	12682.50	12169.50	12255.00
Salvage value at 4th year	10584.00	10902.50	10167.50	10902.50	10461.50	10535.00
Salvage value at 5th year	7992.00	8232.50	7677.50	8232.50	7899.50	7955.00
Salvage value at 6th year	4320.00	4450.00	4150.00	4450.00	4270.00	4300.00
NPV of selling car at the end of 1st year	11101.70	10740.50	10927.52	11061.20	10707.50	10768.03
NPV of selling car at the end of 2nd year	18373.40	17562.60	18165.71	18191.60	17639.50	17734.70
NPV of selling car at the end of 3rd year	24712.60	23449.70	24498.32	24375.20	23659.60	23783.56
NPV of selling car at the end of 4th year	30940.90	29247.30	30715.08	30457.90	29579.60	29732.10
NPV of selling car at the end of 5th year	37583.00	35495.00	37320.35	36979.70	35917.60	36102.16
NPV of selling car at the end of 6th year	44741.20	42297.20	44412.81	44045.40	42774.60	42995.24
Extending to infinite 1st year	288644.00	279253.00	284115.60	287591.00	278394.00	279968.80
Extending to infinite 2nd year	243538.00	232790.00	240784.70	241127.00	233810.00	235071.70
Extending to infinite 3rd year	222629.00	211251.00	220698.40	219589.00	213143.00	214259.30
Extending to infinite 4th year	213098.00	201434.00	211542.50	209771.00	203722.00	204772.50
Extending to infinite 5th year	211054.00	199328.00	209579.10	207666.00	201702.00	202738.10
Extending to infinite 6th year	213373.00	201717.00	211806.80	210055.00	203994.00	205046.40

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Table 1: Continued

Monetary values	G	H	I	J	K
Initial cost	21150.00	30450.00	30990.00	28500.0000	33500.0
Fuel cost (yearly)	3874.50	1539.00	1485.00	1525.5000	1134.0
Maintenance and service cost (yearly)	340.00	320.00	330.00	250.0000	390.0
Insurance cost (yearly)	740.25	1065.75	1084.65	997.5000	1172.5
Road tax cost (yearly)	118.00	384.00	384.00	384.0000	384.0
Salvage value at 1st year	15651.00	22533.00	22932.60	21090.0000	24790.0
Salvage value at 2nd year	13536.00	19488.00	19833.60	18240.0000	21440.0
Salvage value at 3rd year	12055.50	17356.50	17664.30	16245.0000	19095.0
Salvage value at 4th year	10363.50	14920.50	15185.10	13965.0000	16415.0
Salvage value at 5th year	7825.50	11266.50	11466.30	10545.0000	12395.0
Salvage value at 6th year	4230.00	6090.00	6198.00	5700.0000	6700.0
NPV of selling car at the end of 1st year	10978.60	11965.14	12096.78	11256.7308	12625.5
NPV of selling car at the end of 2nd year	18202.90	18672.86	18846.00	17590.4956	19487.6
NPV of selling car at the end of 3rd year	24510.00	24202.22	24398.93	22819.2165	25073.3
NPV of selling car at the end of 4th year	30704.80	29706.31	29929.02	28022.2387	30650.3
NPV of selling car at the end of 5th year	37301.00	35919.73	36183.76	33887.1818	37026.1
NPV of selling car at the end of 6th year	44399.00	42981.90	43304.97	40544.6333	44353.3
Extending to infinite 1st year	285444.00	311093.70	314516.20	292675.0000	328262.0
Extending to infinite 2nd year	241278.00	247507.00	249801.80	233160.2940	258307.0
Extending to infinite 3rd year	220804.00	218030.80	219803.00	205571.7840	225878.0
Extending to infinite 4th year	211472.00	204594.80	206128.70	192996.1950	211096.0
Extending to infinite 5th year	209470.00	201713.60	203196.40	190299.4960	207926.0
Extending to infinite 6th year	211741.00	204982.70	206523.50	193359.2840	211523.0

Table 2a: Overall weights and calculation of Lambda

Monetary factors	Domestic 1	Domestic 2	Foreign
Initial price	8400.000	10000.000	9300.00
Salvage value	3000.000	3250.000	3400.00
Fuel cost	4650.000	3875.000	1950.00
Maintenance cost	800.000	900.000	1400.00
Total yearly cost	5450.000	4775.000	3350.00
NPV	25177.715	24390.716	18839.32

Table 2b:

	Maintenance and service cost			Total millage range	Salvage value 0-10000		
Mileage range per year	Domestic 1	Domestic 2	Foreign		Domestic 1	Domestic 2	Foreign
0-10000	500	500	900	10000-80000	3500	4000	4150
10001-20000	650	700	1250	80001-175000	3000	3250	3400
20001-30000	800	900	1400	175001-obove	2500	2700	2800
30001-50000	1000	1100	1550				

Table 2c:

Attribute	Rank recip. weight	Domestic 1	Weighted average D1	Domestic 2	Weighted average D2	Foreign	Weighted average F	Sum
Comfort	15.56	7.5	0.053045	10.0	0.070727	10.0	0.070727	27.5
Aesthetic appeal 10	13.33	5.0	0.039673	7.0	0.055542	9.0	0.071411	21.0
Passengers	11.11	7.5	0.041663	10.0	0.055550	7.5	0.041663	25.0
Ease of servicing	6.67	10.0	0.037056	7.5	0.027792	5.0	0.018528	22.5
Performance	17.78	2.5	0.031750	7.5	0.095250	7.5	0.095250	17.5
Stereo system	2.22	0.0	0.000000	5.0	0.009250	10.0	0.018500	15.0
Ease of cleaning	4.44	10.0	0.031714	7.5	0.023786	0.0	0.000000	17.5
Storage space	8.89	7.5	0.047625	10.0	0.063500	0.0	0.000000	17.5
Summation	80	SMD1=	0.282525	SMD2=	0.401396	SMF=	0.316078	

Table 2d:

Lambda value 0.3	Smi	Omi	Total
WED1	0.2825254	0.2968494	0.173812
WED2	0.4013963	0.3064277	0.212347
WEF	0.3160783	0.3967229	0.213840

costs of the automobiles are insurance cost, fuel cost, road tax cost, depreciation and maintenance and service costs. First, we calculate the aforementioned annual costs using the salvage values for the each model with respect to each year were. In order to measure the sensitivity of the alternatives, we keep the interest rate and fuel costs constant and change the annual km driven. The selection from these alternatives by using the NPV method varies

with respect to km per year, interest rates and fuel cost. As the km increases, the sensitivity of the fuel prices increase. Table 1 portrays the sensitivity analysis where the capital letters indicate different automobile brands and particular models. The brands and their technical details are available from the authors upon request.

However NPV alone is not adequate when other factors, such as non-monetary factors, are considered. By taking the non-monetary factors into account, the problem becomes a complex multi-objective decision making problem.

Multi-attribute decision making: This study is an application of the Brown-Gibson model of multi-objective decision making[2]. The road tax prices of the automobiles with respect to weights and the maintenance and service cost change with respect to the model of the car and km per year are available from the authors upon request. In addition to the input from the NPV calculations, we set 15 subjective attributes as aesthetic appeal, air conditioning unit, cabin noise, cabin comfort, availability of service, ergonomics, functionality, interior width, performance, quality, security, sight options, stereo system, storage space and suspensions. We assign arbitrary scores to the attributes and assume that the optimal replacement period is 5 years. The attributes and the relative scores assigned to them are available from the authors upon request.

Based on the objective and subjective factors we can estimate the lambda. If the lambda value close to 1 then, the result is close to the NPV selection[1]. If the lambda value is close to 0, then the selection is more dependent on the subjective factors. Table 2a-d shows the calculation of Lambda.

Present results suggest that km driven is the most sensitive influencing factor in the decision. Even within a small range, the km driven changes the decision completely from one alternative to another. The results obtained from NPV and Brown and Gibson are not consistent as the NPV approach only focuses on the monetary values. However Brown and Gibson model approach of evaluation takes into account the facts related to non-monetary values.

REFERENCES

1. Canada, J., W. Sullivan and J. White, 1993. Capital investment analysis for engineering and management. Henkel Scientific Reports, 1: 32-56.
2. Levy, H. and M. Sarnat,1986. Capital Investment and Financial Decisions. Wisdom House, 4th Edn., pp: 1-34.