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STATISTICAL ANALYSIS OF ENGINE PARAMETER FOR 4-STROKE ENGINE FOR FUEL EFFICIENCY

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Abstract
The performance of engine depends on engine parts. Each part gives the different performance in its own way. Fuel efficiency is very important for all the vehicle. Statistical data Analysis of engine parameters will result the main parameters which is give the better efficiency of the vehicle. It is most important to optimize parameter of the engine which is mainly reason for improve the fuel efficiency. In this paper present the results of a statistical analysis of selected parameters for the fuel-efficiency of the car. Statistical analysis of engine parameter has been carried out using statistical packages. For analysis purpose the existing data for various car engine specifications has been used. Based on the analysis result, prediction of important parameters of the engine parameter has been carried out.

Key Words: Engine Parameter – Fuel Efficiency - Vehicle Specification - Statistical Analysis.

I. Introduction

This paper presents a statistical analysis of engine parameters for fuel efficiency. Fuel efficiency is dependent on many parameters of a vehicle, including its engine parameter, aerodynamic drag, weight [4]. Fuel economy is the very important for the all vehicle. All parameters are involved to give the better efficiency of the engine. Design of experiment is a methodology for formulating scientific and engineering problem using statistical models.[1] In engineering applications, the goal if often to optimize a process or parameter or product, rather than to subject a scientific hypothesis to test of its predictive adequacy.[2] Time and methods engineering use statistics to study repetitive operations in manufacturing in order to set standards and find optimum parameters.[3]

The analysis purpose some of car specification has been taken from the existing data. Among the selected parameters to predict which parameter result the fuel efficiency of the car. There are many methods are available to analyze the engine parameter which is give the better efficiency. Statistical Analysis of these data will result the best parameter for the fuel economy among the selected parameters.

II. Methodology

The methodology has been developed for this analysis as shown in fig.1. There are many commercial vehicle are available for transport the customer requirement. Some of the vehicles are selected for this analysis.

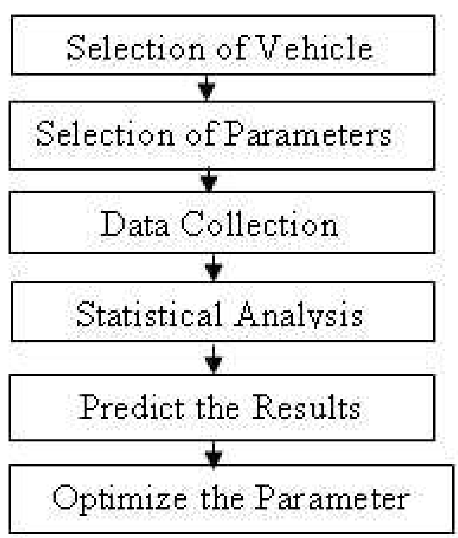

Fig.1 Methodology – Flow Chart

A. Selected Cars

For this analysis light commercial motor vehicle i.e. car has been selected. The selected car has been listed in Table 1.

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Table 1: Selected Cars

Notations	Selected Automobiles	Notations	Selected Automobiles
1	APOLLO	14	ELDORADO
2	NOVA	15	IMPERIAL
3	MONARCH	16	NOVA LN
4	DUSTER	17	STARFIRE
5	JENSON CONV	18	CORDOBA
6	SKYHAWK	19	TRANSAM
7	SCIROCCO	20	COROLLA E-5
8	COROLLA SR-5	21	MARK IV
9	CAMARO	22	CELILCA GT
10	DATSUN B210	23	CHARGER ZS
11	CAPRI II	24	CIUGER
12	PACER	25	CORVETTE
13	GRANADA		

B. Selection of Parameter

The factors considered for this analysis are listed in Table 2.

Table 2: Parameter for Analysis

Selected Parameters	Notations
Mileage	A
Displacement	B
Horse power	C
Torque	D
Compression ratio	E
Rear axle ratio	F
Carburetor	G
Number of transmission speed	H
Overall length	I
Width	J
Weight	K
Type of transmission	L

The above parameters are selected based on available existing data for the various cars.

C. Data Collection

Data for the respective parameter with respect to vehicle has been listed in Table.3. These data’s are collected based on existing available data for various cars.

Table 3: Specification of the Various Cars

Automobile	A	B	C	D	E	F	G	H	I	J	K	L
1	18.9	350	165	260	8	2.56	4	3	200.3	69.9	3910	Automatic
2	20	250	105	185	8.25	2.73	1	3	196.7	72.2	3510	Automatic
3	18.25	351	143	255	8	3	2	3	199.9	74	3890	Automatic
4	20.07	225	95	170	8.4	2.76	1	3	194.1	71.8	3365	Manual
5	11.2	440	215	330	8.2	2.88	4	3	184.5	69	4215	Automatic
6	22.12	231	110	175	8	2.56	2	3	179.3	65.4	3020	Automatic
7	34.7	89.7	70	81	8.2	3.9	2	4	155.7	64	1905	Manual
8	30.4	96.9	75	83	9	4.3	2	5	165.2	65	2320	Manual
9	16.5	350	155	250	8.5	3.08	4	3	195.4	74.4	3885	Automatic
10	36.5	85.3	80	83	8.5	3.89	2	4	160.6	62.2	2009	Manual
11	21.5	171	109	146	8.2	3.22	2	4	170.4	66.9	2655	Manual
12	19.7	258	110	195	8	3.08	1	3	171.5	77	3375	Automatic
13	17.8	302	129	220	8	3	2	3	199.9	74	3890	Automatic

14	14.39	500	190	360	8.5	2.73	4	3	224.1	79.8	5290	Automatic
15	14.89	440	215	330	8.2	2.71	4	3	231	79.7	5185	Automatic
16	17.8	350	155	250	8.5	3.08	4	3	196.7	72.2	3910	Automatic
17	23.54	231	110	175	8	2.56	2	3	179.3	65.4	3050	Automatic
18	21.47	360	180	290	8.4	2.45	2	3	214.2	76.3	4250	Automatic
19	16.59	400	185	0	7.6	3.08	4	3	196	73	3850	Automatic
20	31.9	96.9	75	83	9	4.3	2	5	165.2	61.8	2275	Manual
21	13.27	460	223	366	8	3	4	3	228	79.8	5430	Automatic
22	23.9	133.6	96	120	8.4	3.91	2	5	171.5	63.4	2535	Manual
23	19.73	318	140	255	8.5	2.71	2	3	215.3	76.3	4370	Automatic
24	13.9	351	148	243	8	3.25	2	3	215.5	78.5	4540	Automatic
25	16.5	350	165	255	8.5	2.73	4	3	185.2	69	3660	Automatic

III. Anslysis Procedure

This section presents how to run a stepwise regression analysis of the data presented in this analysis. The data of the car specification can be analyzed using SPSS (Statistical Packages for Social Science). Now variables of the car specification can be specified in the respective text box. Dependent and independent variables are entered in the respective text box. The notations of the string values are entered as per given in the table 1. After enter the all the values run the procedure until the predict the required parameter. After predict the parameter, the ‘R’ square value is adjusted into the required value. For each variable, the Count, Mean, and Standard Deviation are calculated. This report is especially useful for selected the right variables and that the appropriate number of rows was used.

For each iteration, there are three possible actions:

1. Unchanged- No action was taken because of the scan in this step. Because of the “backward look” in the stepwise search method, this will show up a lot when this method is used. Otherwise, it will usually show up as the first and last steps.
2. Removal - A variable was removed from the model.
3. Entry - A variable was added to the model.

IV. Results and Discussion

For analysis of the parameter, miles can take as the dependent variable. Table 4 shows the dependent variable entered in the respective box.

Table 4: Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	Displacement	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
a. Dependent Variable: miles			

The adjusted R square value is listed from the analysis. Table 5 shows the adjusted R square value for the predicted parameter.

Table 5: Adjusted R Square Value

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.900[a]	.811	.802	2.91717
a. Predictors: (Constant), displacement				

Analysis of variance for the both regression and residual model are shown in Table.6. Mean square value for the respective model can also list.

Table 6: Anova

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	837.171	1	837.171	98.377	.000[b]
	Residual	195.727	23	8.510		
	Total	1032.898	24			
a. Dependent Variable: miles						
b. Predictors: (Constant), displacement						

Coefficients for the unstandardized and standardized for predicted model can be shown in Table.7

Table 7: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	34.364	1.503		22.857	.000		
	displacement	-.048	.005	-.900	-9.919	.000	1.000	1.000
a. Dependent Variable: miles								

Eigen value of the respective dimensions listed in the Table 8. Here dimension value 1 as taken as automatic power transmission, 2 as taken as manual power transmission.

Table 8 - Collinearity Diagnostics

Model	Dimension	Eigen Value	Condition Index	Variance Proportions	
				(Constant)	Displacement
1	1	1.922	1.000	.04	.04
	2	.078	4.952	.96	.96
a. Dependent Variable: miles					

From this analysis, the excluded variables and its correlation with dependent variable are listed in the Table.9

Table 9 - Excluded Variables

Model		Beta In	T	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	Automobile	.003[b]	.035	.972	.007	.975	1.026	.975
	Horsepower	.319[b]	1.111	.279	.230	.099	10.126	.099
	Torque	-.035[b]	-.234	.817	-.050	.382	2.618	.382
	Compression ratio	.106[b]	1.076	.294	.224	.840	1.190	.840
	Rearaxleratio	.125[b]	.986	.335	.206	.510	1.961	.510
	Carburetor	.184[b]	1.541	.138	.312	.547	1.829	.547
	No of transmission speed	.080[b]	.557	.583	.118	.415	2.408	.415
	Overall length	.056[b]	.320	.752	.068	.276	3.621	.276
	Width	-.070[b]	-.436	.667	-.093	.334	2.998	.334
	Weight	-.096[b]	-.319	.753	-.068	.095	10.556	.095
a. Dependent Variable: miles								
b. Predictors in the Model: (Constant), displacement								

V.Conclusion

The various parameters of the respective cars can be analyzed using SPSS. Miles can be taken as dependent variable for this analysis. Many iteration are carried out to predict the important parameter of the engine. From the analysis all the parameters are excluded from the dependent variable except predicted variable. The predicted parameter for the dependent variable is stroke length. Among the all the parameters, stroke length as the optimized parameter which give the better fuel efficiency for the cars. Also the adjusted R square value of the stroke length as 81.1%, which is result the best fit for the optimized parameter.

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