PROBABILITY AND STATISTICS

24MT2019

CASE STUDY

CO2

B.TECH - CSE

BY

ROOPESH CHALASANI - 2420030359

PENUMAKA VENKATA SAI CHARAN - 2420030349

ARETI GNANA SAI SRINIVAS - 2420030349

MADINI RAMYSRI - 2420030353

GUDALA MANIKANTA - 2420030366.

DEPARTMENT OF MATHEMATICS

KONERU LAKSHMAIAH EDUCATION FOUNDATION

BOWRAMPET

HYDERABAD.

Verified

15/9/24

CASE STUDY - 5

Relationship Between Engine Size and Fuel Efficiency in Cars.

Problem Statement:-

Automobile engineering often deals with trade-offs between engine power and fuel economy. A data set of 25 cars was collected, recording engine size (X, in litres) and their fuel efficiency (Y, in km/litre).

Car	Engine size (X, L)	Mileage (Y, km/l)
1	1	20
2	1.2	19
3	1.5	18
4	1.8	17
5	2	16
6	2.2	15
7	2.4	14.5
8	1.3	19.2
9	1.6	17.8
10	2.6	14
11	3	12.5
12	1.1	19.5
13	2.8	13.5

15/9/25

14	1.4	18.6
15	1.9	16.8
16	2.1	15.2
17	2.5	14.2
18	3.2	12
19	1.7	17.5
20	1.2	19.3
21	2.9	13
22	1.8	17
23	2.3	15
24	3.1	12.2
25	2.7	13.8

Introduction:-

Correlation analysis is one of the most important statistical tools for engineers and researches. It measures the degree of linear relationship between two variables. Karl Pearson's correlation coefficient. developed by Karl Pearson in the early 20th Century. is widely used in science and engineering for analyzing dependencies.

In this study, we examine whether there exists a significant relationship between engine size and fuel efficiency of cars, Generally larger engine sizes are designed to deliver higher power often at the expence of fuel economy.

18	3.2	12.0	0.980	-4.7760	0.6956	22.8178	-1.6693
19	1.7	17.8	-0.5240	0.2746	0.5242	0.2741	-0.3714
20	1.2	19.3	-1.0240	2.5240	1.04869	6.3694	-2.5858
21	2.9	13.0	0.6760	-3.7760	0.1798	14.2562	-2.5545
22	1.8	17.0	-0.4240	0.2240	0.0058	0.0502	-0.0950
23	2.3	15.0	0.0760	-1.7760	0.4569	3.1542	-0.1349
24	3.1	12.2	0.7760	-4.5760	0.7672	20.9338	-4.0087
25	2.7	13.8	0.4760	-2.9760	0.2266	8.8578	-1.4014

Formulas:-

Karl Pearsons Correlation coefficient:

$$r = \frac{\sum (x - x_i)(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}}$$

Calculations:-

Step1:- mean: $\bar{x} = \frac{\sum x_i}{n} = \frac{55.6}{25} = 2.224$

$$\bar{Y} = \frac{\sum y_i}{n} = \frac{419.4}{25} = 16.776$$

Step 2:-

Sums of: $\sum (x_i - \bar{x})(y_i - \bar{y}) = -34.0848$

$\sum (x_i - \bar{x})^2 = 20.6368$

$\sum (y_i - \bar{y})^2 = 56.8052$

Step 3:- Substitute in formula:-

$$r = \frac{-34.0848}{\sqrt{20.6362 \times 56.8052}} = \frac{-34.0848}{\sqrt{1173.75}} = \frac{-34.0}{34.28}$$

$r \simeq -0.9944.$

Objectives:-

1. Calculate Karl Pearson's correlation between engine size and fuel efficiency.
2. Interpret whether larger engines result in reduced mileage.
3. Discuss how automobile engineers balance power vs efficiency.

Car	X	Y	$X-\bar{X}$	$Y-\bar{Y}$	$(X-\bar{X})^2$	$(Y-\bar{Y})^2$	$(X-\bar{X})(Y-\bar{Y})$
1	1.0	20.0	-1.2940	3.2240	-3.09486	-1.04982	0.3942
2	1.2	19.0	-1.0240	2.2240	1.04886	6.9748	-2.2774
3	1.5	18.0	-0.7240	1.2240	0.5242	1.4982	-0.8863
4	1.8	17.0	-0.9240	0.2240	0.1728	0.0502	-0.0950
5	2.0	16.0	-0.2240	-0.7760	0.0502	0.6022	0.1739
6	2.2	15.0	0.1760	-1.7760	0.0006	3.1542	0.0426
7	2.4	15.5	-0.9240	-2.7760	0.0310	5.1802	-0.4006
8	1.3	19.2	-0.6240	2.4240	0.8538	5.8702	-2.2408
9	1.6	17.8	0.3760	1.0240	0.3844	1.0486	-0.6385
10	2.6	14.0	0.7768	-2.7760	0.4414	7.7002	-1.0435
11	3.0	12.95	1.1248	-4.2760	0.6022	18.2782	-3.3178
12	1.1	19.5	0.5760	2.7240	1.2631	7.4194	-3.0618
13	2.8	13.5	-0.8240	-3.2760	0.3318	10.7342	-1.8883
14	1.4	18.6	-0.1240	1.8240	0.6759	1.3278	-1.5030
15	1.9	16.4	-0.3240	0.0240	0.0048	0.0006	-0.0078
16	2.1	15.2	-0.1240	-1.5760	0.0154	2.4838	0.1954
17	2.5	16.2	0.2760	-2.5760	0.0762	6.6362	0.7106

Interpretation of Relationship:-

The Computed Karl pearson correlation coffficient is approx -0·9994 indicating an extremely strong negative linear between engine size and fuel efficiency. This means that size increases, mileage decreases significantly

How Automobile Engineers Balance Power vs Efficiency.

Automobile engineers face a classic trade-off.

- Large engines provide more power, imp for heavy duty tasks performances cars, towing.
- Smaller Engines often better fuel economy, suitable for everyday commuting.

Modern Engineering solutions include

1) Engine Down sizing + Turbo charging.
smaller engines equipped with turbocharges deliver stuff power while maintaining better fuel efficiency.

15/9/25

2) Hybrid powerdrains:-
Combine internal combustion engines with electric motor to maximize efficiency without sacrificing performance.

3) Intelligent Engine Management systems:-
Optimize fuel injections variable valve timing & cylinder deactivation to balance power and efficiency dynamically base driving conditions.

13/2/25