April 2 — 2023 D2 Set

Latent demand in a demand-response curve is the area obtained when?

Options :

6406531737223. ✔ Price is reduced below the identified optimal price

6406531737224. ✖ Price is increased beyond the identified optimal price

6406531737225. ✖ The optimal price is increased beyond the maximum available price

6406531737226. ✖ Quantity is reduced below the identified optimal quantity

6406531737227. ✖ Quantity is increased beyond the identified maximum quantity

You solve the primal of a linear program with a maximization objective, three decision variables and two constraints of the less than or equal to type. Non-negativity restrictions apply to the decision variables. After solving the linear program, you find that the first constraint is not binding (LHS < RHS) and the second constraint is binding (LHS = RHS). Which of the following statements is/are correct?

Options :

6406531737241. ✖ There are three decision variables in the dual

6406531737242. ✖ The dual variable corresponding to the second constraint is zero

6406531737243. ✔ There are two decision variables in the dual formulation

6406531737244. ✔ The dual variable corresponding to the second constraint is non-zero

In Multiple Linear Regression, the "R" represents _____ (choose all those that are applicable)

Options :

6406531737248. ✖ Correlation between the dependent variable and all independent variables

6406531737249. ✔ Correlation between the actual and predicted values of the dependent variable

6406531737250. ✖ Correlation between the predicted value of the dependent variable and the actual value of the independent variable

6406531737251. ✖ Correlation between the errors

6406531737252. ✖ Correlation between the actual and predicted value of any given independent variable

6406531737253. ✖ Correlation between the actual value of the dependent variable and the predicted value of the errors

6406531737254. ✖ None of these

The price and demand for a product are provided in Table 1. The linear regression model is fit for this data in excel, and the output is given in Table 2. Using this information, answer the given subquestions.

Price	Demand
10	9703
15	4701
20	2284
25	2137
30	1036
35	503
40	144
45	111
50	54

Table-1

Regression Model Parameter	Value
R-Squared	0.7084
Observations	9
Intercept	8125
Co-efficient (Beta-1)	-194.27
S.E of Intercept	1538.44
S.E of Co-efficient (Beta-1)	47.10

Table-2

What is the total market size?

8125

Demand equation can be formed as,

$D(p) = 8125 - 194.27(p)$

$D(0)$ gives total market size

$\Rightarrow D(0) = 8125 - 194.27(0)$

$\Rightarrow \underline{8125}$

What is the satiating price for the price-demand data based on the fitted model *(Note: If your answer is in decimal, enter it rounded to two decimal places. For example, if your answer is "10.256", enter it as "10.26")*

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Range

Text Areas : PlainText

Possible Answers :

41.60 to 42.00

$D(p) = 0$, gives the satiating price

$\Rightarrow 8125 - 194.27(p) = 0$

$\Rightarrow p = \frac{8125}{194.27} = 41.82$

What is the elasticity of the (regression line) demand, when the price is Rs. 33 (round to two decimal places)? *(Note: If your answer is in decimal, enter it rounded to two decimal places. For example, if your answer is "10.256", enter it as "10.26")*

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Range

Text Areas : PlainText

Possible Answers :

3.60 to 3.80

$$\text{Elasticity} = -\frac{\frac{d_2 - d_1}{d_1}}{\frac{p_2 - p_1}{p_1}}$$

We will take satiating price as p_2

$\Rightarrow D(p_2) = 0 = d_2$

$p_1 = 33,$

$\Rightarrow D(p_1) = 8125 - 194.27(33)$

$\Rightarrow 1714.09 = d_1$

$$\Rightarrow \text{Elasticity} = -\frac{\frac{0 - 1714.09}{1714.09}}{\frac{41.82 - 33}{33}} = \frac{1}{\frac{8.82}{33}} = \frac{33}{8.82} \cong 3.75$$

At the price of Rs. 33, based on the elasticity (of the regression line)_____

Options :

6406531737231. ✔ Demand is elastic

6406531737232. ✖ Demand is inelastic

6406531737233. ✖ Demand indicates luxury item

6406531737234. ✖ Demand indicates inferior item

As the price moves to the satiating price, then elasticity _____?

Options :

6406531737235. ✖ Decreases

6406531737236. ✔ Increases

6406531737237. ✖ Remains the same

6406531737238. ✖ Increases then decreases

6406531737239. ✖ Decreases then increases

You have estimated the demand to follow the following relationship: D(p) = 100 - p. Now, you intend to maximize the revenue R(p) = D(p)* p. You find the first derivative of R(p) with respect to p, equate it to 0 and find p*. What is the value of p*? 49.9 to 50.1 → Answer

Direct formula to maximize revenue is,

$\frac{D_0}{2m}$

General equation of demand is,

$D(p) = D_0 - mp$

Here,

$D_0 = 100$ and

$m = 1$

$\Rightarrow$ Max revenue $= \frac{100}{2} = 50$

A multiple linear regression model, as specified below is fit on a data set with 150 data points.

MLR Model: $Y = 2.1 + 1.4 * X_1 - 4.2 * X_2 + 0.5 * X_3 + \varepsilon$

n = number of data points

k = number of explanatory variables ($X_1, X_2, X_3 \ldots$)

Based on the above data, answer the given subquestions.

How many degrees of freedom are present for the "Residuals" in the ANOVA Table?

146

Here, $n = 150$

$k = 3$ (X_1, X_2, X_3)

Residuals $= n - k - 1 = 150 - 3 - 1 = \underline{146}$

How many degrees of freedom are present for the "Regression" in the ANOVA Table?

3

degress of freedom of Regression $= k$

$\Rightarrow$ Here $\underline{k = 3}$

How many total degrees of freedom are present for the fitted model in the ANOVA Table?

149

Total degrees of freedom = d.o.f. of Residuals + d.o.f. of Regression

$\Rightarrow 146 + 3 = \underline{149}$

Direct formula is $= n - k - 1 + k$

$\Rightarrow \underline{n - 1}$

Company "ABC" manufacturer's product "X". Currently, the quality inspection of "X" is done manually through visual inspection. The aim of the quality inspection process is to identify defective products. From historical experience, manual visual inspection correctly identified 75% of defective items in any given batch of only defective items.

The management has decided to replace manual visual inspection with an automatic detection system (ADS). This ADS runs a logistic model in the background for classifying an item as defective or not-defective based on photos taken by a camera. To test the ADS, a sample of 100 units of X is taken. 30% of the sample contains defective items. The samples are passed through the ADS, and the system identifies 20% of the non-defective items as defective and 10% of the defective items as non-defective.

How many "True Positives" is ADS predicting?

27

0 = defective

1 = non-defective

Given,

datapoints (n) = 100

no. of defective items = 30% of 100 = 30 = (TP + FP)

2) no. of non-defective items = (100 − 30) = 70 = (TN + FN)

20% of non-defective is identified as defective

=> 20% of 70 = 14 = FP

		Actual 1	Actual 0
Predicted	1	27	14
	0	3	56

TP	FP
FN	TN

10% of defective items were identified as non-defective

=> 10% of 30 = 3 = FN

We know,

TP + FN = 30

=> TP = 30 − 3 = 27

TN + FP = 70

=> TN = 70 − 14 = 56

How many "False Positives" is ADS predicting?

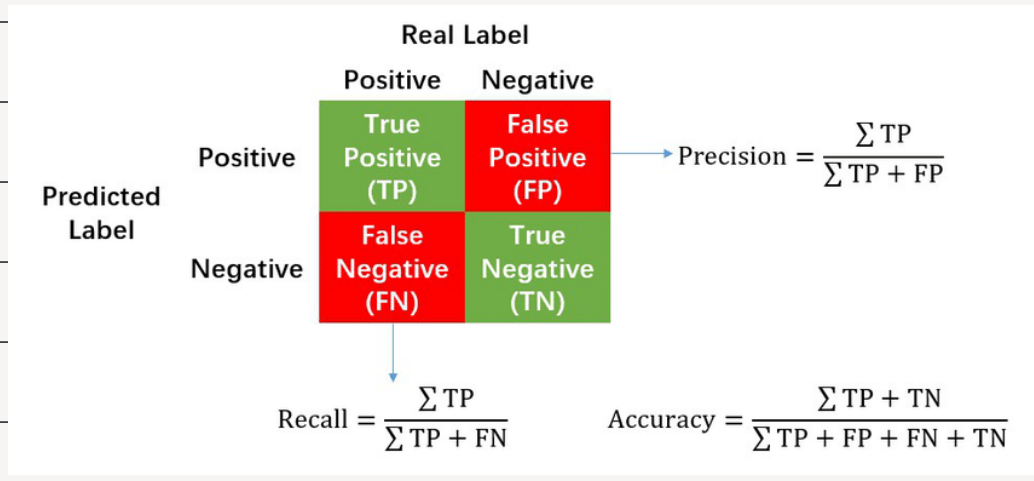
14

How many "True Negatives" is ADS predicting?

56

How many "False Negatives" is ADS predicting?

3



What is the accuracy of the ADS? (*Note: Enter the answer as a numeric percentage value rounded to two decimal places without the % symbol. For example, if your answer is "10.256 %", enter it as "10.26"*)

82.00 to 84.00

$$\Rightarrow \frac{TP+TN}{Total} = \frac{83}{100} = 0.83 = 83\%$$

What is the precision of the ADS when predicting defective products? *(Note: Enter the answer as a numeric percentage value rounded to two decimal places without the % symbol. For example, if your answer is "10.256 %", enter it as "10.26")*

65.00 to 67.00

$$\Rightarrow \text{Precision} = \frac{TP}{TP+FP} = \frac{27}{41} = 0.658 = 65.8\%$$

What is the recall of the ADS when predicting non-defective products? *(Note: Enter the answer as a numeric percentage value rounded to two decimal places without the % symbol. For example, if your*

79.00 to 81.00

$$\Rightarrow \text{Recall} = \frac{TP}{TP+FN} = \frac{27}{30} = 0.9 = 90\%$$

Question Label : Multiple Select Question

Should ADS be implemented?

Options :

6406531737262. ✖ Yes, the precision of ADS in predicting defects is higher than the current manual visual inspection

6406531737263. ✖ No, the precision of ADS in predicting defects is lower than the current manual visual inspection

6406531737264. ✔ Yes, the recall of ADS in predicting defects is higher than the current manual visual inspection

6406531737265. ✖ No, the recall of ADS in predicting defects is lower than the current manual visual inspection

6406531737266. ✖ Yes, the precision of ADS in predicting non-defects is higher than the current manual visual inspection

6406531737267. ✖ No, the precision of ADS in predicting non-defects is lower than the current manual visual inspection

6406531737268. ✖ Yes, the recall of ADS in predicting non-defects is higher than the current manual visual inspection

6406531737269. ✖ No, the recall of ADS in predicting non-defects is lower than the current manual visual inspection

Nov 20 – 2022 QPD1

You are given the following contingency table based on sample data with people belonging to two cities (City A and City B) and their brand preferences. You perform a chi-squared test of independence to make inferences about the population from this sample.

	Brand A	Brand B	Brand C	Brand D	Total
City A	155	145	234	126	660
City B	85	98	97	89	369
	240	243	331	215	1029

Based on the above data, answer the given subquestions.

From the given contingency table, find the expected frequency of people belonging to City B preferring brand C?

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Range

Text Areas : PlainText

Possible Answers :

115 to 121

$\Rightarrow$ Expected value $= \frac{331 \times 369}{1029}$

$\Rightarrow 118.69$

Expected values

$\Rightarrow$	Brand A	Brand B	Brand C	Brand D
City A	153.93	155.86	212.30	137.90
City B	86.06	87.13	118.69	77.09

What is the calculated value of chi-squared?

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Range

Text Areas : PlainText

Possible Answers :

8 to 14

$\Rightarrow 0.007 + 0.75 + 2.21 + 1.02 + 0.01 + 1.35 + 3.96 + 1.84$

$\Rightarrow 11.147$

At the significance level of 0.05, the chi-squared tabular value is 7.814. What do you conclude?

Options :

6406531485055. ✔ Reject the null hypothesis and conclude that the categorical variables are not independent

6406531485056. ✖ Fail to reject the null hypothesis and conclude that the categorical variables are not independent

6406531485057. ✖ Fail to reject the null hypothesis and conclude that the categorical variables are independent

6406531485058. ✖ Reject the null hypothesis and conclude that the categorical variables are independent

T L C

↓ ↓ ↘

Tabulated less than calculated

Here,

Tabulated = 7.814

Calculated = 11.147

$\Rightarrow 7.814 < 11.147$

$\Rightarrow$ Reject Null

You are solving a regression problem with 4 explanatory variables. The data has 40 observations and the R-square value was found to be 0.74.

Based on the above data, answer the given subquestions.

What is the value of adjusted R-square (round off to two decimal values)?

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Equal

Text Areas : PlainText

Possible Answers :

0.71

$$\Rightarrow R_{Adj} = 1 - \frac{(1-R^2)\times(n-1)}{n-k-1}$$

Here,

$R^2 = 0.74$

$n-1 = 39$

$n-k-1 = 35$

$$\Rightarrow R_{Adj} = 1 - \frac{0.26 \times 39}{35}$$

$$\Rightarrow R_{Adj} \simeq 0.710$$

You are adding a new explanatory variable to the dataset and the new adjusted R squared value is 0.745. Is the new variable significant?

Options :

6406531485077. ✖ Yes

6406531485078. ✖ No

6406531485079. ✔ Calculation error in Adjusted R Squared value

You are removing a few explanatory variables from the dataset and the new adjusted R square value is -0.21. Is it possible?

Options :

6406531485080. ✔ Yes. Adjusted R squared value can be negative

6406531485081. ✖ No. Calculation error

6406531485082. ✖ None of these

Using the confusion matrix, answer the given subquestions

n = 165	Predicted: No	Predicted: Yes
Actual: No	50 TN	10 FP
Actual: Yes	5 FN	100 TP

Calculate the precision.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Range

Text Areas : PlainText

Possible Answers :

0.90 to 0.92

$$\Rightarrow \text{Precision} = \frac{TP}{TP+FP}$$

$$\Rightarrow \frac{100}{100+10} = \frac{100}{110} \simeq 0.909$$

Calculate the recall.

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Range

Text Areas : PlainText

Possible Answers :

0.94 to 0.96

$$\text{Recall} = \frac{TP}{TP + FN}$$

$$\Rightarrow \frac{100}{100 + 5} = \frac{100}{105} \simeq 0.952$$

Suppose a factory manufactures products on three machines A, B and C. Suppose 25% of total output comes from machine A, 20% of total output comes from machine B and 55% of total output comes from machine C. From the past data, it is known that 8% of products by machine A are defectives, 15% of products by machine B are defectives and 5% of products by machine C are defectives. What is the probability that the product has come from machine C given that it is a defective?

Response Type : Numeric

Evaluation Required For SA : Yes

Show Word Count : Yes

Answers Type : Range

Text Areas : PlainText

Possible Answers :

0.32 to 0.38

	A	B	C
Output	25%	20%	55%
Defectives	8%	15%	5%

Find: $P(\text{Defective} \mid C)$

$$\Rightarrow P(\text{Defective} \mid C) = \frac{P(C \mid \text{Defective}) \cdot P(C)}{P(\text{Defective})}$$

$$\Rightarrow \frac{0.05 \times 0.55}{0.25 \times 0.08 + 0.2 \times 0.15 + 0.55 \times 0.05}$$

$$\Rightarrow \frac{0.0275}{0.02 + 0.03 + 0.0275} \simeq 0.354$$

What is the meaning of an Elasticity of 2?

Options :

6406531485060. ✔ 10% reduction in price will yield a 20% increase in sales

6406531485061. ✖ 10% reduction in price will yield a 20% decrease in sales

6406531485062. ✖ 25% increase in price will yield 50% increase in sales

6406531485063. ✔ 25% increase in price will yield 50% decrease in sales

Select the correct option from below:

Options :

6406531485068. ✖ For inelastic product demand (ε<1) the revenue can be increased by setting price close to zero.

6406531485069. ✔ For elastic product demand (ε>1) the revenue can only be increased by setting price close to zero

6406531485070. ✔ For inelastic product demand (ε<1) the revenue can be increased by simply increasing the prices

6406531485071. ✖ For elastic product demand (ε>1) the revenue can only be increased by simply increasing the prices

Which of the following data will you use to calculate price elasticity?

Options :

6406531485064. ✖ Protein-powder sales increases by 10% when the national income grows by 15%.

6406531485065. ✖ Tea sales increases by 10% when daily average working hours of employees goes up by 2 hrs .

6406531485066. ✔ Paneer (Indian Cottage Cheese) sales go down by 10% when price goes up from Rs.100 to Rs.120 per 200 gram.

6406531485067. ✖ All of these

In Multiple Linear Regression, if the explanatory variables are highly correlated, then that phenomenon is called

Options :

6406531485072. ✖ Normality

6406531485073. ✖ Singularity

6406531485074. ✔ Collinearity

6406531485075. ✖ Variation Inflation

What is called as efficiency?

Options :

6406531485085. ✖ Output/(1-input)

6406531485086. ✖ 1 - (output/input)

6406531485087. ✔ Output/Input

6406531485088. ✖ None of these