

MARKING GUIDE OF JOB EXAM (at NISR) to the POST of Regional Price & Economic Data collectors OFFICER

1. A national achievement test is administered annually to 3rd graders. The test has a mean score of 100 and a standard deviation of 15. If Yane's z-score is 1.20, what was her score on the test?

Answer

$$\text{We know that } Z = \frac{X - \mu}{\sigma} \Leftrightarrow 1.20 = \frac{X - 100}{15} \Leftrightarrow X - 100 = 18 \Leftrightarrow X = 118$$

Thus, the Yane's score is **118**

2. A researcher uses a regression equation to predict home heating bills (dollar cost), based on home size (square feet). The correlation between predicted bills and home size is 0.70, what is the interpretation of these findings? Download

Answer

Since $r = 0.70$, then $r^2 = 0.49$, which means that 49% of the total variation in y can be explained by the linear relationship between x and y (as described by the regression equation). The other 51% of the total variation in y remains unexplained.

“The coefficient of determination, r^2 , is useful because it gives the proportion of the variance (fluctuation) of one variable that is predictable from the other variable.

It is a measure that allows us to determine how certain one can be in making predictions from a certain model/graph.

The coefficient of determination is the ratio of the explained variation to the total variation.

The coefficient of determination is such that $0 \leq r^2 \leq 1$, and denotes the strength of the linear association between x and y .

The coefficient of determination represents the percent of the data that is the closest to the line of best fit.

For example, if $r = 0.922$, then $r^2 = 0.850$, which means that 85% of the total variation in y can be explained by the linear relationship between x and y (as described by the regression equation). The other 15% of the total variation in y remains unexplained.”

3. A card is drawn randomly from a deck of ordinary playing cards. You win \$10 if the card is a spade or an ace. What is the probability that you will win the game?

Answer

There are 52 ordinary playing cards in a deck

Let S be the event that the card drawn is a spade, then $P(S)=13/52$

A be the event that the card drawn is an ace, then $P(A)=4/52$

$P(S \text{ and } A)=1/52$

$$P(S \text{ or } A)=P(S \cup A)=P(S)+P(A)-P(S \cap A)=\frac{13}{52} + \frac{4}{52} - \frac{1}{52} = \frac{16}{52} = \frac{4}{13}$$

Thus, the probability that you will win the game is **4/13**

4. Use the chain rule to find the derivative of the following expressions
- a) $y = e^{(x^3+4)}$
- b) $y = \ln(\cos x)$

Answer

a) $y = e^{(x^3+4)}$

Let $u = x^3 + 4$ then we have $y = e^u \Leftrightarrow \frac{dy}{du} = e^u$

Also $\frac{du}{dx} = \frac{d}{dx}(x^3 + 4) = 3x^2$

$$\frac{dy}{dx} = \frac{dy}{du} \frac{du}{dx} = (e^u)(3x^2) = e^{(x^3+4)}(3x^2) = \mathbf{3x^2e^{(x^2+4)}}$$

b) $y = \ln(\cos x)$

Let $u = \cos x$ then we have $y = \ln u \Leftrightarrow \frac{dy}{du} = \frac{1}{u}$

Also $\frac{du}{dx} = \frac{d}{dx}(\cos x) = -\sin x$

$$\frac{dy}{dx} = \frac{dy}{du} \frac{du}{dx} = \left(\frac{1}{u}\right)(-\sin x) = \left(\frac{1}{\cos x}\right)(-\sin x) = -\frac{\sin x}{\cos x} = \mathbf{-\tan x}$$

5. Calculate the determinants of the following matrices and decide if the given matrix is invertible or not and the reasons why

a) $A = \begin{pmatrix} 5 & 3 & -1 \\ 0 & 4 & 7 \\ 0 & 0 & 1 \end{pmatrix}$

b) $B = \begin{pmatrix} 0 & -6 & 1 \\ 1 & 0 & 2 \\ 0 & 6 & 2 \end{pmatrix}$

Answer

$$a) A = \begin{pmatrix} 5 & 3 & -1 \\ 0 & 4 & 7 \\ 0 & 0 & 1 \end{pmatrix}$$

$$\det A = \begin{vmatrix} 5 & 3 & -1 \\ 0 & 4 & 7 \\ 0 & 0 & 1 \end{vmatrix} = 5 \begin{vmatrix} 4 & 7 \\ 0 & 1 \end{vmatrix} - 0 + 0 = 5(4 - 0) = 20$$

Since $\det A \neq 0$ then A is invertible

$$b) B = \begin{pmatrix} 0 & -6 & 1 \\ 1 & 0 & 2 \\ 0 & 6 & 2 \end{pmatrix}$$

$$\det B = \begin{vmatrix} 0 & -6 & 1 \\ 1 & 0 & 2 \\ 0 & 6 & 2 \end{vmatrix} = 0 - 1 \begin{vmatrix} -6 & 1 \\ 6 & 2 \end{vmatrix} + 0 = -1(-12 - 6) = 18$$

Since $\det B \neq 0$ then B is invertible

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