CSPB 3022 - Craven - Introduction to Data Science Algorithms

Dashboard / My courses / 2241:CSPB 3022 / 15 January - 21 January / Math Concept Quiz

Started on	Thursday, 18 January 2024, 9:18 PM
State	Finished
Completed on	Thursday, 18 January 2024, 9:59 PM
Time taken	40 mins 43 secs
Grade	Not yet graded

Question **1**

Correct

Mark 1.00 out of 1.00

Please watch the Khan Academy video on Summation Notation at this link:

Khan Academy Summation Notation

The video is ~ 5 mins long.

Then look at this resource Khan Academy Summation Review: Khan Academy Summation Review about "Unpacking the meaning of summation notation"

Please answer the following question from the Coursera review:

$\sum_{n=1}^{4} n^2 = ?$

- a. $1 + 2 + 3 + 4$
- b. $1^2 + 4^2$
- c. $(1 + 2 + 3 + 4)^2$
- d. $1^2 + 2^2 + 3^2 + 4^2$

Question **2**

Complete

Marked out of 1.00

Please watch the video Khan Academy Statistics Intro: Mean, median & mode (~9 mins long) and then answer the following question:

Fill in the following definitions:

- **Mean**:
- **Median**:
- **Mode**:

Consider the data set {4.5, 5.0, 5.0, 7.5, 50.0}

1. **Calculate the Mean**: Show your work.
2. **Calculate the Median**: Show your work.
3. **Identify the Mode**: Determine the number that appears most frequently in the set.
4. **Discuss the Measures of Central Tendency**: Explain how the mean, median, and mode you've calculated differ, and what might explain these differences.

Mean: The mean is the sum of numbers divided by the total quantity of numbers.

The mean of this data set is: $\frac{4.5+5.0+5.0+7.5+50.0)}{5} = \frac{72}{5} = \mathbf{14.4}$.

Median: The median of a set of numbers is the central tendency of those numbers where the set is sorted in ascending order.

Since there are five (an odd value) of numbers in this set, the median would be the value in the middle (the third value).

The median of this data set is: $\mathbf{5.0}$.

Mode: The mode is the number that repeats the most in a set of numbers.

The mode of this data set is: $\mathbf{5.0}$.

Question **3**

Complete

Marked out of 1.00

Consider flipping a fair coin twice. What is the **chance of getting at least one 'head' in those two tosses**?

1. Please clearly describe the method you used to calculate the probability.
2. This resource offers some insights if you are interested.

Note: We will be studying probability further in upcoming weeks. Khan Academy can be a great resource if you would like a head start or are looking for a refresher.

I don't have a cited method for how I calculated this so I am just going to talk through my reasoning as to how this would be answered.

When flipping a coin, you have a 50 / 50 chance of getting heads or tails. When this coin is flipped two times, the possible outcomes are (H for heads, T for tails):

HH, HT, TT, TH.

Since we have a total of four possible outcomes, we need to count the number of times a heads occurred and then dived that number by four. Doing so, we see that a heads occurred three times. This means the probability is:

$P = \frac{3}{4} = \mathbf{0.75} = \mathbf{75}\%.$

So a 75% chance we will get at least one head in those two tosses.

Question **4**

Complete

Marked out of 1.00

For this question, please navigate to the article Finding Maxima and Minima Using Derivatives on the **Math is Fun** website.

As you read, annotate the article to highlight key terms, important concepts, and anything else you find noteworthy. You may use digital tools for annotation or print the article and annotate it by hand.

Some advice for things to focus on are:

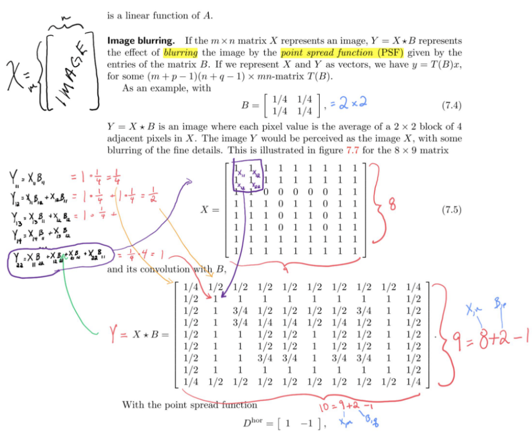
- Definitions of key terms like "maximum," "minimum," and "inflection point"
- Important concepts related to finding maxima and minima with derivatives
- Steps involved in the example problems
- Any other points you find particularly interesting or confusing

Submit Your Annotations:

- **Digital Annotation**: If you've annotated digitally, take screenshots (up to three) that clearly show your annotations and submit them.
- **Printed Annotation**: If you've annotated a printed copy, take a clear picture or scan your annotated pages and submit them.

Evaluation Criteria

- Solid attempt at annotation, shows effort and engagement with the topic.



is a linear function of A.

Image blurring. If the $m \times n$ matrix X represents an image, $Y = X \star B$ represents the effect of *blurring* the image by the *point spread function* (PSF) given by the entries of the matrix B. If we represent X and Y as vectors, we have $y = T(B)x$, for some $(m+p-1)(n+q-1) \times mn$-matrix $T(B)$.

As an example, with

$$B = \begin{bmatrix} 1/4 & 1/4 \\ 1/4 & 1/4 \end{bmatrix}, = 2 \times 2 \qquad (7.4)$$

$Y = X \star B$ is an image where each pixel value is the average of a 2×2 block of 4 adjacent pixels in X. The image Y would be perceived as the image X, with some blurring of the fine details. This is illustrated in figure 7.7 for the 8×9 matrix

$$X = \begin{bmatrix} 1&1&1&1&1&1&1&1&1 \\ 1&1&1&1&1&1&1&1&1 \\ 1&1&0&0&0&0&0&1&1 \\ 1&1&1&0&1&1&0&1&1 \\ 1&1&1&0&1&1&0&1&1 \\ 1&1&1&0&1&1&0&1&1 \\ 1&1&1&1&1&1&1&1&1 \\ 1&1&1&1&1&1&1&1&1 \end{bmatrix} \Big\} 8 \qquad (7.5)$$

$Y_{11} = X_{11}B_{11} = 1 \cdot \frac{1}{4} = \frac{1}{4}$

$Y_{12} = X_{11}B_{12} + X_{12}B_{11} = 1 \cdot \frac{1}{4} + 1 \cdot \frac{1}{4} = \frac{1}{2}$

$Y_{13} = X_{13}B_{11} + X_{12}B_{12} = 1 \cdot \frac{1}{4} +$

$Y_{14} = X_{14}B_{11} + X_{13}B_{12}$

$Y_{22} = X_{11}B_{22} + X_{12}B_{21} + X_{21}B_{12} + X_{22}B_{11} = \frac{1}{4} \cdot 4 = 1$

and its convolution with B,

$$Y = X \star B = \begin{bmatrix} 1/4&1/2&1/2&1/2&1/2&1/2&1/2&1/2&1/2&1/4 \\ 1/2&1&1&1&1&1&1&1&1&1/2 \\ 1/2&1&3/4&1/2&1/2&1/2&1/2&3/4&1&1/2 \\ 1/2&1&3/4&1/4&1/4&1/2&1/4&1/2&1&1/2 \\ 1/2&1&1&1/2&1/2&1&1/2&1/2&1&1/2 \\ 1/2&1&1&1/2&1/2&1&1/2&1/2&1&1/2 \\ 1/2&1&1&3/4&3/4&1&3/4&3/4&1&1/2 \\ 1/2&1&1&1&1&1&1&1&1&1/2 \\ 1/4&1/2&1/2&1/2&1/2&1/2&1/2&1/2&1/2&1/4 \end{bmatrix}. \Big\} 9 = 8+2-1$$

$10 = 9+2-1$

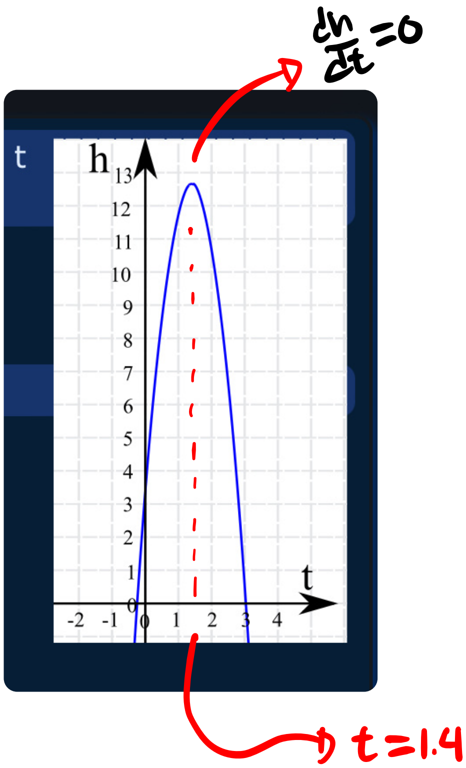
With the point spread function

$$D^{\text{hor}} = \begin{bmatrix} 1 & -1 \end{bmatrix},$$

The method for finding a maxima or minima of a line is calculated with the use of derivatives. The derivative in calculus calculates the change of a function. When calculating maxima or minima, the change at that point is going to be zero. So, to calculate the maxima or minima of a function, we calculate the derivative, and then show that the derivative of that function at the maxima or minima point is zero.

I worked out the examples found in the link since I was unable to find an easy way to print the page and then annotate them.

Notes.pdf



$$y(x) = 3 + 14x - 5x^2$$

$$\frac{dy}{dx} = 14 - 10x$$

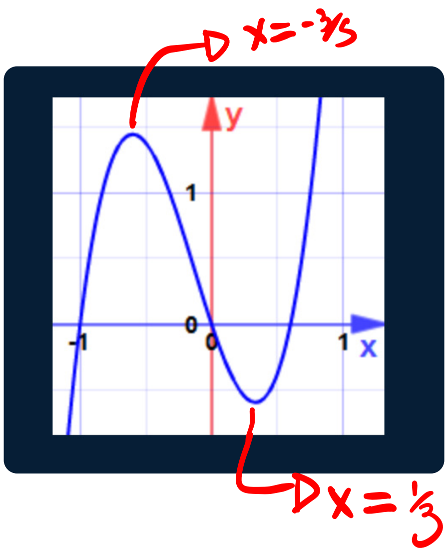
$$14 - 10x = 0 \rightarrow 14 = 10x \rightarrow x = 1.4$$

$$\frac{dy}{dx}(1.4) = 14 - 10(1.4) = 14 - 14 = 0 \checkmark$$

$$\frac{d^2y}{dx^2} = -10$$

when $\frac{d^2y}{dx^2} > 0 \Rightarrow$ minima

$\frac{d^2y}{dx^2} < 0 \Rightarrow$ Maxima



$x = 1.4$ is a maxima because $\frac{d^2y}{dx^2} < 0$

$$y = 5x^3 + 2x^2 - 3x$$

$$\frac{dy}{dx} = 15x^2 + 4x - 3 \qquad 4(15)(-3) = -180$$

$$\frac{-4 \pm \sqrt{16 + 180}}{30} = \frac{-4 \pm 14}{30} = \frac{1}{3}, \frac{-3}{5}$$

$$\frac{d^2y}{dx^2} = 30x + 4$$

$\frac{d^2y}{dx^2}(1/3) = 30 \cdot \frac{1}{3} + 4 = 10 + 4 = 14 \Rightarrow > 0 \therefore$ minima

$\frac{d^2y}{dx^2}(-3/5) = 30\left(\frac{-3}{5}\right) + 4 = -18 + 4 = -14 \Rightarrow < 0 \therefore$ maxima