Introduction to calculus, numbers, functions, limit, continuity, derivatives, project

Calculus is math of continuous change. It is often used in physics, chemistry, biology, economics, etc.

Your project can be about any topic in calculus, which you like or interested in. You may present your project to the audience.

Bernoulli experiment

Question:

Calculate your life.

Question:

Calculate the best country.

Numbers

Question:

s is your student number

m8 = s mod 8

Solve number puzzle for 3 + m8 digits.

1+2=3

3x4=12

4x13=52

3x54=162

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Question:

s is your student number

T = s mod 100

Find approximation of e number.

Calculate (1+1/T)T.

s = 23123456

T = s Mod 100

MsgBox (1 + 1 / T) ^ T

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Function

Question:

s is your student number

L = s mod 10

Calculate half-life, which is related to numbers and functions.

For what x is eLx = 0.5?

s = 23123456

L = s Mod 10

x = Log(0.5) / L

MsgBox x

Question:

Analyse equation of linear function.

Write equation of line perpendicular to y = Tx + L.

Limit

en.wikipedia.org/wiki/Limit\_of\_a\_function

This means that for any ε > 0, there exists δ > 0, such that if |x-p| < δ, then |f(x) - L| < ε

It does NOT matter what is f(p) or whether it exists.

Question:

Illustrate definition of limit using ε – δ language.

s is your student number

T = s mod 100

k = s mod 10000

. f(x) = Tx + k. For any ε find δ, using ε – δ definition of the limit.

Question:

s is your student number

m2 = s mod 2

m2 = 0: When does limit exist?

https://brilliant.org/wiki/when-does-a-limit-exist/

https://en.wikipedia.org/wiki/Limit\_of\_a\_function

Limit exists if it is finite, the same from the left and from the right.

This limit does NOT exist:

m2 = 1: List indeterminate forms.

https://en.wikipedia.org/wiki/Indeterminate\_form

0/0, ∞/∞, 1∞

Question:

Give L’Hopital rule.

https://en.wikipedia.org/wiki/L%27H%C3%B4pital%27s\_rule#targetText=In%20mathematics%2C%20more%20specifically%20calculus,be%20easily%20evaluated%20by%20substitution.

m4 = 0: Use L’Hopital rule to prove First Great Limit of Calculus:

m4 = 1: 1

m4 = 2:

m4 = 3:

symbolab.com/solver/limit-calculator

**Continuity:**

en.wikipedia.org/wiki/Continuous\_function

Question:

Investigate continuity of the function:

m7 = 0: x

m7 = 1:

m7 = 2:

m7 = 3:

m7 = 4:

m7 = 5:

m7 = 6:

symbolab.com/solver/function-continuity-calculator

Derivative

en.wikipedia.org/wiki/Derivative

Question:

What is derivative?

Properties of derivative:

Question:

m2 = 1: Give the properties of derivative: times constant, sum, difference, product, quotient.

Question:

m2 = 0: Prove expression for derivative of x2 using limit.

Question:

Find derivatives of these functions:

m4 = 0: ex

m4 = 1: xp

m4 = 2: cos(x)

m4 = 3:

https://www.derivative-calculator.net/

Chain rule

Question:

Calculate derivative, using Chain Rule for sin(Tx)

df =f’dx

dg = g’dx

Question:

Differential

m4 = 0: d(f+g) = df+dg

m4 = 1: d(f-g) = df-dg

m4 = 2: d(fg) = gdf+fdg

m4 = 3: d(f/g) = (gdf-fdg)/g^2

Application of derivative

A function f(x) is increasing if f’(x) > 0

A function f(x) is decreasing if f’(x) < 0

Question:

Increasing or decreasing:

m5 = 0. -6x

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m5 = 1. 9x

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m5 = 2. sin(x)

m5 = 3. cos(x)

m5 = 4. tan(x)

https://www.derivative-calculator.net/

Question:

Find min and MAX.

MAX and min are at points where f’(x) = 0, these are called critical points.

If f’(x) < 0 then f’(x) > 0, then there is minimum.

If f’(x) > 0 then f’(x) < 0, then there is MAXIMUM.

Find the largest area rectangle with perimeter of T meters.

P is Perimeter.

A is Area.

x is width.

y is height.

P = 2x+2y (1)

A = xy (2)

A is minimum when x = 0 or y = 0, in these cases A = xy = 0.

From (1)

 (3)

We put y from equation (3) to equation (2)

 (5)

Differentiating or taking the derivative from (5), we get (6)

 (6)

x=0.25P

Derivative is positive at (-∞, )

If x < 0.25P, then then the derivative is positive:

Derivative is negative at ()

Therefore x = 0.25P is MAXIMUM.

x=0.25P (4)

Putting (4) into (3)

P = T.

T = s mod 100.

From (2)

Rectangle with the largest area is square, if perimeter is the same.

Calculate the largest area right-angled triangle with perimeter of T meters.

a = b

Find maximum volume cylinder for surface area of T meters square. T = 2πRH (5)

For maximum volume R = H.

Maximum volume is

Calculate maximum volume cone for surface area of T meters square. T = πRL

R = H

Calculate maximum area scalene triangle with perimeter of T meters.

All the sides of the triangle must be the same in length to achieve the largest area for the same perimeter.

Question:

Concave or convex:

m4 = 0: x3

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m4 = 1: -x3

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m4 = 2: cos(x)

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m4 = 3: sin(x)

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tan(x)

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Question:

Find inflection point:

m4 = 0: x3

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m4 = 1: -x3

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m4 = 2: cos(x)

https://www.symbolab.com/solver/function-inflection-points-calculator

m4 = 3: sin(x)

https://www.symbolab.com/solver/function-inflection-points-calculator

Linear regression:

Question:

Find linear least-square approximation for your dataset.

(2, m2), (3, m3), (4, m4)

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Dim x(3), y(3)

s = 23123456

m = 3

x(1) = 2

x(2) = 3

x(3) = 4

y(1) = s mod 2

y(2) = s mod 3

y(3) = s mod 4

sx = 0

For j = 1 To m

sx = sx + x(j)

Next j

sy = 0

For j = 1 To m

sy = sy + y(j)

Next j

sxy = 0

For j = 1 To m

sxy = sxy + x(j) \* y(j)

Next j

sx2 = 0

For j = 1 To m

sx2 = sx2 + x(j) ^ 2

Next j

g = (m \* sxy - sx \* sy) / (m \* sx2 - sx ^ 2)

i = (sy - g \* sx) / m

MsgBox g

MsgBox i

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