Week 1 – Calculus Lab

Please note:

1. You need basic Python knowledge to conduct this lab. Since this is not a module for learning how to program, you can take help from other resources (Textbooks, online web pages).
2. Aim is to explore the various libraries and functions available in Python that will be helpful to you as a Data Scientist.
3. Labs will be done using Google Colab, so please feel free to create your own account.
4. A lab guideline is also available on Moodle.

What to do?

1. First step is to import 4 libraries
    a. Numpy
    b. Scipy
    c. Math
    d. Random
2. Copy paste the following code, comments and questions. Code samples are given in this code followed by the practice problem that you need to solve using the sample code provided.

Importing Library: Numpy

(From Last week's Lab, you can find more information about **"NumPy"** library).

NumPy is the fundamental Python library for numerical computing.

[ ]

```
import numpy as np
```

Importing Library: SciPy

(From Last week's Lab, you can find more information about **"SciPy"** library).

SciPy stands for Scientific python. For some statistical calculation we do need Scipy e.g, during last week, you have used stats from Scipy to calculate "Mode".

[ ]
```
from scipy import stats
```

Importing Library: Math

Math is a library you can apply for performing mathematical tasks by using different Math methods in this library.

[ ]
```
import math as mt
```

Importing Library: Random

Python has a built-in library **random** which can be used for generating random numbers/values

---

[ ]
```
import random as rnd
```

Calculus:

Solving an expression in Python

An example code is provided below, notice the use of paranthesis:

[ ]
```
my_value = 2 * (3 + 2)**2 / 5 - 4

print(my_value) # prints 6.0
```

Question 1

Using the code given above, solve the following expressions

a. 5+[−2(−1+3)]^2

b. 9 - 5 / (8 - 3) * 2 + 6

[ ]

Declaring a linear function in Python

The example code given below shows how to declare a linear function which takes in values and gives an output.

[ ]

```
def f(x):
  return 2 * x + 1


x_values = [0, 1, 2, 3]

for x in x_values:
  y = f(x)
  print(y)
```

Question:2

Declare the following linear functions and calculate the corresponding values of y for the given x values.

a. x + y = 10 x= (3, 5, 6, 8)

b. 4x + 1 = 2y x= (0, 2, 4, 7)

[ ]

Charting a linear function in python:

You can use python to make a graphical representation of any given linear function.

An example code is provided below:

[ ]

```
from sympy import *

x = symbols('x')
f = 2*x + 1
plot(f)
```

Question 3:

Using the example code , make a graph of the following linear function

y = x + 5

Charting an exponential function

Python also gives an option to graphically represent exponential functions, the example code is given below

[ ]

```
from sympy import *

x = symbols('x')
f = x**2 + 1
plot(f)
```

Question 4

Chart the following exponential function, using the example code given above, f(x) = 4x^2 + 1

[ ]

Using Python to solve exponents

Sympy library also helps to solve exponents. Example code is given below.

[ ]

```
from sympy import *

x = symbols('x')
expr = x**2 / x**5
print(expr) # x**(-3)
```

Question 5

Write a code to solve the following exponent (-2/3)^-1

[ ]

Logarithms

The log function helps in solving problems involving logrithms. Example code is given below

[ ]

```
from math import log

# 2 raised to what power gives me 8?
x = log(8, 2)

print(x) # prints 3.0
```

Question 6

Using the code above, solve these logrithm questions

a. 3^x = 81

b. 5^x = 125

[ ]

Using sympy to calculate limits

Python can help calculate limits using the code given below

[ ]

```
from sympy import *

x = symbols('x')
f = 1 / x
result = limit(f, x, oo)

print(result) # 0
```

Question 7

Using the code above, solve the following

lim (x→1)[x^2−1 / x−1]

[ ]

Derivative Calculator in python

The following sample code can help you in calculating the derivative of a given function.

[ ]

```
from sympy import *
```

```
# Declare 'x' to SymPy
x = symbols('x')

# Now just use Python syntax to declare function
f = x**2

# Calculate the derivative of the function
dx_f = diff(f)
print(dx_f) # prints 2*x
```

Question:8

Calculate the derivative of the following functions:

a. 2x + 4x

b. 6x^3 - 2x

[ ]

Integrals

The following code can calculate integrals.

[ ]

```
from sympy import *
# Declare 'x' to SymPy
x = symbols('x')
# Now just use Python syntax to declare function
f = x**2 + 1
# Calculate the integral of the function with respect to x
# for the area between x = 0 and 1
area = integrate(f, (x, 0, 1))
print(area) # prints 4/3
```

Question 9

Using the code given above, write a code to calculate the integrals of the following for the given values of x

a. 4x + 10 between x= 0 and x=20 b. 6x^2 - 5. between x= 3 and x= 4