2110233 Com Eng Math Lab - 1/2022 QUIZ

15 September 2023 @9:30 – 11:30

<u>Submission</u>: <mark>(1) pdf file and (2) references (e.g., chatgpt log, stackoverflow) (3) ipynb</mark>

before 11:30, 15 September 2023

However, only pdf file will be mainly scored, try to put everything here

- This exam is an open book exam.

- You are also allowed to open online resources.

- You are <u>NOT</u> allowed to communicate with your friends, send any information / files/materials to your friends through any channels.

- Please turn off the smartphone or keep it in the silent mode

- Any student who does not obey the regulations listed above will receive punishment under the Faculty of Engineering Official Announcement on July 27, 2017 regarding the exam regulations.

    a) With implicit evidence or showing intention for cheating, student will receive an F in that subject and will receive a lower ethical behavior score.

    b) With explicit evidence for cheating, student will force to withdraw from Chulalongkorn University, or students will an F in that subject during that semester and will be required to withdraw all subjects and receive a lower ethical behavior score.

    I acknowledge all instructions above. This exam represents **only my own work**. I did not give or receive help on this exam.

Signature ....

Date ....15 September 2023.........................

Colab file including template and data in this link:

https://colab.research.google.com/drive/1TDoGoO6x4NSueFOa9aSPD4r_ZF5FxJEN?usp=sharing

1. (10 points) Identify price change rate of a stock in ONE YEAR using Discrete Fourier

Transform (DFT / FFT). Download the stock price data in colab link above; the stock price is

updated one point a day, excluding weekends and holidays.

Your ID:

6	4	3	2	0	2	3	3	2	1

The number in the yellow box is your input "stock_no" in the python colab file

stock_no	Symbol	Stock name	stock_no	Stocks (name)	Stock name
0	'BBL.BK'	Bangkok Bank	5	'CPALL.BK'	CP All
1	'TTB.BK'	TMB Thanachart Bank	6	'CENTEL.BK'	Central Plaza Hotel
2	'KBANK.BK'	Kasikornbank	7	'TISCO.BK'	Tisco Financial Group
3	'PTTEP.BK'	PTT Exploration and Production	8	'CBG.BK'	Carabao Group
4	'PTT.BK'	PTT	9	'LH.BK'	Land and Houses

1.1 To analyze the change rate of the stock prices we can use frequencies hidden in the
stock, first **provide a visualization** of DFT of your assigned stock in the blank box below.
Select appropriate range of frequencies that should show in the visualization.
Hint: should not have redundant / negative frequencies
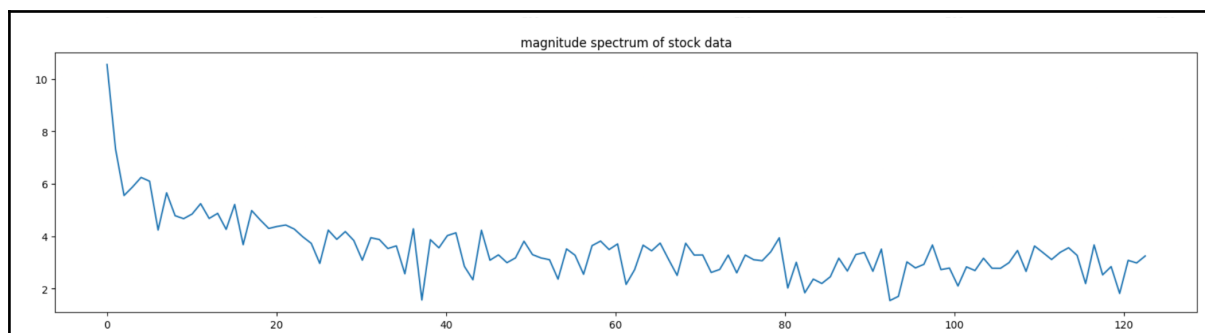
1.2 Provide your code that you use to calculate DFT for the visualization in 1.1. in the blank
box below.

```
stock_data_fft = np.fft.fft(stock_data)
stock_data_fft_shifted = np.fft.fftshift(stock_data_fft)
stock_data_magnitude_spectrum = np.log(1 + np.abs(stock_data_fft_shifted))


plt.title('magnitude spectrum of stock data')
plt.plot(X[:X.shape[0]//2+1], stock_data_magnitude_spectrum[X.shape[0]//2:])
```

1.3 Identify top three dominant frequencies (EXCLUDING the dc component or when
frequency = 0) of your assigned stock in the blank below.

Top three frequencies of ___PTT Exploration and Production_____

(using 6 floating points)

1st highest frequency is   **1.000000** times per year (ครั้งต่อปี)

2nd highest frequency is   **4.000000** times per year

3rd highest frequency is   **5.000000** times per year

2. (10 Points) Convolution in time domain vs. frequency domain

Generate random sequences with size of 4000 for a discrete input signal, $x[n]$ and an impulse response, $h[n]$ (See random function provided in Google Colab).

2.1 Write a code to calculate the output (y1) from the convolution between $x[n]$ and $h[n]$ in time domain and put your code below.

```
y_time = np.convolve(x, h, mode='same')
```

Notes np.convolve do the convolution WITHOUT using DFT

ref : https://numpy.org/doc/stable/reference/generated/numpy.convolve.html

2.2 Write your code to calculate the output (y2) from the convolution using discrete Fourier transform of FFT and put your code here.

```
y_mul = signal.fftconvolve(x, h, mode='same')
```

from the previous reference, numpy said `signal.fftconvolve` from scipy library calculate convolution with `FFT` algo which mean using DFT and multiplication in freq domain.

2.3 What are the computational time used for 2.1 and 2.2. Timing function is provided in Google Colab. (Make sure that the outputs are the same)

Computational time used for convolution in 2.1:

| 5.15e-3 | seconds |

Computational time used for convolution using DFT in 2.2:

112e-6 seconds