Q1:

Assume there two players A and B. Let **p** represents probability of head up, then probability of tail up is **1-p**

Take 2 flips as 1 round:

If it comes up head then tail, A win. Probability of A wins is p*(1-p)

If it comes up tail then head, B win. Probability of B wins is (1-p)*p, which is equal to probability of A wins

If it comes up both tails or both heads, then continue to flip twice until there is a winner.

Q2

```
import re


# dictionary to record frequency of char in a word
def char_freq(word):
    freq_dic = {}
    for char in word:
        freq_dic[char] = freq_dic.get(char, 0) + 1
    return freq_dic


def find_anagram(text):
    # split words
    word_list = text.split()
    # remove special characters
    word_list = [re.sub(r'[^a-zA-Z0-9]','',string) for string in word_list]
    # lower case
    word_list = [string.lower() for string in word_list]


    # initialize anagram list
    anagram_list = []
    # loop thru word_list
    for word1 in word_list:
        for word2 in word_list:
            if word1 != word2 and (char_freq(word1) == char_freq(word2)):
                anagram_list.append(word1)
                anagram_list = list(dict.fromkeys(anagram_list))
    print(anagram_list)
```

Q3:

Given the formula of Newton's Method,

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}.$$

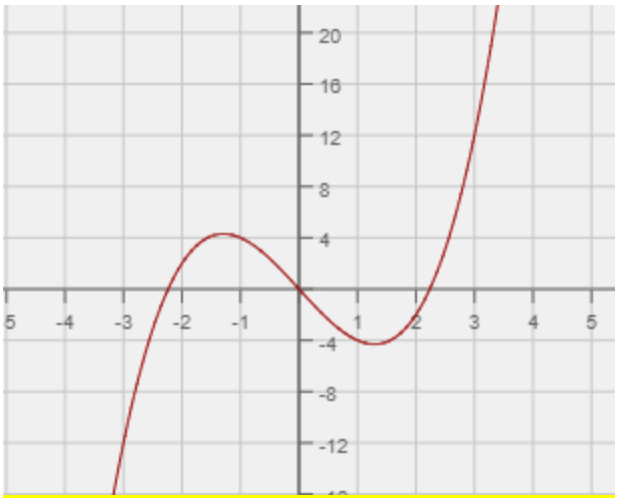
$f'(x_n) \neq 0$, thus there can't be any local maximum or local minimum in the range $[x_0 , 2a - x_0]$

Also, the root can't be a point of inflection (change of concavity)

For example, find x for x^3-5x = 0.

Let $x_0 = 1$, then $x_1 = -1, x_2 = 1$, which go back to x_0

On the graph we can see the root x = 0 is a point of inflection.



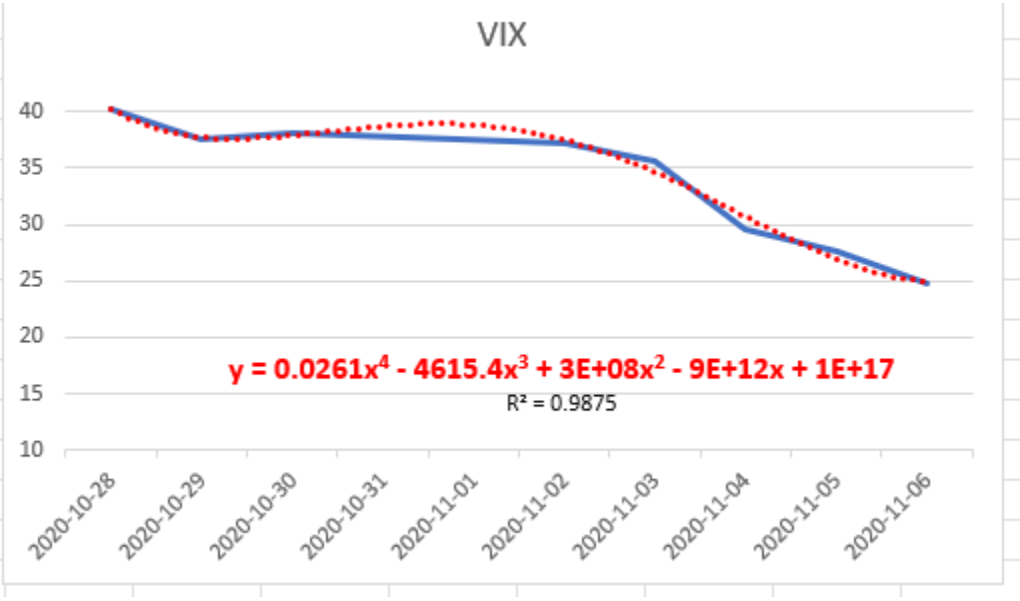
Q4

Polynomial function/regression can be used to model the stress episodes and relaxation phase.

Episodes 1:

Relaxation phase starts on 2020-10-28 and ends on 2020-11-06.

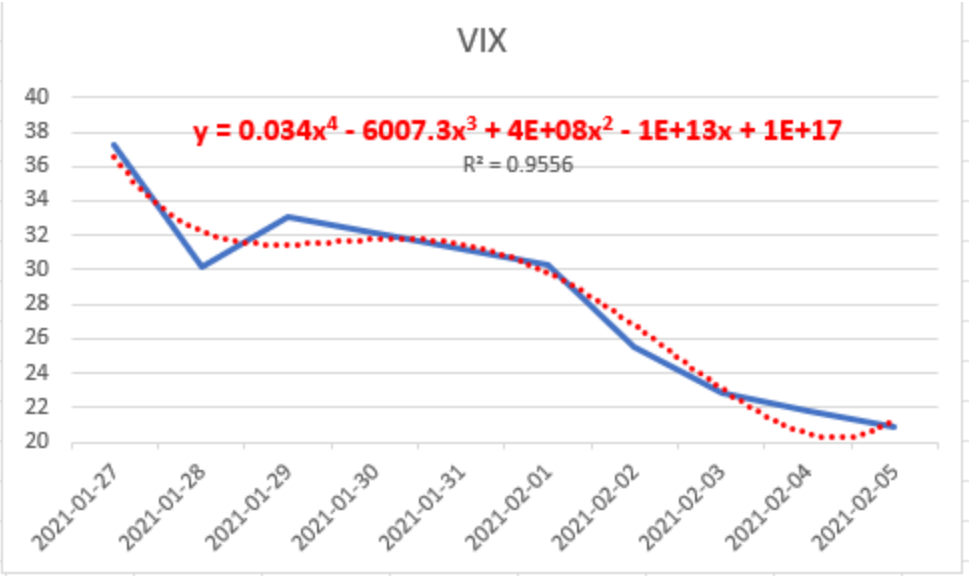
Date	VIX
2020-10-28	40.28
2020-10-29	37.59
2020-10-30	38.02
2020-11-02	37.13
2020-11-03	35.55
2020-11-04	29.57
2020-11-05	27.58
2020-11-06	24.86



Episodes 2:

Relaxation phase starts on 2021-01-27 and ends on 2021-02-16.

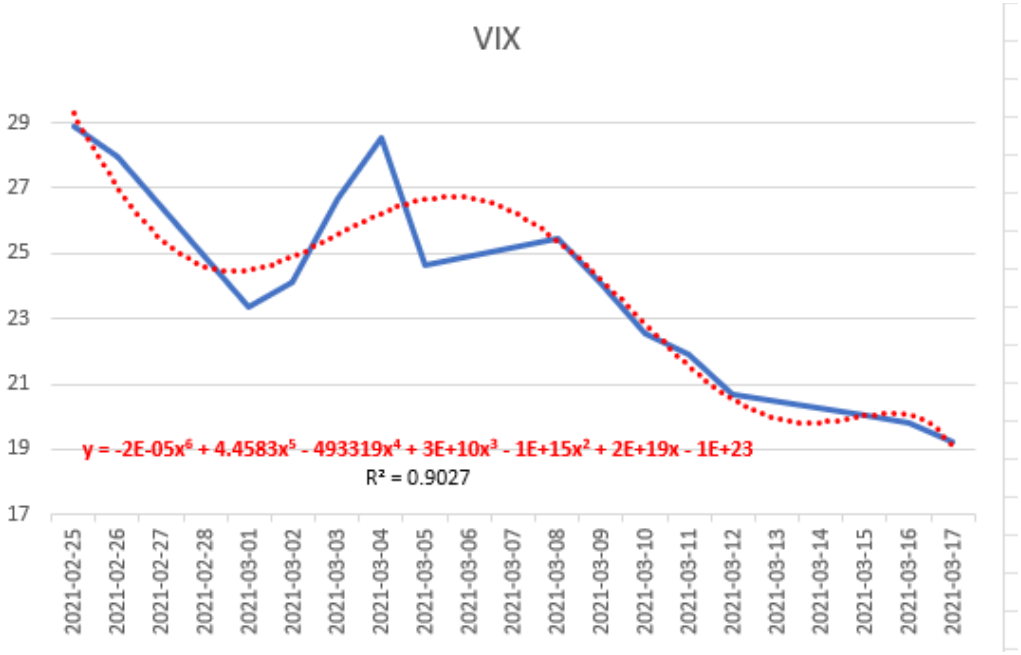
Date	VIX
2021-01-27	37.21
2021-01-28	30.21
2021-01-29	33.09
2021-02-01	30.24
2021-02-02	25.56
2021-02-03	22.91
2021-02-04	21.77
2021-02-05	20.87



Episodes 3:

Relaxation phase start on 2021-02-25, and end on 2021-03-17.

Date	VIX
2021-02-25	28.89
2021-02-26	27.95
2021-03-01	23.35
2021-03-02	24.1
2021-03-03	26.67
2021-03-04	28.57
2021-03-05	24.66
2021-03-08	25.47
2021-03-09	24.03
2021-03-10	22.56
2021-03-11	21.91
2021-03-12	20.69
2021-03-15	20.03
2021-03-16	19.79
2021-03-17	19.23



How could such a model be used for trading or risk management purposes?

- Polynomial function helps to find moving average to determine entry (low point) and exist points (high point) of VIX trade
- To hedge against a fall in market, people buy VIX futures. This model helps us to understand the trend/speed of stress relief and market rise, then when to enter and exist the hedge.