QUESTION 1
CRUDE PALM OIL FUTURES: TO BUY OR NOT?

MYHIMS Solutions PLT is a limited liability partnership that offers industrial mathematics and statistics consultancy services in Malaysia to solve local industry problems. Its client is planning to invest their capital in Crude Palm Oil Futures (FCPO) in Malaysia market. In trading, buying at the right price is vital. However, profit or loss is only known upon selling.

The company's first aim is to project the FCPO's trend direction for five days. They would like to evaluate the frequency of uptrend or downtrend within those five days. Later, they would like to see the price prediction based on the trend before deciding to buy or sell their FCPO contracts. However, their concern involved in maximising the gain from the trade.

Due to extremely volatile Crude Palm Oil (CPO) prices in a very short period of times, challenges emerge in trading the CPO stock prices since the future of CPO stock movement will be hard to be determined. As a result, the decision to buy or to sell will be complicated. Therefore, it is necessary to analyse the trend before selecting appropriate price prediction model.

The company came to MYHIMS Solutions for consultation in finding the trading approach that they can implement to help them make strategic buy and sell decision. As one of the industrial researchers' teams in MYHIMS Solutions, you are required to come out with a mathematical algorithm to optimize the gain from the trade.

Use the latest 6 months of FCPO prices for Spot Month Contract data which can be downloaded from http://www.bursamalaysia.com/market/derivatives/market-statistics/historical-data/ to train, test and validate the model.

-All the best-

QUESTION 2
ANALYSIS OF THE SEAGRASS ABILITY TO GROW IN THE JOHOR COASTAL AREA

Seagrasses are considered as one of the most important species as they play key ecological roles in various types of ecosystems and also provide food sources for endangered animal species. However, they are continually threatened by human activities, causing their degradation and possible habitat loss. In State and National Biodiversity Strategic Plan, Johor is to be made as one of the marine research and reference centres in seagrass research for the purpose of continuous research collaboration between government agencies, universities, private sector and NGOs. Towards achieving this plan, a study on transplanting vegetative fragments or seedlings of seagrass and its ability to grow and survive along Johor coastal area needs to be carried out.

Three sites have been identified for the study; Kelong Atlantis, Pulau Sibu and Pendas. Table 1 presents the physical characteristics of the sites.

Table 1 Physical Characteristics at Identified Sites

Location	Kelong Atlantis, Pulau Tinggi	Pulau Sibu, Tanjung Leman	Pendas, Gelang Patah
Physical Characteristics			
Other Living Beings	Ocean fish Giant clam	Seahorse	Red algae Carpet anemones
Water Quality Parameters			
Temperature (C)	29.40	30.40	29.72
Salinity (ppt)	32.39	31.89	30.83
Dissolved Oxygen (mg/L / %)	5.26	6.21	4.22
pH	8.30	8.31	8.07
Total Suspended Solids (mg/L)	32305.00	32077.50	31189.17
Water Quality Chemistry Parameters			
Alkalinity	78.83	67.15	83.14
Nitrite	0.00	0.00	0.00
Hardness Magnesium	0.22	-0.06	-0.13
Hardness Calcium	-0.15	-0.24	0.04
Iron	0.03	0.02	0.09

From the literature, some of the tropical seagrass species that might be suitable for consideration are Cymodocea Rotundata, Enhalus Acoroides, Halodule Pinifolia, Halodule Uninervis, Halassia Hemprichii, Halophila Minor, Enhalus Acaroides, Cymodocea Serrulata, and Halophila Ovalis.

Given the sites and their physical characteristics, the species that are viable to be considered for growth and the best location to grow this seagrass species are to be identified.

As mentioned, another part of the study is to investigate the ability of the seagrass to survive at the identified location based on its population growth. Suggest a mathematical model that could be used for this purpose.

-All the best-

QUESTION 3
RIVER BIFURCATION

Sg Nenggiri catchment in Kelantan is prone to flooding. Extensive flooding throughout the catchment occurs during heavy and prolonged rainfall resulting into high river flow. The river will overspill the banks of Sg Nenggiri disrupting road networks and human life. Apart from deepening and widening of the river to mitigate flood, the main mitigation action is to divert some of Sg Nenggiri's flow during peak flow to a new river, Sg Anak Nenggiri. The characteristics of the river will change from a single Sg Nenggiri to bifurcated river as in Figure 1.
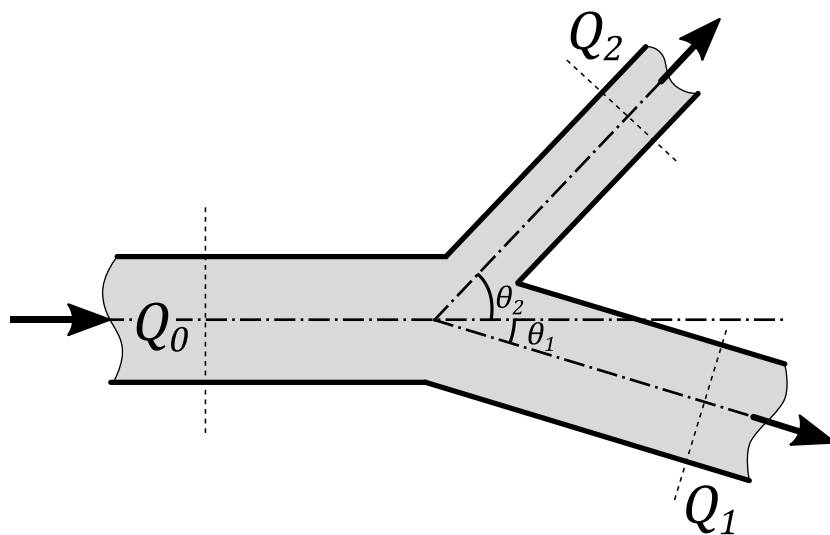

Figure 1

The amount of river flow (river flowrate) going through these two new outlets of the bifurcated river is important in order to mitigate flood. These amount depend on the angles of river bifurcation, θ_1 and θ_2, as shown in Figure 1. Given the flowrate in the main river (Sg Nenggiri), Q_0, **determine the bifurcated flowrates of Sg Nenggiri, Q_1 and Sg Anak Nenggiri, Q_2 with different angles** by applying a suitable mathematical model. Make appropriate assumptions where necessary.

Sample input data:
Flowrate in the main river, $Q_0 = 1000$ m^3/s
Critical flowrate to avoid flood in $Q_1 = 800$ m^3/s (Flood will occur after the bifurcation junction at Sungai Nenggiri if flowrate exceeds this value)
River cross-section of Sg Nenggiri before the bifurcation junction, $A_0 = 1000$ m^2
River cross-section of Sg Nenggiri after the bifurcation junction, $A_1 = 1000$ m^2
River cross-section of Sg Anak Nenggiri, $A_2 = 200$ m^2
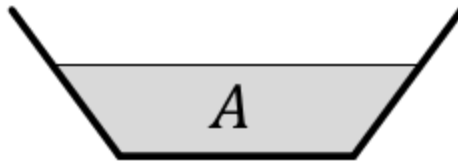
Typical river cross-section is as shown in Figure 2.

Figure 2 - Typical cross-section

*A special note - Even though the river cross-sections before and after the bifurcation junction for Sg Nenggiri are the same, the capability of the river to convey water (the critical flowrate to avoid flood) can vary. Please refer to the Manning's Equation for open channel flow.

-All the best-