UMHackathon 2021
Finance Domain
Problem Statement

Portfolio Recommendation of Top 5 Bonds with highest Return/Volatility Ratio

01 Objective

To build a prediction model that can **forecast price movements of bonds** and then **select 5 bonds that will give us the highest return vs volatility ratio.**

02 Dataset

Monthly BPAM dataset from July 2019 - Oct 2020

03 Input features

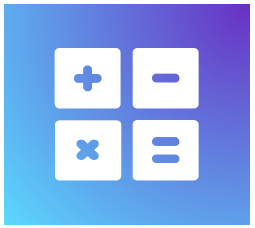
Factors	How	BPAM Column
Rating	The higher the rating, the better the credit (lower coupon). MGS>AAA, AAA>AA	RATING
Coupon Rate	The inflow of interest/profit	NEXT COUPON RATE
Accrued Interest	Accrued interest is the amount of interest earned on bond/Sukuk, but not yet collected.	Calculate*
Frequency of Interest	received interest semi-annually? Annually? Or quarterly?	COUPON FREQUENCY
Current Price	Reverse relationship with yield. Higher yield, lower price.	EVAL MID PRICE

03 Input features

Factors	How	BPAM Column
Maturity	The longer the remaining year, expect higher the coupon/yield.	MATURITY DATE
Duration	The measure of the sensitivity of the price of a bond/Sukuk to a change in interest rates	MODIFIED DURATION
OPR movement	Overnight Policy rate announced by BNM, dictates movement in FI yield.	
MGS movement	Overnight Policy rate announced by BNM, dictates movement in FI yield movement.	
Credit Spread	In expectation of a better economic environment, spreads tighten. Vice versa. i.e.	

04 Predicted output

Predict the bond's price in next month



Calculate the bond return and volatility

Create a portfolio of the Top 5 Bond that gives the highest Return/Volatility ratio.

05 Prototype features

- Upload time-series data
- View and visualize results of model predictions
- Select features to impact the prediction models
- Introduce new features into the models by uploading new excel and selecting columns

Stage 1 - Future Bond's Price Prediction

Input features - nth moth

Factors affect the return

Factors	How	BPAM Column
Rating	The higher the rating, the better the credit (lower coupon). MGS>AAA, AAA>AA	RATING
Coupon Rate	The inflow of interest/profit	NEXT COUPON RATE
Accrued Interest	Accrued interest is the amount of interest earned on bond/Sukuk, but not yet collected.	(Calculate by ourselves)
Frequency of Interest	received interest semi-annually? Annually? Or quarterly?	COUPON FREQUENCY
Current Price	Reverse relationship with yield. Higher yield, lower price.	EVAL MID PRICE
Yield-To-Maturity(YTM)	Current discounted rate of the cash flow	EVAL MID YIELD
Maturity	The longer the remaining year, expect higher the coupon/yield.	MATURITY DATE
Duration	The measure of the sensitivity of the price of a bond/Sukuk to a change in interest rates	MODIFIED DURATION

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OPR movement	Overnight Policy rate announced by BNM, dictates movement in FI yield.
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Additional data from participants they explored.

→ AI Model →

(n+1)th month bond's price

Stage 2 - Bond Return and Volatility Calculation

1. Calculate the return of the bonds using the formula below

a. Yield Income + Rolldown return + Change in price based on expected changes in interest rate movement)

Yield income =	$\frac{\text{Annual coupon payment}}{\text{Current bond price}}$
Rolldown return =	$\frac{\text{Bond price End - Bond price Beg}}{\text{Bond price Beg}}$
Expected Δ in yield =	[-MD x Δ yield] + [0.5 * Covexity * (Δ yield)^2]

Stage 2 - Bond Return and Volatility Calculation

2. Calculate the volatility of bonds by getting monthly average returns and use standard deviation formula on monthly return

	Bond A	Bond B	Bond C	Bond D	Bond E
30/4/2019	1%	1%	1%	1%	1%
31/5/2019	-2%	0%	-3%	-6%	-2%
28/6/2019	3%	3%	3%	5%	2%
31/7/2019	-1%	0%	-1%	-2%	1%
30/8/2019	1%	0%	0%	-4%	2%
30/9/2019	0%	0%	1%	3%	0%
31/10/2019	2%	1%	1%	2%	1%
29/11/2019	0%	-1%	0%	2%	2%
31/12/2019	0%	0%	1%	2%	0%
31/1/2020	0%	-1%	-2%	-3%	1%
28/2/2020	-1%	-2%	-3%	-5%	-1%
31/3/2020	-9%	-12%	-7%	-13%	-6%
30/4/2020	4%	6%	5%	6%	7%
29/5/2020	3%	1%	3%	3%	5%
30/6/2020	0%	1%	1%	1%	1%
	2%	-2%	-1%	-5%	13%
	0.030858	0.037115	0.028602	0.049527	0.029637

	Bond A	Bond B	Bond C	Bond D	Bond E
Average	0.11%	-0.15%	-0.07%	-0.37%	0.85%
Standard	3.09%	3.71%	2.86%	4.95%	2.96%

Stage 3 - Portfolio Recommendation

Prediction bond return and volatility

Bond	Return (R)	Volatility (V)
A	1	12
B	4	12
C	2	11
D	1	12
E	2	51
F	4	61
G	1	57
H	2	6

Create a portfolio of the Top 5 Bond that give **highest Return over Volatility ratio.**