

The background of the slide features a close-up, slightly blurred image of gold bars and silver coins. The gold bars are stacked, with some showing markings like '1000g', 'FINE', and '999.9'. Silver coins are scattered in the foreground, showing various designs and textures. The overall lighting is dim, creating a professional and thematic backdrop for the title.

# Capstone Project: COMMODITY RISK ASSESSMENT PREDICTOR AND RECOMMENDER [CRAPR]

Focusing on Gold, Silver, and Copper

 by Barry Chua



# Why Safe investing is important

Some young investors get burnt by cryptocurrency crash, regret recklessness; experts raise depression fears



BY DARYL CHOO  
BY KIMBERLY LIM  
Published May 17, 2022  
Updated April 8, 2024

Some investors were aware of the risks involved in cryptocurrencies and were sceptical when they entered the market, but others had a larger risk appetite or believed that it was "risk-free".

“Mentally, I am okay. My faith reminds me that life is bigger than a financial portfolio, and though I was irresponsible in risk management, I would accept the mistake and move on and not harp on it.

A cryptocurrency investor in Singapore who lost about S\$40,000 investing in Luna tokens

”



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## I Lost \$400,000, Almost Everything I Had, on a Single Robinhood Bet

By Anonymous December 2, 2021, 10:00am



I put chump change, like three grand, into crypto, when I only had five grand to begin with in 2017, and I lost all of it. But I was seeing everybody making money hand over fist, and I wasn't. I work in tech, and a lot of my colleagues were worth, like, \$10 million. But the big tipping point was GameStop. It was just ridiculous, and I got greedy and had FOMO.



# GREED KILLS!

Losses can reach **hundreds of BILLIONS to TRILLIONS of dollars** globally in pursuit of \$

**"Don't chase money or you will be trapped,  
from where escaping is very difficult!"**  
Invest and Up





# Important to ask yourself these questions:

Why am I investing?

Am I planning short, mid or long-term investing?

Do I even know what I am investing?

What kind of risks am I willing to accept?



# Problem Statement

1

Lack of Accessible Tools

Lack of real-time, user-friendly tools for accurate commodity risk prediction.

2

Investment Complexity

Difficulty in choosing suitable metals for portfolios

3

Risk Management

Balancing potential returns with market risks



# Solution

1

## Customization

Setup risk profile to suit investment goals

2

## Diversification

Develop tailored investment approaches for each metal

3

## Implementation

Recommender tool that matches risk profile to ideal portfolio





# Metal Characteristics and Investor Suitability

## Copper

- Industrial demand driver, Economic indicator
- High volatility
- Good liquidity

## Gold

- Safe-haven asset, hedge against inflation
- Low volatility
- Highly Liquid

## Silver

- Industrial and Investment demand
- Higher volatility than Gold
- Relatively liquid



# Metal Characteristics and Investor Suitability

- Moderate to Aggressive Investor [**HIGH RISK**]
- Short to medium Term Investment
- Conservative Investor [**LOW RISK**]
- Long Term wealth preservation
- Moderately conservative to Moderate Investor [**MED RISK**]
- Seeking Higher returns



# Risk Profile

- Each risk profile corresponds to a different level of risk tolerance.
- Conservative investors prefer lower risk,
- Aggressive investors seek higher returns, potentially accepting greater risk.

## 5 Profiles Overview:



### Conservative

Lowest risk tolerance, aiming for stability and preservation of capital.



### Moderately Conservative

Lower risk, accepting a modest level of volatility to potentially achieve moderate returns.



### Moderate

Balanced approach, seeking a mix of growth and stability, with a moderate level of risk.



### Moderately Aggressive

Higher risk tolerance, willing to accept greater volatility for potentially higher returns.



### Aggressive

Highest risk tolerance, willing to take on significant risk for potentially large returns.



POINTS RANGE	RISK PROFILE
09 – 20	CONSERVATIVE
21 – 31	MODERATELY CONSERVATIVE
32 – 41	MODERATE
42 – 51	MODERATELY AGGRESSIVE
>= 52	AGGRESSIVE



# Introduction

## Welcome to the Commodity Metals Portfolio Recommender



Gold, Silver, and Copper

In this model, you will be introduced to 3 Commodity metals: Gold, Silver and Copper. It is important to understand difference in risks and suitability of each metal hence please refer to summary table below.

Before you invest, it is also important to know on your investment objectives, risk understanding and appetite. You will be tasked to answer a set of Questionnaire based on Time Horizon, Investment knowledge, Budget and Risk Tolerance.

This Questionnaire will help us assess your Investor Risk profile before recommending your ideal portfolio. Do keep in mind to answer each question honestly to accurately reflect your unique profile.

Introductory message to users on Model and what users can anticipate.

## Comparison Summary:

	Metal	Characteristics	Risk Profile	Suitability	Considerations
0	Gold	- Safe-haven asset - Low volatility - Inflation hedge - Highly liquid	Low Risk	Conservative investors Long-term wealth preservation	- Use as a hedge against economic uncertainty like inflation, currency devaluation, and geopolitical risks - Maintain as a stable store of value - Suitable for wealth preservation
1	Silver	- Dual demand: industrial and investment - Higher volatility - Correlates with economic cycles - Relatively liquid	Moderate Risk	Moderately conservative to moderate investors Seeking higher returns	- Balances safe-haven and industrial demand - Higher potential returns with increased risk - Suitable for portfolio diversification
2	Copper	- Primarily industrial use - High volatility - Economic indicator - Good liquidity	High Risk	Moderate to aggressive investors Short to medium-term investments	- Capitalize on global economic growth - Manage closely due to high volatility - Suitable for those willing to take higher risks

**\*\* Do note this model reflects your risk profile but does not assure guarantees on your investments.**

**\*\***

[Click here to Start](#)

Summary table of each metal for users to have quick overview before beginning



# Questionnaire format

## Question 2

When do you plan to begin withdrawing money from your investments in?

Select an option:

- ☐ 11 years or more
- ☐ 6–10 years
- ☐ 3–5 years
- ☐ Less than 3 years

- Points determined in each choice
- Lowest (Top) to Highest (Bottom)

Back

Next

- Warning message to prompt selection before proceeding

Please select an option before proceeding.

## Question 12

In your opinion, what is the best strategy for growing your wealth?

Select an option:

- ☐ Avoiding risk to preserve capital.
- ☐ Taking some risk to achieve moderate growth.
- ☐ Taking significant risk to achieve high growth.
- ☐ Taking maximum risk to maximize potential returns.

Back

Finish

- Click on “Finish” to end questionnaire
- Model will record and calculate total score



# Portfolio Results

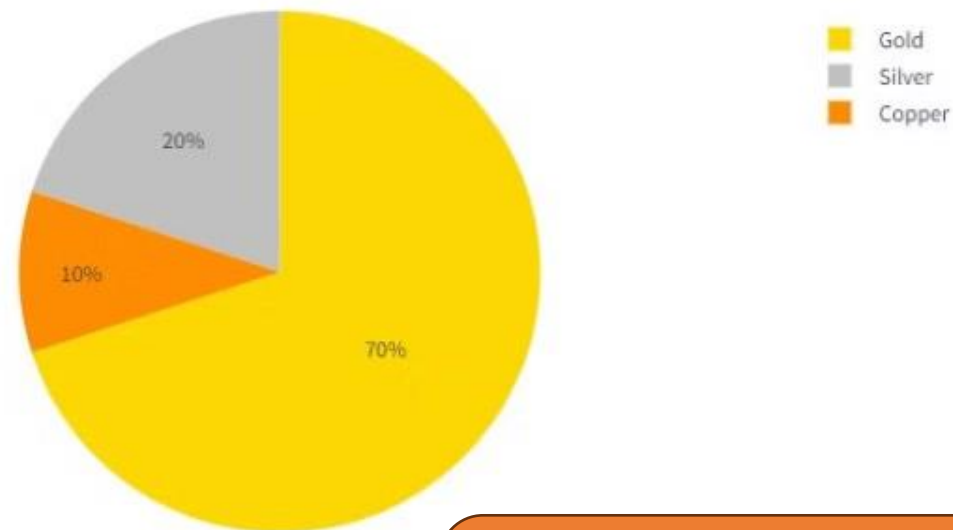
## Your Results

Risk Portrait is: Conservative

Total Points: 17

- Model to predict the relevant “Risk Portrait” based on total points
- Portfolio breakdown on % metal allocation

Your Ideal Portfolio



- Model tag “Risk Portrait” to its relevant profile summary
- Executive Summary of the given Risk profile for user

## Your Risk Profile: Conservative

You have a low tolerance for risk and potential loss of capital. You have a long-term investment time horizon. You are willing to accept some short-term fluctuations. You accept small losses in your investment portfolio in exchange for modest returns. Capital appreciation is not a priority.

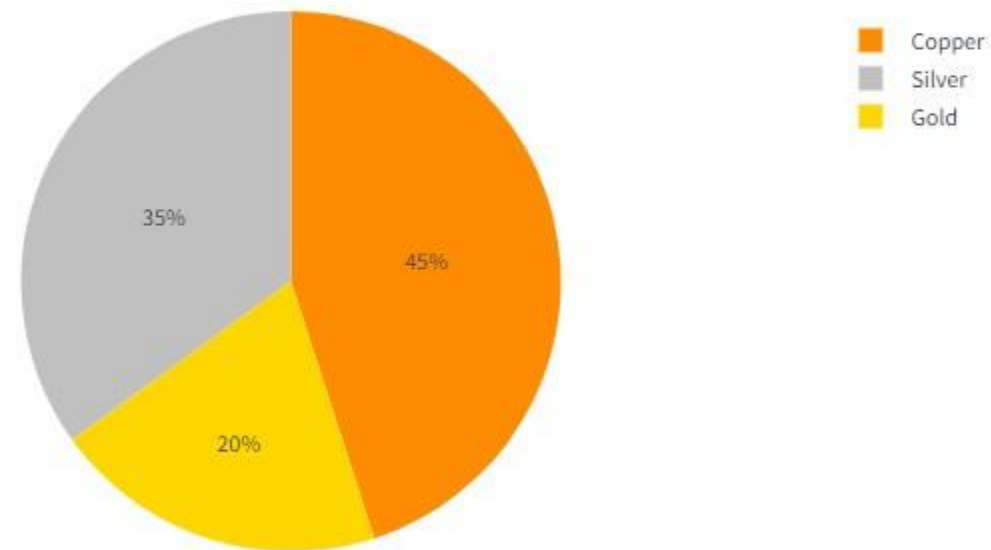


# Your Results

Risk Portrait is: Moderately aggressive

Total Points: 48

Your Ideal Portfolio

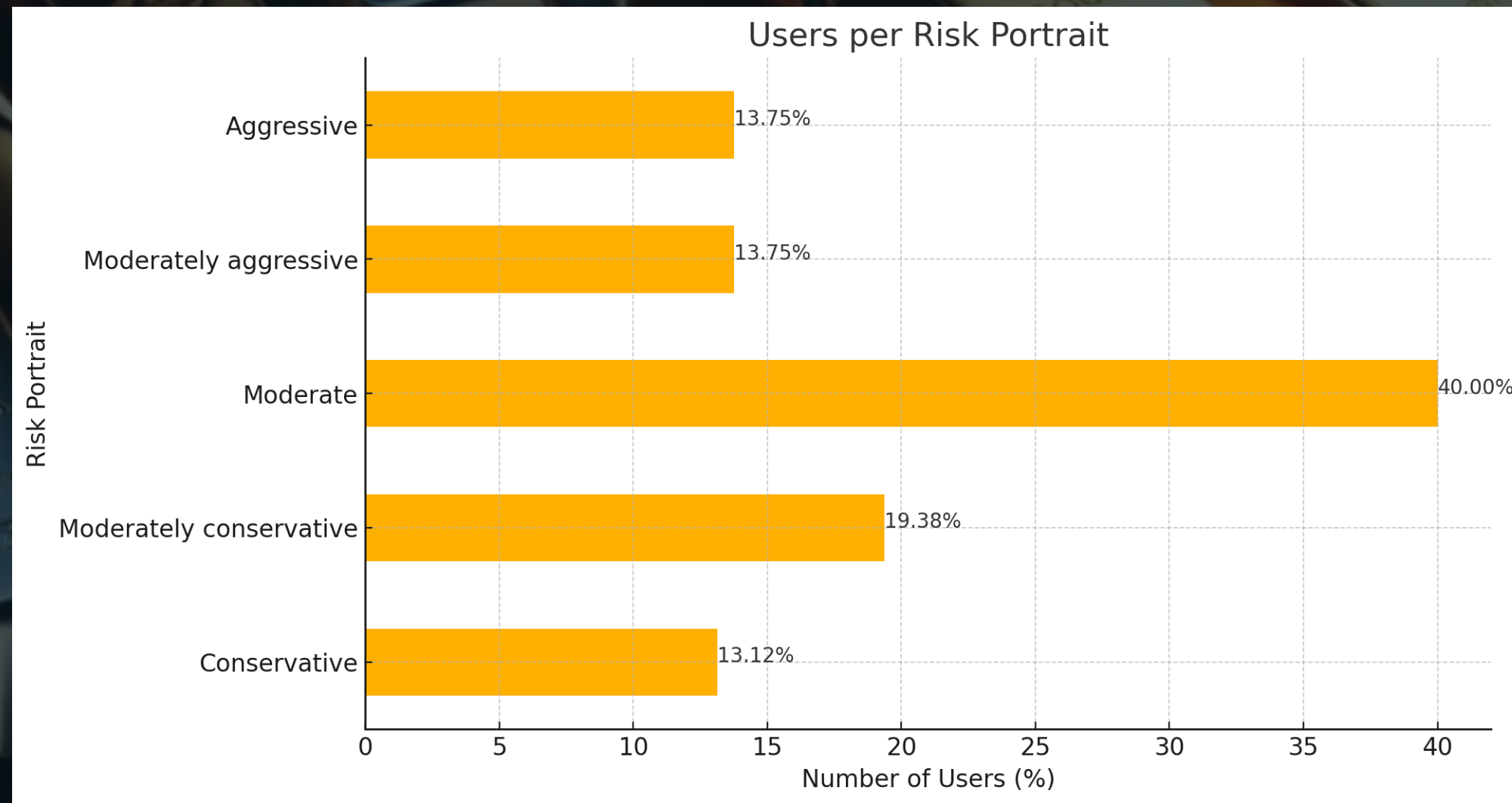


## Your Risk Profile: Moderately aggressive

You are comfortable taking on more risk for the potential of higher returns. You are focused on capital appreciation and are willing to accept moderate fluctuations in your portfolio value over the short/medium-term.



# Number of users per Risk profile



- Risk portrait classification from Conservative [**LOWEST RISK**] to Aggressive [**HIGHEST RISK**]
- Dataset used has substantial "Moderate" users compared to other classes, causing imbalance
- Model still able to produce accurate predictions for other classes



# TOP 3 MODELS

Linear Discriminant Analysis	Naive Bayes	Logistic Regression
A linear classifier that projects data onto a lower-dimensional space while maximizing the separation between classes.	A probabilistic classifier based on Bayes' theorem, assuming features are independent given the class label.	A linear model that predicts the probability of a binary outcome using a logistic function to map predictions to probabilities.



# TOP 3 MODELS

	TRAIN ACCURACY	TEST ACCURACY	ACCURACY DIFFERENCE	TRAIN RUN TIME [SEC]
Linear Discriminant Analysis	<b>0.8830</b>	0.8542	0.03	<b>0.0080</b>
Naive Bayes	0.8206	0.8125	0.01	0.4380
Logistic Regression	0.8198	<b>0.8750</b>	0.06	0.6560



The background of the slide is a close-up, slightly blurred image of numerous gold bars stacked together. The bars are shiny and have some markings on them, including what appears to be a circular logo and some text. The lighting is warm, highlighting the metallic texture of the gold.

Chose Linear Discriminant  
Analysis Model as Best Model due  
to its

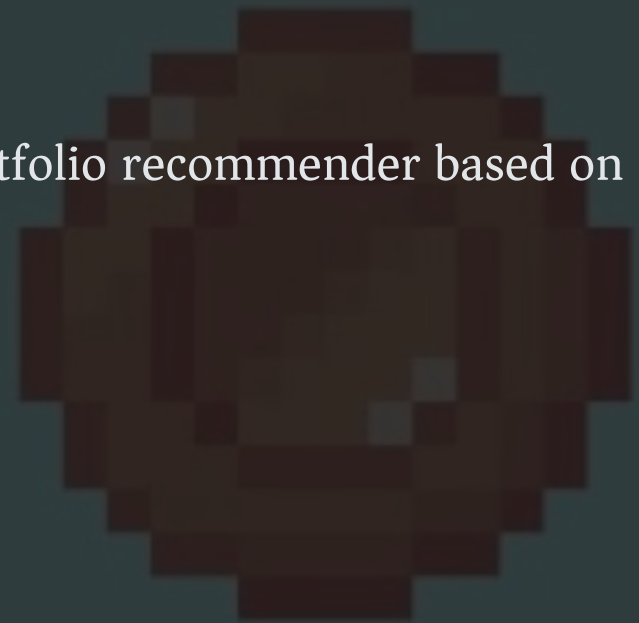
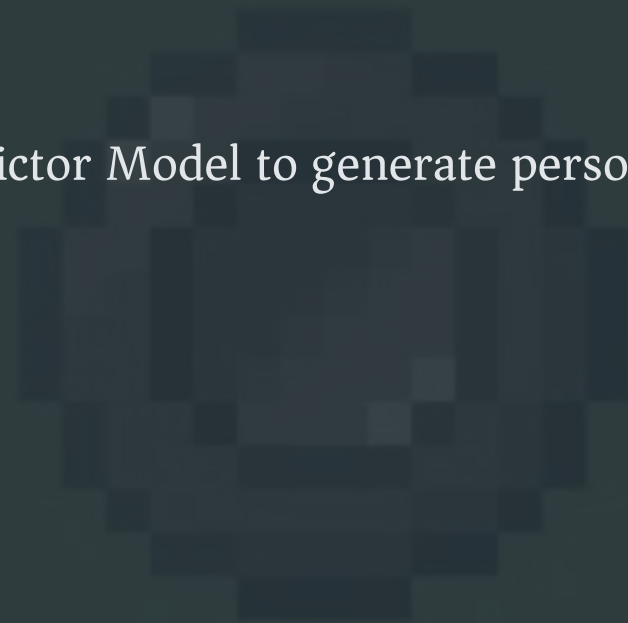
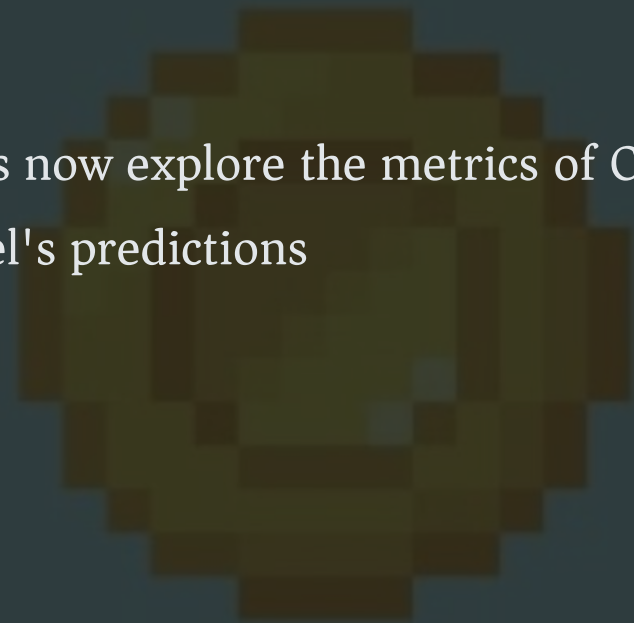
- Highest Train accuracy of **88.3%!**
- Minimal Train-Test accuracy difference of **0.03!**
- Fastest runtime of **0.0080 secs!**



# Portfolio Recommender

## Streamlit Demo

Let us now explore the metrics of CRAPR Predictor Model to generate personalized portfolio recommender based on Model's predictions





# Impact



More Informed Investors

Making smarter investment decisions



Tailored Portfolios

Suit risk appetite and investment goals



Stability Growth

Reduced uncertainty and promoting stability investing.



# Challenges & Limitations

- Model dataset has imbalance of Risk portrait class size
- Questionnaire has user issues when using “Back” button, unable to change answer after initial selection
- Model reliant on user dataset to make accurate predictions
- Model must be updated to match with existing Investor Sentiment and Market conditions





# Benefits

## Informed Investors

Better understanding of  
commodity metal characteristics

## Risk Mitigation

Improved strategies for  
managing market volatility

## Portfolio Optimization

Enhanced ability to balance  
investments effectively

## Smart Money

Making smart investing decisions that leads to wealth growth



# Future Work

1

## Model Enhancements

Resolve bug issues and refine train and test accuracy  
Increase and balance data size of all risk classes for optimal prediction

2

## Expand Scope

Introduce more commodity metals in the analysis

3

## Real-Time Updates

Upgrades to show instant market insights





# In Summary

## Problem

The CRAPR Model aims to address the lack of personalized commodity metals investment recommendations, particularly for investors seeking to diversify their portfolios.

## Solution

CRAPR uses machine learning models to analyze investor risk profiles and investment goals, generating tailored recommendations.

## Impact

Providing actionable insights and personalized recommendations, CRAPR empowers investors to make informed decisions, potentially leading to improved returns and manageable risk.





THANKS AND  
HAPPY INVESTING!





# APPENDIX



# INVESTOR QUESTIONNAIRE REFERENCE LINKS:

BDO UNIBANK:

[file:///C:/Users/BarryCTF/OneDrive/Desktop/Capstone\\_project/Investor%20Questionnaire/CIP%20questionnaire%20example%20\(BDO\).pdf](file:///C:/Users/BarryCTF/OneDrive/Desktop/Capstone_project/Investor%20Questionnaire/CIP%20questionnaire%20example%20(BDO).pdf)

DBS BANK:

[file:///C:/Users/BarryCTF/OneDrive/Desktop/Capstone\\_project/Investor%20Questionnaire/CIP%20questionnaire%20example%20\(DBS\).pdf](file:///C:/Users/BarryCTF/OneDrive/Desktop/Capstone_project/Investor%20Questionnaire/CIP%20questionnaire%20example%20(DBS).pdf)

OCBC:

[file:///C:/Users/BarryCTF/OneDrive/Desktop/Capstone\\_project/Investor%20Questionnaire/CIP%20questionnaire%20example%20\(OCBC\).pdf](file:///C:/Users/BarryCTF/OneDrive/Desktop/Capstone_project/Investor%20Questionnaire/CIP%20questionnaire%20example%20(OCBC).pdf)

SCB:

[file:///C:/Users/BarryCTF/OneDrive/Desktop/Capstone\\_project/Investor%20Questionnaire/CIP%20questionnaire%20example%20\(SCB\).pdf](file:///C:/Users/BarryCTF/OneDrive/Desktop/Capstone_project/Investor%20Questionnaire/CIP%20questionnaire%20example%20(SCB).pdf)

Equitable:

[file:///C:/Users/BarryCTF/OneDrive/Desktop/Capstone\\_project/Investor%20Questionnaire/CIP%20questionnaire%20example%20\(Equitable\).pdf](file:///C:/Users/BarryCTF/OneDrive/Desktop/Capstone_project/Investor%20Questionnaire/CIP%20questionnaire%20example%20(Equitable).pdf)



# ARTICLE LINKS:

Reckless investing consequences:

<https://www.todayonline.com/singapore/some-young-investors-get-burnt-cryptocurrency-crash-regret-recklessness-experts-raise-depression-fears-1900576>

<https://www.vice.com/en/article/i-lost-dollar400000-almost-everything-i-had-on-a-single-robinhood-bet/>

Difference between commodity metal and commodity metal futures:

<https://www.linkedin.com/pulse/what-difference-between-xauusd-gold-forex-broker-forex-global-kcidf/>

Market Sentiment news:

<https://www.morningstar.com/news/marketwatch/2024052154/what-record-highs-for-gold-silver-and-copper-are-saying-about-the-economy>

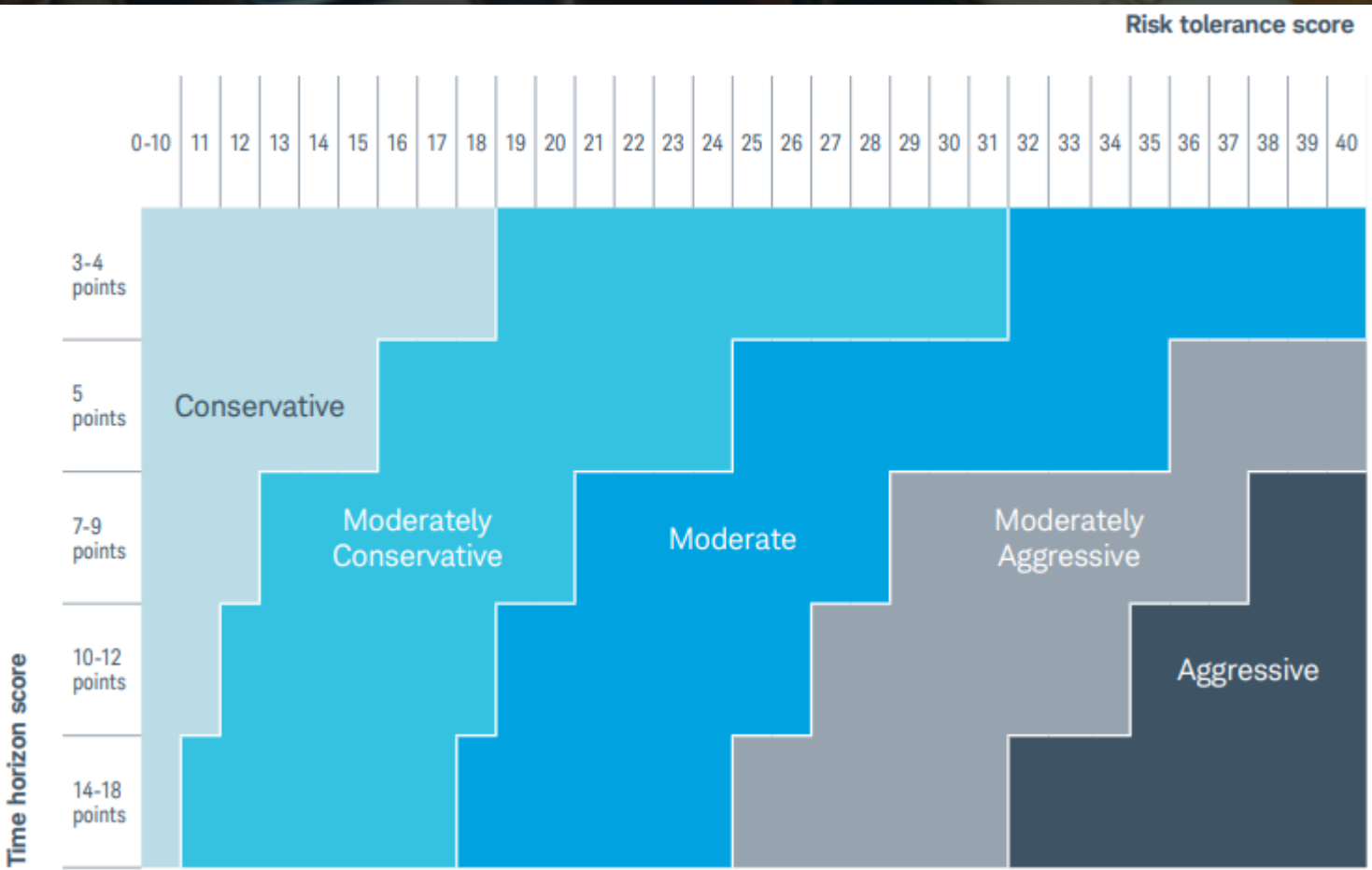
Gold Historical data:

<https://www.investing.com/commodities/gold-historical-data>



Source:

file:///C:/Users/BarryCTF/OneDrive/Desktop/Capstone\_project/Investor%20Questionnaire/Investment-Questionnaire.pdf





Risk portrait	Investment requirements	Investment strategy	Investment timeline	Metal	Gold	Silver	Copper	Point Min	Point Max
Conservative	Stable growth and/or a high level of income.	Conservative strategy required.	Three years or less.	Gold	70.00%	20.00%	10.00%	9	20
Moderately conservative	Fairly stable growth and/or a moderate level of income.	Not comfortable taking risks but requires less conservatism to generate returns.	Three years or more.	Silver	40.00%	45.00%	15.00%	21	31
Moderate	No income required. Client can tolerate fluctuations in the anticipation of higher returns in the long-term.	Moderate investment strategy required.	Five years or more.	Silver	25.00%	50.00%	25.00%	32	41
Moderately aggressive	No income required. Client can tolerate a fair level of fluctuation in the investment based on possible higher returns.	A medium level of risk tolerance must be balanced against a longer time line over which to recoup any paper losses incurred over the timeline of the investment.	Five to ten years.	Copper	20.00%	35.00%	45.00%	42	51
Aggressive	Substantial fluctuations can be tolerated in anticipation of the highest possible return over 10 years or more.	Aggressive strategy can be used. Although volatility will be higher in the short-term, this is off-set by higher long-term returns.	Ten years or more.	Copper	10.00%	20.00%	70.00%	52	64

Metal	Characteristics	Risk Profile	Suitability	Considerations
Gold	<ul style="list-style-type: none"> <li>- Safe-haven asset</li> <li>- Low volatility</li> <li>- Inflation hedge</li> <li>- Highly liquid</li> </ul>	Low Risk	Conservative investors Long-term wealth preservation	<ul style="list-style-type: none"> <li>- Use as a hedge against economic uncertainty</li> <li>- Maintain as a stable store of value</li> <li>- Suitable for wealth preservation</li> </ul>
Silver	<ul style="list-style-type: none"> <li>- Dual demand: industrial and investment</li> <li>- Higher volatility</li> <li>- Correlates with economic cycles</li> <li>- Relatively liquid</li> </ul>	Moderate Risk	Moderately conservative to moderate investors Seeking higher returns	<ul style="list-style-type: none"> <li>- Balances safe-haven and industrial demand</li> <li>- Higher potential returns with increased risk</li> <li>- Suitable for portfolio diversification</li> </ul>
Copper	<ul style="list-style-type: none"> <li>- Primarily industrial use</li> <li>- High volatility</li> <li>- Economic indicator</li> <li>- Good liquidity</li> </ul>	High Risk	Moderate to aggressive investors Short to medium-term investments	<ul style="list-style-type: none"> <li>- Capitalize on global economic growth</li> <li>- Manage closely due to high volatility</li> <li>- Suitable for those willing to take higher risks</li> </ul>

Source:  
<https://www.forbes.com/uk/advisor/investing/risk-profile/#:~:text=There%20are%20three%20main%20categories,balanced%20with%20higher%2Dgrowth%20investments.>

**\*\* Same link as banks investor questionnaire \*\***

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Source:  
<https://www.investopedia.com/articles/basics/09/precious-metals-gold-silver-platinum.asp>  
<https://www.fool.com/investing/2022/04/19/better-buy-now-gold-silver-or-copper/>

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