ISEM 2006 Group Programming Exercise (30 marks) **(11/03/24 version)**

17 marks Program / 8 marks Presentation / 5 marks Individual Reflection

Reference sources :

Mortgage Calculator : **https://www.midland.com.hk/en/calculator/mortgage-calculator**

Stamp duty, according to the formula of the Government
https://www.gov.hk/en/residents/taxes/stamp/stamp_duty_rates.htm

Mortgage insurance information
http://www.hkmc.com.hk/eng/our_business/mortgage_insurance_programme.html

Journey of buying a property in Hong Kong for first time buyer

Dr. Tong WONG is a Professor in economic, he want to develop an **apps "Realize your dream ...."** for young people to use. In order to recruit suitable group of helpers, he decide to launch a competition to HKBU students with a topic : "Journey of buying a property in Hong Kong for first time buyer"

He divided the whole Journey into 3 steps:

1) Finding the target property and calculating the total expense required for the transaction and having a mortgage from a bank.

2) Based on the amount calculated in 1), set up a saving plan and calculate the amount of time required to accumulate the money

3) Determine whether the buyer monthly salary fulfill the **"Debt-to-Income (DTI) Ratio"** and **Stress Test** (which is cancel by the Hong Kong Government in Feb, 2024) under different loan tenor. Provide suitable advice to the buyer

Your group are invited by Dr. Tong WONG and he give your group 5 weeks' time to finish the program. Attached is the detailed information provided for the programs and the requirements from Dr. Tong WONG

Due Date

Monday **Section 1 Due Date :** 2:00p.m. 15/04/2024

Friday **Section 2 Due Date :** 8:00 a.m. 19/04/2024

submit through Moodle, file name for submission is **sX**_gp**Y**.**py (ipynb)** where **X** is your section number, **Y** is A, B, C, D, E, or F correspond to your group. (You can have multiple programs in your work but **sX**_gp**Y**.**py is the main program to call other program**

General requirements (Programs)

1. *Name the variables in a descriptive manner used in the program* *(1 marks)*
2. *Provide descriptive comments in the program* *(3 marks)*
3. *Step 1 program* *(3.5 marks)*
4. *Step 2 program* *(3.5 marks)*
5. *Step 3 program* *(6 marks)*

Bonus marks (allow flexibility and extension) *(3 marks)*

*Use the knowledge you learnt in the **first 9 weeks** to write your programs*

Presentation S1 - 15/04/24; S2 – 19/04/24 (8 marks)

Indicate your group have the capability to develop this generic apps "Realize your dream ...." and your group have enough programming skill in Python and innovative enough to build in flexibility and extension into the apps

Assumptions made for the Prpgram

The buyer is Hong Kong citizens, first time buyer, self-used, no prior mortgage. The maximum value of the property to be consider in this problem is 10 million Hong Kong dollars. The buyer can obtain the mortgage insurance so that he/she can borrow 90% LTV (Loan to valuation) from the bank.

Variables needed to consider.

	Variable to be consider in this program	**Remark**
1.	Transaction price of the property (purchase price)	User-input, correct to dollars
2.	Valuation price of the property	User-input, correct to dollars
3.	Initial saving	User-input, correct to dollars
4.	Monthly salary	User-input, correct to dollars
5.	Agency fee percentage	**1% of transaction value (debatable)**
6.	Legal fee percentage	See table 1
7.	Monthly saving percentage	User-input, percentage
8.	Annual return rate of your saving	User-input, percentage
9.	Stamp Duty rates	See table 2
10.	Mortgage insurance rate	See table 3 and table 4
11.	Mortgage annual interest compound monthly	User-input, percentage
12.	Mortgage rebates percentages (Appl	User-input, percentage
13.	DTI ratio	**<= 50% of the income ***
14.	Stress Test	**<= 60% of the income ***

You must at least write at least **4 functions** in your program, you also need to verify the correct format and range of the data inputted into the programs

The mortgage loan amount approved by a bank is based on the bank's valuation of the property, not the purchase price of the property by the owner. If the valuation price is lower than the transaction price, the buyer need to take more money for the downpayment in order to obtain the mortgage from the bank.

Step 1 : total expense required

downpayment + agency fee + legal fee + Stamp duty fee

Assume the buyer want to borrow 90% LTV

downpayment is equal to

0.1* the minimum of (transaction price, valuation price) +

the maximum of (transaction price – valuation price, 0)

for example

Transaction price = 5M, Valuation price = 5M,

Downpayment = 0.1 * min (5M, 5M) + max (5M – 5M, 0) = 500,000

Loan amount obtain from bank = 5M – 500,000 = 4,500,000

Transaction price = 14M, Valuation price = 13M,

Downpayment = 0.1 * min (14M, 13M) + max (14M – 13M, 0) = 2,300,000

Loan amount obtain from bank = 14M – 2,300,000 = 11,700,000

agency fee is equal to **1% * transaction price, debatable**

legal fee follow table 1

Stamp duty fee follow table 2

mortgage insurance follow table 3 & 4, see examples shown after the tables, the bank will also borrowed the mortgage insurance to the borrower

bank rebates is equal to 1% to 3% in the current market situation applied to the LTV

for example, if the valuation price is 5M for the property from the bank, and the rebate is 3%,

the rebate is 5,000,000* (0.03) = 150,000

Table 1 – Legal fee for buying property

Amount of the transaction cost	Legal fee
Below 3,000,000 (3M)	7,000
3M – 5M	8,000
Above 5M and Below 10M	9,000
10M and above	0.001* Amount of transaction
Disbursement fee in all situations	3,000

Table 2 – Stamp Duty rate applied to the buyer assumed in this case

Amount or value of the consideration		Ad Valorem Stamp duty (AVD) Scale 2 Rates
Exceeds	Does not exceed	
	$3,000,000	$100
$3,000,000	$3,528,240	$100 + 10% of excess over $3,000,000
$3,528,240	$4,500,000	1.5%
$4,500,000	$4,935,480	$67,500 + 10% of excess over $4,500,000
$4,935,480	$6,000,000	2.25%
$6,000,000	$6,642,860	$135,000 + 10% of excess over $6,000,000
$6,642,860	$9,000,000	3%
$9,000,000	$10,080,000	$270,000 + 10% of excess over $9,000,000
$10,080,000	$20,000,000	3.75%
$20,000,000	$21,739,120	$750,000 + 10% of excess over $20,000,000
$21,739,120		4.25%

MORTGAGE INSURANCE PROGRAMME PREMIUM RATE SHEET

Table 3 For Property Value up to HK$6 million & Insurance coverage from 70% LTV to 90% LTV

(For First Time Home Buyer)

Mortgage Insurance Premium			
Mortgage Type	**Insurance coverage according to Loan-to-value Ratio (LTV)**	**Loan Tenor (Years)**	**Single Premium Payment** (% of the Original Principal Balance)
FLOATING RATE	**70% up to 75% LTV**	10	0.00
		15	0.00
		20	0.00
		25	0.00
		30	0.00
	70% up to 80% LTV	10	0.50
		15	0.60
		20	0.76
		25	0.83
		30	0.92
	70% up to 85% LTV	10	0.86
		15	1.02
		20	1.25
		25	1.35
		30	1.41
	70% up to 90% LTV	10	1.25
		15	1.48
		20	1.79
		25	2.03
		30	2.16

Mortgage insurance = The lower of (transaction price, valuation price) * %LTV * respective rate for Loan Tenor

Example 1

Transaction price = 5M, Valuation price = 5M, 90% LTV, Loan Tenor 25 years

Mortgage insurance = 5,000,000 * 0.9 * 2.03/100 = 91,350

Table 4 For Property Value up to HK$15 million & Insurance coverage from 70% LTV to 90% LTV (For First Time Home Buyer)

Mortgage Insurance Premium			
Mortgage Type	**Insurance coverage according to Loan-to-value Ratio (LTV)**	**Loan Tenor (Years)**	**Single Premium Payment** (% of the Original Principal Balance)
FLOATING RATE	**70% up to 75% LTV**	10	0.00
		15	0.00
		20	0.00
		25	0.00
		30	0.00
	70% up to 80% LTV	10	0.60
		15	0.71
		20	0.90
		25	0.97
		30	1.09
	70% up to 85% LTV	10	1.01
		15	1.20
		20	1.46
		25	1.57
		30	1.64
	70% up to 90% LTV	10	1.46
		15	1.72
		20	2.08
		25	2.35
		30	2.50

Example 2

Transaction price = 1.4M, Valuation price = 1.3M, 90% LTV, Loan Tenor 30 years

Mortgage insurance = 13,000,000 * 0.9 * 2.5/100 = 292,500

Step 2 : time required to accumulate the total expense required

1. Assume the user have Initial saving *User input*

2. Assume the user are going to dedicate a certain percentage of your salary each month to saving for the down payment. *User input, if user input 5, it means 5% of the salary will be saved.*

3. Assume that you invest your savings wisely, with an annual return rate is **r_rate,** *User input. if user input 6, it means 6% return per annum which means 6%/12 = 0.5% return each month*

4. Return on investment per month is **cumulative saving * r_rate / 12**

5. At the end of each month, your **cumulative saving** will be increased by the return on your investment, plus a percentage of your **monthly salary.**

   ** The Cumulative saving formula need to be established by linking initial saving and monthly saving

Step 2 programs need to provide a **reasonable answer for the number of months required**

Step 3 : Determine whether the buyer monthly salary fulfill the "Debt-to-Income (DTI) Ratio" and Stress Test under different loan tenor.

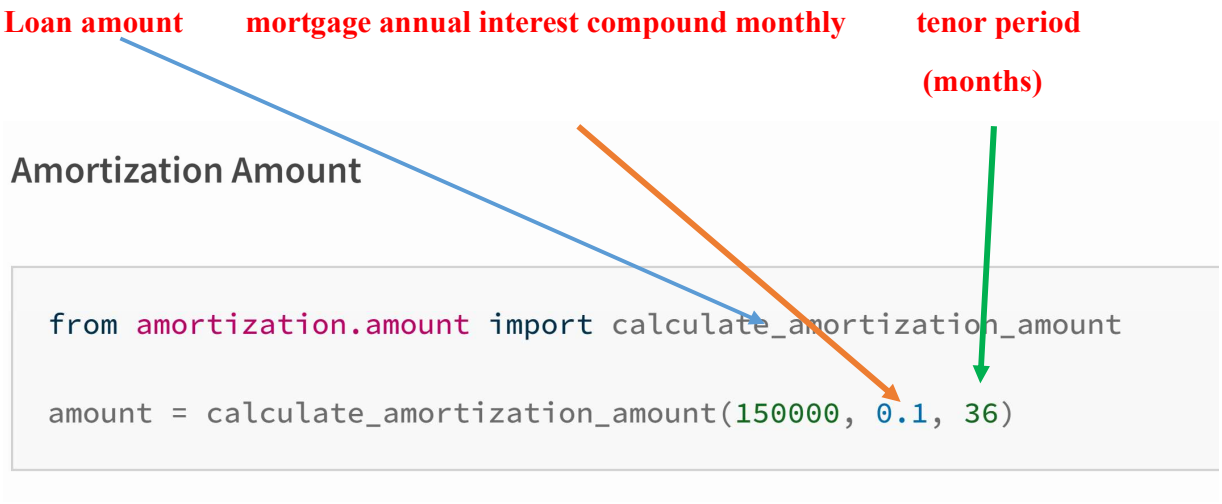
1) Mortgage insurance (Assume 70% from the bank while those above 70% to 90% are using mortgage insurance, using 90%LTV)

   http://www.centamortgage.com/icms/template-en.aspx?series=676&article=42786;
   http://www.hkmc.com.hk/eng/our_business/mortgage_insurance_programme.html

   assume using the Single premium approach and the mortgage insurance amount will be added to the loan amount borrowed from the bank.

2) Based on the formula, calculate the amount need to repay the debt in a monthly basis, (starting with 10 years and iterate over a 5 years period until 30 years to see whether the income can cope with the base DTI – ratio which is 50% and the stress test (interest increased with 2 percentage point while payments cannot exceed 60% of the income)
   https://www.omnicalculator.com/finance/amortization#what-is-amortized-loan-the-amortization-definition

a) Using the **amortiziation 2.3.0 library** https://pypi.org/project/amortization/ to calculate the monthly payment with respect to different loan tenor, also check whether they can pass the DTI – ratio and the Stress test in different loan tenor period. **You need to enter the mortgage annual interest rate compouned monthly here (user_input)**



b) What will be the loan amount with different loan tenor (10, 15, 20, 25, 30 years)? (0.9 * the minimum of (t_cost, v_cost) + mortgage insurance amount for the respective loan tenor years – bank rebate)

c) Assess whether the buyer monthly salary fulfill the "Debt-to-Income (DTI) Ratio" and Stress Test under different loan tenor. **(Also indicate the minimum amount of Salary fulfill the requirements in each loan tenor situation)**

General requirements for Program

1) Provide the list of members in the beginning of the program
2) Write comments to explain your programming logic
3) When your capture input, provide routine to handle the wrong input problems
4) Good use of data structure available in Python
5) To solve the problem

Group submission

Program(s) : **sX_gpY.py (ipynb)**
Test data and output in pdf format OR screen snapshots
The program(s) listing in pdf format
The presentation ppt in ppt
Workload distribution in pdf

Individual submission - Peer assessment and Individual reflection in pdf or WORD format