CPEN/EECE 481, Summer 2021
Final Exam, 25 June 2021

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Q1

Taxable Income	$150,000

If Incorporating	
Pay himself a salary	$100,000
Federal Exemption	$ 12,069
Provincial Exemption	$ 10,582

(a)

Federal Personal Tax

Income	Tax Rate	Tax amount	
$47,630	15%	$ 7,144.50	
$47,629	20.5%	$ 9,763.95	
$52,408	26%	$13,626.08	
$ 2,333	29%	$ 676.57	
		$31,211.10	
$12,069	15%	$ 1,810.35	Exemption
		$29,400.75	Total

Provincial Personal Tax

Income	Tax Rate	Tax amount	
$43,906	5.05%	$ 2,217.25	
$43,907	9.15%	$ 4,017.49	
$62,187	11.16%	$ 6,940.07	
		$13,174.81	
$10,582	5.05%	$ 534.39	Exemption
		$12,640.42	Total

Federal and Provincial Tax

		$42,041.17	Total

(b) Salary

Federal Personal Tax

Income	Tax Rate	Tax amount	
$47,630	15%	$ 7,144.50	
$47,629	20.5%	$ 9,763.95	
$ 4,741	26%	$ 1,232.66	
		$18,141.11	
$12,069	15%	$ 1,810.35	Exemption
		$16,330.76	Total

Salary

Provincial Personal Tax

Income	Tax Rate	Tax amount	
43906	5.05%	2217.253	
43907	9.15%	4017.4905	
12187	11.16%	1360.0692	
		7594.8127	
$10,582	5.05%	$ 534.39	Exemption
		$ 7,060.42	Total

Salary

Federal and Provincial Tax

	$23,391.18	Total

Corporate

Federal Tax

Income	Tax Rate	Tax amount	
$ 50,000	15%	$ 7,500.00	Total

Corporate

Provincial Tax

Income	Tax Rate	Tax amount	
$ 50,000	11.5%	$ 5,750.00	Total

Corporate

Federal and Provincial Tax

	$13,250.00	Total

Salary and Corporate

Federal and Provincial Tax

	$36,641.18	Total

(c)

YES

His taxes would decrease by $5,399.99

(d)

Factors to Consider

- Costs of incorporating
- More detailed tax reporting each year associated with running a business. Also, any fees paid to accountants to shoulder this responsibility
- Issues of liability and how that changes from a proprietorship to a corporation

Canada Personal Income Marginal Tax Rates

Taxable income		Federal Tax rate
Amount between	$0 and $47,630	15%
Amount between	$47,630 and $95,259	20.5%
Amount between	$95,259 and $147,667	26%
Amount between	$147,667 and $210,371	29%
Amount above	$210,371	33%

Ontario Personal Income Marginal Tax Rates

Taxable income		Ontario Tax rate
Amount between	$0 and $43,906	5.05%
Amount between	$43,906 and $87,813	9.15%
Amount between	$87,813 and $150,000	11.16%
Amount between	$150,000 and $220,000	12.16%
Amount above	$220,000	13.16%

Q2

i	6.5%

(a)	
Option A	
Initial Cost	$ 55,000
Useful Life	12
Salvage Value	$ 8,000
Annual Maintenance	$ 3,500
PV	$ 79,798.08
EAUC	$ 9,780.70

(b)	
Option B	
Annual Cost	$ 12,000

(c)

Option A

Option A is cheaper annually by $ 2,219.30

Formula

$$P = F\frac{1}{(1+i)^n}$$

$$A = P\left[\frac{i(1+i)^n}{(1+i)^n-1}\right]$$

Supporting Calculations

$$PV = 55000 + 3500 \cdot \frac{1-(1+0.065)^{-12}}{0.065} - 8000 \cdot (1+0.065)^{-12}$$

$$Annual\ Cost = 0.60 \cdot 20{,}000 = 12{,}000$$

$$EAUC = 79798 \cdot \frac{0.065 \cdot (1+0.065)^{12}}{(1+0.065)^{12}-1} = 9780$$

Q3

i	6%

Year	A	B	C
0	-$6,000	-$2,000	$0
1	$1,950	$700	$0
2	$1,950	$700	$0
3	$1,950	$700	$0
4	$1,950	$700	$0
5	$1,950	$700	$0

(a)	A	B
NPW	$2,214	$949

(b)	A	B
IRR	18.7%	22.1%

(c)	Incremental IRR
	17.0%

(d)

Option A

Option A is the better choice for discount rates under 17%. For a narrow window between 17 and 22.1% Option B is the better option. However these are fairly high borrowing rates that you would expect to have. Based on this assumption, Option A seems like the more sensible option with a more realistic range of borrowing rates you could expect to achieve. This option does come with a higher initial cost. Therefore I am also assuming that the firm involved can sustain this high upfront cost and reap the future benefits down the line. Also, at the discount rate which is given of 6%, Option A yields a higher ROR and a higher NPW and is therefore the better option.

(e)

Choice Table		
If	0 < Borrowing Rate ≤ 17.0	Select A
If	17.0 < Borrowing Rate ≤ 22.1	Select B
If	22.1 < Borrowing Rate	Select C

Formula

$$P = F\frac{1}{(1+i)^n}$$

$$P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

Supporting Calculations

$$6000 - 4000 = 2000$$

$$1950 - 700 = 1250$$

$$4000 = 1250 \cdot \frac{(1+i)^5 - 1}{i \cdot (1+i)^5} \quad \therefore i = 17.0\%$$

Q4

Year	Cost	Cost Index
2006	$ 8,000,000	98
2014	$ 14,000,000	130.3
2020		146
2024		163.6

(a)	
Estimated Inflation Rate	2.9%

(b)	
Original Cost	$ 8,000,000
New Capacity	1.65
Old Capacity	1
Power-sizing Exponent	0.72
Current index	163.6
Old Index	98
Capacity-adjusted Cost	$ 11,473,037.86
Cost Estimate	$ 19,154,464

(c)	
Original Cost	$ 14,000,000
New Capacity	1
Old Capacity	1
Power-sizing Exponent	0.72
Current index	163.6
Old Index	130.3
Capacity-adjusted Cost	$ 14,000,000.00
Cost Estimate	$ 17,581,569

(d)

Option B

(e)

Additional Data

- Maintenance costs associated with each turbine on an annual basis
- Salvage values for each turbine when their useful life has expired
- Advances in technology in this sector and each turbine's characteristics

Supporting Calculations

$$Capacity-Adjusted\ Cost = Original\ Cost \cdot \left(\frac{New\ Capacity}{Old\ Capacity}\right)^{power-sizing\ exponent}$$

$$Cost\ Estimate = Capacity-Adjusted\ Cost \cdot \frac{Current\ Index}{Old\ Index}$$

$$\left(\frac{146}{98}\right)^{\frac{1}{2020-2006}} - 1 = 2.9\%$$

$$\left(\frac{CI}{98}\right)^{\frac{1}{2024-2006}} - 1 = 2.9\%$$

$$\therefore CI = 163.6$$

$$\left(\frac{CI}{98}\right)^{\frac{1}{2024-2014}} - 1 = 2.9\%$$

$$\therefore CI = 130.3$$

Q5

Option A	
Capital Cost (2020 dollars)	$5,000,000
Useful Life years	5
Salvage Value (2028 dollars)	$ 800,000
Revenues/yr (2020 dollars)	$4,100,000
Operating Cost (2020 dollars)	$1,000,000

Option B	
Capital Cost (2020 dollars)	$8,000,000
Useful Life years	5
Salvage Value (2028 dollars)	$ 400,000
Revenues/yr (2020 dollars)	$5,700,000
Operating Cost (2020 dollars)	$1,700,000

Capital Cost Inflation	2.9%
Revenue Inflation	2.0%
Operating Cost Inflation	2.0%
Combined Tax Rate	45.0%
CCA Rate	45.0%
I (MARR of firm)	12.0%

Option A			
Year	Capital Cost	Revenue	Operating Cost
2020	$5,000,000	$4,100,000	$ 1,000,000
2021	$5,145,000	$4,182,000	$ 1,020,000
2022	$5,294,205	$4,265,640	$ 1,040,400
2023	$5,447,737	$4,350,953	$ 1,061,208

Option B			
Year	Capital Cost	Revenue	Operating Cost
2020	$8,000,000	$5,700,000	$ 1,700,000
2021	$8,232,000	$5,814,000	$ 1,734,000
2022	$8,470,728	$5,930,280	$ 1,768,680
2023	$8,716,379	$6,048,886	$ 1,804,054

(a)

CCA Schedule (Option A)

Year	Book value beginning of year	CCA depreciation	Book value end of year
1	$ 5,605,721.32	$ 1,261,287.30	$ 4,344,434.02
2	$ 4,344,434.02	$ 1,954,995.31	$ 2,389,438.71
3	$ 2,389,438.71	$ 1,075,247.42	$ 1,314,191.29
4	$ 1,314,191.29	$ 591,386.08	$ 722,805.21
5	$ 722,805.21	$ 325,262.34	$ 397,542.87
		Loss on Disposal	-$402,457

(b)

CCA Schedule (Option B)

Year	Book value beginning of year	CCA depreciation	Book value end of year
1	$ 8,969,154.11	$ 2,018,059.67	$ 6,951,094.43
2	$ 6,951,094.43	$ 3,127,992.49	$ 3,823,101.94
3	$ 3,823,101.94	$ 1,720,395.87	$ 2,102,706.07
4	$ 2,102,706.07	$ 946,217.73	$ 1,156,488.34
5	$ 1,156,488.34	$ 520,419.75	$ 636,068.58
		Gain on Disposal	$ 236,069

(c)

Option A

Year	Capital Cost	Salvage	Revenue	Operating Cost	CCA depreciation	Taxable Income	Income Tax	After-Tax Cash Flow
0	$ (5,447,737)	$ -	$ -	$ -	$ -	$ -	$ -	$ (5,447,737)
1	$ -	$ -	$ 4,437,972	$ (1,082,432)	$ (1,261,287)	$ 2,094,252	$ 942,414	$ 2,413,126
2	$ -	$ -	$ 4,526,731	$ (1,104,081)	$ (1,954,995)	$ 1,467,655	$ 660,445	$ 2,762,206
3	$ -	$ -	$ 4,617,266	$ (1,126,162)	$ (1,075,247)	$ 2,415,856	$ 1,087,135	$ 2,403,968
4	$ -	$ -	$ 4,709,611	$ (1,148,686)	$ (591,386)	$ 2,969,539	$ 1,336,293	$ 2,224,633
5	$ -	$ 800,000	$ 4,803,803	$ (1,171,659)	$ (325,262)	$ 4,106,882	$ 1,848,097	$ 2,584,047
						NPW	$ 3,500,003	

Option B

Year	Capital Cost	Salvage	Revenue	Operating Cost	CCA depreciation	Taxable Income	Income Tax	After-Tax Cash Flow
0	$ (8,716,379)	$ -	$ -	$ -	$ -	$ -	$ -	$ (8,716,379)
1	$ -	$ -	$ 6,169,863	$ (1,840,135)	$ (2,018,060)	$ 2,311,669	$ 1,040,251	$ 3,289,478
2	$ -	$ -	$ 6,293,261	$ (1,876,937)	$ (3,127,992)	$ 1,288,331	$ 579,749	$ 3,836,574
3	$ -	$ -	$ 6,419,126	$ (1,914,476)	$ (1,720,396)	$ 2,784,254	$ 1,252,914	$ 3,251,735
4	$ -	$ -	$ 6,547,508	$ (1,952,766)	$ (946,218)	$ 3,648,525	$ 1,641,836	$ 2,952,906
5	$ -	$ 400,000	$ 6,678,458	$ (1,991,821)	$ (520,420)	$ 4,566,218	$ 2,054,798	$ 3,031,840
						NPW	$ 3,190,642	

(d)

Option A

Aliya should select Option A. Both have positive Net Present Worth's. However, Option A has a higher NPW

Q6

Objectives

- Design a new building to host a server farm that will support cloud-based services
- Select the servers that will be chosen and installed
- Use business case assessment methods to inform my decisions

(a)

Useful Life (Servers)

- The first thing that is important is to concretely define the useful life of our design. The building will likely have a very long useful life. This is the type of asset that it is. But the servers should be defined concretely so that we know when and where replacement will occur.

Technology

- The specific type of technology. For this kind of venture, the technology is moving very rapidly. Therefore, it is important to choose a design that can keep pace with the latest technological development

(b)

Variables

- Maintenance
- Engineering Drawings
- Shipping and delivery costs

(c)

Capital/Operating Cost

- DIRECT: Cost of Materials
- DIRECT: Cost of storing before delivery
- INDIRECT: Interest Payments
- INDIRECT: Machine Depreciation
- INDIRECT: Insurance Costs

(d)

Tradeoffs

There are various tradeoffs that should be considered with the delivery and implementation of a product. Among them are: Reliability, Performance, Useful life, Flexibility, etc

(e)

Uncertainties

- Breakdown of the machine
- Long-term functionality and performance

(f)

Analysis Method

- **Triple Bottom Line**. It's the most comprehensive and fully engaged analysis method and would be suitable for this design

Q7

Option 1 (Buy Home)	
Total cost of home	$ 550,000
Initial Cost (Deposit)	$ 55,000
Mortgage interest rate	7.0%
Mortgage payments/yr	1
Total years to pay off mortgage	20
Home value inc/yr	2.7%
Utilities/Properties Year 1	$ 3,200
Utilities/Properties inc/yr	5.5%
Sell home after 20yrs	95% house value

Option 2 (Rent)	
rent/yr	$ 25,000
% rent inc/yr	2.1%

Savings	
Money in bank	$ 55,000
% savings inc/yr	2.5%
Withdraw all	Year 20

$$P = \frac{(0.07)\cdot(550{,}000 - 55{,}000)}{1-(1+0.07)^{-20}} = 46{,}724$$

(a)	Annual mortgage loan payment	$ 46,724

Formula

$$P = \frac{i \cdot PV}{1-(1+i)^{-n}}$$

Supporting Calculations

(b)	
Year	House Value
0	$ 550,000
1	$ 564,850
2	$ 580,101
3	$ 595,764
4	$ 611,849
5	$ 628,369
6	$ 645,335
7	$ 662,759
8	$ 680,654
9	$ 699,031
10	$ 717,905
11	$ 737,289
12	$ 757,195
13	$ 777,640
14	$ 798,636
15	$ 820,199
16	$ 842,345
17	$ 865,088
18	$ 888,445
19	$ 912,433
20	$ 937,069

(c)	Option 1 (Buy Home)	Has Lower Undiscounted Costs			
Year	Mortgage Payment	Utilities/Properties	House Sale	Total (Cost)	
0	$ 55,000	$ -	$ -	$ 55,000	
1	$ 46,724	$ 3,200	$ -	$ 49,924	
2	$ 46,724	$ 3,376	$ -	$ 50,100	
3	$ 46,724	$ 3,562	$ -	$ 50,286	
4	$ 46,724	$ 3,758	$ -	$ 50,482	
5	$ 46,724	$ 3,964	$ -	$ 50,689	
6	$ 46,724	$ 4,182	$ -	$ 50,907	
7	$ 46,724	$ 4,412	$ -	$ 51,137	
8	$ 46,724	$ 4,655	$ -	$ 51,379	
9	$ 46,724	$ 4,911	$ -	$ 51,635	
10	$ 46,724	$ 5,181	$ -	$ 51,906	
11	$ 46,724	$ 5,466	$ -	$ 52,191	
12	$ 46,724	$ 5,767	$ -	$ 52,491	
13	$ 46,724	$ 6,084	$ -	$ 52,808	
14	$ 46,724	$ 6,418	$ -	$ 53,143	
15	$ 46,724	$ 6,771	$ -	$ 53,496	
16	$ 46,724	$ 7,144	$ -	$ 53,868	
17	$ 46,724	$ 7,537	$ -	$ 54,261	
18	$ 46,724	$ 7,951	$ -	$ 54,676	
19	$ 46,724	$ 8,389	$ -	$ 55,113	With House Sale
20	$ 46,724	$ 8,850	-$890,216	$55,575	-$834,641

Option 2 (Rent)				
Year	Rent	Savings in Bank	Bank Withdrawal	Total (Cost)
0	$ -	$ 55,000	$ -	$ -
1	$ 25,000	$ 56,375	$ -	$ 25,000
2	$ 25,525	$ 57,784	$ -	$ 25,525
3	$ 26,061	$ 59,229	$ -	$ 26,061
4	$ 26,608	$ 60,710	$ -	$ 26,608
5	$ 27,167	$ 62,227	$ -	$ 27,167
6	$ 27,738	$ 63,783	$ -	$ 27,738
7	$ 28,320	$ 65,378	$ -	$ 28,320
8	$ 28,915	$ 67,012	$ -	$ 28,915
9	$ 29,522	$ 68,687	$ -	$ 29,522
10	$ 30,142	$ 70,405	$ -	$ 30,142
11	$ 30,775	$ 72,165	$ -	$ 30,775
12	$ 31,421	$ 73,969	$ -	$ 31,421
13	$ 32,081	$ 75,818	$ -	$ 32,081
14	$ 32,755	$ 77,714	$ -	$ 32,755
15	$ 33,443	$ 79,656	$ -	$ 33,443
16	$ 34,145	$ 81,648	$ -	$ 34,145
17	$ 34,862	$ 83,689	$ -	$ 34,862
18	$ 35,594	$ 85,781	$ -	$ 35,594
19	$ 36,342	$ 87,926	$ -	$ 36,342
20	$ 37,105	$ 90,124	-$35,124	$ 1,981

Undiscounted sum of all mortgage payments	$ 989,490
Undiscounted sum of all Utility/Property payments	$ 111,579
Undiscounted revenue from sale of the house	$340,216
Undiscounted sum of all cash flows	-$210,853

Undiscounted sum of all rent payments	$ 613,520
Bank savings	$ 35,124
Undiscounted sum of all cash flows	-$578,396

(d)	
i	10%

(c)	
NPW (Option A)	-$360,737
NPW (Option B)	-$239,954

(f)	
i	2.76%

At a borrowing rate of 2.76%, I would be indifferent. At this rate the NPW of both options are equal. I solved by guess and check

Option B (Rent) leaves you in a better financial condition. Ie: Option B costs less

Q8

Error	Location
1	H8
2	L66
3	M9-Q9
4	M14
5	L32
6	ROW 62
7	M24
8	ROW 12
9	ROW 52
10	V49
11	L62
12	P13

Errors

- **CELL H8**: Half-year rule applies in the first year of CCA depreciation. The depreciation should be $7500 not $15000
- **CELL L66**: IRR formulas yields an error. Methodology was correct but should have noticed this error
- **CELL M9-Q9**: Error along this row. The sales should be increasing at a rate of 3%/year but instead it is the same year-year
- **CELL M14**: This is an incorrect value for the CCA depreciation
- **CELL L32**: The B/C Ratio is incorrect. It's using incorrect values
- **ROW 62**: Discounted Net ATCF is Off from the first number
- **CELL M24**: Incorrect value carried from above
- **ROW 12**: Capital Asset Loan repayment scheme is incorrect
- **ROW 52**: Income tax is still being calculated in Option B even though taxable income is negative. No income tax should be payed in these columns. S,T,U,V
- **CELL V49**: Gain on disposal is being used to offset tax when the reverse should be applied
- **CELL L62**: NPW Calculation is missing values in its sum and is therefore producing a negative NPW that is incorrect
- **CELL P13**: Value is incorrect

Q9

Option A (National Bank)	
i	12%
Annual Fee	$ 150

Option B (Local Bank)	
i	14%
Food and Grocery	$

Year	Option A	Option B
1	$ 100	$ 100
2	$ 100	$ 100
3	$ 100	$ 100
4	$ 100	$ 100
5	$ 100	$ 100
6	$ 100	$ 100
7	$ 100	$ 100
8	$ 100	$ 100
9	$ 100	$ 100
10	$ 100	$ 100
11	$ 100	$ 100
12	$ 100	$ 100
13	$ 100	$ 100
14	$ 100	$ 100
15	$ 100	$ 100
NPW (Costs)	$681.09	$614.22

Option A (National Bank)

- PRO: It is a National Bank therefore I can have good assurances that my money is safe and secure. It is unlikely for a large accredited bank to fail (although not impossible)
- PRO: Low interest rate (Relative to Option B). This option has a lower interest rate associated with the credit card and that would yield cost savings over time
- CON: $150 annual fee. There is no fee associated with option B so this would be an additional yearly cost I would undertake if I went with this option

Option B (Local Bank)

- PRO: No annual fee associated with the card
- PRO: 2% rebate on Gas and Grocery purchases. If I spend a lot on Gas and Groceries than this would seem like a very good option that yields high savings. Conversely, If I spend little on Gas and Groceries than this rebate would not concern me
- CON: High interest rate (Relative to Option A). The interest rate for this option is slightly higher. For a credit card, this would cost more money over time

Steps to Analyze Options

- Weigh PROS and CONS of each
- Ensure this bank aligns with my long-term financial goals and objectives
- Make an informed financial decision and seek professional advice if necessary

Additional Data

- Consider other options available if present
- Consider the importance of an interest rate, fees, benefits, etc and weigh all of these based off of my own value that I put on each of them
- Calculate my Gas and Groceries spending and determine how useful this rebate is to me
- Consider any future loans I'm expecting to take on in the future for various projects

Q10

(a)

i	10%

Year	Capital value	(A/P, i, n)	EUAC of capital recovery costs	Maint	(A/G, i, n)	EUAC of Maint Costs	Total EUAC	
0	$20,000						——	
1	$18,000	1.10	$22,000	$ -	-	$0	$22,000	
2	$16,200	0.58	$11,524	$ 850	0.48	$405	$11,929	
3	$14,580	0.40	$8,042	$1,700	0.94	$796	$8,838	
4	$13,122	0.32	$6,309	$2,550	1.38	$1,174	$7,483	
5	$11,810	0.26	$5,276	$3,400	1.81	$1,539	$6,815	
6	$10,629	0.23	$4,592	$4,250	2.22	$1,890	$6,482	
7	$9,566	0.21	$4,108	$5,100	2.62	$2,228	$6,336	(b)
8	$8,609	0.19	$3,749	$5,950	3.00	$2,554	$6,303	Minimum value
9	$7,748	0.17	$3,473	$6,800	3.37	$2,866	$6,339	
10	$6,974	0.16	$3,255	$7,650	3.73	$3,167	$6,422	

(c)

We don't know how many years the machine should be used for before it is sold. We need more information.

Required Information:

- Marginal Cost data for the Defender
- Minimum EAUC of the Challenger

Given this information. We could then compare the EAUC of the Defender in each year with the Challenger's minimum EAUC and determine how many years the machine should be used for.

Formula

$$A = P\left[\frac{i(1+i)^n}{(1+i)^n-1}\right] \qquad A = G * (A/G, i, n) = G\left[\frac{1}{i} - \frac{n}{(1+i)^n-1}\right]$$

Q11

	Job Offer 1	Job Offer 2
Starting (year 1) salary	$ 110,000	$ 101,000
Increase years 2-5	2.3%	2.8%
Increase years 6-10	2.4%	4.7%
Inflation years 2-10	2.2%	1.0%

Market Interest Rate (i)	Job 1	Job 2
years 2-5	2.3%	2.8%
years 6-10	2.4%	4.7%

Inflation Rate (f)	Job 1	Job 2
years 2-10	2.2%	1.0%

Real Interest Rate (i')	Job 1	Job 2
years 2-5	0.1%	1.8%
years 6-10	0.2%	3.7%

(a)

	Market	
Year	Job 1 (Salary)	Job 2 (Salary)
1	$ 110,000	$ 101,000
2	$ 112,530	$ 103,828
3	$ 115,118	$ 106,735
4	$ 117,766	$ 109,724
5	$ 120,475	$ 112,796
6	$ 123,366	$ 118,097
7	$ 126,327	$ 123,648
8	$ 129,359	$ 129,459
9	$ 132,463	$ 135,544
10	$ 135,642	$ 141,915

(b)

	Real	
Year	Job 1 (Salary)	Job 2 (Salary)
1	$ 110,000	$ 101,000
2	$ 110,108	$ 102,800
3	$ 110,215	$ 104,632
4	$ 110,323	$ 106,497
5	$ 110,431	$ 108,395
6	$ 110,647	$ 112,366
7	$ 110,864	$ 116,482
8	$ 111,081	$ 120,749
9	$ 111,298	$ 125,173
10	$ 111,516	$ 129,758

(c)

Year 6

(d)

Job Offer 2

Reasons

- The salary of Job Offer 1 begins higher but it surpassed by Job Offer 2 due to its higher salary increase per year
- It has a higher NPW given an equivalent discount rate and the cash flows over 10 years
- Better at "fighting" inflation and yielding real buying power in the marketplace that increases yearly

Formula

Inflation rate (f)

Real interest rate (i')

Market interest rate (i)

$$i = i' + f + i'f$$

$$F = P(1+f)^n$$

$$i' = (i-f)/(1+f)$$

Q12

i	5%

	Winner	
	Year	Cash-Flow
0	2021	$0
1	2022	$10,000
2	2023	$12,000
3	2024	$14,000
4	2025	$16,000
5	2026	$18,000
6	2027	$20,000
7	2028	$22,000
8	2029	$24,000
9	2030	$26,000
10	2031	$28,000
11	2032	$30,000
12	2033	$32,000
13	2034	$34,000
14	2035	$36,000
15	2036	$38,000
	NPW	$530,373

-$300,000

Year	Cash-Flow
2021	$0
2022	$0
2023	$10,000
2024	$12,000
2025	$14,000
2026	$16,000
2027	$18,000
2028	$20,000
2029	$22,000
2030	$24,000
2031	$26,000
2032	$28,000
2033	$30,000
2034	$32,000
2035	$34,000
2036	$36,000
2037	$38,000
NPW	$505,117

-$300,000

Year	Cash-Flow
2021	$0
2022	$0
2023	$0
2024	$10,000
2025	$12,000
2026	$14,000
2027	$16,000
2028	$18,000
2029	$20,000
2030	$22,000
2031	$24,000
2032	$26,000
2033	$28,000
2034	$30,000
2035	$32,000
2036	$34,000
2037	$36,000
2038	$38,000
NPW	$481,064

-$300,000

Year	Cash-Flow
2021	$0
2022	$0
2023	$0
2024	$0
2025	$10,000
2026	$12,000
2027	$14,000
2028	$16,000
2029	$18,000
2030	$20,000
2031	$22,000
2032	$24,000
2033	$26,000
2034	$28,000
2035	$30,000
2036	$32,000
2037	$34,000
2038	$36,000
2039	$38,000
NPW	$458,156

-$300,000

Year	Cash-Flow
2021	$0
2022	$0
2023	$0
2024	$0
2025	$0
2026	$10,000
2027	$12,000
2028	$14,000
2029	$16,000
2030	$18,000
2031	$20,000
2032	$22,000
2033	$24,000
2034	$26,000
2035	$28,000
2036	$30,000
2037	$32,000
2038	$34,000
2039	$36,000
2040	$38,000
NPW	$436,339

-$300,000

Year	Cash-Flow
2021	$0
2022	$0
2023	$0
2024	$0
2025	$0
2026	$0
2027	$10,000
2028	$12,000
2029	$14,000
2030	$16,000
2031	$18,000
2032	$20,000
2033	$22,000
2034	$24,000
2035	$26,000
2036	$28,000
2037	$30,000
2038	$32,000
2039	$34,000
2040	$36,000
2041	$38,000
NPW	$415,561

-$300,000

YES, the project should be constructed.

- It should be constructed in the year 2021
- This gives a NPW of $530,373

Formula

$$P = F\frac{1}{(1+i)^n} \qquad P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$