

ECON 180 FALL 2022: PROJECT 1

DUE **SEPTEMBER 20, 2022** by 11:59 PM VICTORIA, B.C. TIME

Version 1.1 (Sep 14): Fixed a typo in Question 2 (the cost of housing in Victoria is the cost of the garden suite) and a typo on p. 20 (Question 3.c, not 4.c in the heading).

Honor Code: I guarantee that this submission is **entirely my own work**. I have **cited any outside sources** in APA or IEEE style. **(You must accept this code to receive a mark.)**

Name or Signature for Honor Code: _____

Last 3 digits of student number: _____

Please enter your answers in the spaces and tables provided. Your submission must be in either PDF or Microsoft 365 (Word, etc.) format, so Brightspace can read it properly.

Question		Marks
0	a	5
1	a	75
	b	75
	c	75
	d	75
	e	75
	Q1 (Average)	75
2	Q2 (Total)	75
Q1 to Q2	$(Q1+Q2)/2$	75
3	a	3
	b	3
	c	4
	Q3 (Total)	10
Subtotal	$Q0 + (Q1 + Q2)/2 + Q3$	90
Communication		10
Total		100

I've provided an Excel spreadsheet with this project, but you don't have to use it. None of the questions require that you submit it, but you may find it very useful to have the information you gather tabulated and ready for use by projects 2 through 6. Note that the spreadsheet has three tabs: one for Salary, one for Housing, and one for Mortgage information.

Grading

Each part of questions 1 and 2 will be assigned one of the following marks, in accordance with UVic's grading scale.

- 0: Blank or entirely irrelevant.
- 25: An attempt was made, but the result is not in line with what was asked for.
- 45: You tried, but there were major issues with understanding the material.
- 55: Minimally acceptable work. Significant conceptual or calculation issues.
- 65: Adequate work. Minor conceptual or calculation issues.
- 75: Good work and full engagement with the course.

For more information, see UVic's [Undergraduate Grading Guidelines](#).

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Introduction: Mandeep's Seeking a Solution

Mandeep (nonbinary, they/them) is completing a bachelor's degree in your engineering specialty at UVic. They expect to graduate exactly three years from now. Immediately after graduation, they will begin to work as an engineer, but they're open to the possibility of getting a Master's degree and/or a PhD.

Mandeep has three options on where to work: Victoria, Regina and Montreal. If they end up in Victoria, they will build a garden suite for their parents and move into the main house on the same property. If they choose to work in Montreal, they will rent an apartment or condo. If they end up in Regina, they will buy a home and take out a mortgage to pay for it. Mandeep is firm in the belief that they will work as an engineer for exactly 40 years before retiring.

Throughout the four projects in this course, you will examine the benefits and drawbacks of working and living in each city. We'll start with the basics, and then add more layers to the problem as the relevant topics are covered in class.

Question 0 (Informal): Going with your instincts

This question is only worth 5 marks. Please don't burn yourself out over it. Since I'm asking you to go with your instincts, spending 15 minutes on it (plus reading the question) should be more than enough for many students. As the first question in the course, it will be marked very leniently. It's here because I want you to be able to see how your perception of how to solve this problem changes as you pick up different tools and ways of thinking throughout the course. The idea is that once you've handed in your final project, you can look back at this question and see how it started, vs. how it ended up.

As an engineering student, you are a trained problem solver. For this first question, before we develop the tools of engineering economics in class, briefly tell us how you would solve this problem. To recap:

- Mandeep is non-binary (which may matter because labour market outcomes can depend on perceived gender).
- Mandeep is currently working toward a bachelor's degree in engineering, in your specialty, at UVic. No matter what, they *will* finish this degree, and will graduate three years from now.
- Mandeep is willing to go for a master's degree, or master's plus PhD, if this will improve their career prospects.
- When Mandeep graduates (from the highest degree they complete) they will immediately start working as an engineer in one of three cities: Victoria, Montreal or Regina.
- In Victoria, Mandeep will build a garden suite for their parents and move into the main house on the same property. In Montreal, Mandeep will rent their home. In Regina, they will buy a home and use a mortgage to pay for it.
- Mandeep firmly believes they will work for exactly 40 years before retiring.

(5 marks) Suppose Mandeep has reached out to you for help deciding which degree(s) to go for, and where to live and work after graduating. The only information you start with is what is found in the bullet points above. You can, of course, find additional information via web searches, etc. As a trained problem solver, how would you go about answering Mandeep's question in a specific and helpful fashion? (By 'specific', I mean that you need to specify which degree Mandeep should go for, and which city they should live and work with after graduation.)

[Write your answer here. Take as little or as much space as you need. I expect most answers to be half a page long.]

Question 1 (Regular): Data Gathering

For this project, we need information on Mandeep's housing costs, salary and mortgage rates (if buying a house in Regina). For these parameters, we will need *baseline*, minimum and maximum values.

Most calculations will use the baseline values, but part of the course – the portion on sensitivity analysis - will focus on what to do if your numbers aren't exactly right, or can vary from what you expect. That's why we need the minimum and maximum values. We'll be 'sitting' on these for a while, since they won't come into play until Project 4.

Baseline Value: If I asked you for only one value, this is the value you would choose. It's the value you'll use in your main calculations.

Minimum Value: What's the lowest the value could reasonably go? Maybe you expect Mandeep's income to be \$100,000 a year, but there's a good chance it could be as low as \$50,000 a year.

Maximum Value: What's the highest the value could reasonably go? Maybe houses of the type Mandeep wants in Regina go for about \$500,000, but if Mandeep's very unlucky they may end up paying up to \$750,000.

In brief: the baseline value is what you expect the value to be. The minimum and maximum are the lowest and highest values in the range within which the value can fall. For example, I expect a 473 mL energy drink to cost about \$3.50. That's the baseline. If I'm lucky, I can get it on sale for as low as \$1.50, but that's the minimum price. I've also rarely seen them being sold for as much as \$4.50. That's the maximum.

a. Income

What specialty will Mandeep pursue? (e.g. Software Engineering, Mechanical Engineering)

- Mandeep's Specialty: _____ Engineering

City	Value Type	Yearly Salary ¹ (\$)
Victoria	Minimum	
	Baseline	
	Maximum	
Montreal	Minimum	
	Baseline	
	Maximum	
Regina	Minimum	
	Baseline	
	Maximum	

To find yearly salaries, two useful sites are <https://www.glassdoor.ca/index.htm> and <https://www.payscale.com>. Their home pages are not particularly useful, but using Google to search for (e.g.) 'mechanical engineer salary Victoria' will take you to the correct sub-pages within the first page of hits. These sites give you the average yearly salary, which you can use as your baseline, as well as the minimum and maximum values.

Don't worry about raises, bonuses, taxes, etc. We'll deal with those in later projects.

Sources used to find salary (cite in IEEE or APA format):

¹ How much does an average engineer in your specialty earn, per year, in Victoria? Regina? Montreal? Halifax?

Explain the reasoning behind your choices below. This will only count toward your project-wide communication mark, so you can skip it and still get a very high mark on the project. Please try to keep your explanation to half a page or less. There's no minimum length – if you can explain your reasoning in one word, great!

Why did you choose these particular values for the minimum, baseline & maximum salaries in Regina?

b. Housing near Victoria²

Mandeep's parents own a house in Saanich. This house has a large backyard. They would like their child to continue to live with them, so they're making the following offer:

If, after graduation, Mandeep stays in Victoria for work, they can have their parents' house, as long as they build a garden suite in the backyard, for the parents. The deal is that Mandeep would have to pay for the garden suite, but it would be built for the parents, and then the parents would vacate their house and leave it to Mandeep.

For more information (including a ballpark estimate of cost) on garden suites in Saanich, see the following articles:

Derosa, Katie. (2020, September 18). Saanich gives green light to garden suites after years of consultation. <https://www.timescolonist.com/local-news/saanich-gives-green-light-to-garden-suites-after-years-of-consultation-4684095>

District of Saanich. (2022). Garden suites. <https://www.saanich.ca/EN/main/local-government/development-applications/garden-suites.html>

Juras, S. (2020, February 10). How much to build a garden suite in City of Victoria or Saanich? [Video File]. https://youtu.be/D_VuAb3uPgU

City	Value Type	Garden Suite Construction Cost in Saanich (\$)
Victoria (Saanich)	Minimum	
	Baseline	
	Maximum	

(For now, we're ignoring taxes. This is on purpose. A later project, due after we've covered taxes in class, may add property taxes as a recurring expense if Mandeep chooses to work in Victoria – or in Regina, where we assume Mandeep will buy a home if they settle there.)

² The scenario in this question, and much of the phrasing, is by Dr. E. Gugl. The rest of the assignment questions are by C. Willmore.

Explain the reasoning behind your choices below. This will only count toward your project-wide communication mark, so you can skip it and still get a very high mark on the project. Please try to keep your explanation to half a page or less. There's no minimum length – if you can explain your reasoning in one word, great!

Why did you choose these particular values for the minimum, baseline & maximum garden suite construction costs in Saanich?

c. Housing in Montreal

What kind of housing will Mandeep rent while working as an engineer? (2-bedroom condo? 3-bedroom?)

- Type of housing (Montreal) : _____

City	Value Type	Monthly Rent (\$)
Montreal	Minimum	
	Baseline	
	Maximum	

A convenient place to find the figures needed above is the Rent Board web site. They have tabulated minimum, average and maximum rental values by type of housing in each city:

- Montreal: <https://www.rentboard.ca/montreal-qc>

This is only a suggestion. You may use other sources if you wish.

Sources used to find rent (cite in IEEE or APA format):

Explain the reasoning behind your choices below. This will only count toward your project-wide communication mark, so you can skip it and still get a very high mark on the project. Please try to keep your explanation to half a page or less. There's no minimum length – if you can explain your reasoning in one word, great!

Why did you choose these particular values for the housing type and minimum, baseline & maximum rents in Montreal?

d. Housing in Regina

If they choose to live in Regina, Mandeep will *buy* a housing unit that they will live in until the end of their working life. Due to the way in which house price data is reported in public sources, it may be easier to treat the minimum, maximum and baseline prices as different *types* of housing that Mandeep may choose – for example, they may expect to buy a mid-price condo, but may end up with a cheap bungalow or expensive two-storey home. You are free, however, to choose the *Same* housing type for the minimum, baseline and maximum.

Type of Regina housing used for minimum price: _____

Type of Regina housing used for baseline price: _____

Type of Regina housing used for maximum price: _____

City	Value Type	Home Purchase Price (\$)
Regina	Minimum	
	Baseline	
	Maximum	

If you are using a different type of housing for the min/baseline/max, there are good standard sources with this information available:

- Royal LePage's Home Prices and Forecasts:
<https://www.royalpage.ca/en/realestate/info-and-advice/market-reports-and-surveys/regional-market-updates/>

Their National House Price Composite for Q1 2022 is especially useful:

- https://marketing.rlpnetwork.com/Communications/Royal_LePage_National_House_Price_Composite_in_the_First_Quarter_2022.pdf

If you are using the *Same* type of housing for all three prices, then you will probably have to search real estate listings at sites such as the following:

- Realtor.ca: <https://www.realtor.ca/sk/regina/real-estate>
- Homes Regina: <https://www.homesregina.ca/property-search/results/?city=Regina&state=SK>
- Royal LePage's Regina listings: <https://www.royalpage.ca/en/sk/regina/properties/>

The above sources are just a suggestion. You are free to use your own.

Sources used to find rent (cite in IEEE or APA format):

Explain the reasoning behind your choices below. This will only count toward your project-wide communication mark, so you can skip it and still get a very high mark on the project. Please try to keep your explanation to half a page or less. There's no minimum length – if you can explain your reasoning in one word, great!

Why did you choose these particular values and housing types for the minimum, baseline & maximum housing costs in Regina?

e. Mortgage Rates

Pick a Canadian bank, visit its web page, and find *minimum, baseline and maximum* values for the APR (the advertised rate) it charges on **fixed rate mortgages**. (Almost any rate quoted for a fixed mortgage will be an APR, as the term is used in our course³.) Note that a 1-year fixed mortgage does not mean the entire loan must be paid back in one year – a typical mortgage term is 25 years, and the ‘1-year fixed’ means that the bank won’t change the rate charged for at least 1 year. That means you could choose a 1-year fixed rate for your minimum, a 5-year for your baseline and a 10-year for your maximum. **We will be using a 25-year amortization period** (just in case this matters for your rates – basically, we assume mortgage payments go on for 25 years).

Bank Chosen: _____

Value Type	Mortgage Type	Fixed Rate APR (%)
Minimum		
Baseline		
Maximum		

A few bank mortgage sites to get you started. **Feel free to choose another bank:**

- CIBC: <https://www.cibc.com/en/interest-rates/mortgage-rates.html>
- Royal Bank: <https://www.rbcroyalbank.com/mortgages/mortgage-rates.html>
- TD: <https://www.td.com/ca/en/personal-banking/products/mortgages/mortgage-rates/>

³ If a bank advertises a ‘Special Rate’ and ‘APR’ for the Same mortgage, use the APR. If a bank only lists a ‘posted rate,’ use that as the APR.

Why did you choose these particular values for the mortgage rates? (There's no 'wrong' answer here, but I hope that putting this question here may encourage you to think about what mortgage would be preferred by Mandeep.)

Question 2 (Regular): Benefit-Cost Analysis (Lecture 2)

Assume the following:

- For this question, **ignore the time value of money (present values, etc.)**, and don't worry about realistic considerations like inflation, taxes, raises, being paid twice a month, etc. We'll bring those in during later projects.
- Mandeep will work as an engineer for exactly 40 years. Their yearly salary and monthly rent (if they live in Victoria or Montreal) will never change.
- The **benefits** of living in a city are equal to the total salary Mandeep earns, as an engineer, after graduating. If you earn \$100,000 a year for 40 years, then the total benefits are \$4,000,000.
- The **costs** of living in a city are equal to the total housing costs. For Montreal, this is $40 \times 12 = 480$ rent payments.
- For Regina, instead of rent payments, housing costs are a single payment equal to the cost of the house (we're ignoring mortgages for now).
- For Victoria (well, Saanich), housing costs are equal to the cost of the garden suite.
- The relevant values are the **baseline** values.

Use incremental benefit-cost analysis to determine the preferred city to live and work in. The cities are mutually exclusive, and you may assume you **MUST** pick one of the cities (even if it turns out they all have negative benefit-cost ratios).

- Preferred city: _____

Work: The preferred city is just a checksum, and different students may end up with different preferred cities – what you're being graded on here is your ability to correctly perform a simple incremental benefit-cost analysis. Because of this, you must **show your work**. No work, no mark. If you're going for a high communication mark, make sure that your calculation is clearly laid out, in such a way that someone else reading it can understand each step without having to ask additional questions. (Think of the format that YOU would like to see in a long-form answer key for this question.)

[Use space as needed. Most students will need an extra page.]

Question 3 (Challenge): Thinking about the MARR (Lectures 4 & 5)

Don't burn yourself out on this question. It's only worth 10 marks, and answering anything not completely irrelevant for each of the three parts will give you at least 3 marks, so you're really only working for the remaining 7 marks. It's up to you to decide how much work it's appropriate for you to put in, given the other possible uses of your time and mental health.

In later projects, you'll be given a default MARR to use in your calculations. In this question, I'd like you to think in a bit more detail about what MARR is appropriate for Mandeep's situation.

Mandeep is currently an engineering student, and will continue to be one for the next three years. After graduation, Mandeep will be a working engineer. The opportunities available to students and to practicing engineers are very different. Since the MARR is a measure of *opportunity cost* (to choose to engage in a project, you need to be at least as well off with that project as with anything else you could have done with the same resources), it's reasonable to think that Mandeep will have different MARRs for the three years when they're a student, than for the years.

a. MARR while studying

(3 marks) What is the appropriate MARR for Mandeep, while they are still a student? Briefly explain your reasoning. I do not need a numerical value. The TAs marking this question will look for evidence that you understand the concept of a MARR, and that your choice is consistent with that understanding. This is not a trick question, and there's no single right answer – a case can be made for more than one choice, depending on your reasoning.

Choice & Reasoning:

b. MARR while working

(3 marks) What is the appropriate MARR for Mandeep, while they are working as an engineer? Briefly explain your reasoning. I do not need a numerical value. The TAs marking this question will look for evidence that you understand the concept of a MARR, and that your choice is consistent with that understanding. If it matters for your answer, you may specify whether Mandeep lives in Victoria, Montreal or Regina. *This is not a trick question, and there's no single right answer – a case can be made for more than one choice, depending on your reasoning.*

Choice & Reasoning:

c. Student loans and timing (Very Challenging)

(4 marks) Your friend is working on a similar question in another class. In that class, students were not only asked to choose MARRs for Mandeep while studying and while working as an engineer – they were also asked to calculate the present value of an investment that cost Mandeep \$1,000 today, while Mandeep is a student, and pays Mandeep \$10,000 twenty years in the future (17 years after Mandeep starts working as an engineer).

Your friend believes that the rate on B.C. student loans is the correct MARR when Mandeep is a student, and a 10% per year MARR is appropriate while Mandeep is working as an engineer.

Here's the problem: In B.C., interest doesn't start 'ticking' on your student loans until six months after you graduate. A standard repayment period is 10 years from graduation (6 months of non-payment, then 114 months of equal payments).

Taking this into account, your friend believes that Mandeep's MARR should be 0% for the first 3.5 years (since Mandeep is a student for the first 3 years and no interest on student loans is charged until 6 months after graduation), then the interest rate on student loans from year 3.5 to year 13 (since student loans take 10 years from graduation to pay off), then 10% from year 13 to year 17, since Mandeep's MARR while working as an engineer is 10%.

Do you agree or disagree with your friend's assessment? Briefly explain your reasoning. Remember that this is in the specific context of a project that costs Mandeep \$1,000 today, while they are a UVic student, and pays \$10,000 twenty years later, while they are an established, professional engineer. (Hint: To keep things simple, assume that for their question, your friend is correct about 10% per year being an appropriate MARR for a practicing engineer.)

There is no minimum length for your answer, but please try to keep your discussion to half a page or less. If you can explain your reasoning in one word, great!

Hints for Question 3.c

These hints were originally part of the answer key. To reduce student frustration, I've reproduced here as much of my solution in the key as I can without compromising the learning objectives.

The question explicitly mentions only three candidates for a MARR: 0%, the rate on loans prior to the interest clock starting 6 months after graduation, the interest rate on student loans once that clock ticks (usually less than 5% per year), and the assumed investment available to Mandeep while working which somehow pays 10% per year. That very profitable investment should be taken as given. It just *exists*, like chocolate-flavored soda pop⁴.

The claim that Mandeep must agree with or debunk is actually a combination of four claims:

- Claim 1: Mandeep's MARR is 0% while Mandeep is studying.
- Claim 2: Mandeep's MARR is 0% while Mandeep is working, but student loans don't yet charge interest (the first 6 months after graduation).
- Claim 3: Mandeep's MARR is the interest rate on student loans from when these loans first start charging interest, to when Mandeep finishes paying off these loans. Note that Mandeep is working during this whole time period.
- Claim 4: Mandeep's MARR is 10% per year after Mandeep finishes paying off student loans. Mandeep is working during this time.

One approach to answering Question 4.c is to go claim by claim and examine whether they're true or false.

⁴ See Rossen, J. (2021, January 21). Fudge Fever: The Bizarre Chocolate Soda Craze of the 1980s. <https://www.mentalfloss.com/article/640132/1980s-chocolate-soda-craze>