- "Numbers for Life" at McMaster University
- Idea: to think with numbers in context
- Numeracy is the "ability to access, use, interpret and communicate quantitative information and ideas, in order to engage in and manage quantitative demands of a range of situations in adult life" [OECD]
- What is the relation between math and numeracy? Why would that be important? Maybe it's not...

[Diagram with overlapping circles labeled MATH and NUMERACY]
Is numeracy math?

**NO** - because we do not do functions, etc.

**YES** - because the content forces students to 

- **THINK**
- **PROBLEM-SOLVE**
- **ESTIMATE, APPROXIMATE**
- **EXPERIMENT**
- **ANALYZE**
- **INTERPRET**

* Math habits of mind

[CUOCO ETAL., 1996]

**Important** but not routinely done in math

* Numeracy should not be viewed as Math. Why?
  Needs its own identity so that it does not "drown" in math

**Question:** Who is a numerate person?
What should they know, be able to do?

- Fibonacci sequence, golden ratio, chaos, etc...
- \( \frac{3.7}{4} \), \( \pi \), \( f(x) = x^2 \), etc...?
NUMBERS FOR LIFE course at McMaster

Math 2UU3 Calendar Description

MATH 2UU3
NUMBERS FOR LIFE
3 Units
Principles of quantitative reasoning, problem-solving and critical thinking, discussed in contexts related to, and relevant for, our daily lives, our society and the environment we live in. Content delivered through lecture and class discussion in an engaging and non-threatening way. Course develops core competencies often referred to as numeracy, or numeric literacy.
Three lectures; one term
Not open to students registered in any Honours program in Mathematics and Statistics.

* offered once per year
* open to, and taken by, students from all faculties and programs (except math and stats).
* the only course offered by Math Dept which is not restricted to certain populations (such as "Calc for the Life Sciences")
* ≈ 600 students
* dominant mode: lecture, discussion, and (when in person) class activities
* assessment (limited because of no resources): tests and exam
* TAs: 30 minutes/student for the entire term (so just marking)
* free textbook 😊
COURSE CONTENT

- examining numbers and reasoning as they appear in everyday situations
PART 1
Introduction ................................................................. 1
Mathematical Reasoning and Numeracy ........................................ 7
Numbers: Quantitative in Quantitative Reasoning .......................... 38
Counting and Number Systems .............................................. 69
Proportional Relationships .................................................... 84
Linear and Non-linear Relationships ......................................... 99
Quantities Changing Exponentially ......................................... 122
Covid-19 .......................................................................... 149

PART 2
Financial Matters ............................................................... 168
Cryptocurrencies and Blockchain ............................................. 188
Economy and Social Indicators ................................................ 200
Human Population ................................................................ 225
Climate Change .................................................................. 240
Uncertainty and Probability ..................................................... 261
Working with Probability ......................................................... 282
Gambling ........................................................................... 301
Basics of Statistics and Data Collection .................................... 312
Working With Data ................................................................ 328
Important Statistical Principles .............................................. 348

Gini index

FYMSIC LOVRIC@MCMASTER.CA
Your turn:

Suggest a good/appropriate numeracy task!

Even though we likely don’t agree what numeracy is

0.1% \[ \frac{1}{1000} \text{ 1 in 1000} \]

FRAME

* SAMPLES FROM MY COURSE...

* EXAMPLES OF COMPLEX PROBLEMS...

(A) How much water is wasted in Canada every day because (some) people do not turn the tap off while brushing their teeth?

(B) How to measure (quantify) income inequalities in a given population?

| Pop. I | 20, 30, 50, 100 |
| Pop. II | 20, 20, 20, 30, 30 |

(C) If the temperature of all oceans on Earth increases by 1°C, by how much will their lead increase?

\[ Gini \]
Present world population is about 8 billion.
If, from 2020, every couple has exactly two children, what is the maximum population when it stabilizes?

What goes into (A)?

* identify what data you need, and find it
  how accurate is the data, can I verify?

* survey: how often do you brush teeth/day?
  turn tap off, keep on?
  bias, how to summarize data so that it can be used?

* find an approximation (no formulas given!)
  if you can’t approximate, estimate

* analyze: compare with others — accuracy?
  orders of magnitude
  "robustness"
* Present: how to communicate a large number?  
  ➔ visualize, present in familiar terms

**Key Thing:** Daily life is a great source of problems which require quantitative approaches

Questions? Comments?
**13. How we calculate interest**

The interest rates we charge are:
- the annual cash advance and purchase interest rates shown on the card carrier or any notice we provide to you; or
- any promotional interest rates that we may provide to you.

Your account statement shows your annual and daily interest rates.

If you do not make a minimum payment by the due date, your interest rate will increase as shown on the card carrier or any notice we provide to you. The amount of interest we charge you on each account statement is calculated as follows:

- **first, we determine your average daily balance by adding the interest-bearing amount you owe each day and dividing that total by the number of days in the statement period.**

- **next, we determine the daily interest rate by dividing the annual interest rate by the number of days in a year.**

Your interest charge is then calculated by multiplying the daily interest rate by the average daily balance by the number of days in the statement period.

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This is a summary of credit card balances for one month. **How much interest will we pay for the period from 1 October to and including 31 October (31 days)?**

<table>
<thead>
<tr>
<th>Date</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 October</td>
<td>$500</td>
</tr>
<tr>
<td>5 October</td>
<td>$575</td>
</tr>
<tr>
<td>18 October</td>
<td>$475</td>
</tr>
<tr>
<td>24 October</td>
<td>$920</td>
</tr>
<tr>
<td>1 November</td>
<td>$920</td>
</tr>
</tbody>
</table>

**Interest = Average daily balance * number of days in a month**

*daily interest rate (=APR/365 or APR/366)*
How Effective are Condoms at Preventing Pregnancy?

Using what we have learned, we will answer the following question: What is the probability that a sexually active woman who regularly uses condoms (and no other protection) during the four years at university, will get pregnant?

- 98%
- 2%
- 99% or 100%
The Government of Canada Health Site [https://bit.ly/2SDZdVv](https://bit.ly/2SDZdVv) states that “Condoms help prevent pregnancy when used as intended by the manufacturer. But condoms sometimes fail because of improper use or the material gets damaged. Pregnancy happens in about 10% of cases.”

On the U.K.’s National Health Services web page [https://bit.ly/2Gho70V0](https://bit.ly/2Gho70V0) we read “When used correctly every time you have sex, male condoms are 98% effective. This means 2 out of 100 women will become pregnant in one year when male condoms are used as instructed.”

According to their web page, Planned Parenthood is “a trusted health care provider, an informed educator, a passionate advocate, and a global partner helping similar organizations around the world.” On [https://bit.ly/2TsfkFQ](https://bit.ly/2TsfkFQ) we read “If you use condoms perfectly every single time you have sex, they’re 98% effective at preventing pregnancy. But people aren’t perfect, so in real life condoms are about 82% effective that means about 18 out of 100 people who use condoms as their only birth control method will get pregnant each year.”

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**Student - Elementary/Secondary**

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Person between the ages of 5 and 19 who attends an elementary or secondary school in the City of Hamilton. All secondary students must present their HSR photo ID when using a student fare.

- Paper Ticket or PRESTO - $2
- Monthly Pass or PRESTO - $88

**High school student: (5 <=age<=19) monthly pass:**

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>$83.60</td>
</tr>
<tr>
<td>2018</td>
<td>$88.00</td>
</tr>
</tbody>
</table>

Increase - due to inflation?

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**Salary of a postdoc**
Combined hormonal contraception (CHC) has side effects: blood clots are generally rare but sometimes occur in otherwise healthy people, even those not taking CHCs.

Evidence:

Between 1 and 5 of every 10,000 women (who are not pregnant and not using CHCs) will experience a blood clot in any given year.

Between 3 and 9 of every 10,000 CHC users will experience a blood clot in any given year.

How can this be interpreted as double the rate?

Change from 1-5 per 10,000 to 3-9 per 10,000 could be interpreted as double the rate, as the doubles of numbers from 1 to 5 are 2 to 10, which is close to the 3-9 range given.
Or: the average of 1-5 is 3 and the average of 3-9 is 6, so the average doubles.

Some contraceptive pills said to have the risk of blood clots

British university ‘sorry’ after wrongly giving students 300 coffee cups’ worth of caffeine

The University of Northumbria has apologised for an experiment on caffeine that went horribly wrong, after they were found to have given two students the equivalent of 300 cups of coffee each.
This Is How Many Calories You Burn While Walking

Kcals burned per minute = \(0.035 \times \text{body weight in kilograms}\) + \((\text{Velocity}^2/\text{Height})^{0.029} \times \text{body weight in kilograms}\)

on the next slide we will write it as a mathematical formula:

Calories per minute = 0.035 \cdot B + 0.029 \cdot B \cdot \frac{V^2}{H}

\(B=\text{body mass in kilograms}\)
\(V = \text{velocity in metres per second}\)
\(H = \text{height in metres}\)

"Height essentially economizes walking, so the taller you are, the less energy it takes per pound to walk a mile, or the slower the rate you burn calories while walking at the same speed compared to someone who is shorter." - Peter Weyand, co-author of the study, tells RealSimple.com.

the taller you are, less energy it takes ... I how is it reflected in the formula?
The human development index is calculated from the three indices according to the following formula:

\[ \text{HDI} = \sqrt[3]{EI \cdot EI \cdot EI} \]
I loved how things that are often overlooked and misinterpreted are finally being slowly explained so we get a better understanding of it. Very beneficial course and I am very happy I took it.

The relevance of the material to real life gives me confidence in handling real life problems and breaking down what I need to understand. I feel less intimidated when math numbers are presented to me in real life. I understand that if I break it down, I will be able to understand it.

I really enjoyed all the practical aspects of this course and how they can be used in our day to day lives. It didn't really feel like a math course but rather a pay-attention-to-this-in-life course and I really enjoyed it. The problem sets were a great way to practice what we have learnt in class and prepare for the tests.

I enjoyed having hands-on experience in this course that I didn't really have in other math classes. I learnt to appreciate math through the many ways we learnt how to apply math. I also found it helpful how the prof would prove math equations when we learnt it. It helped me feel that I wasn't just memorizing math equations.
GOOD THINGS ABOUT THE COURSE...

1. The actual materials are very useful in the daily life.  
2. The thinking structure, let students consider things or events in a very logical way.

What will I remember...

I think I will remember that when reading articles and it says something like ‘double the risk of a blood clot’ to consider the actual numbers and remember a really small number doubled is still a really small number.

A Starbucks venti cup of coffee can be claimed to be 99.9% caffeine free.

I feel like most of the lessons stuck with me because the concepts are so practical!

I specifically enjoyed the Avocado Toast Index because I eat a lot of Avocado toast.

I even showed my friends.

Something else that stuck with me was the technique of extending the chart when we did statistics. For example, when comparing men and women who received a vaccine or did not receive a vaccine and figuring out the percentages.

That percentages are relative information. You should always know what people are measuring when they throw percentages out there. I'm now more skeptical of certain videos when they throw out random percentage facts.

contingency table