MATHEMATICS FOR PROGRAMMING

RECAP

- Basic Geometry
  - Points – Lines
  - Rectangle – Square
  - Circle
- Coordinate system
  - 2D and 3D – Distance between points
- Sequence and Series
- Finding sum of series

UNITARY METHOD

- Unit: একক
- Unitary: ঐকিক
- Problem solving method:
  - Find value for single unit
  - Then multiply for necessary units

UNITARY METHOD

- **Problem: You and your 6 friends went to a restaurant. All ordered the same meal, and the total bill was 1218 Taka. Now if you go there with your 2 best friends and have the same meal, what would be the bill this time?**
  - Given: Cost for 7 persons
  - Goal: Finding cost for 3 persons
  - Unitary method: Find cost for 1 person first

  Cost for 7 persons $= 1218$
  Cost for 1 person $= 1218/7 = 174$
  Cost for 3 persons $= 174 \times 3 = 522$

UNITARY METHOD

- **Tom finishes his homework within 15 hours while Jerry takes 10 hours. How many hours will the same homework take to be done if they work together?**
- Pause the video and try

- Idea: How is their performance per hour?
- Tom's 15 hour of work $\equiv$ 1 homework
  - Tom's 1 hour of work $\equiv 1/15$ homework
- Jerry's 10 hour of work $\equiv$ 1 homework
  - Jerry's 1 hour of work $\equiv 1/10$ homework
- Tom and Jerry's 1 hour of work combined $\equiv \left(\frac{1}{15}+\frac{1}{10}\right)$ homework $= 1/6$ homework
- Answer: 6 days.

PERCENTAGE

- Per hundred quantity
- Scaling reference to 100
- Example:
  - You gave a test on 40 marks. Your score was 32.
  - What would be the score if the test was taken with 100 marks?
  - May use unitary method
    - Out of 40 your score $= 32$
    - Out of 1 your score $= \frac{32}{40}$
    - Out of 100 your score $= \left(\frac{32}{40}\right) * 100 = 80$
    - This is per hundred quantity, therefore, **percentage**!
    - You got 80% marks (See how we avoid mentioning the total marks!)
  - You may just multiply the ratio with 100% $\quad (= 100 \times \frac{1}{100} = 1)$
    - $\left(\frac{32}{40}\right) * 100\% = 80\%$

PERCENTAGE PROBLEM

- **A clothing store is selling one of their most popular products at 870 Tk after 40% discount. What was the original price?**
- What we don't know is the original price
- Let it be x
- The discounted price = $x \times (100 - 40)\% = x \times \frac{60}{100} = 870$
- The original price,
  - $x = 870 \times \frac{100}{60} = 1450$

PERCENTAGE PROBLEM

- **The price of oil increased by 25% and then decreased by 15%. What is the net percentage of increase or decrease in oil price?**
- We don't know the initial value
- Let's assume the initial price was 100
- Increase by 25%: Updated price = 125
- Decrease by 15%:
  - Price gets reduced to 85%
  - Updated price = $125 \times 85\% = 125 \times \frac{85}{100} = 106.25$
- Final price is more than 100
- Net increase $(106.25 - 100) = 6.25$ if the original price was 100 (per hundred)
- Answer: Increased by 6.25%

CAPITAL AND INTEREST

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- Capital
- Interest
- Interest rate
  - Per 100 taka
  - Per 1 year (3 months, 6 months are also common)
- Simple interest vs compound interest
- Simple interest
    - $I = P \times n \times r$
    - Interest = Capital x Time unit x Interest rate

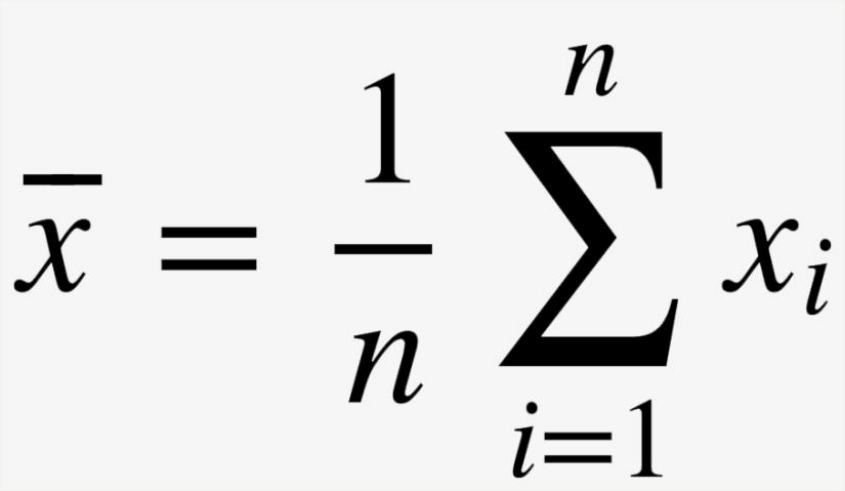
SIMPLE INTEREST

- **Your friend deposits 7000 Tk in Sonali bank for 3 years which earn him an interest of 8%. What is the amount he gets after 3 years?**
  - $I = ?, P = 7000, n = 3, r = 8\%$
  - Calculate yourself

- **You deposit 5400 Tk and got back an amount of 6000 Tk after 2 years. Find the simple interest rate of the bank.**
  - Try without formula
  - $r = ?, P = 5400, n = 2,\ I = 6000 - 5400 = 600$
  - $r = \frac{1}{18} = \frac{1}{18} \times 100\% = 5.56\%$

MEAN & MEDIAN

- Mean
  - Given some numbers
  - Take the sum of them
  - Divide by the count of numbers
  - You get the mean or average
  - Can you interpret the formula on right?



MEAN

- Example: You and your friends went to a restaurant. Everyone puts their money on the table and orders the same meal for all within budget. How much is the maximum budget for each person?
  - Money collected from 6 friends: $103, 210, 57, 85, 500, 180$

- Answer: Everyone has a budget of at most the average amount
- $\frac{103+210+57+85+500+180}{6} = 189.167$

MEAN & MEDIAN

- Median
  - Given some numbers
  - Sort them in ascending order
  - Take the number found at the middle
  - If count is odd
    - Middle one is unique
  - If count is even
    - There are two elements in the middle
    - Take average of those two

What does it mean to take the middle number?

- Say your median value is X
- Then ~50% of the values are less than X
- And ~50% of the values are greater than X

8, 7, 3, 2, 10
Sort: 2, 3, 7, 8, 10
Median: 7

8, 7, 3, 2, 10, 1
Sort: 1, 2, 3, 7, 8, 10
Median: (3+7)/2=5

MEDIAN

- Why median?
- Because sometimes mean can be misleading
- Example:
- You try to walk everyday around 4km. Here is the history of ten days of your walking:
  - $3.5\ km, 7\ km, 5\ km, 4\ km, 4.5\ km, 24\ km, 5\ km, 5.5\ km, 5\ km, 6.5\ km.$
  - Mean: $7\ km$
  - Leave out the ***outlier*** 24 km and mean would be: $5.11\ km$
  - Let's look at the median
    - 3.5, 4,4.5, 5, **5**, **5**, 5.5, 6.5, 7, 24 (Sorted)
    - Median: (5+5)/2 = 5
  - Even if we leave out 24
    - 3.5, 4,4.5, 5, **5**, 5, 5.5, 6.5, 7
    - Median = 5
- Takeaway: Median cannot be deviated as much as mean by some outliers

SUMMARY

- Unitary method and percentage
  - Solving problems
- Interest rate and related problems
- Mean and Median