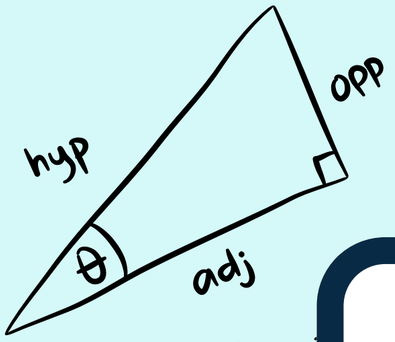
MATHEMATICAL EXPERIMENT

DAMINIKA YUKHNEVICH, 3DP
IV LICEUM OGÓLNOKSZTAŁCĄCE IM.
EMILII SCZANIECKIEJ W ŁODZI

Does a person's height affect their step length?



$\sin(\theta) =$

$V = lwh$

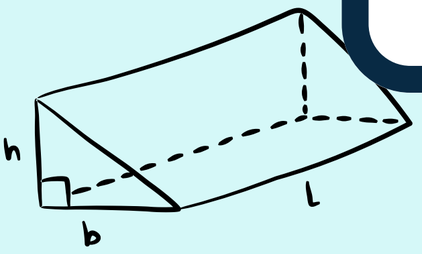
$V = \pi r^2 h$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$y = mx + b$

$a = \frac{V_f - V}{t}$

$V = \frac{4}{3}\pi r^3$



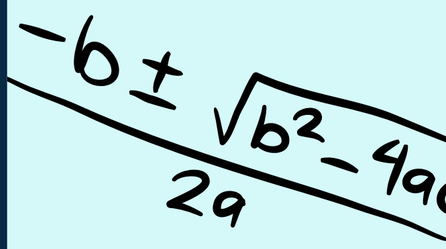
$V = \frac{1}{2}bhl$

$\frac{x}{a} + \frac{y}{b} = 1$

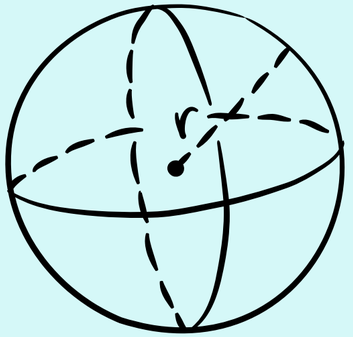
$ax^2 + bx + c = 0$

Observation:

Since I am not a very tall person, most of my friends are taller than me. When me and one of them were walking together, I'd noticed that I had to put an extra effort just to catch up with him. This made me think: can the height of a person influence their step length?



$y = mx + b$



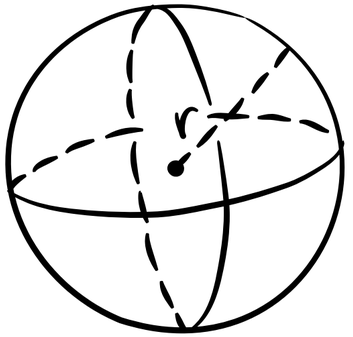
$V = \frac{4}{3}\pi r^3$

REASERCH QUESTION:

Is there a correlation between a person's height and their average length of a step?

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

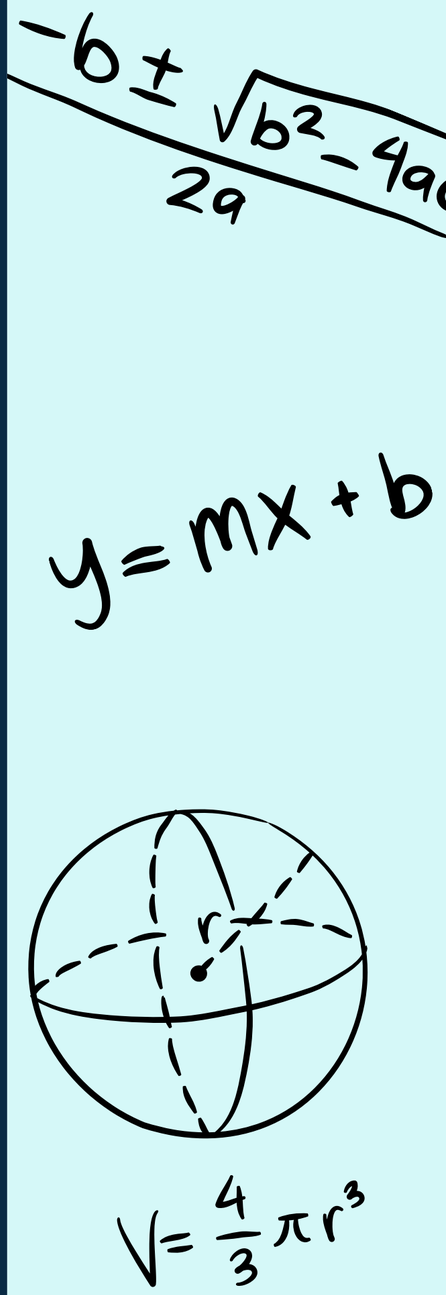
$$y = mx + b$$



$$V = \frac{4}{3}\pi r^3$$

HYPOTHESIS:

Taller people will generally have longer steps. Length of a step will increase with height, possibly in a linear relationship.



Background Information:

- The step length is the distance from the heel print of one foot to the heel print of the other foot during a walking stride. This is the distance traveled forward by a single leg.
- Step length can vary depending on walking speed, terrain, and personal habits, but height is often a significant factor.

PROCEDURE:

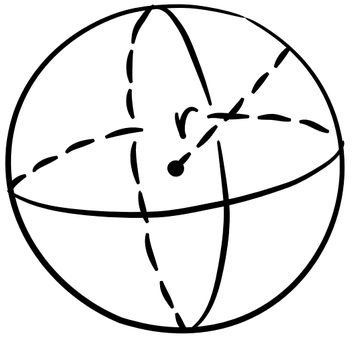
1. Measure and record each participant's height (in cm).
2. Mark a 10-meter straight line on the ground.
3. Ask each participant to walk the 10 meters at a natural, comfortable pace (no running or tiny steps).
4. Count and record how many steps they took to walk the 10 meters.
5. Calculate the average **step length**:

Step length = 1000 centimetres ÷ number of steps

6. Repeat for each person and record all data.

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

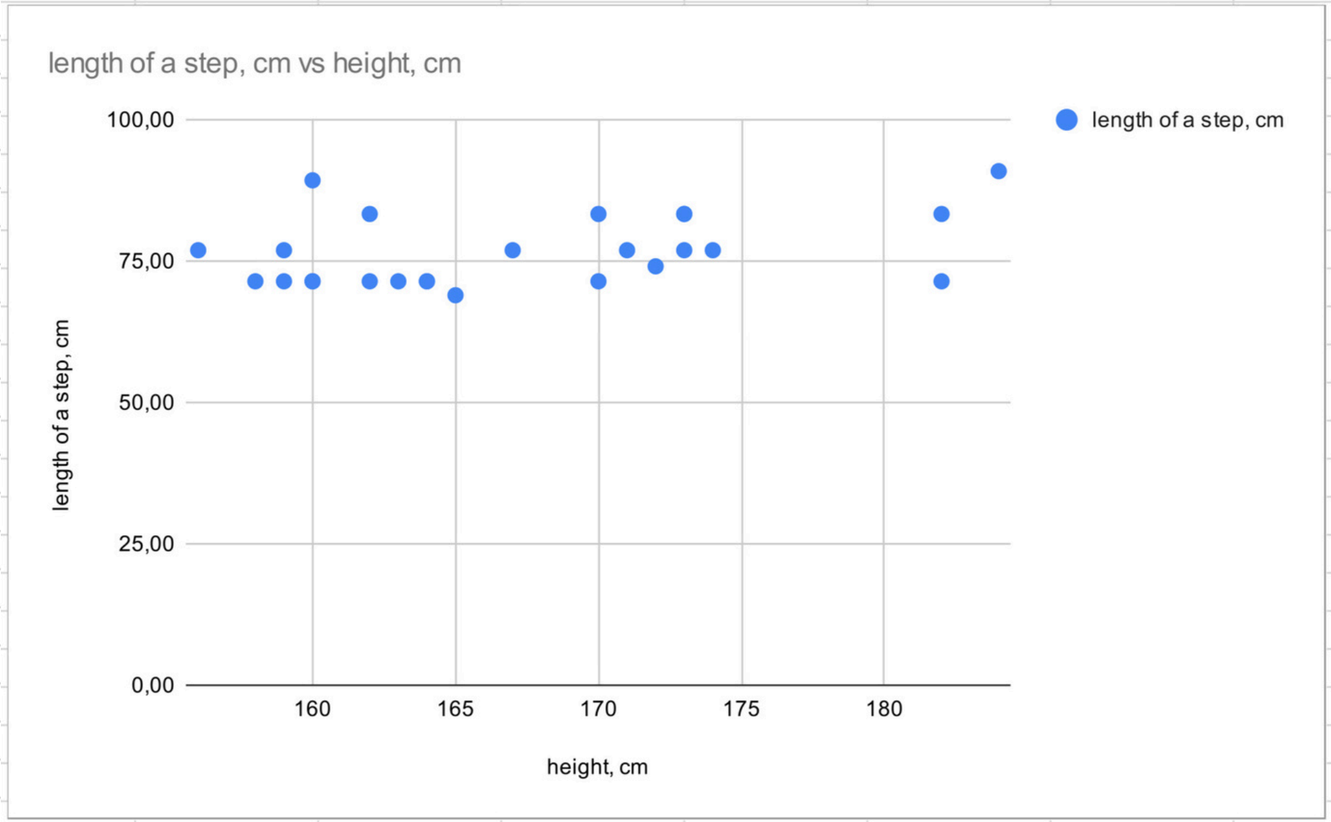
$$y = mx + b$$



$$V = \frac{4}{3}\pi r^3$$

Data table and graph

number of steps	height, cm	length of a step, cm
14	159	71,43
12	170	83,33
14	160	71,43
11,2	160	89,29
12	173	83,33
14	164	71,43
13	174	76,92
12	162	83,33
13	171	76,92
14	163	71,43
13	167	76,92
14	182	71,43
11	184	90,91
12	182	83,33
14	160	71,43
13,5	172	74,07
13	156	76,92
14,5	165	68,97
12	173	83,33
13	173	76,92
14	162	71,43
14	164	71,43
14	170	71,43
14	158	71,43
13	159	76,92



via: Google Sheets

TREND LINE

- To better understand the relationship between height and step length, I'm going to add a linear trend line to the scatter plot.
- A linear trend line shows the general direction of the data and helps us see whether there is a consistent increase or decrease.
- In this case, the line has a positive slope, meaning as height increases, step length also tends to increase.
- I calculated the equation of the line using my GDC (Graphical Display Calculator):

  y = 0.309x + 24.9

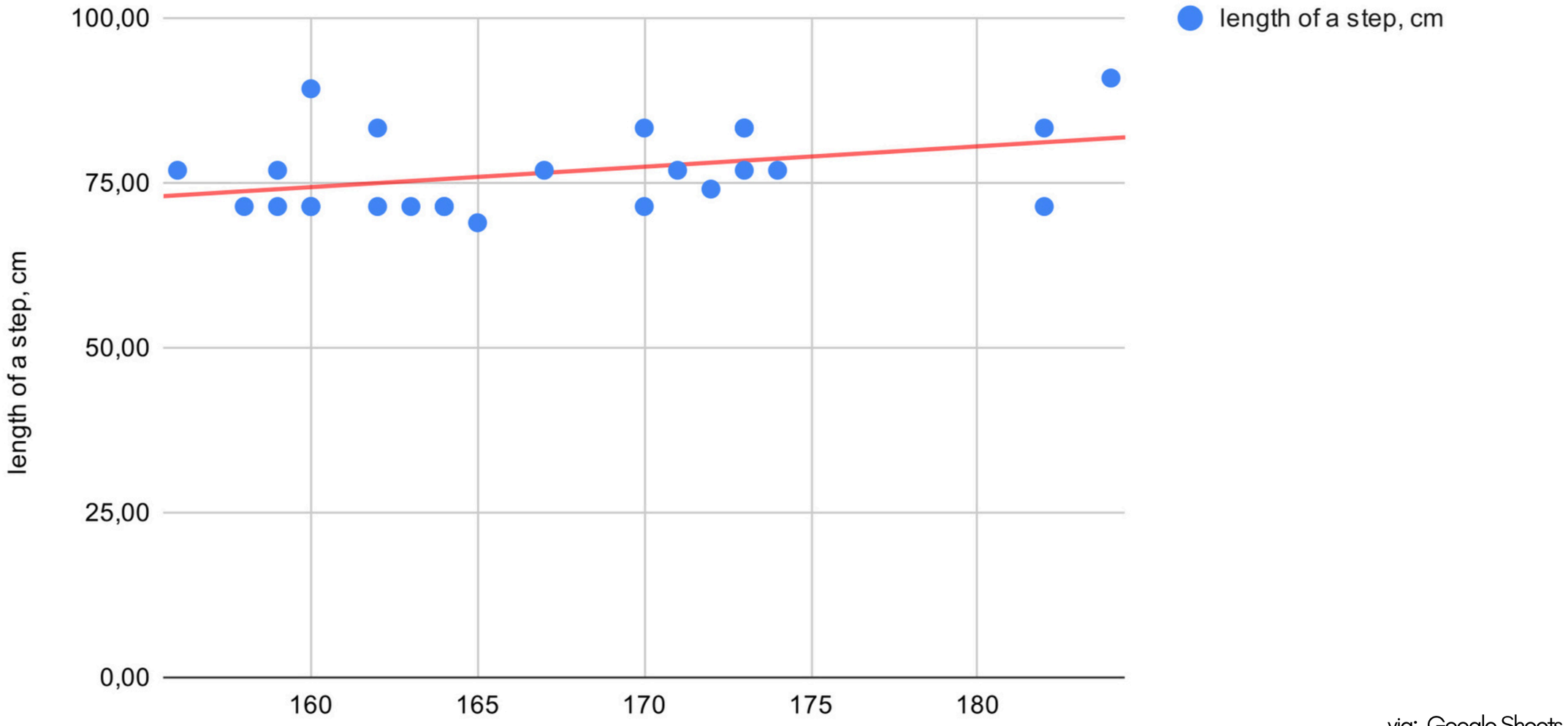
where:

x = height (in cm)

y = predicted step length (in cm)

- This means that for every additional 1 cm of height, the step length increases by approximately 0.31 cm.

TREND LINE


100,00
75,00
50,00
25,00
0,00
length of a step, cm
160
165
170
175
180
length of a step, cm
via: Google Sheets

Results and Analysis:

Findings:

- Each blue dot represents one person. The x-axis shows their step length in centimeters, while the y-axis shows their height in centimeters.
- The red line is a trend line (linear regression), which shows the general direction of the data.

Interpretation:

- The scatter plot shows a positive linear trend between height and step length.
- As height increases, step length also tends to increase.
- The trend line on the graph slopes upward, supporting this relationship.

Confounding variables:

Small variations occurred (i.e. one person with the height 160cm did ≈11 steps, while the other one with the same height did 14)

Possible Explanations:

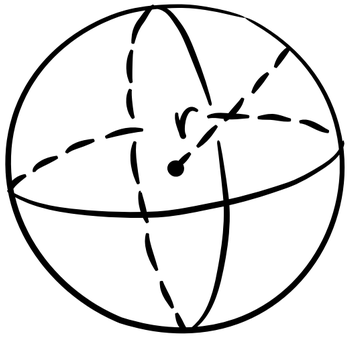
1. Walking style – some taller people may take shorter steps than expected due to habit or comfort.
2. Measurement variability – there may have been differences in how steps were counted or measured, since it's hard to determine the most accurate amount of steps made, as some people only did half of a step.
3. Small height differences – most participants seem to be between approximately 160–175 cm, so the height range might be too narrow to show a strong trend.
4. External factors – the surface, footwear, or walking speed could have affected results.

Conclusion:

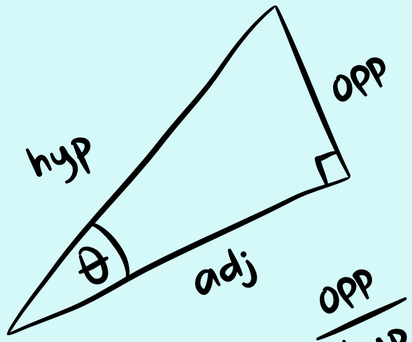
Based on the data, it appears that step length does increase with height. This supports the hypothesis that taller people take longer steps. The relationship is linear, but slight variations may occur due to walking style, leg proportions, or posture.

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$y = mx + b$$



$$V = \frac{4}{3}\pi r^3$$



$$\sin(\theta) = \frac{opp}{hyp}$$

$$V = lwh$$

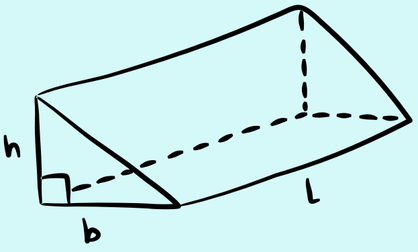
$$V = \pi r^2 h$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

THANK YOU!

$$y = mx + b$$

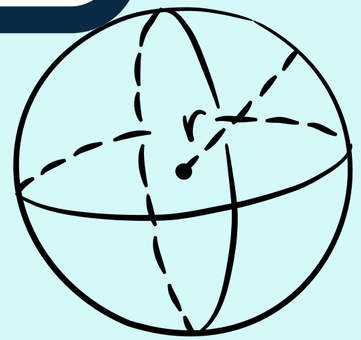
$$a = \frac{V_f - V_i}{t}$$



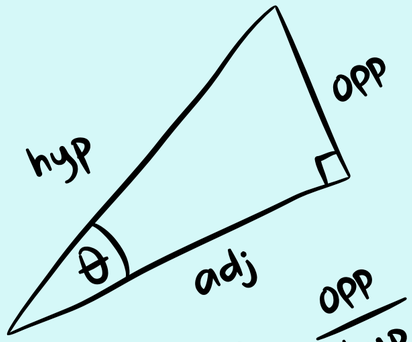
$$V = \frac{1}{2}bhl$$

$$\frac{x}{a} + \frac{y}{b} = 1$$

$$ax^2 + bx + c = 0$$



$$V = \frac{4}{3}\pi r^3$$



$$\sin(\theta) = \frac{opp}{hyp}$$

$$V = lwh$$

$$V = \pi r^2 h$$

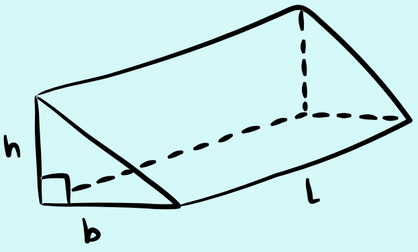
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Credits:

- https://www.verywellfit.com/set-pedometer-better-accuracy-3432895
- Google Sheets

$$a = \frac{V_f - V_i}{t}$$

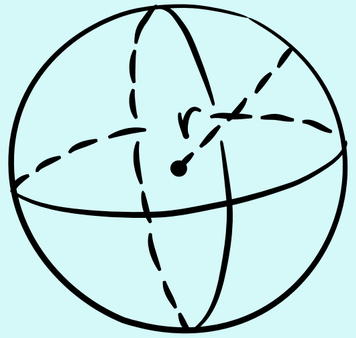
$$y = mx + b$$



$$V = \frac{1}{2}bhl$$

$$\frac{x}{a} + \frac{y}{b} = 1$$

$$ax^2 + bx + c = 0$$



$$V = \frac{4}{3}\pi r^3$$