

5.2 Rate of Change

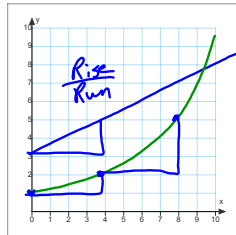
Rate of change can be found using a table or a graph (slope)

Table:

x Independent Variable	y Dependent Variable

Δ dependent
 Δ Independent

Graph



The average rate of change between two points is the slope of the line segment joining the points.

Average Rate of Change = $\frac{\text{Rise}}{\text{Run}}$ or $\frac{\Delta y}{\Delta x}$

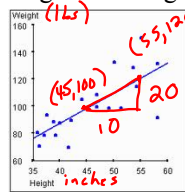
Explain what rate of change represents in each situation.

Bicycle Trip

Time (h)	Distance (km)
0	5
2	10

$\frac{\Delta y}{\Delta x} = \frac{5}{2}$
 $= 2.5 \text{ km/h}$
Represents speed

Height and weight



$\frac{\Delta y}{\Delta x} = \frac{20}{10} = 2 \text{ lbs/inch}$

Nov 30-8:58 AM

Example: Comparing Rates of Change

The distance required to stop a car depends on the speed at which the car is travelling. The following table shows the reaction distance and the breaking distance needed to stop a car on dry pavement for given speeds.

Speed (km/h)	0	10	20	30	40	50
Reaction distance (m)	0	1.5	3	4.5	6	7.5

Speed (km/h)	0	10	20	30	40	50
Breakin g Distance (m)	0	0.5	2	4.5	8	12.5

- Calculate the average rate of change between consecutive points in each table. Describe the rates of change revealed in each table.
- Graph the data in the tables. Describe how the graph reflects the rates of change across the data.

Nov 30-10:13 AM

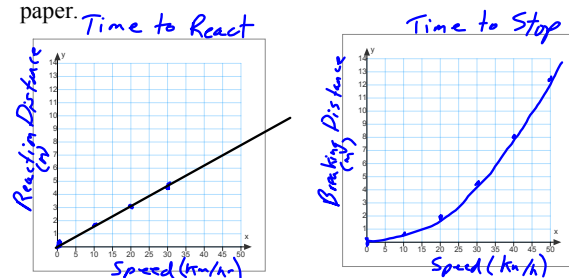
Solution:

Speed km/h	ReactionDistance (m)	Change in distance Change in speed
0	0	$\frac{1.5-0}{10-0} = 0.15 \text{ m/km/h}$
10	1.5	$\frac{3-1.5}{20-10} = 0.15 \text{ m/km/h}$
20	3	0.15 m/km/h
30	4.5	0.15 m/km/h
40	6	0.15 m/km/h
50	7.5	0.15 m/km/h

Speed (km/h)	BreakingDistance (m)	Change in distance Change in speed
0	0	$\frac{0.5-0}{10-0} = 0.05 \text{ m/km/h}$
10	0.5	0.15 m/km/h
20	2	0.25 m/km/h
30	4.5	0.35 m/km/h
40	8	0.45 m/km/h
50	12.5	0.45 m/km/h

Nov 30-10:21 AM

Graph both tables from above using your on graph paper.



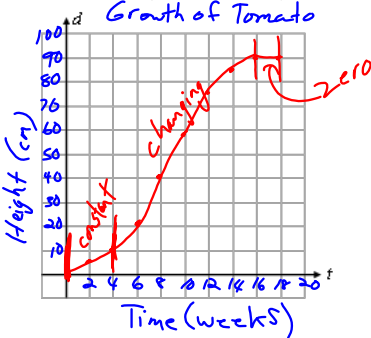
May 7-8:34 PM

Example: Use a table and graph to describe rates of change in the following situation.

This table shows the change in height of a tomato plant from germination until the tomatoes ripens.

Time (weeks)	0	2	4	6	8	10	12	14	16	18
Height (cm)	0	5	10	20	40	58	75	86	90	90

- Determine when the rate of change in the height is:
 - Zero
 - Constant
 - Changing
- When is the rate of change in height the greatest? *8-10 weeks*
- Describe the growth of the plant.



Nov 30-10:26 AM

Create a table of first differences

Time (weeks)	Height (cm)	First Differences	Rate of change
0	0		
2	5	$5-0=5$	$\frac{5}{2}=2.5$
4	10	$10-5=5$	$\frac{5}{2}=2.5$
6	20	$20-10=10$	$\frac{10}{2}=5$
8	40	$40-20=20$	$\frac{20}{2}=10$
10	58	$58-40=18$	$\frac{18}{2}=9$
12	75	$75-58=17$	$\frac{17}{2}=8.5$
14	86	$86-75=11$	$\frac{11}{2}=5.5$
16	90	$90-86=4$	$\frac{4}{2}=2$
18	90	$90-90=0$	$\frac{0}{2}=0$

PATTERNS OF CHANGE IN A GRAPH OR TABLE SUMMARY:

Identifying Rates of Change

Rate of Change	First differences on Table	Example of graph
Zero	"0"	
Constant	The same value	
Changing	Different	

Nov 30-12:08 PM

Complete each of the following on lined paper.

1. For each table, name the variables.

a)	Hours worked	Earnings (\$)	b)	Pages printed	Cost (\$)	c)	Distance driven (km)	Fuel used (L)
	4	32		1000	56		45	3
	20	160		5000	145		60	12

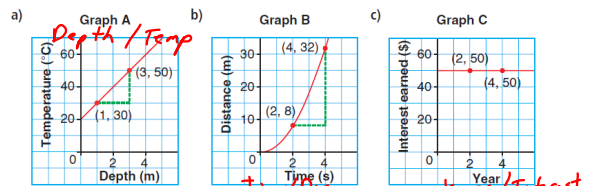
Handwritten units: a) \$/hr, b) \$/page, c) L/km

2. State the units of the rate of change for each table in question 1. What does the rate of change represent?
 a) wage b) price c) fuel efficiency.

3. Refer to the tables in question 1. Determine the average rate of change between each pair of points in the table.
- a) $\frac{160-32}{20-4} = \frac{128}{16} = 8 \text{ \$/hr}$
- b) $\frac{145-56}{5000-1000} = \frac{89}{4000} = 0.02225/\text{page}$
- c) $\frac{12-3}{60-45} = \frac{9}{15} = 0.6 \text{ L/km}$

May 7-7:06 PM

4. For each graph, name the variables.



5. State the units of the rate of change for each graph. What does the rate of change represent in each situation?
 a) m/c b) m/s c) \$/year

6. Determine the average rate of change between the indicated points on the graph.
- a) $\frac{50-30}{3-1} = \frac{20}{2} = 10 \text{ m/}^\circ\text{C}$
- b) $\frac{32-8}{4-2} = \frac{24}{2} = 12 \text{ m/s}$
- c) $\frac{50-50}{4-2} = \frac{0}{2} = 0 \text{ \$/year}$

May 7-7:35 PM

9. Bipin is a financial advisor. He uses these tables to help his clients understand the difference between simple interest and compound interest.

Simple Interest				
Year	0	5	10	15
Amount (\$)	500	700	900	1100

Compound Interest				
Year	0	5	10	15
Amount (\$)	500	735	1079	1586

- a. Calculate the average annual rate of change for consecutive pairs of data in each table.
- b. Describe the rates of change in each table. What do these values indicate about each type of interest?
- c. Graph the data in the tables. How is the rate of change reflected in the graph?

Homework: p.274 #7, 8. If you did all the work in class today. If not, please complete all homework listed.

May 7-7:39 PM

May 7-7:44 PM