Activity Worksheet for Section 1.3

Exercises for active learning curated from Applied Calculus, seventh edition. No overlap with recommended homework assignments, so they can be used in conjunction. Both are available as WileyPLUS pre-built assignments.

Summary of Section

- **Average rate of change** of $y = f(t)$ on $a \le t \le b$ is

$$\frac{\Delta y}{\Delta t} = \frac{f(b) - f(a)}{b - a}.$$

  Average rate of change can be visualized as the **slope** of the line between the points on the graph of f from $t = a$ to $t = b$.
  - The **units** of average rate of change of a function are units of y per unit of t.
- **Concavity:** The graph of a function is **concave up** if it bends upward as we move left to right; the graph is **concave down** if it bends downward.
- Average velocity $= \dfrac{\text{Change in distance}}{\text{Change in time}} =$ Average rate of change of distance with respect to time.
- **Relative change**: When a quantity P changes from P_0 to P_1, we define

$$\text{Relative change in } P = \frac{\text{Change in } P}{P_0} = \frac{P_1 - P_0}{P_0}.$$

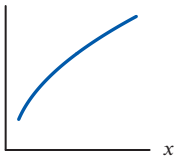
- **Elasticity** is equal to the ratio:

$$\left| \frac{\text{Relative change in quantity}}{\text{Relative change in price}} \right|$$

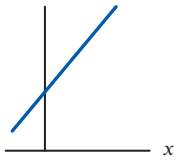
Problems from Section 1.3

■ In Problems **1–2**, decide whether the graph is concave up, concave down, or neither.

1. (Problem 1 in Applied Calculus 7th edition)



2. (Problem 4 in Applied Calculus 7th edition)



3. (Problem 8 in Applied Calculus 7th edition)
Find the average rate of change of $f(x) = 2x^2$ between $x = 1$ and $x = 3$.

4. (Problem 16 in Applied Calculus 7th edition)
Table 1 gives the net sales of The Gap, a clothing retailer.[1]

(a) Find the change in net sales between 2017 and 2019.

(b) Find the average rate of change in net sales between 2015 and 2019. Give units and interpret your answer.

(c) From 2015 to 2019, were there any one-year intervals during which the average rate of change was negative? If so, when?

Table 1 *Gap net sales, in billions of dollars*

Year	2015	2016	2017	2018	2019
Sales	15.80	15.52	15.86	16.58	16.38

[1] https://www.statista.com/statistics/242386/net-sales-of-the-gap-inc/, accessed March 11, 2021.

5. (Problem 21 in Applied Calculus 7th edition)
Figure 1 shows a particle's distance from a point as a function of time, t. What is the particle's average velocity from $t = 1$ to $t = 3$?

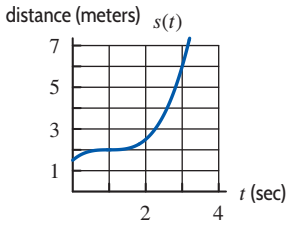


Figure 1

6. (Problem 25 in Applied Calculus 7th edition)
Figure 2 shows the total value of US imports, in trillions of dollars.[2]

(a) Was the value of the imports higher in 2005 or in 2020? Approximately how much higher?

(b) Estimate the average rate of change of US imports between 2005 and 2020. Give units and interpret your answer in terms of imports.

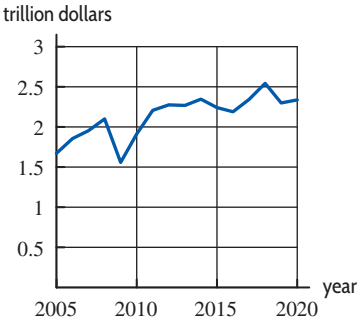


Figure 2

7. (Problem 28 in Applied Calculus 7th edition)
Table 2 shows world population, P, in billions of people, world passenger automobile production, A, in millions of cars[3], and world cell phone subscribers, C, in billions of subscribers.[4]

(a) Find the average rate of change, with units, for each of P, A, and C between 2005 and 2015.

(b) Between 2005 and 2015, which increased faster:

(i) Population or the number of automobiles?

(ii) Population or the number of cell phone subscribers?

Table 2

Year	2005	2010	2015
P (billions)	6.51	6.92	7.34
A (millions)	59.7	73.3	90.8
C (billions)	2.71	5.27	7.15

8. (Problem 32 in Applied Calculus 7th edition)
Figure 3 shows the length, L, in cm, of a sturgeon (a type of fish) as a function of the time, t, in years.[5]

(a) Is the function increasing or decreasing? Is the graph concave up or concave down?

(b) Estimate the average rate of growth of the sturgeon between $t = 5$ and $t = 15$. Give units and interpret your answer in terms of the sturgeon.

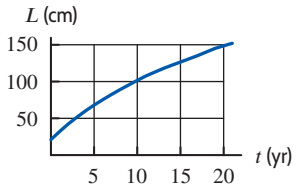


Figure 3

9. (Problem 34 in Applied Calculus 7th edition)
The total world marine catch[6] of fish, in metric tons, was 18.71 million in 1950 and 90.91 million in 2016. What was the average rate of change in the marine catch during this period? Give units and interpret your answer.

■ In Problem **10**, which relative change is bigger in magnitude? Justify your answer.

10. (Problem 56 in Applied Calculus 7th edition)
An increase in class size from 5 to 10; an increase in class size from 30 to 50.

[2]https://www.statista.com/statistics/218255/total-value-of-us-trade-in-goods-worldwide-since-2004/, accessed March 12, 2021.
[3]*The World Almanac and Book of Facts, 2020,* p. 51.
[4]data.worldbank.org/indicator/IT.CEL.SETS.P2, accessed March 14, 2020.
[5]Data from L. von Bertalanffy, *General System Theory*, p. 177 (New York: Braziller, 1968).
[6]www.fao.org/state-of-fisheries-aquaculture/en/, accessed March 3, 2020.