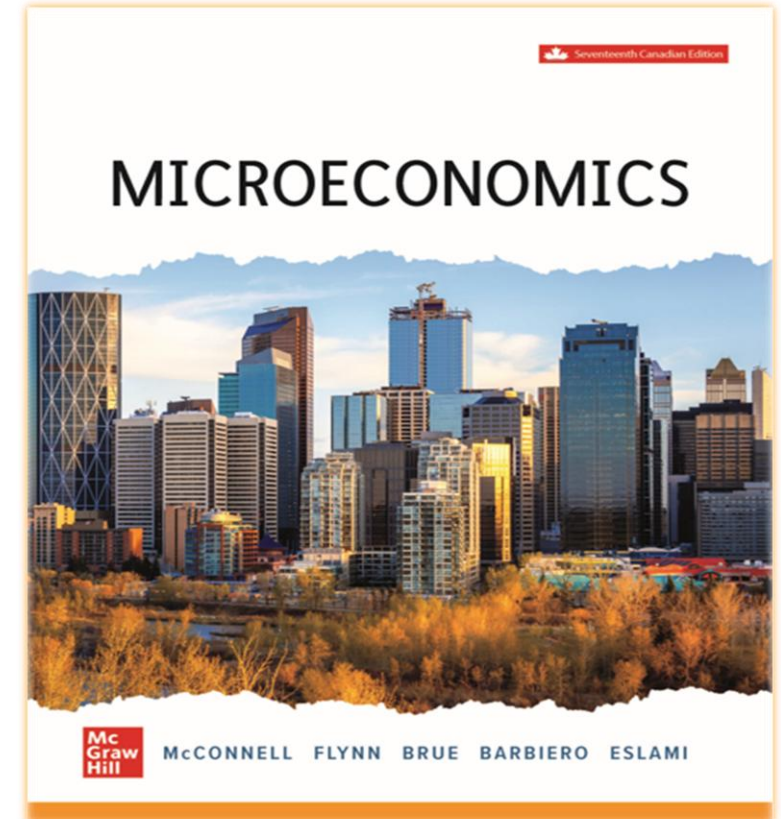


CHAPTER 1-APPENDIX

Graphs and Their Meanings

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LEARNING OBJECTIVE

LOA1.1 Understand graphs, curves, and slopes as they relate to economics.

A1.1 GRAPHS AND THEIR MEANINGS 1/17

Construction of a Graph

- A visual representation of the relationship between two variables
 - Horizontal axis
 - Vertical axis
 - Independent variable
 - Dependent variable
 - *Ceteris paribus*

FIGURE A1-1 The relationship between income and consumption 1/3

Table		
Income	Consumption	Point
\$ 0	\$ 50	a
100	100	<i>b</i>
200	150	<i>c</i>
300	200	<i>d</i>
400	250	<i>e</i>

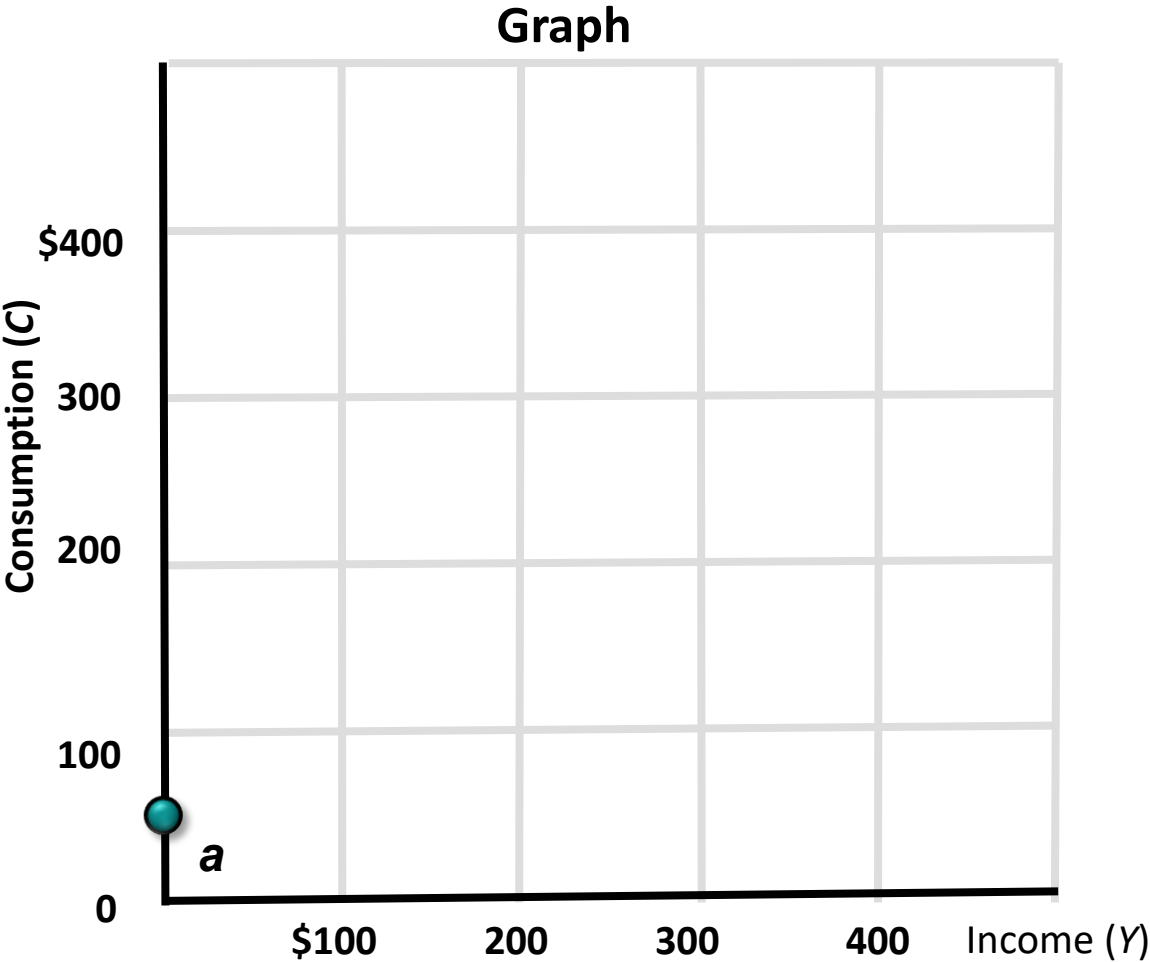


FIGURE A1-1 The relationship between income and consumption 2/3

Table		
Income	Consumption	Point
\$ 0	\$ 50	<i>a</i>
100	100	<i>b</i>
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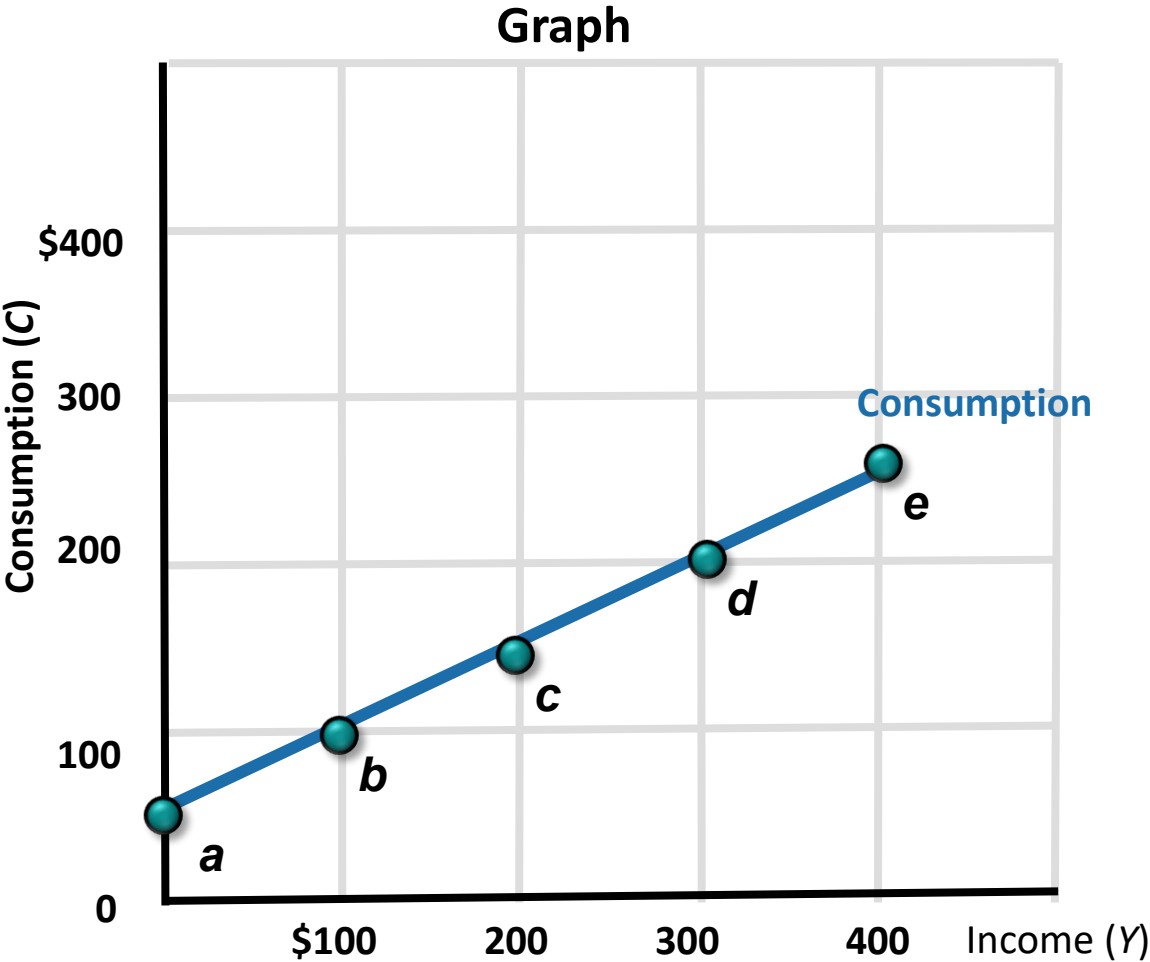
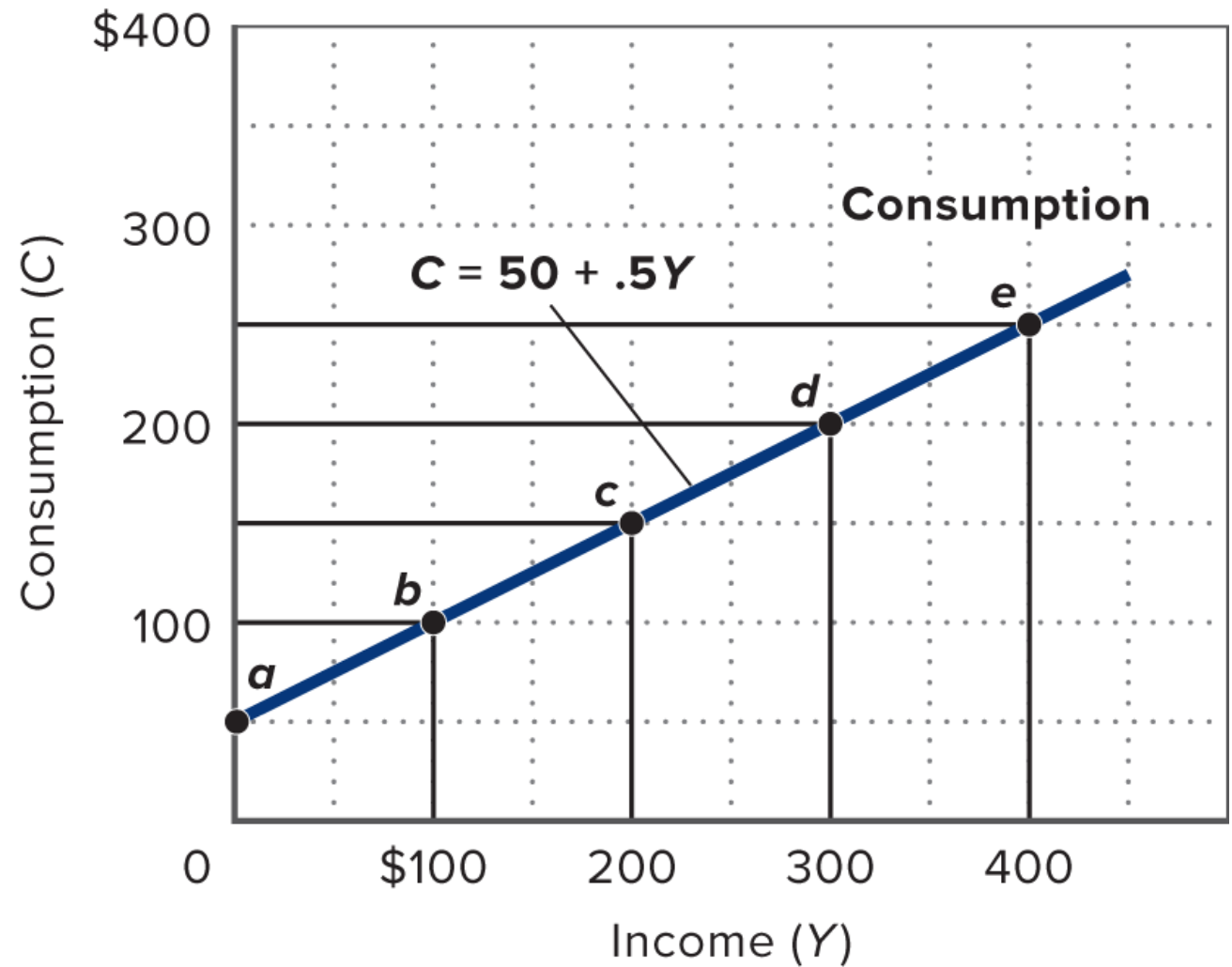


FIGURE A1-1 The relationship between income and consumption 3/3

- The line or curve represents the income–consumption relationship. We say that the relationship is linear.
- It is permissible and customary to refer to straight lines in graphs as “curves.”



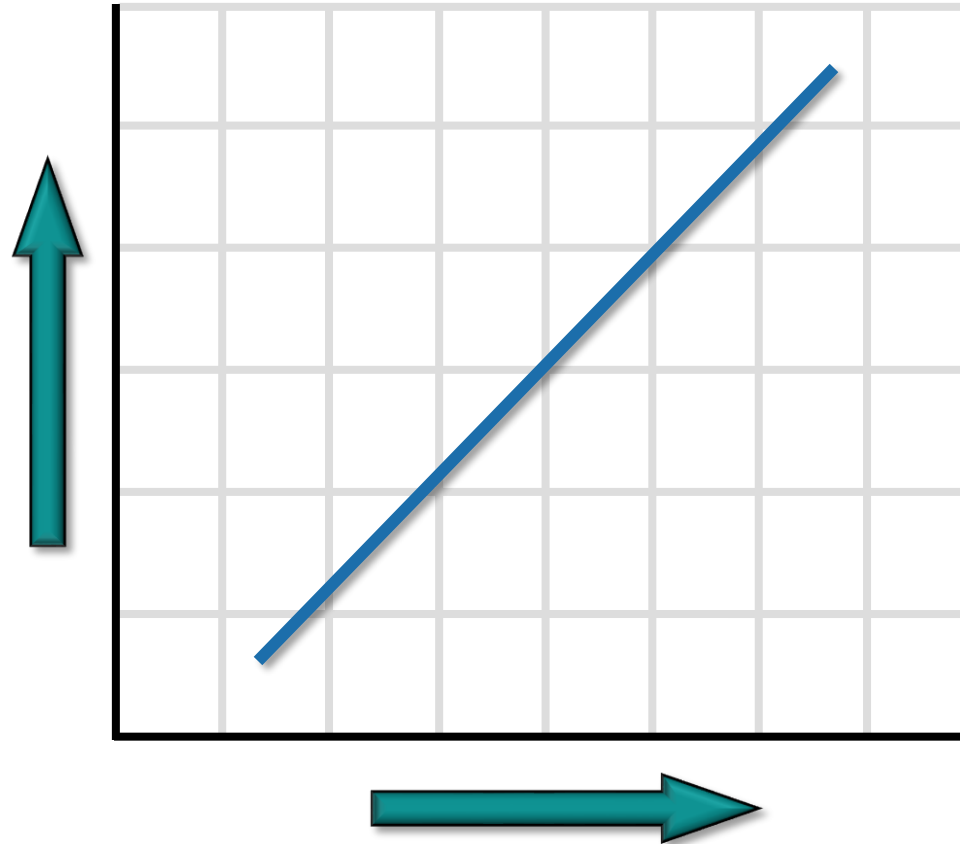
A1.1 GRAPHS AND THEIR MEANINGS 2/17

Direct and Inverse Relationships

- A direct relationship between income and consumption is shown by an upward-sloping line, with both variables moving in the same direction.
- An inverse relationship, like ticket prices and attendance, is shown by a downward-sloping line, with variables moving in opposite directions.
- Upward slopes indicate direct relationships; downward slopes indicate inverse relationships.

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Direct Relationship



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Inverse Relationship

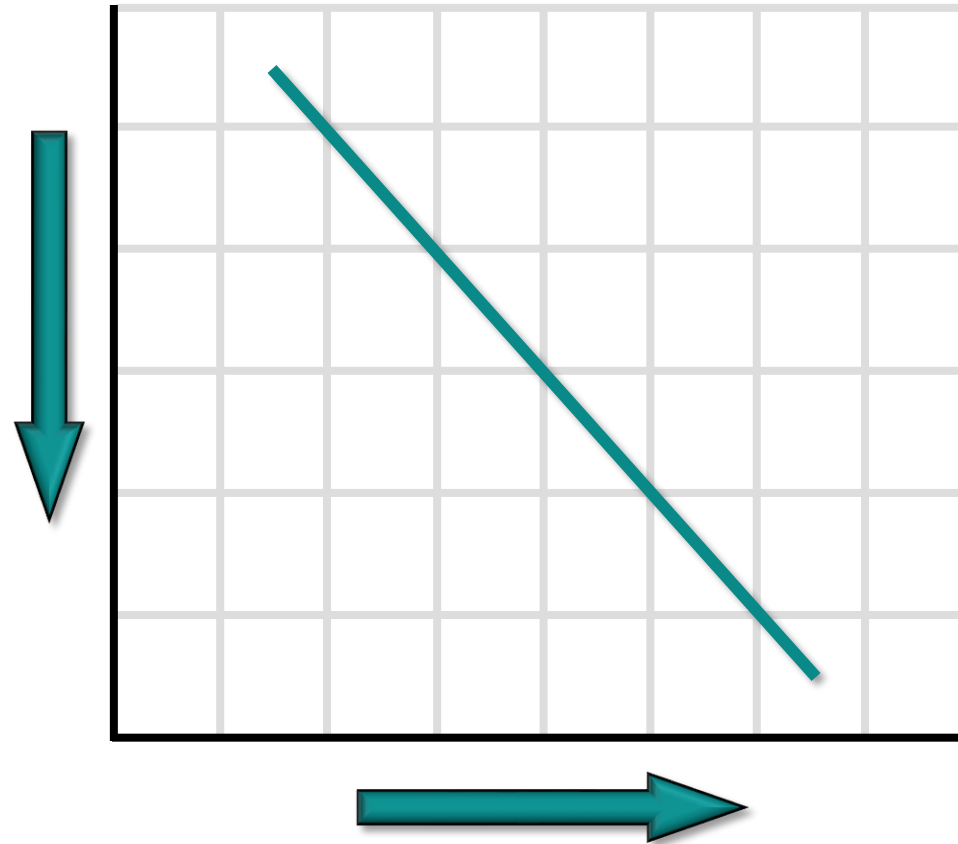
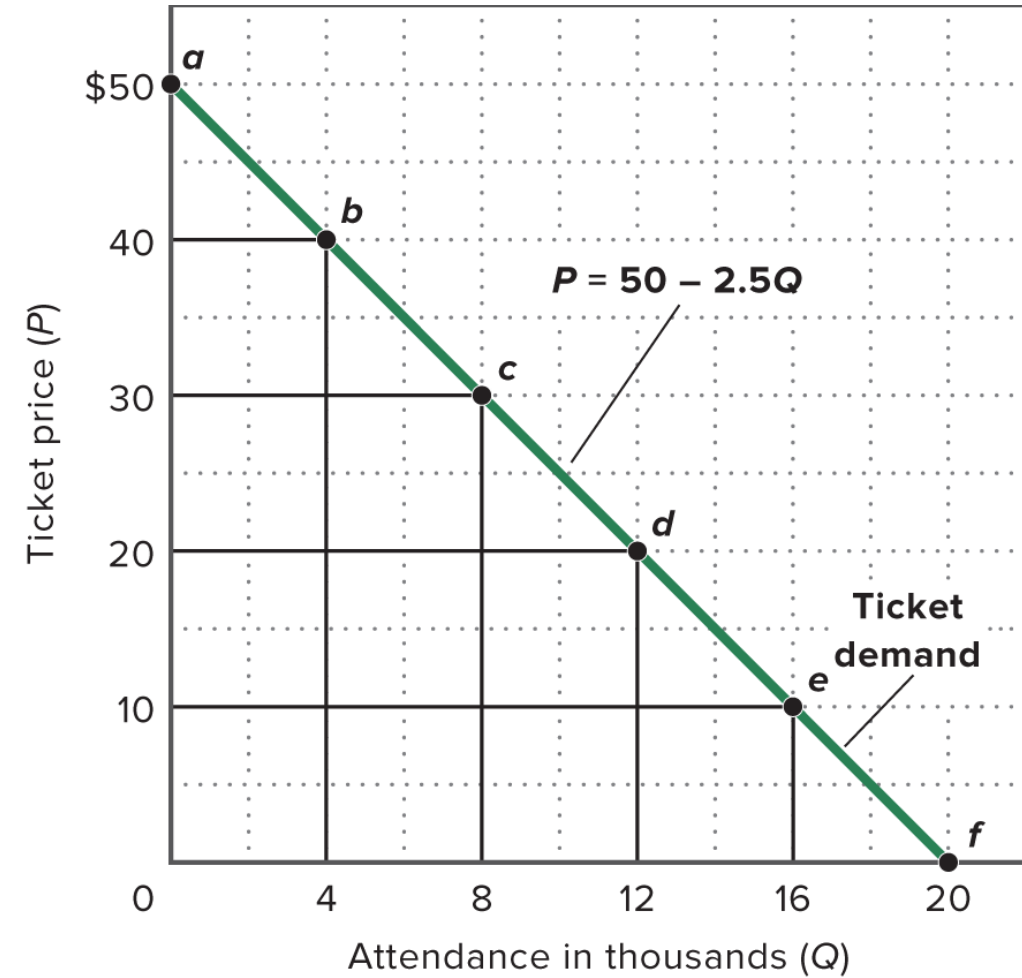


FIGURE A1-2 The relationship between ticket prices and attendance(thousands)

Price	Attendance	Point
\$50	0	a
40	4	b
30	8	c
20	12	d
10	16	e
0	20	f



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Dependent and Independent Variables

- The independent variable is the cause, and the dependent variable is the effect or outcome.
- In economics, income typically serves as the independent variable, while consumption is the dependent variable.
- Similarly, ticket prices are the independent variable determining game attendance, which is the dependent variable.

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Axis Placement of Dependent and Independent Variables

- Mathematicians place the independent variable on the horizontal axis and the dependent on the vertical.
- Economists often put price and cost on the vertical axis, regardless of which is independent.
- Axis placement varies in economics, so be aware to avoid confusion.

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Other Things Equal

- Two-variable graphs use the ceteris paribus assumption, holding all other factors constant to isolate the relationship between the variables.
- Changes in external factors can shift the plotted lines in graphs, altering the relationship depicted.
- For example, a stock market crash might shift the consumption line downward, while poor game performance might reduce attendance at each ticket price.

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Slope of a line

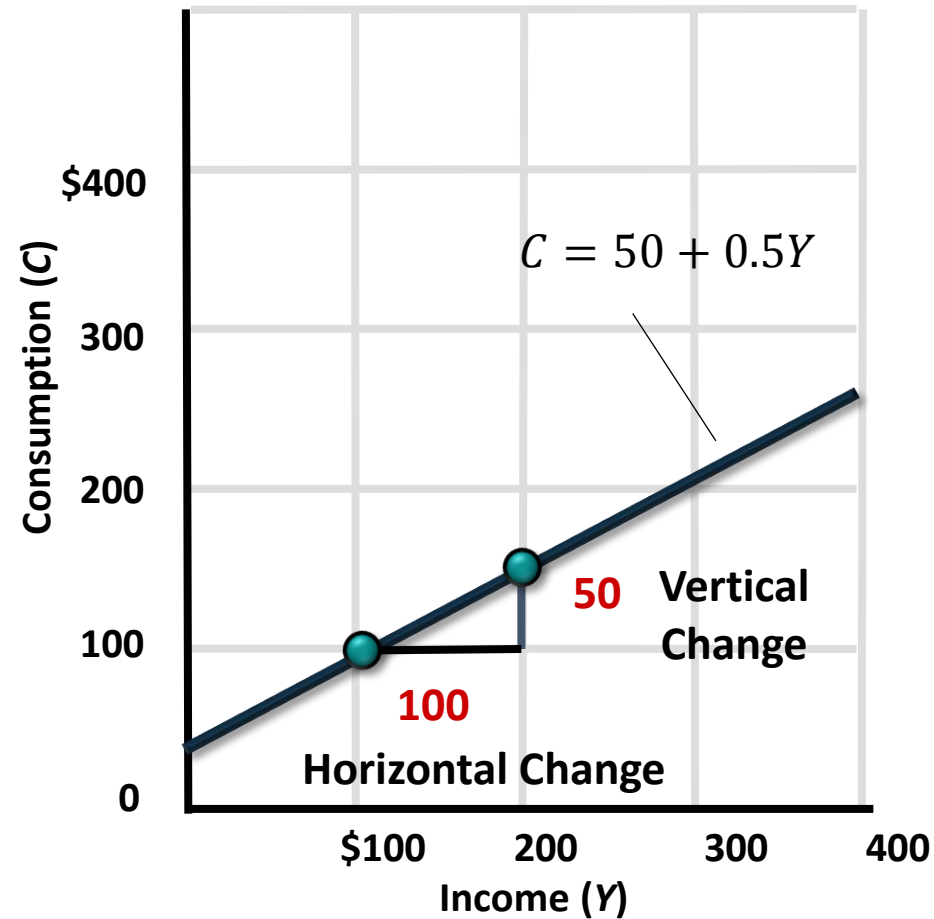
- Lines can be described in terms of their slopes and their intercepts.
- The slope of a straight line is the ratio of the vertical change (the rise or drop) to the horizontal change (the run) between any two points of the line—or rise over run.

Positive Slope

- Between point c and point d in Figure A1-1, the rise or vertical change (the change in consumption) is +\$50, and the run or horizontal change (the change in income) is +\$100.

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Positive Slope



$$\text{Slope} = \frac{\text{Vertical Change}}{\text{Horizontal Change}}$$

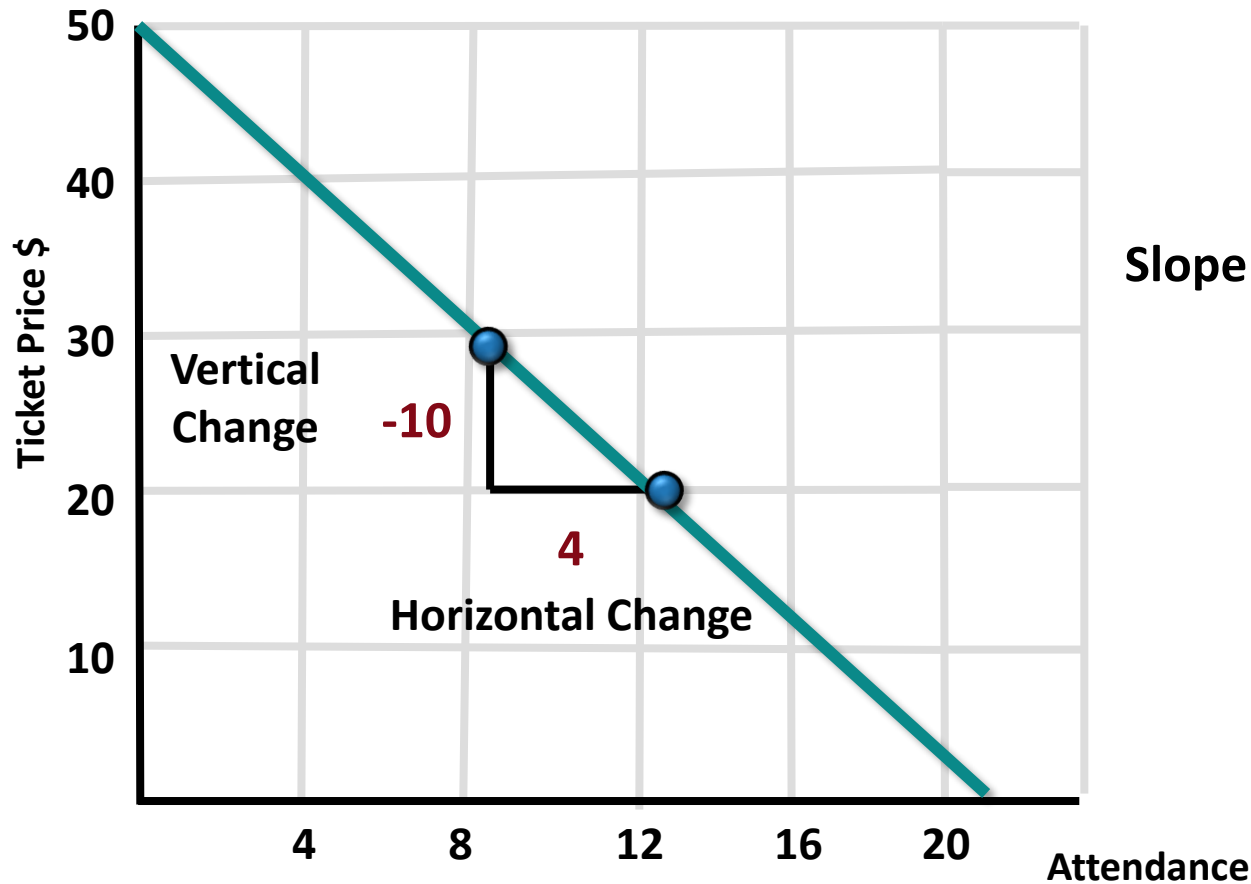
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Negative Slope

- Between any two identified points in Figure A1-2—say, point c and point d—the vertical change is 10 (the drop), and the horizontal change is +4 (the run).

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Negative Slope



$$\begin{aligned}\text{Slope} &= \frac{\text{Vertical Change}}{\text{Horizontal Change}} \\ &= \frac{-10}{+4} = -2.5\end{aligned}$$

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Slopes and Marginal Analysis

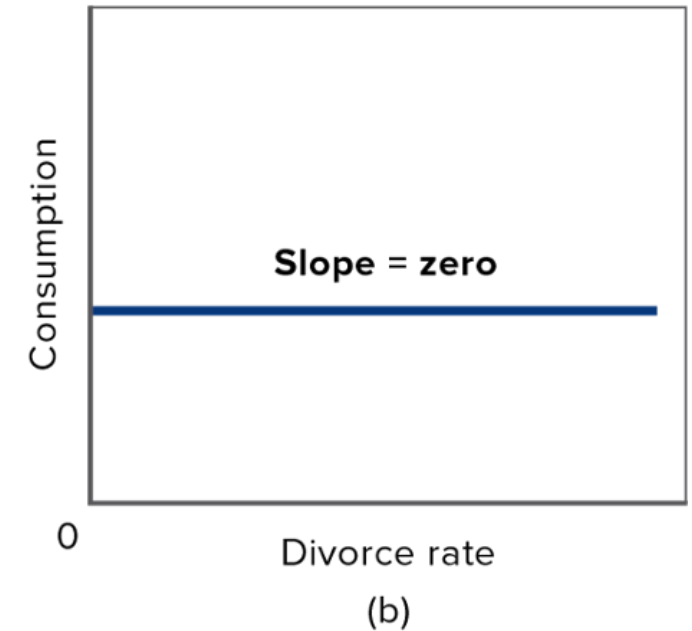
- Slope shows how one variable changes in response to a one-unit change in another.
- In Figure A1-1, a slope of 0.5 means consumption changes by \$0.50 for every \$1 change in income.

Infinite and Zero Slopes

- Unrelated variables show no relationship, like the price of bananas and the quantity of watches purchased.
- In Figure A1-3a, this is depicted by a vertical line with an infinite slope, indicating the quantity of watches remains constant regardless of banana prices.

FIGURE A1-3 Infinite and zero slopes

- A vertical line with an infinite slope shows no change in quantity despite price changes.
- A horizontal line with zero slope shows no change in consumption despite other variable changes.



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Absolute Value of Slopes

- Demand and production possibilities curves usually have negative slopes due to inverse relationships.
- It's often useful to consider only the absolute value of the slope, ignoring the negative sign.

Vertical Intercept

- A line can be positioned on a graph using its slope and vertical intercept, where it meets the vertical axis.
- In Figure A1-1, a \$50 intercept suggests consumers would spend \$50 even with zero income, while in Figure A1-2, a \$50 intercept implies an empty arena at that ticket price.

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Equation of a linear relationship

$$y = a + bx$$

- y is the dependent variable
- a is the vertical intercept
- b is the slope of the line
- x is the independent variable

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Equation of a linear relationship

- For our income–consumption example, if C represents consumption and Y represents income, we can write $C = a + bY$. By substituting the known values of the intercept and the slope, we get $C = 50 + 0.5Y$.
- For ticket prices and attendance, we get $P = 50 - 2.5Q$

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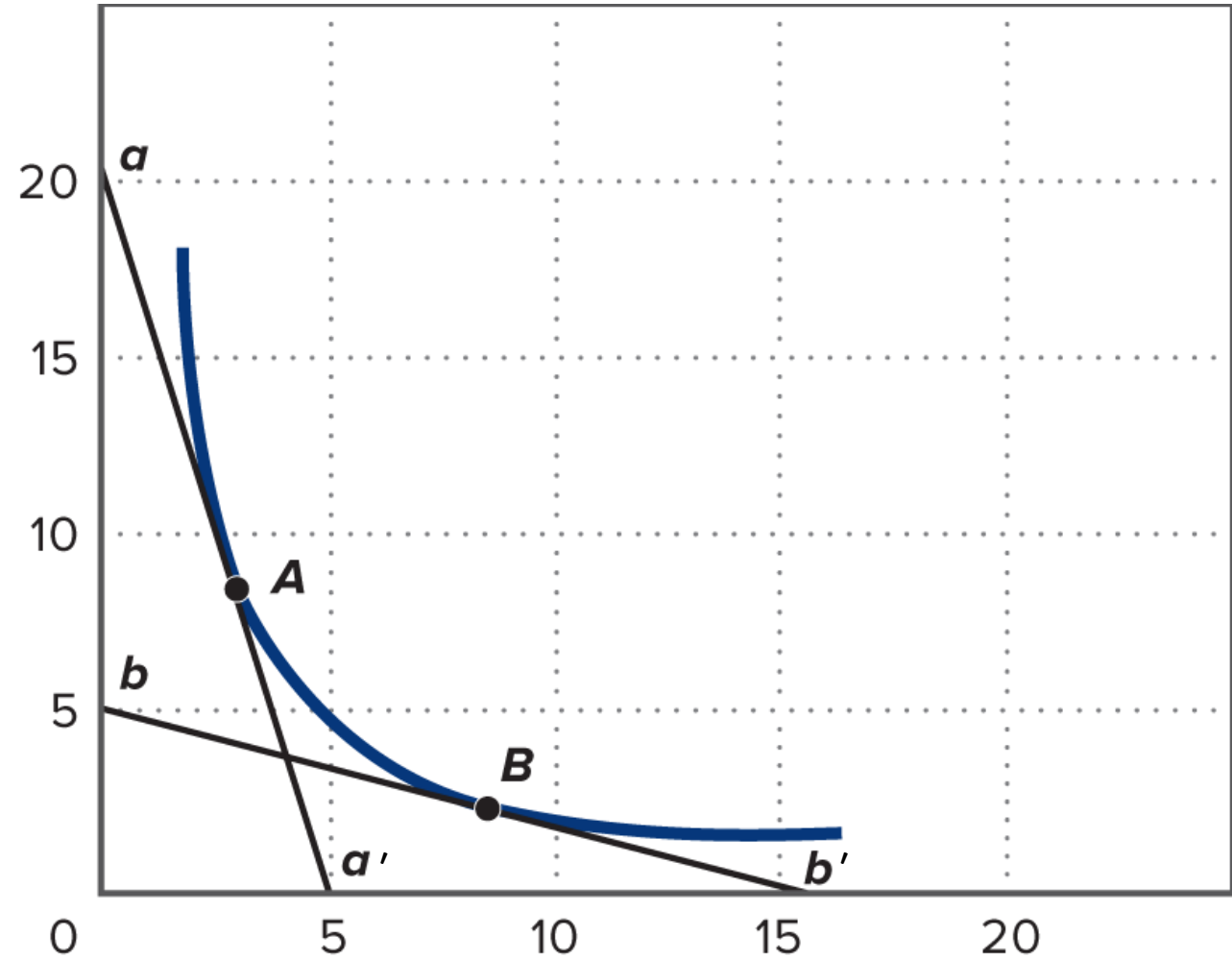
Slope of a non-linear curve

- Non-linear relationships are represented by curved lines, where the slope changes at different points.
- Unlike straight lines with constant slopes, curves have varying slopes along their length.
- In Figure A1-4, the down-sloping curve has a negative slope that flattens as you move down, indicating continuous slope change.

FIGURE A1-4 Determining the slopes of curves

The slope of a non-linear curve changes from point to point on the curve.

- The slope at any point (say B) can be determined by drawing a straight line that is tangent to that point (line bb') and calculating the slope of that line.



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Slope of a non-linear curve

- To find the slope at a specific point on a curve, draw a straight line tangent to the curve at that point.
- The tangent line's slope equals the curve's slope at that point; for example, at point A in Figure A1-4, the slope is -4.
- The slope varies along the curve, as seen at point B, where the slope is less negative at $-\frac{1}{3}$.

CHAPTER SUMMARY

- Graphs represent economic relationships.
- Positive/directly related variables and positive sloped line.
- Negative/inversely related variables and negative sloped line.
- The slope of a straight line is the ratio of the vertical change to the horizontal change between any two points.
- The slope of a curve at any point is determined by calculating the slope of a straight-line tangent to the curve at that point.