Practice Problems for “Definitions of Cost-Revenue-Profit Functions Using Linear Equations”

Questions:

1). We are provided a cost function, \( C(x) = 12x + 14 \), by a firm that manufactures shoes.

What is the fixed cost? What is the variable cost?

2). A firm is trying to create a cost function to represent the costs of producing denim jeans. They figure that the general cost of operating the machines for a whole day is $120, regardless of how many jeans they make that day. In addition to this, they figure that each pair of jeans will cost about $13 to make (for cost of materials, cost of labor, etc).

What is the fixed cost? What is the variable cost? Create a cost function

3). A firm is planning on producing 7 units of \( x \) and has created a cost function, \( C(x) = 14x + 35 \), to estimate their general costs of production. How much will it cost the firm to produce the 7 units?
4). A video game manufacturer has created the following cost and revenue functions to track the cost and revenue from the sales of their brand new game:

\[ C(q) = 18q + 80 \]
\[ R(q) = 30q \]

**Generate a profit function** using these two equations. (Remind yourself what the relationship between cost, revenue, and profit is.)

5). Using the Profit function from problem 4:

a) Would the video game manufacturer make a **gain or a loss** from producing a quantity of 5 video games? How much?

Producing 5 video games results in a ______ of _______.

b) Would the video game manufacturer make a **gain or a loss** from producing a quantity of 12 video games? How much?

Producing 12 video games results in a ______ of _______.

6.) A stand that sells t-shirts estimates their revenue with the function,

\[ R(x) = 16x \]

What’s the revenue from producing 3 t-shirts?

7.) Suppose a firm has a profit function of,

\[ P(x) = 27x - 297 \]

How much output would they have to produce to break even (what is the break-even point)?

If the firm produces _________ units, they will break even and have profits of zero (they will have neither any gains in profits nor any losses in profits)
8). How many units would a company have to produce in order to gain profits of $87

Given the profit functions

\[ P(x) = 7x + 24 \]

**Hint:** we don’t know how many units of x we need yet, but we do know that profits have to be $87. So we know that: \( P(?) = 87 \)

(“?” meaning some unknown value of x we are solving for)
Solutions:

1). We are provided a cost function, \( C(x) = 12x + 14 \), by a firm that manufactures shoes. What is the fixed cost? What is the variable cost?

Total Cost, \( C(x) \rightarrow C(x) = (m \times x) + b = (\text{Variable Cost} \times \text{Output}) + \text{Fixed Cost} \)

- Fixed cost: $14
- Variable cost: $12

2). A firm is trying to create a cost function to represent the costs of producing denim jeans. They figure that the general cost of operating the machine for a whole day is $120, regardless of how many jeans they make that day. In addition to this, they figure that each pair of jeans will cost about $13 to make (for cost of materials, cost of labor, etc).

- What is the fixed cost?  **Fixed cost: $120**
- What is the variable cost?  **Variable cost: $13**

Create a Cost Function:

Total Cost, \( C(x) \rightarrow C(x) = (m \times x) + b = (\text{Variable Cost} \times \text{Output}) + \text{Fixed Cost} \)

\[ C(x) = 13x + 120 \]

3). A firm is planning on producing 7 units of \( x \) and has created a cost function, \( C(x) = 14x + 35 \), to estimate their general costs of production. How much will it cost the firm to produce the 7 units?

Units of Output: \( x = 7 \)

\[ C(x) = 14x + 35 \]

Plug in the amount of output, \( x \), and simplify

\[ C(7) = 14(7) + 35 \]

\[ C(7) = 98 + 35 \]

\[ C(7) = 133 \]

It will cost the firm $133 to produce 7 units of output.
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4). A video game manufacture has created the following cost and revenue functions to track the cost and revenue from the sales of their brand new game:

\[
C(q) = 18q + 80 \\
R(q) = 30q
\]

Generate a profit function using these two equations. Remember what the relationship between cost, revenue, and profit is.

\[
P(q) = R(q) - C(q)
\]

\[
P(q) = [30q] - [18q + 80] \\
P(q) = 12q - 80
\]

5). Using the Profit function from problem 4:

Would the video game manufacturer make a gain or a loss from producing 5 video games? How much?

\[
P(q) = 12q - 80 \\
P(5) = 12(5) - 80 \\
P(5) = 60 - 80 \\
P(5) = -20
\]

Producing 5 video games results in a loss of $20

Would the video game manufacturer make a gain or a loss from producing 12 video games? How much?

\[
P(x) = 12x - 80 \\
P(12) = 12(12) - 80 \\
P(12) = 144 - 80 \\
P(12) = 64
\]

Producing 12 video games results in a profit of $64
6.) A stand that sells t-shirts estimates their revenue with the function,
\[ R(x) = 16x \]
What’s the revenue from producing 3 t-shirts?
\[ R(3) = 16(3) \]
\[ R(3) = 48 \]
Revenue from producing 3 t-shirts is $48

7.) Suppose a firm has a profit function of,
\[ P(x) = 27x - 297 \]
How much would they have to produce to break even (what is the break-even point)?
\[ P(x) = 27x - 297 = 0 \]
We set profits equal to zero to abide by the definition of the break-even point.
This is where Revenue equals cost \[ R(x) = C(x) \] and profits are zero

solve for \( x \):
\[ 27x - 297 = 0 \]
\[ 27x = 297 \]
\[ x = 11 \]
If the firm produces 11 units, they will break even and have profits of zero (they will have neither any gains in profits nor any losses in profits)
8). How many units would a company have to produce in order to gain profits of $87

Given the profit functions

\[ P(x) = 7x + 24 \]

**Hint:** we don’t know how many units of x we need but we know profits have to be $87. So we know that: \( P(x) = 87 \)

\[ 7x + 24 = 87 \]
\[ 7x = 63 \]
\[ x = 9 \]