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Project: Residential Water Bill Rates

Company: Arlington County Virginia Government

Website: <https://www.arlingtonva.us/Government/Programs/Water-Utilities/Customer-Service/Rates>

Objectives:

- (1.) Calculate the Residential water rates of the residents in Arlington County using the Arithmetic Method.
- (2.) Write a piecewise function of the residential rates.
- (3.) Recalculate the same water bill of the residents in Arlington, Virginia within each range of specific water usage algebraically using the piecewise function method.

Information:

ADOPTED RATE STRUCTURE TG = Thousand Gallons

Residential

Charge Category	Effective July 1, 2024-June 30, 2025
Base Charge (Water)	\$16.81/ Quarterly
Water Use (Less than 9,000 Gallons)	\$4.17/ TG
Water Use (9,000 Gallons and above)	\$6.68/ TG

Conversions:

$$\frac{\$4.17}{TG} = \frac{\$4.17}{1000} = \$0.00417 \text{ per gallon}$$

$$\frac{\$6.68}{TG} = \frac{\$6.68}{1000} = \$0.00668 \text{ per gallon}$$

Number of Gallons to test:

I will test the following gallons of water:

- (1.) 0 gallons
- (2.) 3000 gallons
- (3.) 10000 gallons

Arithmetic Method:

(1.) For the consumption of 0 gallon:

$$\text{Cost} = \$16.81$$

(2.) For the usage of 3000 gallons:

$$\text{Cost} = 16.81 + 0.00417 (3000)$$

$$\text{Cost} = 16.81 + 12.51$$

$$\text{Cost} = \$29.32$$

(3.) For the usage of 10000 gallons:

$$\text{Cost} = 16.81 + 0.00417 (8999) + 0.00668(10000 - 8999)$$

$$\text{Cost} = 16.81 + 0.00417(8999) + 0.00668(1001)$$

$$\text{Cost} = 16.81 + 37.52583 + 6.68668$$

$$\text{Cost} = \$61.02251$$

$$\text{Cost} \cong \$61.02$$

Piecewise Function:

Let us define variables that we shall use:

Let: g be the gallons of water used

$c(g)$ is the cost per gallons of water usage in \$

Basic Customer Charge: \$16.81 per quarterly billing

First Category: Less than 9000 gallons: $0 \leq g < 9000$

$$c(g) = 16.81 + 0.00417g$$

$$c(g) = 0.00417g + 16.81$$

Second Category: 9000 gallons and above: $g \geq 9000$

$$c(g) = 16.81 + 0.00417(8999) + 0.00668(g - 8999)$$

$$c(g) = 16.81 + 37.52583 + 0.00668g - 60.11332$$

$$c(g) = 0.00668g - 5.77749$$

$$c(g) = \begin{cases} 0.00417g + 16.81; & 0 \leq g < 9000 \\ 0.00668g - 5.77749; & g \geq 9000 \end{cases}$$

Piecewise Function Method (Algebraic Method):

I will test the same numbers as I did with the Arithmetic Method.

- (1.) For the usage of 0 gallon:

0 gallon falls in the first piece

$$c(g) = 0.00417g + 16.81$$

$$c(0) = 0.00417(0) + 16.81$$

$$c(0) = 0 + 16.81$$

$$c(0) = \$16.81$$

- (2.) For the consumption of 3000 gallons:

3000 gallons falls in the first piece

$$c(g) = 0.00417g + 16.81$$

$$c(3000) = 0.00417(3000) + 16.81$$

$$c(3000) = 12.51 + 16.81$$

$$c(3000) = \$29.32$$

- (3.) For the consumption of 10000 gallons:

10000 gallons falls in the second piece

$$c(g) = 0.00668g - 5.77749$$

$$c(10000) = 0.00668(10000) - 5.77749$$

$$c(10000) = 66.8 - 5.77749$$

$$c(10000) = 61.02251$$

$$c(10000) \cong \$61.02$$

The exact and approximate results of the numbers tested using the Arithmetic Method and the Algebraic Method are the same.

Reference (APA 7)

Chukwuemeka, S. D. (n.d.). Where is the water bill? it is a piecewise function!. Piecewise Function Application: Water Bill.

<https://conferencepresentations.appspot.com/Projects/PreCalculus/PiecewiseFunctions/WaterBill.html>

Granicus. (n.d.). Water-sewer-refuse rates by customer class. 2024 Arlington County Virginia.

<https://www.arlingtonva.us/Government/Programs/Water-Utilities/Customer-Service/Rates>