

Assignment 6

PART-A

1.

Future average demand can be expressed with equation below:

$$D_{2025} = D_{2011}(1 + i)^n$$

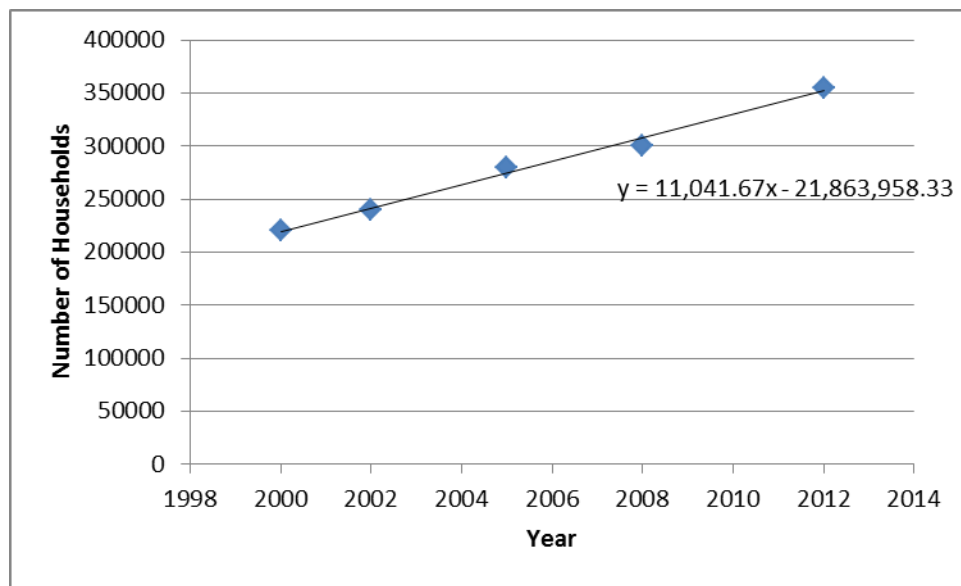
D_{2011} - average demand in 2011 = $6.12 \times 10^5 \text{ m}^3/\text{d}$

i - Demand growth rate = 0.05

n - Number of years = (2025-2011) = 14

So, **Avg. demand in 2025** = $12.12 \times 10^5 \text{ m}^3/\text{d}$

2.



Total population in **2025** = $(11,041.67(2025) - 21,863,958.33) \times 2.8$
= 1,387,185

Per capita water use = $(12.12 \times 10^5) / 1,387,185$
= 873.7 l/d-person

3.

$\ln Q = 3.61 + 0.251 \ln M + 0.212 \ln I + 1.64 \ln N$
= $3.61 + 0.251 \ln(2.35) + 0.212 \ln(150000) + 1.54 \ln(2.4)$
= 7.699

$$Q = e^{7.699} = 2207 \text{ m}^3/(\text{year}\cdot\text{household})$$

$$\text{From Q2} \rightarrow \text{Households in } \mathbf{2035} = (11,041.67(2035) - 21,863,958.33) \\ = 605,840$$

$$\text{Average demand per household} = 2207 \cdot 605,840 = 1337 \cdot 10^6 \text{ m}^3/\text{year} \\ = 3.66 \cdot 10^6 \text{ m}^3/\text{day}$$

$$\frac{1}{Q} \frac{dQ}{dM} = 0.251 \frac{1}{M} \rightarrow -\frac{\frac{dQ}{Q}}{\frac{dM}{M}} = -0.251$$

So, the price elasticity is equal to -0.251 and therefore, doubling the price of water will cause a 25% reduction in water demand.

4.

$$\text{Max. Demand} = 3.0 \cdot 12.12 \cdot 10^5 \text{ m}^3/\text{d} \\ = 36.36 \cdot 10^5 \text{ m}^3/\text{d}$$

$$\text{Required number of pumps} = 36.36 \cdot 10^5 \text{ m}^3/\text{d} / 2500 \text{ l/s} \\ = 36.36 \cdot 10^5 \text{ m}^3/\text{d} / [(2500 \cdot 3600 \cdot 24)/1000 \text{ m}^3/\text{d}] \\ = 17$$

At least 17 pumps need to be installed to meet the demand capacity requirements in 2025.