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# Water Demand and Quantity Formulas

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# List of 31 Water Demand and Quantity Formulas

## Water Demand and Quantity

### Determination of Population For Inter Censal and Post Censal Years

#### 1) Constant Factor given Population at Last Census

$$\text{fx } K_A = \frac{P_L - P_E}{T_L - T_E}$$

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2\_img.jpg\)](#)

$$\text{ex } 1.99 = \frac{20.01 - 22}{19 - 20}$$

#### 2) Earlier Census Date given Constant Factor

$$\text{fx } T_E = T_L - \left( \frac{P_L - P_E}{K_A} \right)$$

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa\_img.jpg\)](#)

$$\text{ex } 19.995 = 19 - \left( \frac{20.01 - 22}{2} \right)$$



### 3) Earlier Census Date given Proportionality Factor

$$\text{fx } T_E = T_L - \left( \frac{\log(P_L, e) - \log(P_E, e)}{K_G} \right)$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

$$\text{ex } 18.65876 = 19 - \left( \frac{\log(20.01, e) - \log(22, e)}{0.03} \right)$$

### 4) Last Census Date given Constant Factor

$$\text{fx } T_L = T_E + \left( \frac{P_L - P_E}{K_A} \right)$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

$$\text{ex } 19.005 = 20 + \left( \frac{20.01 - 22}{2} \right)$$

### 5) Last Census Date given Proportionality Factor

$$\text{fx } T_L = T_E + \left( \frac{\log(P_L, e) - \log(P_E, e)}{K_G} \right)$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

$$\text{ex } 20.34124 = 20 + \left( \frac{\log(20.01, e) - \log(22, e)}{0.03} \right)$$

### 6) Population at Earlier Census

$$\text{fx } P_E = P_L - K_A \cdot (T_L - T_E)$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754\_img.jpg\)](#)

$$\text{ex } 22.01 = 20.01 - 2 \cdot (19 - 20)$$



## 7) Population at Last Census

$$fx \quad P_L = P_E + K_A \cdot (T_L - T_E)$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

$$ex \quad 20 = 22 + 2 \cdot (19 - 20)$$

## 8) Population at Last Census given Proportionality Factor

$$fx \quad P_L = \exp((T_L - T_E) \cdot K_G + \log_{10}(P_E))$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

$$ex \quad 3.715163 = \exp((19 - 20) \cdot 0.03 + \log_{10}(22))$$

## 9) Proportionality Factor given Population at Last Census

$$fx \quad K_G = \frac{\log_{10}(P_L) - \log_{10}(P_E)}{T_L - T_E}$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

$$ex \quad 0.041176 = \frac{\log_{10}(20.01) - \log_{10}(22)}{19 - 20}$$

## Arithmetic Increase Method

### Inter Censal Period

## 10) Constant Factor for Inter Censal Period

$$fx \quad K_A = \frac{P_M - P_E}{T_M - T_E}$$

[Open Calculator !\[\]\(cbd8541a32dfc32f356f5c6c994b0a21\_img.jpg\)](#)

$$ex \quad 2 = \frac{40 - 22}{29 - 20}$$



### 11) Earlier Census Date for Inter Censal Period

$$fx \quad T_E = T_M - \left( \frac{P_M - P_E}{K_A} \right)$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a\_img.jpg\)](#)

$$ex \quad 20 = 29 - \left( \frac{40 - 22}{2} \right)$$

### 12) Mid Year Census Date for Inter Censal Period

$$fx \quad T_M = \left( \frac{P_M - P_E}{K_A} \right) + T_E$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021\_img.jpg\)](#)

$$ex \quad 29 = \left( \frac{40 - 22}{2} \right) + 20$$

### 13) Population at Earlier Census for Inter Censal Period

$$fx \quad P_E = P_M - K_A \cdot (T_M - T_E)$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

$$ex \quad 22 = 40 - 2 \cdot (29 - 20)$$

### 14) Population at Mid Year

$$fx \quad P_M = P_E + K_A \cdot (T_M - T_E)$$

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80\_img.jpg\)](#)

$$ex \quad 40 = 22 + 2 \cdot (29 - 20)$$



## Post Censal Period

### 15) Constant Factor for Post Censal Period

$$\text{fx } K_A = \frac{P_M - P_L}{T_M - T_L}$$

[Open Calculator !\[\]\(950a62bbddad88d64435fd35607dfc42\_img.jpg\)](#)

$$\text{ex } 1.999 = \frac{40 - 20.01}{29 - 19}$$

### 16) Last Census Date for Post Censal Period

$$\text{fx } T_L = T_M - \left( \frac{P_M - P_L}{K_A} \right)$$

[Open Calculator !\[\]\(73002692dd5e7a64e60946be3158e719\_img.jpg\)](#)

$$\text{ex } 19.005 = 29 - \left( \frac{40 - 20.01}{2} \right)$$

### 17) Mid Year Census Date for Post Censal Period

$$\text{fx } T_M = T_L + \left( \frac{P_M - P_L}{K_A} \right)$$

[Open Calculator !\[\]\(104fbf564e2e5a8fbd84f31656d114c7\_img.jpg\)](#)

$$\text{ex } 28.995 = 19 + \left( \frac{40 - 20.01}{2} \right)$$

### 18) Population at Last Census for Post Censal Period

$$\text{fx } P_L = P_M - K_A \cdot (T_M - T_L)$$

[Open Calculator !\[\]\(21226b58c700e5231ab98d27101bac58\_img.jpg\)](#)

$$\text{ex } 20 = 40 - 2 \cdot (29 - 19)$$



## 19) Population at Mid Year for Post Censal Period

$$fx \quad P_M = P_L + K_A \cdot (T_M - T_L)$$

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5\_img.jpg\)](#)

$$ex \quad 40.01 = 20.01 + 2 \cdot (29 - 19)$$

## Geometric Increase Method

### Inter Censal Period

## 20) Earlier Census Date for Geometric Increase Method

$$fx \quad T_E = T_M - \left( \frac{\log_{10}(P_M) - \log_{10}(P_E)}{K_G} \right)$$

[Open Calculator !\[\]\(d0262bbe9d2356661a2e89321dfcc781\_img.jpg\)](#)

$$ex \quad 20.34542 = 29 - \left( \frac{\log_{10}(40) - \log_{10}(22)}{0.03} \right)$$

## 21) Mid Year Census Date for Geometric Increase Method

$$fx \quad T_M = T_E + \left( \frac{\log_{10}(P_M) - \log_{10}(P_E)}{K_G} \right)$$

[Open Calculator !\[\]\(274fd520e03b61c1b9ffc861754cacdc\_img.jpg\)](#)

$$ex \quad 28.65458 = 20 + \left( \frac{\log_{10}(40) - \log_{10}(22)}{0.03} \right)$$

## 22) Population at Earlier Census for Geometric Increase Method

$$fx \quad P_E = \exp(\log_{10}(P_M) - K_G \cdot (T_M - T_E))$$

[Open Calculator !\[\]\(df47d6bec273bbb8b349135fff3a20f7\_img.jpg\)](#)

$$ex \quad 3.78884 = \exp(\log_{10}(40) - 0.03 \cdot (29 - 20))$$



### 23) Population at Mid Year for Geometric Increase Method

$$fx \quad P_M = \exp(\log_{10}(P_E) + K_G \cdot (T_M - T_E))$$

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107\_img.jpg\)](#)

$$ex \quad 5.014946 = \exp(\log_{10}(22) + 0.03 \cdot (29 - 20))$$

### 24) Proportionality Factor for Geometric Increase Method

$$fx \quad K_G = \frac{\log_{10}(P_M) - \log_{10}(P_E)}{T_M - T_E}$$

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6\_img.jpg\)](#)

$$ex \quad 0.028849 = \frac{\log_{10}(40) - \log_{10}(22)}{29 - 20}$$

### Post Censal Period

### 25) Last Census Date for Geometric Increase Method Post Censal

$$fx \quad T_L = T_M - \left( \frac{\log_{10}(P_M) - \log_{10}(P_L)}{K_G} \right)$$

[Open Calculator !\[\]\(e9474ce1d70442456f8fe9c393ea149c\_img.jpg\)](#)

$$ex \quad 18.9729 = 29 - \left( \frac{\log_{10}(40) - \log_{10}(20.01)}{0.03} \right)$$

### 26) Mid Year Census Date for Geometric Increase Method Post Censal

$$fx \quad T_M = T_L + \left( \frac{\log_{10}(P_M) - \log_{10}(P_L)}{K_G} \right)$$

[Open Calculator !\[\]\(9db214d549b9aeebe72aa11d3a5c4b1a\_img.jpg\)](#)

$$ex \quad 29.0271 = 19 + \left( \frac{\log_{10}(40) - \log_{10}(20.01)}{0.03} \right)$$





## 27) Population at Earlier Census given Proportionality Factor

$$fx \quad P_E = \exp(\log_{10}(P_L) - (T_L - T_E) \cdot K_G)$$

[Open Calculator !\[\]\(c3d993ca47bfe2a953c700506ce31fa0\_img.jpg\)](#)

$$ex \quad 3.785762 = \exp(\log_{10}(20.01) - (19 - 20) \cdot 0.03)$$

## 28) Population at Last Census for Geometric Increase Method Post Censal

$$fx \quad P_L = \exp(\log_{10}(P_M) - K_G \cdot (T_M - T_L))$$

[Open Calculator !\[\]\(17413706fd4997a1a4bdf85c6864eee1\_img.jpg\)](#)

$$ex \quad 3.676863 = \exp(\log_{10}(40) - 0.03 \cdot (29 - 19))$$

## 29) Population at Mid Year for Geometric Increase Method Post Censal

$$fx \quad P_M = \exp(\log_{10}(P_L) + K_G \cdot (T_M - T_L))$$

[Open Calculator !\[\]\(4b7a79268f6ba26c1471d4232fffa85a\_img.jpg\)](#)

$$ex \quad 4.959213 = \exp(\log_{10}(20.01) + 0.03 \cdot (29 - 19))$$

## 30) Proportionality Factor for Geometric Increase Method Post Censal

$$fx \quad K_G = \frac{\log_{10}(P_M) - \log_{10}(P_L)}{T_M - T_L}$$

[Open Calculator !\[\]\(3342c215b2a8b663596a81468d5dc314\_img.jpg\)](#)

$$ex \quad 0.030081 = \frac{\log_{10}(40) - \log_{10}(20.01)}{29 - 19}$$



## Variation In Rate of Demand

### 31) Percentage of Annual Average Consumption by Goodrich Formula

$$\text{fx APR} = \left(180 \cdot (t)^{-0.10}\right)$$

Open Calculator 

$$\text{ex } 142.9791 = \left(180 \cdot (10d)^{-0.10}\right)$$




## Variables Used

- **APR** Annual Percentage Rate
- **$K_A$**  Constant Factor
- **$K_G$**  Proportionality Factor
- **$P_E$**  Population at Earlier Census
- **$P_L$**  Population at Last Census
- **$P_M$**  Population at Mid Year Census
- **t** Time in days (*Day*)
- **$T_E$**  Earlier Census Date
- **$T_L$**  Last Census Date
- **$T_M$**  Mid-Year Census Date























## Constants, Functions, Measurements used

- **Constant:** **e**, 2.71828182845904523536028747135266249  
*Napier's constant*
- **Function:** **exp**,  $\exp(\text{Number})$   
*n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.*
- **Function:** **log**,  $\log(\text{Base}, \text{Number})$   
*Logarithmic function is an inverse function to exponentiation.*
- **Function:** **log10**,  $\log_{10}(\text{Number})$   
*The common logarithm, also known as the base-10 logarithm or the decimal logarithm, is a mathematical function that is the inverse of the exponential function.*
- **Measurement:** **Time** in Day (d)  
*Time Unit Conversion* 



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