Population Forecast: Arithmetic, Geometric and Incremental Increase

Future population for water supply design from four census figures at equal intervals, by the arithmetic, geometric and incremental increase methods.

Method: Classical water supply engineering methods (population forecasting, fire demand formulas)

Input parameters

Unit system: SI

Parameter	Value	Unit
Population, first census	50,000	
Population, second census	62,000	
Population, third census	77,000	
Population, latest census	95,000	
Intervals (decades) ahead	2.0000	

Calculated results

Parameter	Value	Unit
Arithmetic increase	125,000	
Geometric increase	145,733	
Incremental increase	134,000	
Geometric growth rate per interval	23.856	%

Notes for this case

• Arithmetic increase adds the mean increase per interval and suits old, stable cities; geometric increase compounds the mean growth rate (geometric mean of the ratios) and suits young, fast-growing towns but can overestimate; incremental increase adds the mean increase plus the mean change in increase, n(n + 1)/2 times, and usually lies between. Planners compare the methods and choose with judgement on the town's growth stage; design periods are typically 30 years.

Formula and method

$$P_A = P_4 + n\bar{x}, \quad P_G = P_4(1+r)^n, \quad P_I = P_4 + n\bar{x} + \frac{n(n+1)}{2}\bar{y}$$

Variables

P_1	Population, first census	-
P_2	Population, second census	-
P_3	Population, third census	-
P_4	Population, latest census	-
n	Intervals (decades) ahead	-
P_A	Arithmetic increase	-
P_G	Geometric increase	-
P_I	Incremental increase	-
r	Geometric growth rate per interval	-

Method and standards

Population forecast.

Assumptions and limits

- Equal census intervals.

References

Classical water supply engineering methods (population forecasting, fire demand formulas)

Report details

Report reference	FCC-NHCN-REDJ (the same inputs always give the same reference)
Generated	23 November 2026, 17:50 UTC
Calculator	Population Forecast: Arithmetic, Geometric and Incremental Increase
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/civil/hydraulics/population-forecast-methods

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.