# Estimate the Strength of Concrete at an Arbitrary Age

This application implements three methods of estimating the compressible strength of concrete.

## From Two Cube Test Results

| | Test 1 | Test 2 |
|---|---|---|
| Age (days) | $T1 := 7$ | $T2 := 14$ |
| Compressive strength (MPa) | $S1 := 20$ | $S2 := 26$ |

$$A := \begin{bmatrix} S1 & -T1 \\ S2 & -T2 \end{bmatrix} \qquad B := \begin{bmatrix} -T1 \cdot S1 \\ -T2 \cdot S2 \end{bmatrix}$$

Model parameters

$$X := A^{-1} \cdot B = \begin{bmatrix} 6 \\ 37.143 \end{bmatrix}$$

Note: coeffs agrees with the result of Statistics:-NonLinearfit)

$$f := \text{Statistics:-NonlinearFit}\left(\frac{n \cdot p}{n+q}, [[T1, S1], [T2, S2]], n\right) = \frac{37.143 \cdot n}{n + 6.000}$$

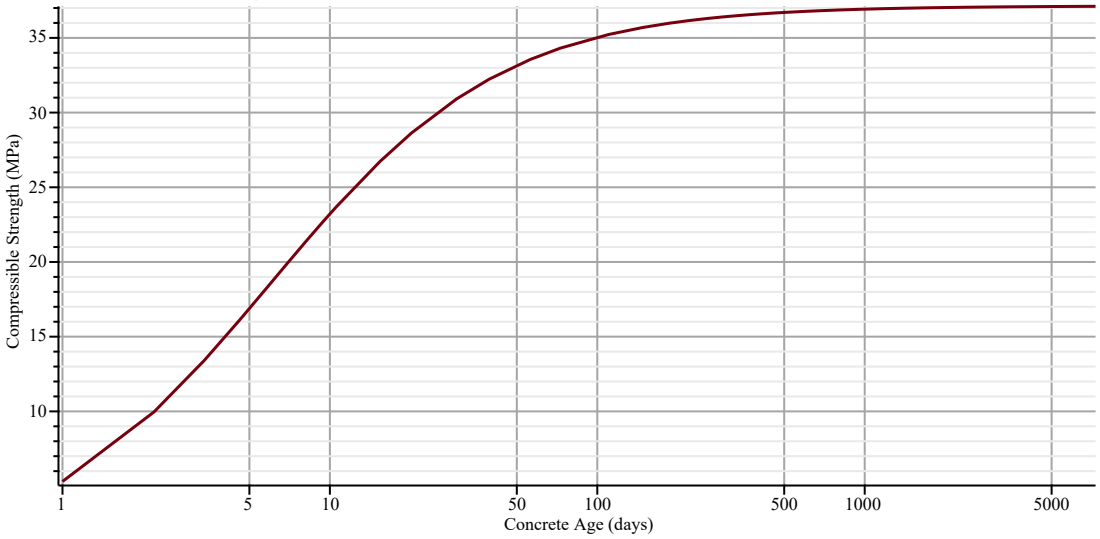
Function to estimate strength

$$f_{cm1} := n \ \frac{n \cdot X[2]}{n + X[1]}$$

Hence at 30 days the strength is

$$f_{cm1}(30) = 30.952$$

plot($f_{cm1}(n)$, n = 1 ..20·365, axis[1] = [mode = log], gridlines,
labels = ["Concrete Age (days)", "Compressible Strength (MPa)"], labeldirections =
[horizontal, vertical]) =




## Concrete Strength (Abd elaty, 2014)

Reference:
Metwally abd allah Abd elaty (2014) Compressive strength prediction of Portland cement concrete with age using a new model, HBRC Journal, 10:2, 145-155, DOI: 10.1016/j.hbrcj.2013.09.005

| | |
|---|---|
| Strength at 28 days (MPa) | $S_{28} := 30$ |
| Grade constant (eq 10 ) | $B := 0.005 \cdot S_{28}^{2.2} = 8.885$ |
| Rate constant (eq 11) | $A := 1.4035 \cdot \ln(B) + 2.9956 = 6.061$ |
| Age required | $T := 7$ |
| Estimate strength eq 9 | $f_{cm2} := T \ A \cdot \ln(T) + B$ |
| Hence at 30 days the strength is | $f_{cm2}(30) = 29.500$ |

# CEB-FIP Model Code 90

Strength at 28 days (MPa) $S_{28} := 30$

Cement type cement_type := "slow hardening"

Cement factor

$$S := \begin{cases} 0.20 & \text{cement\_type} = \text{"rapid hardening high strength"} \\ 0.25 & \text{cement\_type} = \text{"normal and rapid hardening"} \\ 0.38 & \text{cement\_type} = \text{"slow hardening"} \end{cases}$$

Function to estimate strength $f_{cm3} := T \; e^{S \cdot \left(1 - \sqrt{\frac{28}{T}}\right)} \cdot S_{28}$

Hence at 30 days the strength is $f_{cm3}(30) = 30.389$