

Discrete Assignment

EE1205 Signals and Systems

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Question 11.9.5.32: 150 workers were engaged to finish a job in a certain number of days, 4 workers dropped out on second day, 4 more workers dropped out on third day and so on. It took 8 more days to finish the work. Find the number of days in which the work was completed.

Solution:

Variable	values	Description
$x(0)$	150	first term
d	-4	common difference
p	?	no. of days to complete work
$x(n)$	$(150 - 4n)u(n)$	A.P formed when 4 workers stop working
$y(n)$	$(148n - 2n^2 + 150)u(n)$	sum of $n+1$ terms of $x(n)$

TABLE 1
INPUT PARAMETERS

$$\text{Total work done} = 150p \quad (1)$$

$$x(n) = (150 - 4n)u(n) \quad (2)$$

$$X(z) = \frac{150}{1 - z^{-1}} - \frac{4z^{-1}}{(1 - z^{-1})^2}, \quad |z| > 1 \quad (3)$$

$$y(n) = x(n) * u(n) \quad (4)$$

$$Y(z) = X(z)U(z) \quad (5)$$

$$Y(z) = \frac{150}{(1 - z^{-1})^2} - \frac{4z^{-1}}{(1 - z^{-1})^3}, \quad |z| > 1 \quad (6)$$

Using the z transforms given below:

$$(n+1)u(n) \xleftrightarrow{z} \frac{1}{(1 - z^{-1})^2}, \quad |z| > 1 \quad (7)$$

$$n((n+1)u(n)) \xleftrightarrow{z} \frac{2z^{-1}}{(1 - z^{-1})^3}, \quad |z| > 1 \quad (8)$$

$$\Rightarrow y(n) = 150(n+1)u(n) - 2n((n+1)u(n)) \quad (9)$$

$$y(n) = (148n - 2n^2 + 150)u(n) \quad (10)$$

It takes additional 8 days to complete work

$$\text{Total work done} = y(p+7) \quad (11)$$

Equating (1) and (11):

$$120p - 2p^2 + 1088 = 150p \quad (12)$$

$$(p-17)(p+32) = 0 \quad (13)$$

$$p = 17, \quad (p \geq 0) \quad (14)$$

$$\text{Work completed in} = p + 8 = 25 \text{ days} \quad (15)$$

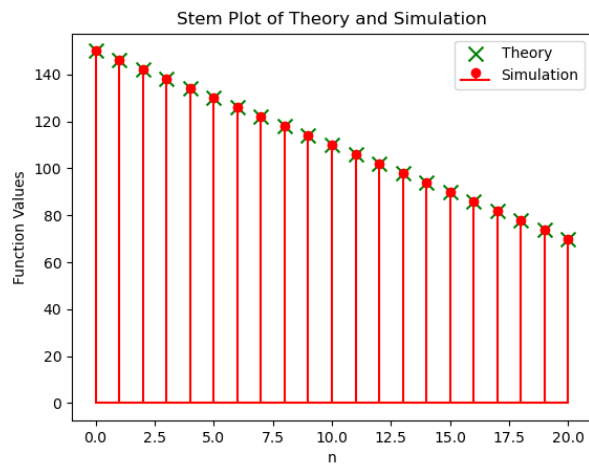


Fig. 1. Comparison of Theory and Simulated Values