Discrete Assignment
EE1205 Signals and Systems

Nimal Sreekumar
EE23BTECH11044

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
$y(n)$	$\left(148n-2n^2+150\right)u(n)$	sum of n+1 terms of $x(n)$

TABLE 1
Input Parameters

$$\text{Total work done} = 150p \tag{1}$$

$$x(n) = (150-4n)\,u(n) \tag{2}$$

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

$$y(n) = x(n) * u(n) \tag{4}$$

$$Y(z) = X(z)\,U(z) \tag{5}$$

$$Y(z) = \frac{150}{\left(1-z^{-1}\right)^2} - \frac{4z^{-1}}{\left(1-z^{-1}\right)^3} \tag{6}$$

Using the z transforms given below:

$$(n+1)\,u(n) \overset{z}{\leftrightarrow} \frac{1}{\left(1-z^{-1}\right)^2} \qquad ,|z|>1 \tag{7}$$

$$n\left((n+1)\,u(n)\right) \overset{z}{\leftrightarrow} \frac{2z^{-1}}{\left(1-z^{-1}\right)^3} \qquad ,|z|>1 \tag{8}$$

$$\implies y(n) = 150\,(n+1)\,u(n) - 2n\left((n+1)\,u(n)\right) \tag{9}$$

$$y(n) = \left(148n-2n^2+150\right)u(n) \tag{10}$$

It takes additional 8 days to complete work

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

Equating (1) and (11):

$$120p - 2p^2 + 1088 = 150p \tag{12}$$

$$(p-17)(p+32) = 0 \tag{13}$$

$$p = 17 \qquad ,(p \geq 0) \tag{14}$$

$$\text{Work completed in} = p+8 = 25\text{days} \tag{15}$$

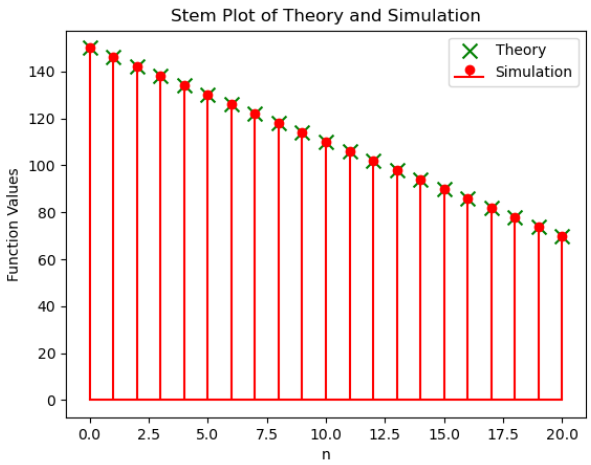

Fig. 1. Comparison of Theory and Simulated Values