

The Rabbit Problem

- Situation:** 1) The females of a certain rabbit species produce 6 females per year.
- 2) These mature in 1 year.
- 3) None die.
- 4) We start with $\begin{cases} a_0 \text{ adults} \\ b_0 \text{ young} \end{cases}$.

- Questions:** 1) How many female rabbits are there after n years?
- 2) If c_{k-1} is the cost (in dollars) of feeding a mature female in the k^{th} year, what is the total cost $T(n)$ to feed the rabbits for n years?

Assume: there is no cost to feed the young.

Analysis: Let $a_n = \#$ adult females at end of year n
 $b_n = \#$ females born in year n

Then:

- (1) $b_{n+1} = 6a_n$ (by hypothesis 1))
- (2) $a_{n+1} = a_n + b_n$ (by hypotheses 2), 3))
- (3) $T(n) = \underbrace{c_0 a_0}_{\substack{\text{cost of} \\ \text{feeding} \\ \text{1st year}}} + \underbrace{c_1 a_1}_{\substack{\text{cost of} \\ \text{feeding} \\ \text{2nd year}}} + \dots + \underbrace{c_{n-1} a_{n-1}}_{\substack{\text{cost of} \\ \text{feeding} \\ \text{nth year}}}$