Life Tables

A. Cohort life table

You are studying the life of the common tribble. In a large tribble colony, you mark 1000 newborn tribbles and observe them for the next 5 years. You find the following:

Year (age)	# tribbles alive at start of year	Survivor-ship	Mortality rate	Mean # tribbles alive in year	Average Remaining Life Expectancy	Average life expectancy for individuals of age x
x	n_x	l_x	m_x	L_x	e_x	
0	1000					
1	900					
2	700					
3	200					
4	50					
5	0					

1. Derive formulas for and calculate the remaining values in the table, based on the following definitions.

l_x survivorship in year x = survival of individuals to age x
m_x mortality rate in year x = proportion of individuals of age x dying by age x+1
L_x age units lived in year x = mean # of individuals alive between year x and x+1
e_x remaining life expectancy at age x = expectation of further life for individuals of age x

$$e_x = \frac{\sum_{i=x}^{5} L_i}{n_x}$$

1

2. Sketch the survivorship curve for tribbles:

3. Describe this curve in words. Why does the shape of the curve make sense qualitatively?

4. What other types of curves are there? Describe qualitative conditions that produce these curves.

B. Replacement rates

You also collected data on the tribbles born to the cohort you are studying. This is summarized below:

YEAR (age) x	# tribbles alive at start of year n_x	# individuals born to members of cohort during year x	Fecundity b_x	$l_x b_x$	for part 3	for part 4
0	1000	0				
1	900	1200				
2	700	100				
3	200	50				
4	50	5				
5	0	0				

1. Calculate the fecundity and realized fecundity ($l_x b_x$) for each age group.

2. Calculate the net reproductive rate, $R_0 = \sum_{i=0}^{i=5} l_i b_i$. Is this population stable (R_0=1), growing (R_0>1), or shrinking (R_0<1)?

3. Suppose you find tribbles with the same life expectancies except that they all give birth to 2 new tribbles only once in their lifetime, at an age of 2 years. Will the resulting population be stable?

4. Suppose you find tribbles with the same life expectancies except that they all give birth to 4 new tribbles only once in their lifetime, at an age of 3 years. Will the resulting population be stable?