Answers to Exercise 14

Reproductive Value: Life Table Approach

1–3. Your reproductive values should be as follows:

	J	K	L	M
2	**Reproductive value distribution**			
3	e^{rx}/l_x	$e^{-rx} l_x b_x$	$\Sigma e^{-ry} l_y b_y$	v_x
4	1	0	0.9999999	0.9999999
5	2.7166524	0.7362002	0.9999999	0.7166521
6	11.80832	0.2540581	0.2637997	0.1150313
7	102.65313	0.0097415	0.0097415	0
8				

In this population, age 0 has the highest reproductive value, followed by age 1. Ages 2 and 3 have low reproductive values. You might think that if populations are to be kept at a high level, the older age classes should be harvested because the removal of these individuals will have little impact on future population growth. In contrast, if you were trying to introduce an endangered species to a new habitat, you would want to introduce the younger ages to the area, since this group will reproduce and produce the greatest increase in population growth quickly. You would be right if in fact the numbers of individuals in each age class was approximately the same (i.e., the stable age distribution consists of roughly the same proportion of individuals from all age classes). However, if there individuals with the highest reproductive value in the population also makes up a very small proportion of the stable population, simply targeting individuals with the highest reproductive value may not be beneficial. See Exercise 15, "Sensitivity and Elasticity Analysis," to learn more about this topic.

4. For a population with a Type III survival curve and a single reproductive bout at the end of life, the reproductive values are as follows:

	M
3	v_x
4	0.9999993
5	2.3207934
6	4.3088684
7	0
8	

Three-year-olds are "worth" over 4 times as much in terms of future population growth because younger individuals have a very high mortality rate.

5. In contrast to Question 4, a Type I survival schedule produces the following reproductive values:

	J	K	L	M
2	**Reproductive value distribution**			
3	e^{rx}/l_x	$e^{-rx} l_x b_x$	$\Sigma e^{-ry} l_y b_y$	v_x
4	1	0	0.9999998	0.9999998
5	1.5559809	0	0.9999998	1.5559805
6	3.0142525	0.6635144	0.9999998	1.0142517
7	6.2409854	0.3364853	0.3364853	0

In this population, 1-year-olds have the highest reproductive value. Since mortality is low in the early age classes, 1-year-olds are just about to enter their reproductive life, and have their entire reproductive life ahead of them. Two-year-olds already have started reproducing, so in terms of future offspring, they have less to contribute to the population than the 1-year-olds. Three-year-olds can reproduce, but since they all die before they reach the age of 4, their reproductive value is forced to 0 because age class $y(x + 1)$ in the reproductive value calculations is equal to 0.