Answers to Exercise 19

Sensitivity and Elasticity Analysis

1. Overall, sea turtle population growth, λ, is much more sensitive to small changes in survival values than fertility values. The model was most sensitive to the transition period from large juveniles to small adults, where a very small increase in $P_{lj,sa}$ will cause a change in λ by a factor of 0.29 when all of the other elements in the **L** matrix are held constant. That is, increasing $P_{lj,sa}$ by 0.01 will increase λ by (0.01)(0.29) = 0.0029.

	R	S	T	U	V	W
10		**Sensitivity matrix**				
11		***F*(*h*)**	***F*(*sj*)**	***F*(*lj*)**	***F*(*sa*)**	***F*(*a*)**
12	**Hatchlings**	0.0579	0.1573	0.0251	0.0018	0.0008
13	**Small juveniles**	0.0816	0.2217	0.0354	0.0025	0.0011
14	**Large juveniles**	0.4318	1.1725	0.1871	0.0132	0.0056
15	**Subadults**	6.6950	18.1795	2.9005	0.2044	0.0875
16	**Adults**	25.1585	68.3155	10.8996	0.7682	0.3289

2. Elasticity analysis estimates the effect of a *proportional* change in the vital rates on population growth. In essence, elasticities are proportional sensitivities, scaled so that they are dimen-sionless. This allows you to directly compare survival and reproductive matrix elements. Inspection of the elasticity matrix shows that, by far, adult survival (the probability that an adult will remain an adult in the next time step) is the most important matrix element in terms of λ. The elasticity for adult survival 0.279, indicates that a 1% increase in adult survival will cause 0.279 % increase in λ.

	R	S	T	U	V	W
19		**Elasticity matrix**				
20		***F*(*h*)**	***F*(*sj*)**	***F*(*lj*)**	***F*(*sa*)**	***F*(*a*)**
21	**Hatchlings**	0	0	0	0.008669156	0.049244572
22	**Small juveniles**	0.057913728	0.16378255	0	0	0
23	**Large juveniles**	0	0.057913728	0.129163877	0	0
24	**Subadults**	0	0	0.057913728	0.146512753	0
25	**Adults**	0	0	0	0.049244572	0.279641337

3. Sensitivity and elasticity calculations depend on the parameters entered in the original matrix, and how well those parameters have been estimated. A change in one parameter will change the sensitivity and elasticity computations (try it for yourself by changing some original matrix entries). These parameters are likely to vary over time and are often difficult to estimate. Be careful not to over-interpret your results. Your results basically tell you what would happen *if* the matrix parameters are in fact unbiased, and *if* you are able to hold other elements in the matrix constant to examine the effect of each element.