Ecostats Homework 4

November 22, 2019

1) Shrub transition martices

(a) Asymptotic growth rate

- The asymptoic growth rate, λ, is 0.94.

(b) Stable age distribution

- The stable age distribution for stages 1-8 are 0.28, 0.03, 0.53, 0.01, 0.06, 0.06, 0.02, and 0.01, respectively.

(c) Stable stage distribution ignoring seeds

- The stable stage distribution for stages 2-8 (ignoring seeds) is 0.09, 0.82, 0.02, 0.04, 0.02, 0.00, and 0.00, respectively.

(d) Increasing matrix elements

- The largest element in the sensitivity matrix is row 5, column 5: 0.35. The new lambda is 1.01, which is an increase of 0.06 from the first lambda in part (a).

(e) Effect of canopy cover

- The elements [4,3] = 0.241; [1,5] = 0.087; [1,4] = 0.084 are the three highest values in the relative contribution to lambda matrix.

(f) part one: LTRE and lambda

- These values are fairly close: the calculated difference between lambda for both transition matrices equals 0.618, while the estimated difference in lambda from the LTRE is 0.560. These values differ by about 0.058.

(f) part two: transition matrix logic

- Well, the matrix as given shows a plant that flowered in 2010 was a seed in 2011 that had to transition to seedling with 0.1 in 2012. So it takes two years.

(g) re-written transition matrix

```
shrub2
```

```
##   sdl  juv  pre   sm  med   lg  vlg
## 2 0.0 0.00 0.00 0.09 0.23 0.26 0.30
## 3 0.7 0.90 0.17 0.00 0.00 0.00 0.00
## 4 0.0 0.01 0.56 0.00 0.00 0.00 0.00
## 5 0.0 0.00 0.15 0.91 0.00 0.00 0.00
## 6 0.0 0.00 0.00 0.04 0.90 0.03 0.00
## 7 0.0 0.00 0.00 0.00 0.02 0.86 0.01
## 8 0.0 0.00 0.00 0.00 0.00 0.02 0.90
```

(h) lambda with new transition matrix

- The asymptotic growth rate is 0.94 and the stable stage distribution is 0.04, 0.73, 0.02, 0.08, 0.09, 0.02, 0.01. for stages seedling-large adult, respectively.

(i) comparing the two no-seed models

```
round(uc-u2, 4)
```

```
## [1]  0.0531  0.0954  0.0005 -0.0450 -0.0736 -0.0204 -0.0100
```

```
round(l.c-lambda3, 4)
```

```
## [1] 0.0402
```

- For the method from part (c), the first two stages (seedling and juvenile) have higher relative abundances than the distribution from part (h) by 5% and 9%, respectively. The pre-adult stage is nearly the same in both approaches. All the adult stages have lower relative abundances in part (c) compared to (h), by about 1% to 7%. The population growth rate from part (c) is about 4% larger than in part (h). Since both the stable stage distribution and the population growth rates are roughly similar, this shows that there are many ways to organize a transition matrix and obtain similar estimates. Being thoughtful of the biology and the research question will inform how a transition matrix should be constructed.

2) Shrubs and hurricanes

```
round(one.a$meanlogl, 2)
```

```
## [1] 0.05
```

```
round(one.a$varlogl, 2)
```

```
## [1] 0.97
```

The population seems to be growing by about 6% annually.

(b) variance of lambda

The variance of the stochastic log lambda is estimated from the collection of 90,000 lambda values of all simulated years, which captures year-to-year variability. It does not factor in sample size, which would be

needed for standard error.

(c) Re-written environmental variability matrix

```
hurricane2
```

```
##   env1 env2 env3 env4
## 1 0.95 0.95 0.00 0.00
## 2 0.00 0.00 0.95 0.00
## 3 0.00 0.00 0.00 0.95
## 4 0.05 0.05 0.05 0.05
```

```
round(one.c$meanlogl, 2)
```

```
## [1] 0.06
```

```
round(one.c$varlogl,2)
```

```
## [1] 0.97
```

(d)

```
hurricane3
```

```
##   env1 env2 env3 env4
## 1 0.99 0.99 0.00 0.00
## 2 0.00 0.00 0.99 0.00
## 3 0.00 0.00 0.00 0.99
## 4 0.01 0.01 0.01 0.01
```

```
round(one.d$meanlogl,2)
```

```
## [1] -0.03
```

```
round(one.d$varlogl,2)
```

```
## [1] 0.27
```

(e)

```
hurricane4
```

```
##   env1 env2 env3 env4
## 1 0.95 0.95 0.00 0.50
## 2 0.00 0.00 0.95 0.45
## 3 0.00 0.00 0.00 0.00
## 4 0.05 0.05 0.05 0.05
```

```
round(one.e$meanlogl,2)
```

```
## [1] 0.03
```

```
round(one.e$varlogl,2)
```

```
## [1] 1.1
```