*Homework*

1. Given that the female grizzly bear population was 44 in 1959 and 34 in 1975, estimate the reproductive ratio ($\lambda$) during this time.
2. Starting from 1975, if there were no interventions (i.e., $\lambda$ did not change) how many female grizzly bears would there be after 5 years (rounding to the nearest individual)?
3. In the same scenario of no interventions in 1975, and assuming an equal sex ratio, in which year would the total Yellowstone population first drop below two individuals?
4. Consider a population in a reserve with year-round births ($b$=0.2 offspring per individual per year), deaths ($d$=0.16 per individual per year), and emigration ($a$=0.5 per individual per year). Will this population grow or decline?
5. Now, suppose emigration is eliminated by the construction of a barrier around the reserve. Does this change the qualitative behavior of the population (i.e., growth versus decline)?
6. If the population size at the time the barrier is constructed is $n_0$ = 10, what will the population size be in 50 years?

Q3 Hint: equation 10 can be used to determine a time interval. What biological factors might contribute to the answer being an over-estimate?

1 FROM EQN 11

$$\log \lambda = \frac{\ln(34/44)}{1975 \cdot 1959} = {}^{-}0.016114$$

$$\hat{\lambda} = 0.982$$

2 In class (and on slides) we calculated $\lambda = 0.984$ THIS COMES FROM ROUNDING 34/44 TO 3 PLACES

Using $N_t = \lambda^t N_0$ we know $N_0 = 34$ (in 1975) and we want to project $t=5$ yrs forward. $N_5 = (0.984)^5 \times 34 = 31.3 \sim 31$ to nearest individual. THIS ANSWER CORRECT EITHER WAY

[1 mark for correct formula, 1 mark for correct implementation]

4 "year-round births" implies continuous time fundamental equation:

$$\frac{dn}{dt} = (b-d-a)n = -0.46\,n \quad \therefore \text{pop. will decline}$$

[1 mark for correct formula, 1 mark for correct implementation/conclusion]

5 "barrier" implies no emigration $\therefore a = \emptyset$. Now

$$\frac{dn}{dt} = (b-d)n = +0.04\,n \quad \therefore \text{pop. will grow}$$

[1 mark for correct answer]

(6) Using $n_t = n_0 e^{rt}$ (Chapter 2, equation 2)

$$n_t = 10 \times e^{0.04 \times 50} = 73.9 \sim 73 \text{ or } 74$$

[1 mark for correct formula, 1 mark for correct implementation]

(3) Assuming an equal sex ratio, then the total population declining to 2 individuals is equivalent to the censused female populations declining to 1 individual. In 1974, there were 34 females (N0) and lamba~0.984. Using the formula log(lambda)=log(Nt/N0)/t we seek the value of t corresponding to Nt=1. Rearranging, we get t=log(Nt/N0)/log(lambda). Putting in the relevant numbers we get: t=log(1/34)/log(0.984)=218 years, which is approximately the year 2192.