

Introduction to Mathematical Modeling

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Stochastic Cranes – In Class Project

Today we will model a population of Cranes that have some randomness in their populations. Both Demographic and Environmental stochasticity will be considered.

Assume the following information

- We are modeling a closed non-migrating population.
- The cranes have an average birth rate of $b = 0.5$ that is normally distributed with a standard deviation of ± 0.03
- The cranes have an average death rate of $d = 0.1$ that is normally distributed with a standard deviation of ± 0.05

- There is an environmental catastrophe, a major flood, about once every 25 years.
- When there is a flood the birth rate is lowered by 40% and the death rate increases by 25%
- Assume that the current initial population is $P(0) = 100$ birds.
- As climate changes flooding becomes more common. If the temperature in Jan, Feb, or March exceeds 75 degrees, then the chance of a major flood is increased by 10%.

Our question is, do we need to worry about the long term survival of this animal if flooding becomes more frequent?

We will work together to build a model for this animal.

Some Helpful Spreadsheet Commands

1. RAND() - generates a uniform random variable between 0 and 1
2. RANDBETWEEN(top,bottom) - generates an integer between the top and bottom numbers.
3. NORMINV(rand(),mean,standard deviation) - generates a random number from a normal distribution
4. GAMMAINV(rand(),alpha,beta) - generates a random number from a gamma
5. COUNTIF(cell range, test) - looks at the cell range and then counts anything that matches the test condition
6. INDIRECT("text" & cell#) - can look up a cell reference based on numbers stored in cell#
7. SUM(range) - sums all the cells in the range.
8. AVERAGE(range) - finds the average of a range of numbers
9. MEDIAN(range) - finds the median of a range of numbers
10. MOD(number,divisor) - finds the mod of a number with the given divisor. MOD(cell,12)+1 translates whatever time step is in cell into a month.
11. IF(test,true,false) - test a relationship and then returns true if true and false if false