This exercise uses the population model from Worksheet 2, in which birth rate and death rate are

\[ p_b = 0.05 \quad \text{and} \quad p_d = \frac{N}{5000} \]

and expected population is governed by the difference equation

\[ \Delta N = \frac{1}{5000} (250N - N^2) \]

The goal is a “one click” model of a full year of population numbers using random data on every
day of the year. Here’s how you get there:

1. Generate two independent columns of normally distributed random numbers. Each column
needs at least 365 numbers.

2. Use one of these columns to generate actual numbers of births each day. These should be
approximately binomial with mean and standard deviation

\[ \mu = p_b N \quad \text{and} \quad \sigma = \sqrt{Np_b(1-p_b)} \]

[Hint: \( p_b \) is always 0.05]

3. Use the other column to generate actual numbers of deaths each day. These should be ap-
proximately binomial with mean and standard deviation

\[ \mu = p_d N \quad \text{and} \quad \sigma = \sqrt{Np_d(1-p_d)} \]

[Hint: \( p_d \) changes every day!]

4. Use all this data to compute the number of animals on each day for a year. You can pick any
starting population you like. I used 100.

5. Graph your data. It should look fairly jagged, particularly over the last half of the year. But
the jaggedness should hover around 250.

6. Copy the Day 2 Population cell and paste it back in the same cell. This will cause all the
random numbers to reset. You can watch the effect of this by watching the graph when you
click “Paste”.

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