Answers to Exercise 17

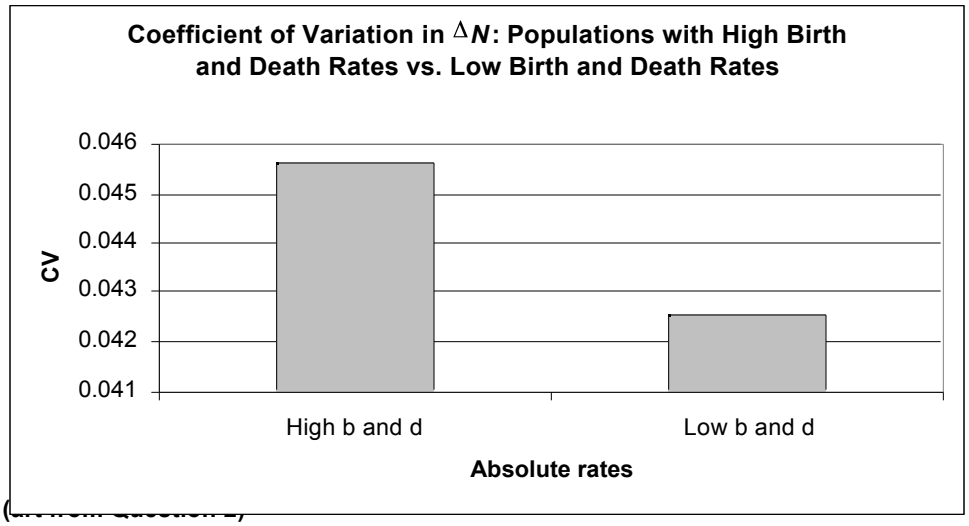
Demographic Stochasticity

1. When *s* and *b* are low, the chances of extinction increase substantially. One example of an extinction event is shown below. In this case, the difference between *d* (the death rate, which is 1 minus the survival rate) and *b* is high. As this difference decreases, stochasticity decreases.

	A	B	C	D	E
1	***Demographic Stochasticity***				
2	**Survival rate = *s* =**		0.3	**Death rate = *d* =**	0.7
3	**Birth rate = *b* =**		0.1		
4					
5	**POPULATION 1**				
6	Individual	Random #	Survive?	Random #	Reproduce?
7	1	0.98	0	0.39	0
8	2	0.45	0	0.62	0
9	3	0.97	0	0.11	0
10	4	0.98	0	0.68	0
11	5	0.96	0	0.39	0
12	6	0.48	0	0.57	0
13	7	0.50	0	0.81	0
14	8	0.86	0	0.51	0
15	9	0.49	0	0.65	0
16	10	0.50	0	0.90	0
17			0		0

Note that your results will generate different random numbers.

2. You should see that extinction risk due to stochasticity is much greater when $b + d$ is large (high birth and low survival) compared to small. Thus, populations with high birth and death rates tend to vary more due to demographic stochasticity than populations with low $b + d$ (low birth and high survival), even when population size is high (N = 100). Our results are graphed on the following page; your results may differ.



(Art from Question 2)

3. There are many ways to let *b* (the birth rate) or *s* (the survival rate) vary stochastically. When these variables change with each time step or trial, the variation is called environmental stochasticity. The simplest way to add this kind of variation to the existing model is to let cells C2 and C3 vary with each trial, rather than fixing them across all trails. This can be done with the **NORMINV** function combined with a random number function. This function draws a random number from a distribution whose mean and variances are specified. For example, in cell C2 we could enter the formula **=NORMINV(RAND(),0.6,0.1)**. This tells the spreadsheet to draw a random number from a distribution whose mean is 0.6 and standard deviation is 0.1. For each trial, the survival rate will vary and an element of environmental stochasticity will have been added to the model.