Appendix

Appendix 1: Introductory dungeons and vaccines.

"Introductory Dungeons and Vaccines (D&V)"

Welcome to Dungeons and Vaccines, the first roleplaying game in which you are a character in a world where people interact with pathogenic organisms and defend themselves with the magical elixirs known as vaccines, a world not unlike our very own. On the cards you have received, you will find your character's origins (demographics), strengths (vaccinations), and weaknesses (infections). You will use this information to navigate this mystical world, where you will interact with other characters to see who will live, who will die, and who will get sick.

In today's game, we will play through 8 scenarios that reflect the vaccination rate, mortality, communicability, vaccine effectiveness, duration of infectivity, and demographic influence of 4 different diseases.

Gameplay is conducted in rounds, and each round consists of a series of steps. At the beginning of each round, follow the procedure below:

- Examine your card, make note of your **infection status** (indicated by a **green** star) and **vaccination** status (indicated by a **red** star). Determine the result of your infection status:
  a. If you are **not infected**, role your die 3 times. If the sum of your rolls is 3, you **die** (because you know, you could always get hit by a bus). Remove yourself from the game and wait for the next scenario.
  b. If you are **infected**, roll your die 3 times and calculate the sum of the rolls.
  c. Based on the attached rubric, determine whether you recover from the disease, die from the disease, or remain infected

  i. If you **recover**, remove your green star and place a **blue** star on your card.
  ii. If you **die** remove yourself from the game by standing in the corner and wait for the next scenario.

- Turn to someone at your table and prepare to battle.
  a. If **neither of you are infected**, roll each of your die 2 times (4 total rolls). If the sum of your rolls is a 4 then congratulations! You fell in love and got married.
  b. If **both of you are infected**, roll each of your die 2 times (4 total rolls). If the sum of your rolls is a 24 then mazel tov! You decided to go into business with each other cooking and distributing methamphetamines in order to leave your families with enough money in case you ultimately succumb to this disease.
  c. If **one of you is infected**, roll each of your die 2 times (4 total rolls).

  i. Based on the attached rubric, determine if the disease has been **transmitted** by calculating the sum of your combined rolls and your **vaccination/recovery status**.
  ii. If you become **infected**, indicate this change in status by placing a **green** star on your card. You now have the possibility of transmitting the infection to someone else.

- Repeat steps 1-2, making each pairwise interaction at your table (e.g. if there are 6 people at your bench, you will carry out steps 1 and 2 a total of 5 times, once for each other person at your bench, interacting with a new person each time).
- After all pairwise interactions have been completed at your table, the individuals with an odd number on their cards will move to the next table in a clockwise fashion. Individuals with an even number on their cards will stay put. Repeat each new pairwise interaction.
- Continue the process of making pairwise interactions and moving tables until you have made it back to your original table.
- After the completion of each scenario, fill out the appropriate table corresponding to your character's fate.

Scenario	Did you begin the scenario vaccinated?	Are you between the ages of 5 and 65?	Did you become infected during the scenario?	If you started the scenario infected or became infected during the scenario, did you die?	If you started the scenario infected or became infected during the scenario, did you recover?	If you recovered, did you get re-infected?
1						
2						
3						
4						
5						
6						
7						
8						

Yes = "X" No = " "

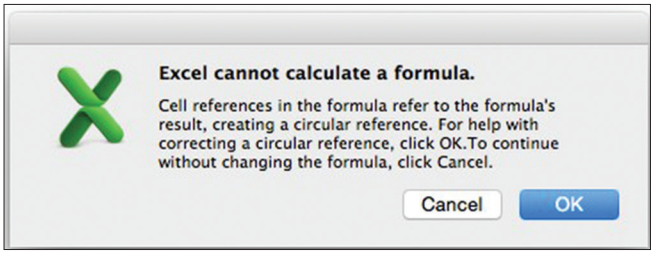
		PATHOGEN			
		Influenza virus	Measles virus	*B. pertussis*	Ebola virus
STEP 1					
5 years old		7 = death	4 = death	8 = death	11 or less = death
		8 or 14 = recover	5 or 8 = recover	4 or 7 = recover	15 or 18 = recover
5 < years old < 65		6 = death	4 = death	5 = death	11 or less = death
		8 or 14 = recover	5 or 8 = recover	4 or 7 = recover	15 or 18 = recover
65 years old 8 or 14 = recover		7 = death	4 = death	5 = death	11 or less = death
		8 or 14 = recover	5 or 8 = recover	4 or 7 = recover	15 or 18 = recover
STEP 2					
Transmission	If vaccinated	9 or less	8 or less	10 or less	7 or less
	If unvaccinated	11 or less	18 or less	16 or less	9 or less
	If recovered*	22 or more	No number	24	No number

*Recovered trumps vaccinated

Group #

In this part of the lab you will use a computer model of vaccine-preventable disease transmission to test hypotheses regarding herd immunity.

Start by opening the file containing the model in Excel (D2L, IdEALS II, Content, Lab 14). You will probably get the following error message:

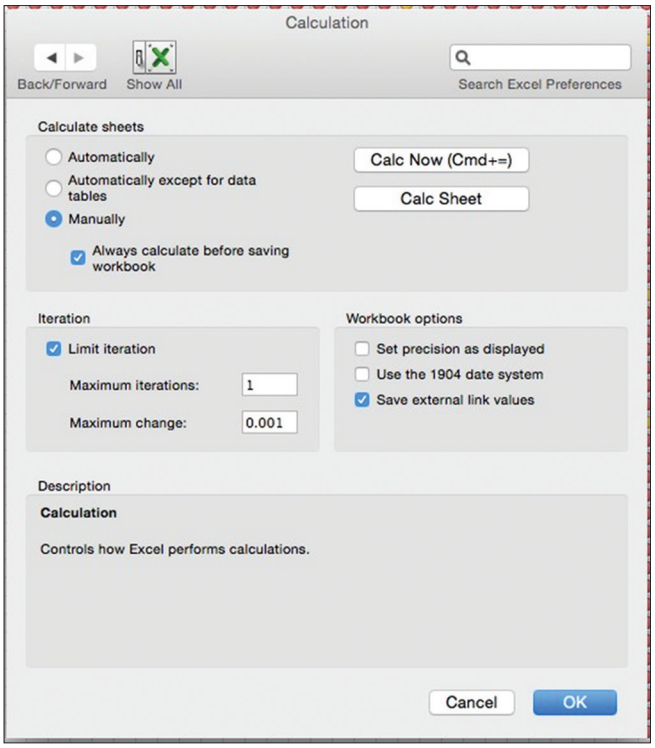


Click "Cancel"

Within Excel, go to Preferences !Calculations

Change "Calculate sheets" to "Manually"

Click on the box that says "Limit iteration", then enter a "1" for "Maximum iterations" and click "OK"



Now you should be ready to model the first pathogen: **Influenza Virus**

Enter the following information on the left hand side of the spreadsheet:

Mortality rate
1
Secondary household attack rate
26
Number of days infectious
6

Now reset the board by entering "0" below the cell labeled "reset" and then pressing F9 for Windows, and "Command-Equal sign" for OSX.

To begin the simulation, change the mode by entering a "1" below the cell labeled "reset". Now every time you press F9 (Windows) or "Command-Equal sign" (OSX), you will advance the simulation one step.

For each simulation, advance the model until "# infected" equals 0.

Once "# infected" equals 0, record all the pertinent information in the table provided.

The initial settings I gave you above represent the estimates from last year's flu season. Systematically alter "% vaccinated" and "vaccine effectiveness" and record the results:

From January 1 to April 10, 2015, 159 people from 18 states and the District of Columbia were reported to have measles. Most of these cases [117 cases (74%)] are part of a large, multi-state outbreak linked to an amusement park in California. The United States experienced a record number of measles cases during 2014, with 668 cases from 27 states reported to CDC's National Center for Immunization and Respiratory Diseases (NCIRD). This is the greatest number of cases since measles elimination was documented in the U.S. in 2000.

% vaccinated	20	20	20	40	40	40	80	80	80
Vaccine effectiveness	30	60	90	30	60	90	30	60	90
Iterations									
Greatest # sick at any time									
% unvaccinated that became sick or died									
% vaccinated that became sick or died									
% population that became sick or died									

FYI: Based on data collected during last year's flue season, the % of the American population vaccinated against influenza was ~40% and the vaccine effectiveness was 61%

Mortality rate
0.3
Secondary household attack rate
90
Number of days infectious
8

The measles vaccine confers remarkable protection against the virus. Its effectiveness has been estimated at ~95%.

What is the lowest percentage of the population that must be immunized to confer protection to at least 90% of the unvaccinated population? Record your results in the following table:

% vaccinated									
Vaccine effectiveness	95	95	95	95	95	95	95	95	95
Iterations									
Greatest # sick at any time									
% unvaccinated that became sick or died									
% vaccinated that became sick or died									
% population that became sick or died									

Mortality rate
0.5
Secondary household attack rate
80
Number of days infectious
13

In 2012, 48,277 cases of pertussis (whooping cough) were reported in the U.S., but many more go undiagnosed and unreported. This is the most number of cases reported in the U.S. since 1955 when 62,786 cases were reported.

What is the lowest combination of vaccination rate and vaccine effectiveness required to protect at least 90% of the unvaccinated population? Record your results in the following table:

% vaccinated	Vaccine effectiveness	Iterations	Greatest # sick at any time	% unvaccinated that became sick or died	% vaccinated that became sick or died	% population that became sick or died

Mortality rate	Secondary household attack rate	Number of days infectious
42	12	20

The 2014 Ebola epidemic is the largest in history, affecting multiple countries in West Africa. Two imported cases, including one death, and two locally acquired cases in healthcare workers have been reported in the United States. CDC and partners are taking precautions to prevent additional cases of Ebola in the United States.

Many groups are currently developing vaccines to combat Ebola, but only two have been tested in humans so far. GSK/National Institute of Allergy and Infectious Disease have developed cAd3- ZEBOV, a live-attenuated chimpanzee adenovirus variant engineered to express Ebola glycoproteins. Merck/Public Health Agency of Canada have developed VSV-EBOV, a live-attenuated variant of vesicular stomatitis virus engineered to express Ebola glycoproteins.

For either of these vaccines to be successful, they must adequately protect the population. What is the lowest combination of vaccination rate and vaccine effectiveness required to protect at least 90% of the total population? Record your results in the following table:

% vaccinated	Vaccine effectiveness	Iterations	Greatest # sick at any time	% unvaccinated that became sick or died	% vaccinated that became sick or died	% population that became sick or died