MATHEMATICAL SCIENCES
ARTS & SCIENCE

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE WOMEN

APPLICATION DEADLINE: 03/01/2017

PROJECT TITLE: Mathematical modeling for Yellow Fever

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Project Description

Yellow fever (YF) is a viral hemorrhagic fever transmitted by infected mosquitoes. Yellow fever is spread into human populations in three stages:
1. Sylvatic (or jungle). YF occurs in tropical rain forests where mosquitoes, which feed on infected monkeys, pass the virus to humans who work in the forest.
2. Intermediate. YF occurs as infected individuals bring the disease into rural villages, where it is spread by mosquitoes amongst humans (and also monkeys).
3. Urban. YF occurs as soon as an infected individual enters urban areas. This can lead to an explosive epidemic in densely inhabited regions. Domestic mosquitoes carry the virus from person to person.

The epidemic can be controlled by vaccination. YF vaccine is safe and effective and provides immunity within 1 week in 95% of those vaccinated. We have a data set of YF cases and YF deaths of an outbreak in Senegal in 2002 collected from the internet archives of the World Health Organization (WHO). As soon as the virus was identified a vaccination program was started (Oct 1, 2002). On Oct 11, 2002 the disease was reported in Touba, a city of 800,000 residents. More information can be found on the WHO Web sites (www.who.int).

The goals of this project and the possible questions it seeks to answer are:
1. Develop a model for the three stages of YF as outlined above.
2. Include a fourth stage that describes vaccination in urban areas.
3. Fit your model to the data.
4. What would have happened without vaccination?
5. Would you expect that the disease dies out, or that it becomes persistent?

Requirements: The student should have completed MATH2073 or MATH2074 course, with a minimum grade of C.
Expected Research Tasks: 1. Literature reviews; 2. Basic modeling using differential equations; 3. Programming using Matlab or Maple or R to do numerical simulations; 4. Writing a scientific report; 5. Presentation.

Training and Support: I will meet regularly (weekly or bi-weekly) with the student, to provide training and support for the Expected Research Tasks 1 through 5.