College of the Holy Cross, Fall Semester 2018
MONT 104N – Modeling the Environment
Midterm Exam, October 26

Your Name: _____

Instructions Please write your answers in the spaces provided on the following pages, and show work on the test itself. **For possible partial credit, you must show work**. Use the back of the preceding page if you need more space for scratch work.

Please do not write in the space below

Problem	Points/Poss
I	/ 20
II	/ 30
III	/ 20
Essay	/ 30
Total	/100

Do all work on these sheets. You may use the back sides if necessary. There are 100 possible points (distributed as indicated in the questions).

I. In discussing amounts of water needed for irrigation of farmland, a common unit of volume is the acre-foot. One acre-foot of water is the amount of water necessary to cover a perfectly flat field one acre in area, to a depth of one foot. Using the information below, answer questions A and B.

- 1 yard = 3 feet
- 1 acre = 43560 square feet
- 1 meter $\doteq$ 3.28 feet

A. (10) How many cubic yards (yd^3) of water are there in one acre-foot?

B. (10) How many cubic meters (m^3) of water are there in one acre-foot?

II. According to the 2014 Advancing Sustainable Materials Management factsheet produced by the U.S. Environmental Protection Agency, the total amounts of various types of materials produced, recycled, and disposed of in landfills in the U.S. were as follows. All figures are in units of millions of tons.

Category	**Produced**	**Recycled**	**Landfilled**
Paper and paperboard	68.61	44.40	19.47
Metals	23.26	7.90	12.82
Plastics	33.25	3.17	25.10
Glass	11.48	2.99	7.04
Others	4.44	1.29	2.58

A. (15) Construct a bar chart showing the *percentages* of the amounts produced that are *recycled* for each of these materials.

B. (5) Which material is landfilled most, proportionally (that is, considering the landfilled amount as a fraction of the amount produced)? Explain.

C. (10) What percentage of the total weight of these classes of materials produced is recycled? What percentage of the total produced is landfilled?

III.

A. (11) In 2010, 2.74×10^5 hybrid and electric vehicles were sold in the US. In 2015, the number was 4.98×10^5. Construct a linear model for the number of hybrid vehicles sold as a function of t = years after 2010 using this information. What does your model predict about the number of hybrid and electric vehicles sold in 2018?

B. The following spreadsheet shows more complete data for the total number of hybrid (and electric) vehicles sold for each year from 2010 through 2015.

Answer each of the following questions based on this information:

1. (3) Based on the scatter plot, the R^2 ("coefficient of determination") is probably:
   between 0 and .25 _____
   between .25 and .5 _____
   between .5 and .75 _____
   between .75 and 1 _____
2. (3) The least squares regression line for this data set would have a slope m about:
   $m = 60000$ _____
   $m = -60000$ _____
   $m = 30000$ _____
3. (3) What are the units of the slope?

Essay (30)

Why is there great interest in creating synthetic bacteria and other single-cell organisms? For what jobs might they be useful? On the other hand, what potential dangers have people suggested in this kind of work? Considering *Frankenstein* as a warning, is this something we should be pursuing with our technology? Are the potential good effects enough to outweigh the possible dangers?