Quantitative Reasoning 28:
The Magic of Numbers

Homework 22

Assigned on Wednesday November 17th
Due at 12 noon **Friday** November 19th

Please submit problem sets at the end of the relevant lecture, or leave in the box labeled QR28 outside the Math Department's main office, on the third floor of the Science Center (Room 325).

Reading:

Gross-Harris, Chapter 19

Problems:

Please explain your reasoning and show your work.

1. The goal of this problem is to find the 11th root of 5 (mod 29).
   (a) Find a number k such that $11k \equiv 1 \pmod{28}$. (Caution: for this part, we are working (mod 28)).
   (b) Compute $5^k \pmod{29}$. Why is this number the 11th root of 5 (mod 29)?
   (c) Check that your answer to part (b) is correct by raising it to the 11th power and seeing if you get 5.
2. The method we know for computing roots (mod p) can be applied to only 2 of the following 4 problems. Say which 2 can be solved by this method, and solve them.
   (a) The 5th root of 3 (mod 23);
   (b) The 5th root of 7 (mod 31);
   (c) The 5th root of 6 (mod 33);
   (d) The 5th root of 4 (mod 37).

3. Compute the following roots:

   (a) The 3rd root of 7 $\pmod{11}$

   (b) The 7th root of 3 $\pmod{17}$