**Brent Allman** **Homework 2** **Due 07-03-2013**

1. Break this chiphertext that was enciphered using Vigenere with a two letter keyword (the keyword will not necessarily be a real dictionary word):

   ```
   VL GO KR IM UK QM PK DE PE PE UX GP NR QS PI
   ```

   given that "bananas" appears in it.

2. Find $q, r$ with $0 \leq r < a$, so that $b = a \cdot q + r$ with:
   (a) $a = 317121, b = 1951985$
   (b) $a = 78919, b = -2156568$.
   (c) $a = 640610, b = 295159$.

3. Find the inverse of 8 (mod 38) (that is, find $c$ such that $8c \equiv 1 \pmod{38}$) or explain why it does not exist.

4. Break the message:

   ```
   RUUI ARIK RMM
   ```

   knowing it was encoded with an affine cipher and contains the word "jazz".

5. Use the vigenere applet at

   ```
   http://math.ucsd.edu/\~crypto/java/EARLYCIPHERS/Vigenere.html.
   ```

   Choose a random ciphertext and try to break it. Write down the keyword.

6. Prove that if $d|a$ and $d|b$ then $d|a + b$ and $d|a - b$.

7. Prove that if $a \equiv b \pmod{m}$ and $c \equiv d \pmod{m}$ then $a+c \equiv b+d \pmod{m}$, $a-c \equiv b-d \pmod{m}$ and $ac \equiv bd \pmod{m}$ .