1. Finish typing the following Matlab programs from the Matlab Intro on Blackboard: `factorial.m`, `fibonacci.m`, `choose.m`. Print out your three `*.m` files and attach them to this homework. (Don't copy/paste into Word or anything, just print from Matlab.)

2. Read sections 1,1, 1.5, 1.6, and 1.7 in the book.

3. Do problem 7.1 (page 22) and problem 7.1 (page 27). (Short answers please.)

4. A factory has 9 lathes and 4 grinders. Each machine runs for 40 hours per week. The machines are used to make three different products. Each unit of product 1 requires 2 hours of time on a grinder machine, each unit of product 2 requires 4 hours on a lathe, and each unit of product 3 requires 5 hours on a lathe and 3 hours on a grinder. The products also have monetary costs of 25, 10, and 15, respectively. The sale price per unit depends on the supply, and is given by $p_1(x_1) = 20 + 50x_1^{-1/2}$, $p_2(x_2) = 15 + 40x_2^{-1/4}$, and $p_3(x_3) = 35 + 100x_3^{-1/3}$, where x_j is the number of units of product j per week.

   (a) What key properties do the functions p_j have? How realistic are these?

   (b) The company wants to maximize its weekly profit. Construct the appropriate objective function.

   (c) Construct appropriate constraints for the amounts of products made. One constraint is non-negativity; namely, $x_1,\ x_2,\ x_3 \geq 0$. Find at least two more constraints.

5. Suppose we have a collection of $n > 3$ data points (x_j, y_j), and we wish to find the quadratic polynomial function $f(x) = a + bx + cx^2$ that minimizes the residual sum of squares $R(a, b, c) = \sum_{j=1}^{n}(y_j - f(x_j))^2$. Let $\mathbf{u}$ be the column vector with components a, b, and c. Use the fact that the minimizer must occur at a point where the first partial derivatives of R are all 0 to construct a matrix $\mathbf{M}$ and a vector $\mathbf{v}$ such that $\mathbf{v}$ is determined by the equation $\mathbf{Mu} = \mathbf{v}$.[1]

[1] In general, the first partial derivatives all 0 is a necessary condition for a minimizer but not a sufficient condition. We will eventually learn a theorem that gives additional restrictions needed for the condition to be sufficient as well as necessary.