Dr. Wolfe MATH 240 MATLAB PROJECT #4 Due December 2, 2004

1. Ex. 35 & 36, p.393, *Lay*. To normalize a vector v, write $u = v/\mathbf{norm}(v)$. For 34(b) do $y = \mathbf{rand}(8,1)$.

2. Ex. 25, p.401, *Lay*.

3. Ex. 24 & 25, p.408, *Lay*. Do $[Q, R] = \mathbf{qr}(A, 0)$.

4. The vapor pressure P of water (in bars) as a function of temperature T (°C) is

T	0	10	20	30
P(T)	.006107	.012277	.023378	.042433
T	40	50	60	70
P(T)	.073774	.12338	.19924	.31166
T	80	90	100	110
P(T)	.47364	.70112	1.01325	1.22341

We wish to fit this data to a quadratic polynomial $P = \beta_0 + \beta_1 T + \beta_2 T^2$ in the sense of least squares.

(a) MATLAB has commands to do this automatically. Write $T = 0 : 10 : 110$ and $P = [.006107 \quad .012277 \quad \cdots]$. (Sorry, there is no easy way to do this.) Then do $p = \mathbf{polyfit}(T, P, 2)$. p is a row vector with $p_1 = \beta_2$, $p_2 = \beta_1$, $p_3 = \beta_0$. We now plot the curve and the data points:

$$t = 0 : .5 : 110; y = \mathbf{polyval}(p, t); \mathbf{plot}(t, y, T, P, 'o')$$

To use the quadratic to estimate $P(45)$ do $a = \mathbf{polyval}(p, 45)$.

Now we work with the design matrix. So write

$$X = T', \quad A = [\text{ones}(12, 1) \quad X \quad X.*X], \quad b = P'$$

We will find $x = (\beta_0, \beta_1, \beta_2)^T$ in three different ways:

(b) Do $x = A \backslash b$.

(c) Solve the normal equations $A^T Ax = A^T b$ with the backslash operator.

(d) Do $[Q, R] = \mathbf{qr}(A, 0)$. Then solve $Rx = Q^T b$.

In each case compare your answer with the one found above.