Math 2568, Quiz #16, Fall 2013   Name ___KEY___

Instructions: Show all work. Use exact answers unless specifically asked to round.

1. A healthy child's systolic blood pressure p (in millimeters of mercury) ad weight w (in pounds) are approximately related to the equation $\beta_0 + \beta_1(\ln w) = p$. Use the following experimental data to estimate the systolic blood pressure of a healthy child weighing 100 pounds.

w	44	61	81	113	131
ln w	3.78	4.11	4.39	4.73	4.88
p	91	98	103	110	112

$$A = \begin{bmatrix} 1 & 3.78 \\ 1 & 4.11 \\ 1 & 4.39 \\ 1 & 4.73 \\ 1 & 4.88 \end{bmatrix} \qquad \vec{y} = \begin{bmatrix} 91 \\ 98 \\ 103 \\ 110 \\ 112 \end{bmatrix}$$

$$\beta_0 = 18.564$$
$$\beta_1 = 19.241$$

$$(A^TA)^{-1}A^T\vec{y} = \begin{bmatrix} 18.564 \\ 19.240 \end{bmatrix}$$

$$p = 18.564 + 19.241 \ln w \Rightarrow$$
$$p = 18.564 + 19.241(\ln 100) = 107.17 \text{ mm.}$$

2. To measure the take-off performance of an airplane, the horizontal position of the plane was measured every second, the data is provided in the table below. Find the least squares cubic curve $v = \beta_0 + \beta_1 t + \beta_2 t^2 + \beta_3 t^3$ for this data. Use your answer to estimate the speed at t=4.5 seconds.

t	0	1	2	3	4	5	6	7	8	9	10	11	12
v	0	8.8	29.9	62	104.7	159.1	222	294.5	380.4	471.1	571.1	686.8	809.2

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 \\ 1 & 2 & 4 & 8 \\ 1 & 3 & 9 & 27 \\ 1 & 4 & 16 & 64 \\ 1 & 5 & 25 & 125 \\ 1 & 6 & 36 & 216 \\ 1 & 7 & 49 & 343 \\ 1 & 8 & 64 & 512 \\ 1 & 9 & 81 & 729 \\ 1 & 10 & 100 & 1000 \\ 1 & 11 & 121 & 1331 \\ 1 & 12 & 144 & 1728 \end{bmatrix} \quad y = \begin{bmatrix} 0 \\ 8.8 \\ 29.9 \\ 62 \\ 104.7 \\ 159.1 \\ 222 \\ 294.5 \\ 380.4 \\ 471.1 \\ 571.1 \\ 686.8 \\ 809.2 \end{bmatrix}$$

$$(A^TA)^{-1}A^Ty = \begin{bmatrix} -.905 \\ 4.784 \\ 5.536 \\ -.026 \end{bmatrix}$$

$$v = -.905 + 4.784t + 5.536t^2 - .026t^3$$

$$t = 4.5$$

$$v = 130.358.$$