

Linear Least Squares Approximation Lab

II Vehicle Crashes

a)

$$\begin{bmatrix} 1975 & 1 \\ 1980 & 1 \\ 1985 & 1 \\ 1990 & 1 \\ 1995 & 1 \\ 2000 & 1 \\ 2005 & 1 \end{bmatrix} \begin{bmatrix} m \\ b \end{bmatrix} = \begin{bmatrix} 20.6 \\ 22.5 \\ 18.4 \\ 17.9 \\ 15.9 \\ 14.9 \\ 14.7 \end{bmatrix}$$

$$\text{b) } A^T = \begin{bmatrix} 1975 & 1980 & 1985 & 1990 & 1995 & 2000 & 2005 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

$$\text{c) } A^T A x = A^T b$$

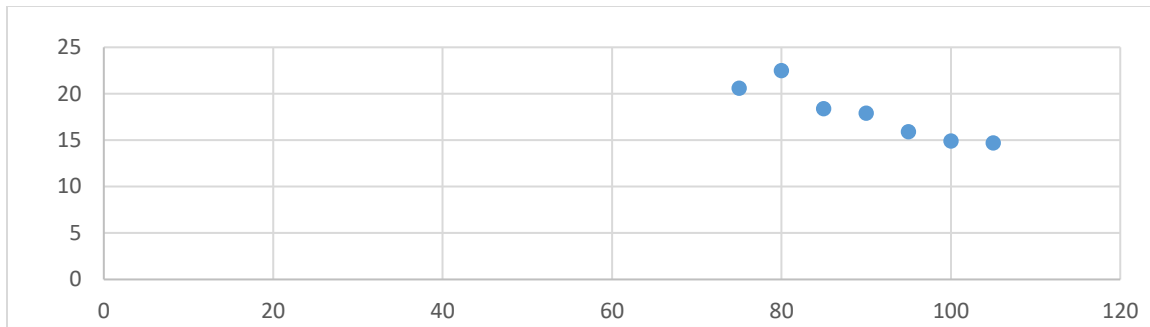
$$\begin{bmatrix} 1975 & 1980 & 1985 & 1990 & 1995 & 2000 & 2005 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 1975 & 1 \\ 1980 & 1 \\ 1985 & 1 \\ 1990 & 1 \\ 1995 & 1 \\ 2000 & 1 \\ 2005 & 1 \end{bmatrix} \begin{bmatrix} m \\ b \end{bmatrix} \Rightarrow$$

$$\begin{bmatrix} 1975 & 1980 & 1985 & 1990 & 1995 & 2000 & 2005 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 20.6 \\ 22.5 \\ 18.4 \\ 17.9 \\ 15.9 \\ 14.9 \\ 14.7 \end{bmatrix}$$

$$\begin{bmatrix} 57400 & 630 \\ 630 & 7 \end{bmatrix} \begin{bmatrix} m \\ b \end{bmatrix} = \begin{bmatrix} 11064 \\ 124.9 \end{bmatrix} \leftarrow$$

$$\text{d) } y = -0.253x + 40.6$$

e)



f) $-0.255(110) + 40.6 = 12.55$ out of 100,000 people

III Stopping Distance

a) $Ax = b$

$$\begin{bmatrix} 400 & 20 & 1 \\ 900 & 30 & 1 \\ 1600 & 40 & 1 \\ 2500 & 50 & 1 \\ 3600 & 60 & 1 \\ 4900 & 70 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 47 \\ 83 \\ 145 \\ 243 \\ 366 \\ 529 \end{bmatrix}$$

b) $\begin{bmatrix} 400 & 900 & 1600 & 2500 & 3600 & 4700 \\ 20 & 30 & 40 & 50 & 60 & 70 \\ 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$

c) $A^T Ax = A^T b$

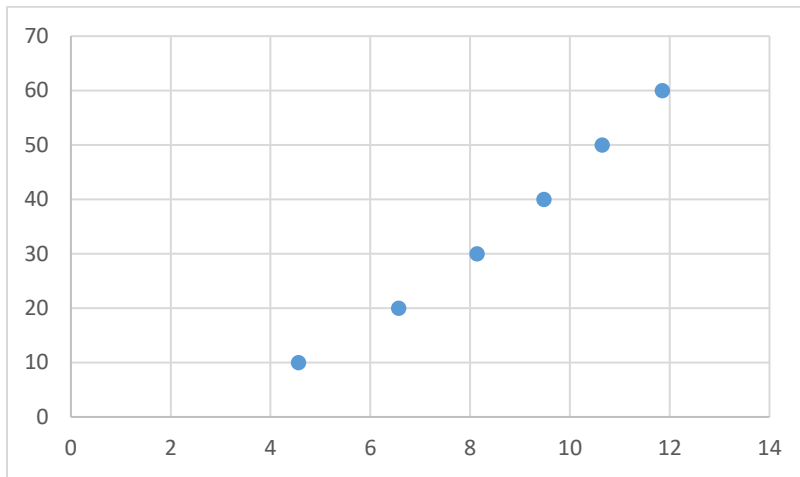
$$\begin{bmatrix} 400 & 900 & 1600 & 2500 & 3600 & 4700 \\ 20 & 30 & 40 & 50 & 60 & 70 \\ 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 400 & 20 & 1 \\ 900 & 30 & 1 \\ 1600 & 40 & 1 \\ 2500 & 50 & 1 \\ 3600 & 60 & 1 \\ 4900 & 70 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} \Rightarrow$$

$$\begin{bmatrix} 400 & 900 & 1600 & 2500 & 3600 & 4700 \\ 20 & 30 & 40 & 50 & 60 & 70 \\ 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 47 \\ 83 \\ 145 \\ 243 \\ 366 \\ 529 \end{bmatrix}$$

$$\begin{bmatrix} 44830000 & 769000 & 6 \\ 769000 & 13700 & 270 \\ 13700 & 270 & 6 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 4736900 \\ 80370 \\ 1413 \end{bmatrix} \leftarrow$$

d) $y = 0.0106x^2 + 5.27x + 0.000.3$

e)



f) $y = 722 \text{ ft}, x = 111.84 \text{ mph}$

IV Linear or Quadratic? Golf Ball Distance

a) $y = ax^2 + bx + c$

b) $Ax + b$

$$\begin{bmatrix} 20.79 & 4.56 & 1 \\ 43.16 & 6.57 & 1 \\ 66.25 & 8.14 & 1 \\ 89.87 & 9.48 & 1 \\ 113.42 & 10.65 & 1 \\ 140.42 & 11.85 & 1 \\ 115.25 & 12.46 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 10 \\ 20 \\ 30 \\ 40 \\ 50 \\ 60 \\ 70 \end{bmatrix}$$

c) A^T

$$\begin{bmatrix} 20.79 & 43.16 & 66.25 & 89.87 & 113.42 & 140.42 & 155.25 \\ 4.56 & 6.57 & 8.14 & 9.48 & 10.65 & 11.85 & 12.46 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

d) $A^T A x = A^T b$

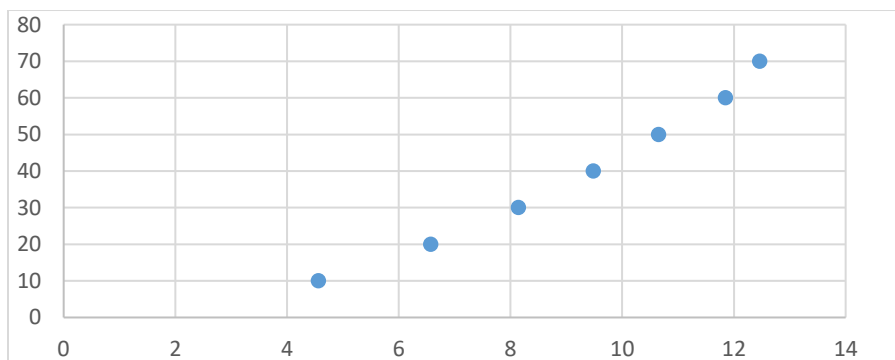
$$\begin{bmatrix} 20.79 & 43.16 & 66.25 & 89.87 & 113.42 & 140.42 & 155.25 \\ 4.56 & 6.57 & 8.14 & 9.48 & 10.65 & 11.85 & 12.46 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 20.79 & 4.56 & 1 \\ 43.16 & 6.57 & 1 \\ 66.25 & 8.14 & 1 \\ 89.87 & 9.48 & 1 \\ 113.42 & 10.65 & 1 \\ 140.42 & 11.85 & 1 \\ 155.25 & 12.46 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} \Rightarrow$$

$$\begin{bmatrix} 20.79 & 43.16 & 66.25 & 89.87 & 113.42 & 140.42 & 155.25 \\ 4.56 & 6.57 & 8.14 & 9.48 & 10.65 & 11.85 & 12.46 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 10 \\ 20 \\ 30 \\ 40 \\ 50 \\ 60 \\ 70 \end{bmatrix}$$

$$\begin{bmatrix} 71445.12 & 6575.92 & 629.16 \\ 6575.92 & 492.19 & 75.56 \\ 629.16 & 75.56 & 7 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 31617.1 \\ 2916.1 \\ 280 \end{bmatrix} \leftarrow$$

e) $0.0313x^2 + 0.344x + 38.4$

f)



g)