1.1 $E(w) = \frac{1}{2}\sum_{n=1}^{N}\{y(x_n, w) - t_n\}^2$

where $y(x_n, w) = w_0 + w_1 x_n + \cdots + w_M x_n^M = \sum_{j=0}^{M} w_j x_n^j$

$E(w)$ is convex quadratic function

To minimize the $E(w)$, apply partial derivative with respect to $w_j$

$$\frac{\partial E(w)}{\partial w_i} = \frac{\partial\left(\frac{1}{2}\sum_{n=1}^{N}\{\sum_{j=0}^{M} w_j x_n^j - t_n\}^2\right)}{\partial w_i}$$

$$= \cancel{\sum_{n=1}^{N}\left(\sum_{j=0}^{M}(w_j x_n^j - t_n)\right)}$$

$$\sum_{n=1}^{N}\{\sum_{j=0}^{M} w_j x_n^j - t_n\} \cdot x_n^i$$

$$= \sum_{n=1}^{N}\sum_{j=0}^{M} w_j x_n^{i+j} - \sum_{n=1}^{N} t_n x_n^i$$

$$= 0$$

$$\sum_{n=1}^{N}\sum_{j=0}^{M} w_j x_n^{i+j} = \sum_{n=1}^{N} t_n x_n^i$$

$$\Rightarrow \sum_{j=0}^{M}\sum_{n=1}^{N} x_n^{i+j} w_j = \sum_{n=1}^{N}(x_n)^i t_n$$

Let $A_{ij} = \sum_{n=1}^{N}(x_n)^{i+j}$ , $T_i = \sum_{n=1}^{N}(x_n)^i t_n$

we have $\sum_{j=0}^{M} A_{ij} w_j = T_i$