$H_{b+\epsilon}$). The region bounded by the hyperplanes $H_{w,b-\epsilon}$ and $H_{b+\epsilon}$ (which contains the best fit hyperplane $H_{w,b}$) is called the ϵ-slab.

We also allow *errors* by allowing the point (x_i, y_i) to be outside of the ϵ-slab but in the slab between the hyperplane $H_{w,b-\epsilon-\xi_i}$ of equation

$$(w^\top \quad - 1) \begin{pmatrix} x \\ z \end{pmatrix} + b - \epsilon - \xi_i = w^\top x - z + b - \epsilon - \xi_i = 0$$

for some $\xi_i > 0$ (which is below the blue margin hyperplane $H_{w,b-\epsilon}$) and the hyperplane $H_{w,b+\epsilon+\xi_i'}$ of equation

$$(w^\top \quad - 1) \begin{pmatrix} x \\ z \end{pmatrix} + b + \epsilon + \xi_i' = w^\top x_i - z + b + \epsilon + \xi_i' = 0$$

for some $\xi_i' > 0$ (which is above the red margin hyperplane $H_{w,b+\epsilon}$),
so that $w^\top x_i - y_i + b - \epsilon - \xi_i \leq 0$ and $w^\top x_i - y_i + b + \epsilon + \xi_i' \geq 0$, that is,

$$f(x) - y_i = w^\top x_i + b - y_i \leq \epsilon + \xi_i,$$
$$-(f(x) - y_i) = -w^\top x_i - b + y_i \leq \epsilon + \xi_i'.$$

Our goal is to minimize ϵ and the errors ξ_i and ξ_i'. See Figure 56.1. The trade off between

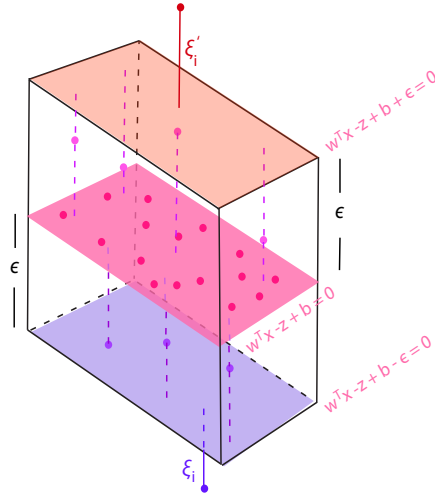Figure 56.1: The ϵ-slab around the graph of the best fit affine function $f(x) = x^\top w + b$.

the size of ϵ and the size of the slack variables ξ_i and ξ_i' is achieved by using two constants $\nu \geq 0$ and $C > 0$. The method of ν-*support vector regression*, for short ν-*SV regression*, is specified by the following minimization problem: