Orthogonality and Least Squares

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A linear system

$$\mathbf{Ax} = \mathbf{b} \tag{1}$$

that arises from experimental data frequently has no solution. A solution is a vector $\widehat{\mathbf{x}}$ that makes the distance between $\mathbf{A}\widehat{\mathbf{x}}$ and $\mathbf{b}$ as small as possible. The $\widehat{\mathbf{x}}$ is called a least-square solution of $\mathbf{Ax} = \mathbf{b}$.