Answer: We had the variance derivation of PCA for $k = 1$ being seeking to maximise the variance of the projections, i.e. maximising $\sum_{i=1}^{n}(u^T x_i)^2$ (where we use the fact that the vectors x_i have been mean zeroed already to ensure that the mean of $u^T x_i$ is 0, so we are indeed capturing the sample variance). So then we're equivalently maximising $u^T(\sum_{i=1}^{n} x_i x_i^T)u$ which shows us that the optimal unit vector u is the eigenvector of the largest eigenvalue of the sample covariance matrix.

In the minimal projection error setup we want to instead minimise over unit vector u the value of $\sum_{i=1}^{n} ||x_i - f_u(x_i)||^2$, however $f_u(x_i) = (u^T x_i)u$, so we're minimising over

$$\sum_{i=1}^{n} ||x_i - (u^T x_i)u||^2 = \sum_{i=1}^{n}(x_i - (u^T x_i)u)^T(x_i - (u^T x_i)u) = \sum_{i=1}^{n} x_i^T x_i - (u^T x_i)^2$$

where the last line comes through since $u^T u = 1$. Hence equivalent to the previous variance maximisation.