MSE with Variance-Bias components

$$\text{MSE}[\hat{t}] = \text{Var}[\hat{t}] + \text{Bias}[\hat{t}]^2$$

For an SRS of size n from a population of size N, the sample mean is an unbiased estimator of the population mean; i.e., $\text{E}(\bar{y}) = \bar{y}_U$.

Under SRS,

$$\text{Var}(\bar{y}) = \frac{S^2}{n}\left(1 - \frac{n}{N}\right)$$

where

$$S^2 = \frac{1}{N-1}\sum_{i=1}^{N}(y_i - \bar{y}_U)^2$$