Auxiliary information is often used to improve the precision of survey estimators through ratio or linear regression estimation techniques. Resulting estimators have good theoretical and practical properties, including invariance, calibration and design consistency. However, it is not always clear that ratio or linear models are good approximations to the true relationship between the auxiliary variables and the variable of interest in the survey, resulting in efficiency loss when the model is not appropriate. In this paper, we explain how regression estimation can be extended to incorporate nonparametric and semiparametric regression models, in both simple and more complicated designs. While maintaining the good theoretical and practical properties of the linear models, nonparametric/semiparametric models are better able to capture complicated relationships between variables. This often results in substantial gains in efficiency. The applicability of the approach for complex designs using multiple types of auxiliary variables will be illustrated by estimating several acidification-related characteristics for a survey of lakes in the Northeastern US.

**Key words:** regression estimation, smoothing, kernel regression, lake chemistry.