CHAPTER OVERVIEW

9: Optimizing Data

In the presence of H_2O_2 and H_2SO_4, a solution of vanadium forms a reddish brown color that is believed to be a compound with the general formula $(VO)_2(SO_4)_3$. The intensity of the solution's color depends on the concentration of vanadium, which means we can use its absorbance at a wavelength of 450 nm to develop a quantitative method for vanadium. The intensity of the solution's color also depends on the amounts of H_2O_2 and H_2SO_4 that we add to the sample—in particular, a large excess of H_2O_2 decreases the solution's absorbance as it changes from a reddish brown color to a yellowish color [*Vogel's Textbook of Quantitative Inorganic Analysis*, Longman: London, 1978, p. 752.]. Developing a standard method for vanadium based on this reaction requires that we optimize the amount of H_2O_2 and H_2SO_4 added if we want to maximize the absorbance at 450 nm. Using the terminology of statisticians, we call the solution's absorbance the system's response. Hydrogen peroxide and sulfuric acid are factors whose concentrations, or factor levels, determine the system's response. To optimize the method we need to find the best combination of factor levels. Usually we seek a maximum response, as is the case for the quantitative analysis of vanadium as $(VO)_2(SO_4)_3$. In other situations, such as minimizing an analysis's percent error, we seek a minimum response. How we design experiments to optimize the response is the subject of this chapter.