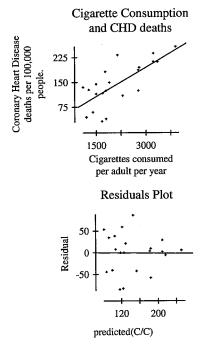# Chapter 8 – Investigative Task - Sample Solution - Smoking

Information from the *American Journal of Public Health* reports on the number of cigarettes consumed per adult per year and the rate of deaths related to coronary heart disease, with statistics reported from 21 countries. Is there a relationship between cigarette consumption and CHD death rates? Furthermore, what are the potential health benefits associated with reducing cigarette consumption in the U.S. by half?

In the 21 countries surveyed, the mean cigarette consumption was approximately 2148 cigarettes per adult per year, with a standard deviation of 809 cigarettes per adult per year. The mean CHD rate was 144.9 deaths per 100,000 citizens, with a standard deviation of 66.5 deaths per 100,000 residents.

Cigarette Consumption and CHD deaths

The association between cigarette consumption and CHD deaths is moderate, with $r = 0.731$, linear, and positive. Countries with higher cigarette consumption generally have higher rates of CHD deaths. There are several unusual points. Mexico and Greece have CHD death rates lower than we would expect, given their cigarette consumption, and Finland has a higher rate of CHD deaths than we would expect for its level of cigarette consumption. These points are notable, but not drastic departures from the pattern.

Residuals Plot

Since the relationship is straight enough, both variables are quantitative, and there are no outliers, we can model the association with a linear model. The regression equation for the relationship is $\hat{CHD} = 15.6415 + 0.060176(Cigarettes)$. The model predicts that a country in which there is no cigarette consumption would have a CHD death rate of about 15.6 deaths per 100,000. Furthermore, according to the model, for each additional 100 cigarettes consumed per adult per year, there is an expected increase of about 6 deaths due to CHD. With $R^2 = 53.4\%$, the model explains 53.4% of the variability in CHD death rate. The residuals plot shows no pattern, so the linear model is appropriate.

If the U.S. were to cut its cigarette consumption in half, from 3900 cigarettes per adult per year to 1950, the model predicts that the CHD rate would drop from 257 to approximately 133 deaths per 100,000 citizens.

$\hat{CHD} = 15.6415 + 0.060176(Cigarettes)$

$\hat{CHD} = 15.6415 + 0.060176(1950)$

$\hat{CHD} = 132.98$

There is no guarantee of a decrease in CHD death rate, since we are dealing with a model, not reality, and their may not be a causal relationship between average cigarette consumption and CHD death rate.