EXECUTIVE SUMMARY

STATISTICAL ANALYSIS OF DAILY LONDON MORTALITY AND ASSOCIATED WEATHER AND POLLUTION EFFECTS

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The possibility that there may be an association between daily fluctuations in air pollution levels and mortality is of concern to environmental agencies responsible for monitoring ambient levels of pollution. In particular, the possible adverse health effects of relatively low levels of regulated air pollutants are of great interest in the State of California where such low levels routinely occur. The highly questionable assumption is sometimes made that there exists a lower threshold such that no adverse health effects will occur at pollution levels below this threshold.

The purpose of this investigation was to study in some detail the possible short-term effects of weather and the primary pollutants black smoke and sulfur dioxide on cardiovascular, respiratory, and overall mortality. One primarily would be interested in examining California data for these purposes, and this is planned for a future study. However, a reasonably comprehensive data base spanning a period of fourteen years in London was available, and we used it as a compromise for testing statistical methodology as well as for examining the effects on mortality of pollution and weather. The relatively long time period chosen guaranteed that any statistically significant correlations would be derived from data which included primarily low to moderate levels of the primary pollutants.

A number of investigators have developed regression models which relate the instantaneous same-day mortality levels observed in various population groups to daily fluctuations in pollution and weather effects. These studies have largely ignored models involving potential lagged effects; for example, the possibility that weather or pollution changes may precede mortality fluctuations by several days may be of importance. A second factor which has been slighted in previous studies is the possibility that one may be able to learn more about the nature of the phenomenon of short-term correlations by isolating these effects as a function of period or frequency. The fact that the most important fluctuations are repeating at a period of ten days may imply that a certain regulatory policy is optimal. While early studies recognized the need for filtering out long-term fluctuations caused by epidemics and other trends, there had been no analysis of the fluctuations remaining, even on a period-by-period basis. The present study analyzes in detail the multiple relations possible between daily mortality and weather and pollution as a function of both lag and period. The specific results of the study are of interest because they are developed using a general methodology that can be used in the future to analyze the data from the Los Angeles Basin.

For the London data, the possible correlations between three kinds of mortality and several weather and pollution variables were investigated using a frequency domain (period-by-period) stepwise multiple regression procedure. For respiratory and total mortality, the primary statistically significant contributor was always the instantaneous daily level of either the logarithm of the black smoke level or the logarithm of the sulfur dioxide level. These

pollutants appear to act virtually as surrogates--when one is present, the other makes no significant additional contribution and vice versa. Since both pollutants were highly significant at approximately the same level, one cannot say that one of the two is more important than the other in influencing mortality. The effect of temperature was also highly significant with the total and respiratory mortality related negatively to the two-day temperature differential, i.e., the difference between today's temperature and the temperature measured two days ago. The situation changed slightly for cardiovascular mortality where the lagged negative effect of temperature occurred at two days and was stronger than that of either of the pollutants. Relative humidity did not contribute significantly after temperature had been included in the model.

The effects noted above were strongest in a period band which was centered at about ten days but ranged from seven to twenty-one days. This implies that changes in mortality can be produced only by temperature and pollution excursions which persist for more than three to four days (one-half of the lowest period of seven days). A temporary excursion of the pollution levels does not seem to evoke the same response in the mortality series.

The general nature of the above conclusions suggests that it would be important to apply the same methodology to a set of data gathered in California. The fact that mortality and pollution were strongly associated at low and moderate pollution levels may be peculiar to the London data, or it may apply more generally to other data including that which is available for the Los Angeles Basin. It will be important, in future efforts, to use the analysis to sort out the possible associations between pollution, weather, and mortality in California.