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Analysis of The World Bank's Findings on Air Pollution (PM10 Concentration) in World Cities

The World Bank is an international non-governmental organization with the goal of aiding developing countries throughout the world with financial and technical assistance. Besides the obvious concern of financial stability for the impoverished countries of the world, the World Bank also focuses on education, health, infrastructure, and communications. Our analysis deals with the environment and infrastructure aspects of the World Bank's work. The World Bank provided us with the dataset entitled "Air Pollution in World Cities (PM10 Concentration)." "PM" stands for particulate matter pollution in the air. This dataset showed every major city in the world with a population of 100,000 or more and also every country's PM concentration. The country-based portion of the dataset was used for this analysis. The primary determinants of PM concentrations are the scale and composition of economic activity, population, the energy mix, the strength of local pollution regulation, and geographic and atmospheric conditions that affect pollutant dispersion in the atmosphere. (World Bank) Thanks to economic improvements throughout the world and technological advancements, PM10 concentration has increased at a very slow rate.

The objective of this analysis was to determine the pollution concentration of several regions throughout the world, including Africa, Asia, Australia/Oceania, Central America, Europe, the Middle East, North America, and South America. Our original null hypothesis was that the μ of the pollution concentration of each region was equal.

Conversely, the alternative hypothesis states that the μ of each region is not equal. We used several procedures of SAS to determine whether our hypothesis would stand.

After importing the Microsoft Excel dataset into SAS, we performed several procedures to sort the data by region in order to determine the relative pollution concentrations. First, we used “proc sort” to separate the dataset using the aforementioned regions of the world. Next, we performed the “proc univariate” procedure. This derived the mean, standard deviation, outliers, and sample t statistic for each region. After this step, we were able to compare each region’s mean pollution concentration. This showed that the Africa region was most polluted and the Europe region was the cleanest, barely edging out North America. These results are very understandable, considering the relative developmental state of most countries in Africa and the highly technologically and industrially advanced positions of European nations. The next step was to compare these region specific means to that of the entire world. The mean for the world calculated to a PM10 concentration of 47.42.

The next step was using the “proc corr” procedure to determine any sort of correlation between population and PM10 concentration. This showed us several outliers, however, they were somewhat unexpected. It could be implied that a greater population would produce more pollution, however, the outliers we observed were those with smaller populations, yet very high pollution counts because they were underdeveloped nations; this included states such as Sudan and Mali. In order to truly determine the validity of our hypothesis, we needed to observe the variance between two groups, namely region with respect to pollution. To do this, we carried out a one-way ANOVA procedure. The results of the ANOVA gave an “F Value” of 9.81, significantly greater

than one. Also, the test showed a Root MSE of 33.48 that differed significantly from the concentration Mean of 56.22.

$$H_0: \mu_{Africa} = \mu_{Asia} = \mu_{Australia} = \mu_{Central\ America}\ \mu_{Europe} = \mu_{Middle\ East} = \mu_{North\ America} = \mu_{South\ America}$$
$$H_A: \mu_{Africa} \neq \mu_{Asia} \neq \mu_{Australia} \neq \mu_{Central\ America} \neq \mu_{Europe} \neq \mu_{Middle\ East} \neq \mu_{North\ America} \neq \mu_{South\ America}$$

Because of the significantly large F value we were able to reject the null hypothesis with an α value of .05. Not only does the ANOVA test show the discrepancy between region means, but it can also be physically observed when comparing the two extremes of Europe at 30.95 and Africa at 73.31 PM10 concentrations. It is obvious from the results of this analysis that the world has a wide range of pollution effects. Traditionally more advanced regions such as Europe and North America have pollution under control because of a stable economy and a wide array of technological resources. Other regions such as Africa and Central America are struggling with pollution, relative to more developed regions, improvements in technology and structural shifts (World Bank) in the world economy are helping these regions keep air pollution to a minimum.

WORKS CITED

1. The World Bank http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0,,contentMDK:20785646~pagePK:64214825~piPK:64214943~theSitePK:469382,00.html

Group Contributions