Investigation into State Claims Regarding Air Pollution Regulations

<u>Background</u>: In 1990, the Clean Air Act required the Environmental Protection Agency (EPA) to set primary standards for the maximum amount of annual air pollution. A specific type of air pollution is called PM$_{2.5}$, which stands for particulate matter (dust, smoke, chemical byproducts, etc.) that are 2.5 micrometers or smaller.

The primary standard for PM$_{2.5}$ states that the maximum yearly value should not exceed 12 $\mu m/m^3$. In this report, I will test the claim that Washington D.C.'s yearly PM$_{2.5}$ value is not exceeding 12 $\mu m/m^3$ by using 48 months' worth of data collected by the Center for Disease Control from 2008-2011.

<u>Data</u>:

Washington DC PM$_{2.5}$ Levels/Month (micrometers per cubic meter)

2008	14.09	14.44	11.57	11.18	10.77	15.27	19.89	13.34	11.01	8.83	9.46	9
2009	13.76	10.46	11.52	12.09	10.73	14.74	14.75	14.57	15.66	8.58	12.63	11.25
2010	11.71	11.15	10.32	12.23	12.35	13.2	17.38	17.5	12	12.4	12.33	12.08
2011	13.54	11.48	11.74	10.53	11.76	15.83	14.22	13.57	13.47	11.52	10.23	13.71

<u>Work/Results</u>

In order to test whether Washington D.C. is meeting the EPA standards, I am going to run a hypothesis test on the claim that the average annual PM$_{2.5}$ level is 12 $\mu m/m^3$ or less. I am justified in doing this because the sample size of 48 is large enough.

Let $\mu = average\ annual\ PM_{2.5}\ level\ in\ Washington\ D.C.$

$$H_0: \mu \leq 12 \qquad H_a: \mu > 12$$

From the 48-month sample above, the sample mean is $\bar{x} = 12.62\ \mu m/m^3$ with a sample standard deviation of $s = 2.31\ \mu m/m^3$.

I next calculate the z-score for the test statistic.

$$z = \frac{\bar{x} - \mu}{s/\sqrt{n}} = \frac{12.62 - 12}{2.31/\sqrt{48}} = 1.86$$

The likelihood of obtaining a z-score of 1.86 or higher can be found from a table or computer. I used the TI calculator function normalcdf(1.86,1000,0,1) and found the corresponding p-value to be $p = 0.031$.

<u>Summary</u>

With a p-value of 0.031 for the 12.62 $\mu m/m^3$ sample mean found for the average annual PM$_{2.5}$ level in Washington D.C., I have moderate evidence against the claim that the city is abiding by the EPA standards. Therefore, I have moderate evidence in rejecting the city's claim in favor of supporting the statement that the average annual PM$_{2.5}$ level in Washington D.C. is higher than the suggested standard.

Score			Characteristic
/4			Correct answer to each portion of the investigation (sample mean, sample st. dev., z-score, p-value)
0	0.5	1	State the background/problem you are addressing.
0	0.5	1	Share any information that you were given or is assumed (numbers, graphs, charts, etc.).
0	0.5	1	Rephrase and write in complete sentences (imagine you are writing it for a boss who is not familiar with the situation until the moment he/she is reading what you have composed).
0	0.5	1	Justify why you can use the statistical tools you do. You need to state how it meets required criteria.
0	0.5	1	Show the mathematical/statistical calculations you perform and restate your answer as a complete sentence.
0	0.5	1	Answer the original question in a complete sentence by correctly interpreting the p-value in context.
0	0.5	1	General organization and appearance of the report
0		1	Rubric included at end of report
/12			Total Score