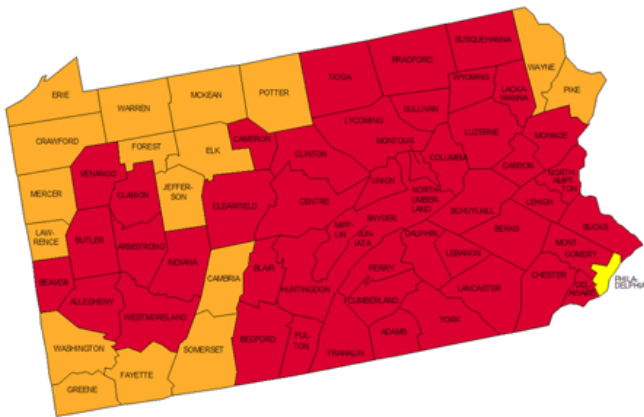
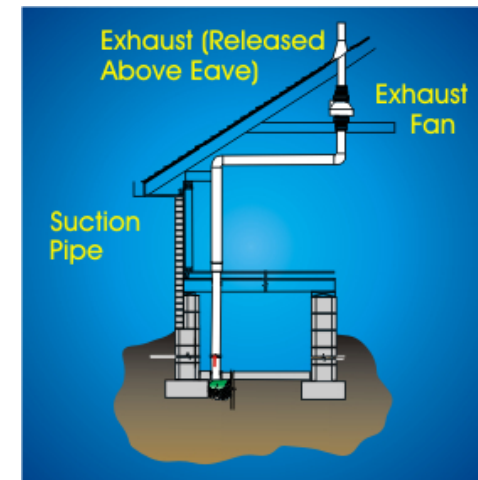


Modeling Radon in Pennsylvania



Mike Huber



MAA Session on Quantitative Reasoning and the Environment



MUHLENBERG COLLEGE



Agenda

Why study Radon?

How can we get actual data?

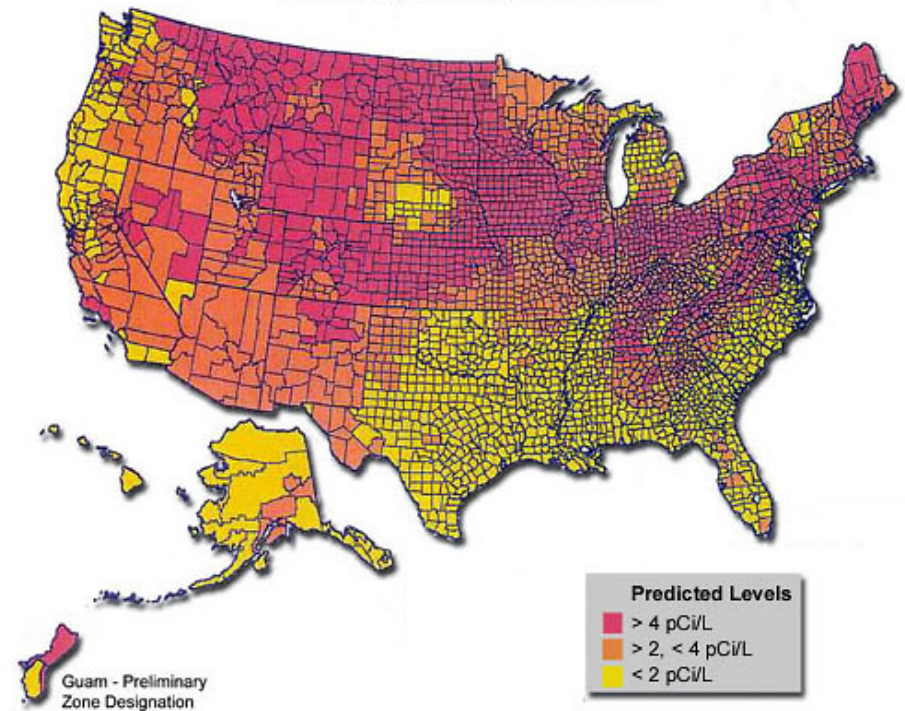
The Project

Discovering Trends

Assessment

References / Questions

EPA Map of Radon Zones

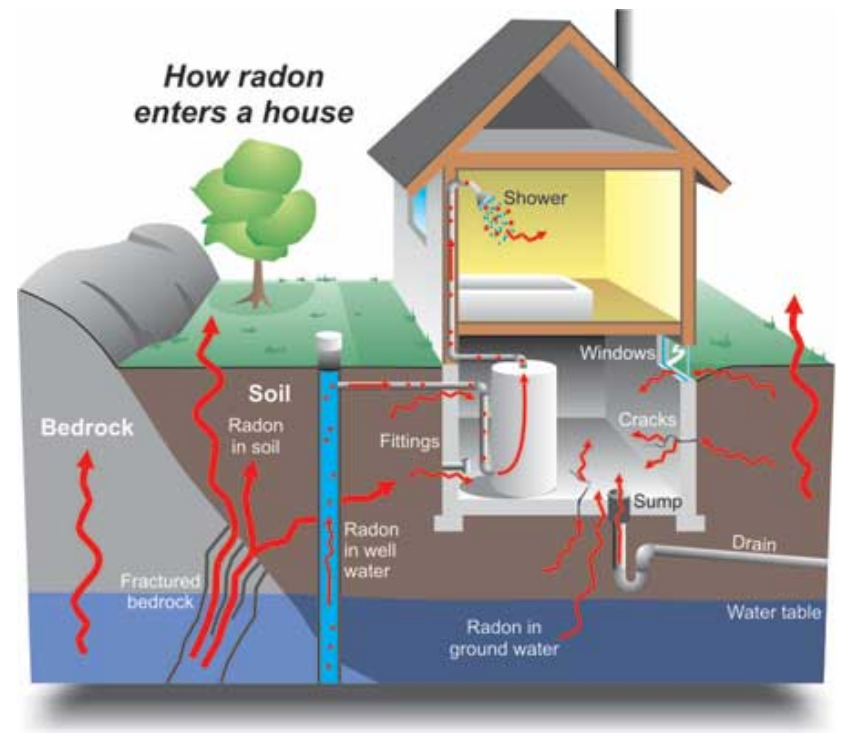


MUHLENBERG COLLEGE



Why Study Radon?

Radon is a serious issue in Lehigh County, Pennsylvania. The Environmental Protection Agency has established guidelines and safe levels for residents in the county. Any reading greater than 4 pCi/l (pico Curies per liter) is potentially dangerous. Long-term exposure to radon can lead to lung cancer.



MUHLENBERG COLLEGE



The Project

Download the data set for your area (Allentown, Whitehall or Upper Macungie). The data set contains reading of homes tested by the EPA in 2000 in the Allentown area. Each radon reading is given by its location in a latitude/longitude format.

Develop a model to predict radon levels in the Allentown area. Predict each level first as a function of latitude and then as a function of longitude.

Using a linear regression model, develop a linear model to predict the radon level at the center of each area. The centers are located at:

Allentown	Lat 40.61N	Lon -75.49W
Whitehall	Lat 40.36N	Lon -75.99W
Upper Macungie	Lat 40.58N	Lon -75.66W

How confident are you in the models?

Do you notice any trends in the data?

What cautions might you give a resident who is concerned about radon levels?



MUHLENBERG COLLEGE



The EPA Website

www.dep.state.pa.us/RadiationProtection_Apps/Radon

PENNSYLVANIA
Department of Environmental Protection

Radon Test Results Data

What is Radon?

Radon is a cancer-causing, radioactive gas. You can't see radon. And you can't smell it or taste it. But it may be a problem in your home. Radon is estimated to cause many thousands of deaths each year. That's because when you breathe air containing radon, you can get lung cancer. In fact, the Surgeon General has warned that radon is the second leading cause of lung cancer in the United States today. For more information please visit the [DEP's Radon Page](#) or the [EPA's Radon Page](#).

Search for Radon Test Results by Zip Code

You can search for Radon test results which were taken in basements of homes. To view the Radon data simply enter the 5 digit zip code of the area you wish to search for and click on the Search button. To search with a partial zip code simply type in the digits you wish to search by and click on the Search button.

Zip Code:

Submit



MUHLENBERG COLLEGE



The EPA Website

PENNSYLVANIA Department of Environmental Protection

Search Results for zip code: '18104'

The Environmental Protection Agency (EPA) recommends that you take action to reduce your home indoor radon levels if your radon test is 4 pCi/L (pico Curies per liter) or higher.

<u>Zip Code</u>	<u>Number of Tests</u>	<u>Minimum Result pCiL</u>	<u>Maximum Result pCiL</u>	<u>Average Result pCiL</u>
18104	4633	0	433.4	7.3

[Search Again](#)

[DEP's Radon Page](#)

[PA Home Site](#) | [Ask DEP](#) | [Plug-Ins](#) | [Home Page](#)



MUHLENBERG COLLEGE



Data for Students

Microsoft Excel - Radon Project Data for students

	A	B	C	D	E	F	G	H
		TEST_RESULT	MCD_NAME	LONGITUDE	LATITUDE			
1								
2	1	0.10	ALLENTOWN	-75.5137	40.5944			
3	2	0.20	ALLENTOWN	-75.5386	40.5913			
4	3	0.30	ALLENTOWN	-75.5340	40.5893			
5	4	0.50	ALLENTOWN	-75.5143	40.6007			
6	5	0.50	ALLENTOWN	-75.5296	40.6035			
7	6	0.50	ALLENTOWN	-75.5204	40.6062			
8	7	0.50	ALLENTOWN	-75.5115	40.5997			
9	8	0.70	ALLENTOWN	-75.5087	40.5914			
10	9	0.70	ALLENTOWN	-75.5027	40.6030			
11	10	0.80	ALLENTOWN	-75.5133	40.6033			
12	11	0.80	ALLENTOWN	-75.5179	40.5958			
13	12	0.85	ALLENTOWN	-75.5103	40.6049			
14	13	0.86	ALLENTOWN	-75.5103	40.6049			
15	14	0.90	ALLENTOWN	-75.5034	40.6133			
16	15	0.90	ALLENTOWN	-75.5084	40.6110			
17	16	0.90	ALLENTOWN	-75.5133	40.6033			
18	17	1.00	ALLENTOWN	-75.5016	40.6039			
19	18	1.00	ALLENTOWN	-75.5156	40.5883			
20	19	1.20	ALLENTOWN	-75.5034	40.6133			
21	20	1.20	ALLENTOWN	-75.5087	40.5914			
22	21	1.30	ALLENTOWN	-75.5084	40.6084			
23	22	1.30	ALLENTOWN	-75.5179	40.5958			
24	23	1.30	ALLENTOWN	-75.5434	40.5962			
25	24	1.37	ALLENTOWN	-75.4983	40.5919			
26	25	1.40	ALLENTOWN	-75.5084	40.6084			
27	26	1.50	ALLENTOWN	-75.5157	40.5882			
28	27	1.50	ALLENTOWN	-75.5065	40.6044			
29	28	1.55	ALLENTOWN	-75.4983	40.5919			
30	29	1.60	ALLENTOWN	-75.5230	40.5912			
31	30	1.60	ALLENTOWN	-75.5223	40.5951			
32	31	1.80	ALLENTOWN	-75.5069	40.5909			
33	32	1.85	ALLENTOWN	-75.5113	40.6005			
34	33	1.85	ALLENTOWN	-75.5113	40.6005			
35	34	1.90	ALLENTOWN	-75.5445	40.6000			
36	35	1.90	ALLENTOWN	-75.5076	40.6085			
37	36	2.00	ALLENTOWN	-75.5388	40.5913			
38	37	2.10	ALLENTOWN	-75.5069	40.5909			

Altentown / Whitehall / Upper Macungie /

91	90	9.20	ALLENTOWN	-75.5106	40.6040	
92	91	9.30	ALLENTOWN	-75.5209	40.5969	
93	92	9.40	ALLENTOWN	-75.5079	40.5896	
94	93	9.40	ALLENTOWN	-75.5063	40.6035	
95	94	9.40	ALLENTOWN	-75.5172	40.6040	
96	95	9.50	ALLENTOWN	-75.5007	40.6096	
97	96	9.80	ALLENTOWN	-75.5026	40.6100	
98	97	10.10	ALLENTOWN	-75.5244	40.5993	
99	98	10.50	ALLENTOWN	-75.5172	40.6040	
100	99	10.54	ALLENTOWN	-75.5257	40.6053	
101	100	10.57	ALLENTOWN	-75.5036	40.6032	
102	101	10.64	ALLENTOWN	-75.5036	40.6032	
103	102	10.70	ALLENTOWN	-75.5386	40.5913	
104	103	10.90	ALLENTOWN	-75.5157	40.6009	
105	104	10.90	ALLENTOWN	-75.5172	40.6040	
106	105	11.10	ALLENTOWN	-75.5446	40.6002	
107	106	11.10	ALLENTOWN	-75.5179	40.5958	
108	107	11.30	ALLENTOWN	-75.5091	40.6072	
109	108	11.37	ALLENTOWN	-75.5257	40.6053	
110	109	11.40	ALLENTOWN	-75.5204	40.5996	
111	110	11.50	ALLENTOWN	-75.5179	40.5958	
112	111	11.70	ALLENTOWN	-75.5204	40.5996	
113	112	12.10	ALLENTOWN	-75.5170	40.6005	
114	113	12.90	ALLENTOWN	-75.5257	40.6053	
115	114	13.10	ALLENTOWN	-75.5257	40.6053	
116	115	13.30	ALLENTOWN	-75.5091	40.6072	
117	116	14.40	ALLENTOWN	-75.5091	40.6072	
118	117	14.80	ALLENTOWN	-75.5446	40.6002	
119	118	17.00	ALLENTOWN	-75.5229	40.5963	
120	119	17.10	ALLENTOWN	-75.5204	40.6062	
121	120	18.80	ALLENTOWN	-75.4986	40.6103	
122	121	19.30	ALLENTOWN	-75.4986	40.6103	
123	122	20.00	ALLENTOWN	-75.5157	40.6009	
124	123	20.50	ALLENTOWN	-75.5103	40.6024	
125	124	23.50	ALLENTOWN	-75.5103	40.6024	
126	125	26.60	ALLENTOWN	-75.5053	40.5842	
127	126	28.60	ALLENTOWN	-75.5034	40.6133	
128	127	31.20	ALLENTOWN	-75.5053	40.5842	
129						

Altentown / Whitehall / Upper Macungie /

***From PA EPA Bureau of Radiation Protection

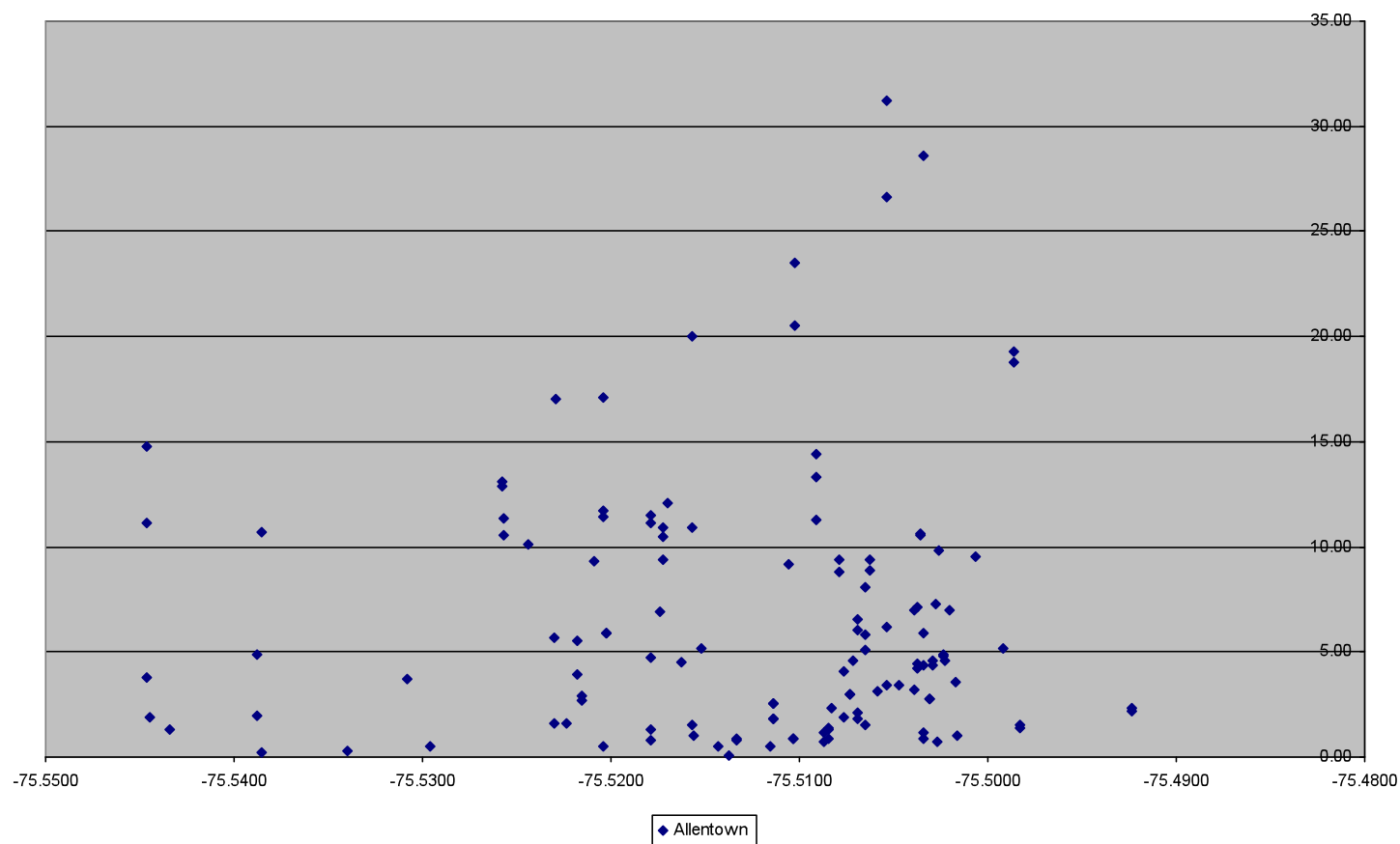


MUHLENBERG COLLEGE



Results by Longitude

Allentown



MUHLENBERG COLLEGE



Finding a Trend

Gather data for the following cities:

Tamaqua	18252
Scranton	18510
East Stroudsburg	18301
Emmaus	18049
Easton	18040
Bethlehem	18018
Nazareth	18064
Reading	18640
Jim Thorpe	18229
Quakertown	18951



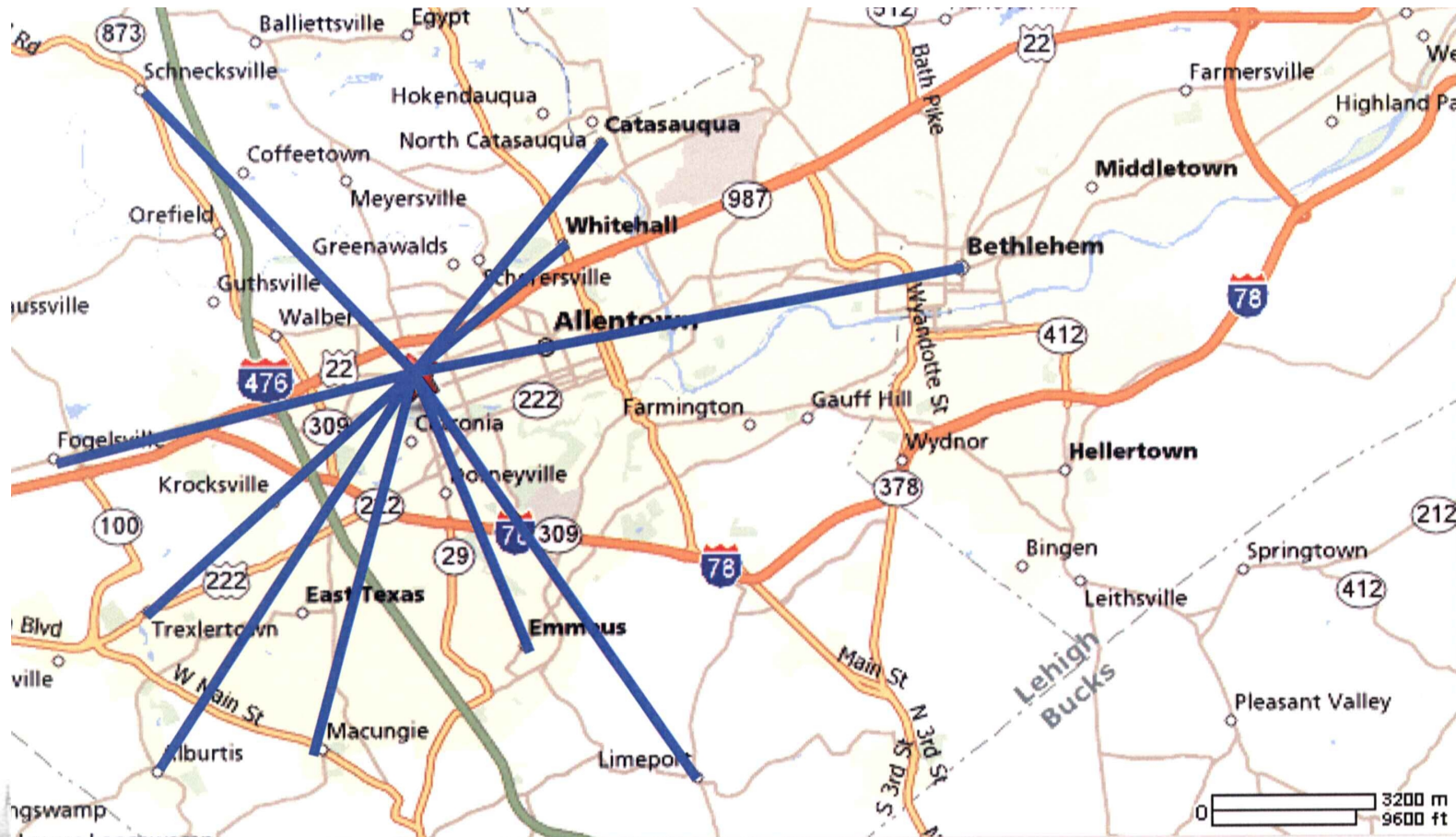
***From Google Maps (Terrain)



MUHLENBERG COLLEGE



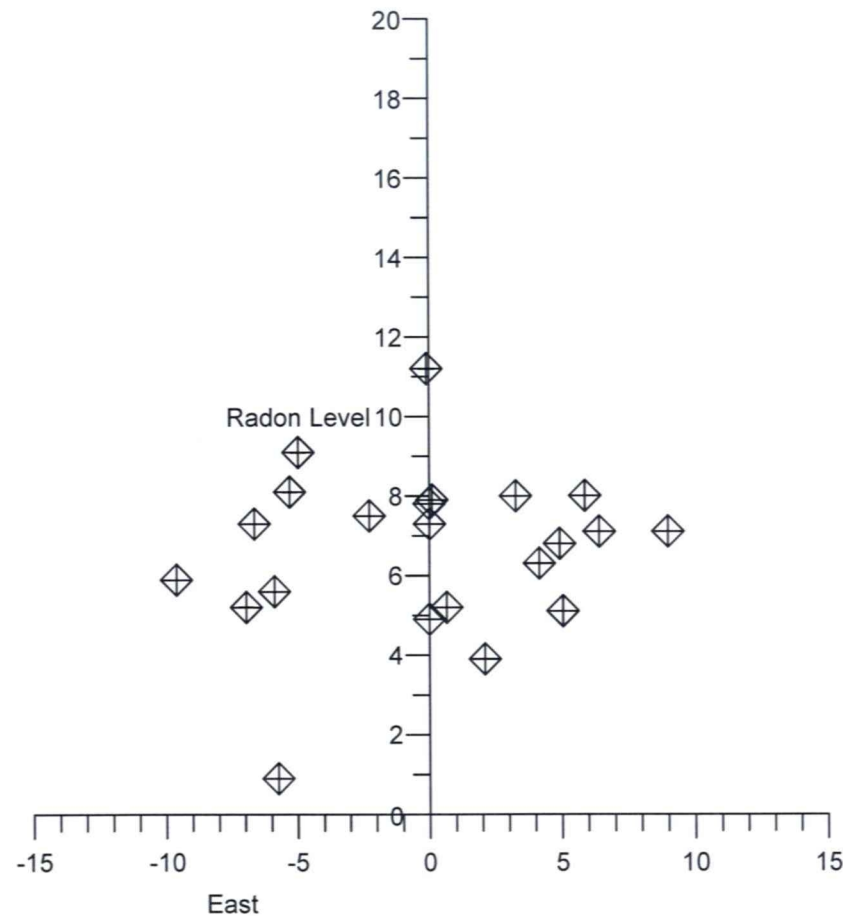
Local Trends (Closer to 'Berg)



MUHLENBERG COLLEGE



Local Trends (Closer to 'Berg)



MUHLENBERG COLLEGE



Assessment

Part I: Developing a Model
Predicting radon levels (latitude, longitude)
Using linear regression
Confidence and trends
Cautions to resident
Comments

Part II: Comparing to other zip codes
Discussing trends
Creating a better model
Influential factors
Comments

Learning Assessment Thread

	Needs Improvement		Satisfactory		Excellent
Mathematical Reasoning	1	2	3	4	5
Mathematical Modeling	1	2	3	4	5
Scientific Computing	1	2	3	4	5
Communicating Mathematics	1	2	3	4	5



MUHLENBERG COLLEGE



References / Questions

- http://www.homeprocanada.ca/radon/radon_450x397.jpg
- http://www.dep.state.pa.us/RadiationProtection_Apps/Radon
- <http://www.nationalsafety.biz/radon/images/zonemap2.jpg>
- “The Pennsylvania Radon Story,” found online at http://www.dep.state.pa.us/brp/Radon_Division/PA_Radon_Story1.htm
- Conversations with Robert Lewis, Radon Division, Pennsylvania EPA, Bureau of Radiation protection, 2008.

