Modeling Knowledge of Air Quality at UC Berkeley

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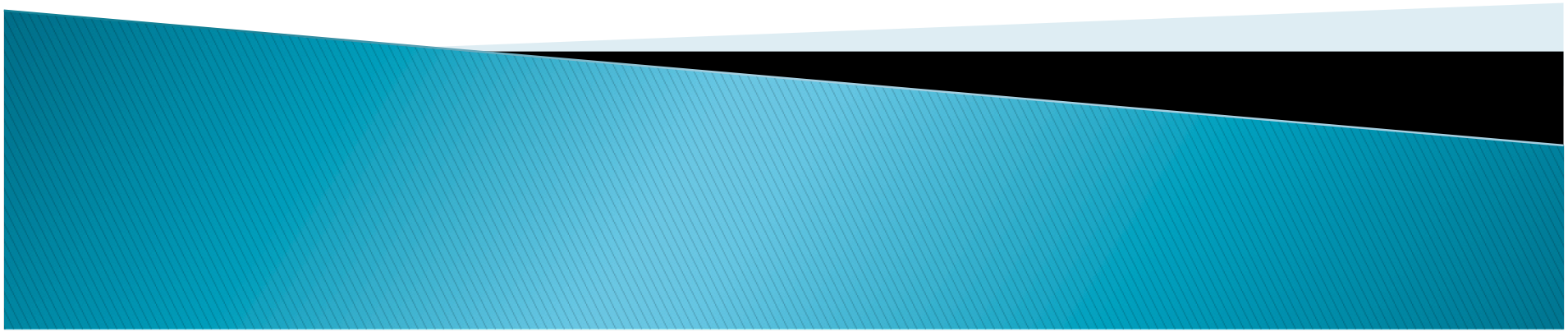
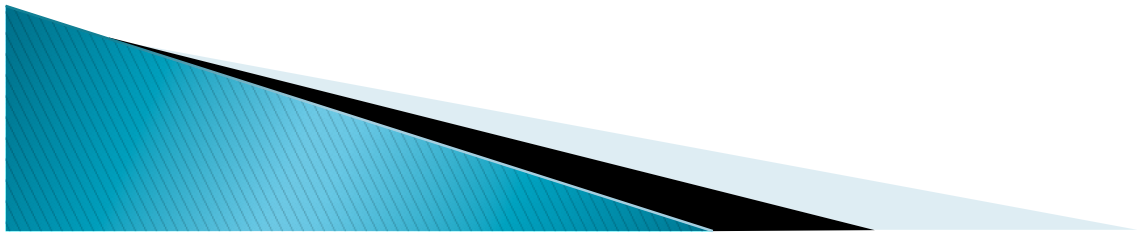
Marc Lipoff
CE264, Spring 2011



Literature Review

- "Psychological Responses to Air Pollution: Some Personality and Demographic Correlates"
  - Zeidner and Schechter, 1988
- "Air Pollution and Human Behavior"
  - Evans and Jacobs, 1981



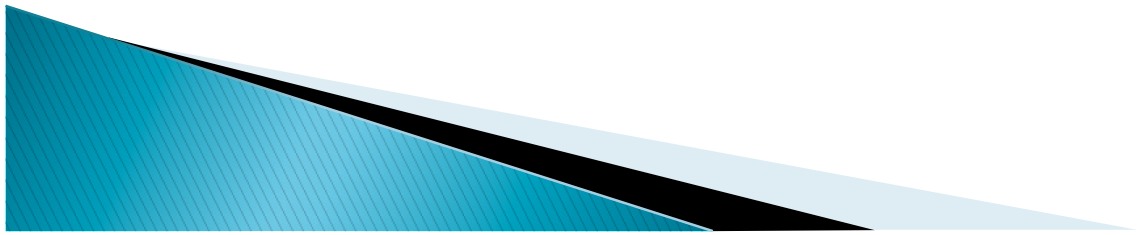
Motivation

- Air pollution costs California $28 billion per year[1]
- Measures have been taken around the world, but people need to be informed
- What policy changes can be made to better inform the public?

1 http://calstate.fullerton.edu/News/2008/091-air-pollution-study.html

Our Problem & Goals

- Assess what factors contribute to AQ knowledge
- Determine what factors can help influence change
- Utilize behavior modeling in an innovative way
  - Use a “quiz” to determine knowledge

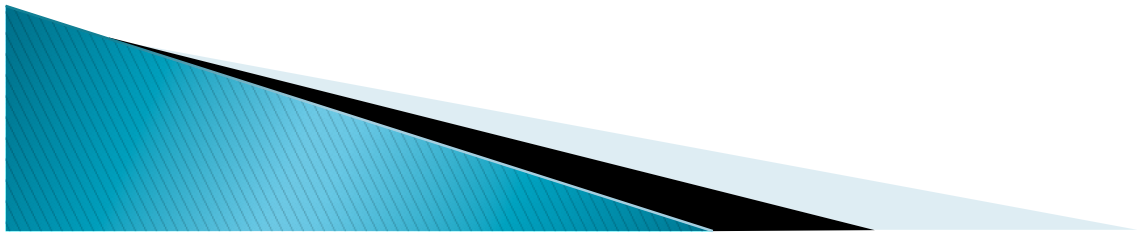


Survey

- 108 Respondents
- Online survey and in-person across campus
- Selected Background Questions
  - What is your area of study?
  - Did you go to high school in an urban, suburban, or rural area?
  - Do you know what "Spare the Air Day" is?
  - Have you ever been diagnosed with a breathing disorder?
  - How frequently do you read and/or watch the news?
  - In the past week, what sources have you used to get the news?
  - How frequently do you check the weather report?
  - Do you consider yourself environmentally conscious?
  - How many environment-based classes have you taken?
  - What is your political affiliation?
  - Have you lived in the U.S. for more than 5 years?

Survey – Quiz

- Do all of the following air pollutants influence human health: carbon monoxide, nitrogen dioxide, and sulfur dioxide?
- Does the Center for Disease Control set the national air quality standards?
- Does San Francisco have higher levels of air pollution than Bakersfield?
- Is obesity a direct symptom of high air pollution?
- In the Bay Area, do wildfires produce more air pollution than do transportation related sources?
- In early 2011, did the federal government announce significant changes to its regulations regarding sulfur dioxide and carbon monoxide?



Quiz Results

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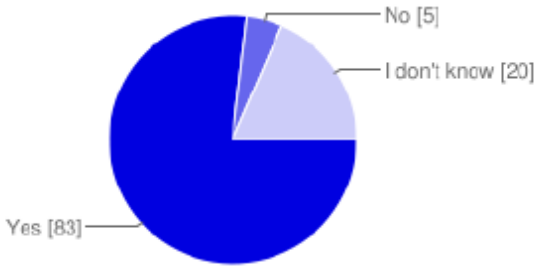

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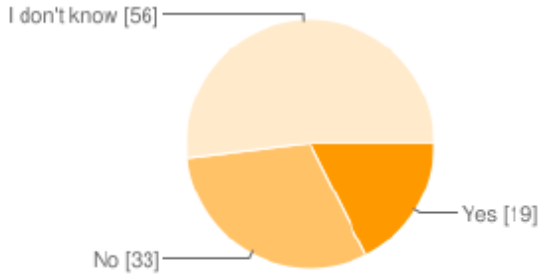
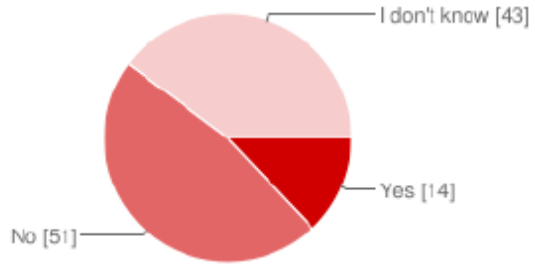


Does San Francisco have higher levels of air pollution than Bakersfield?



Quiz Results

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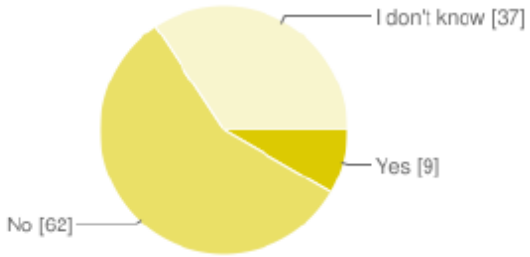

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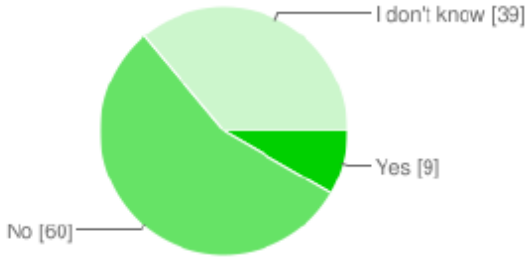

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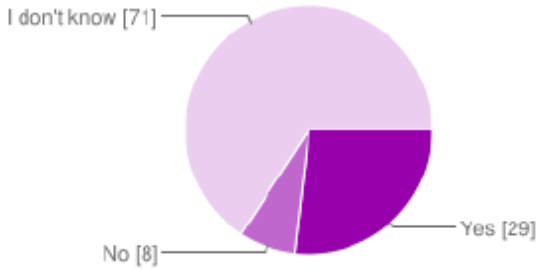
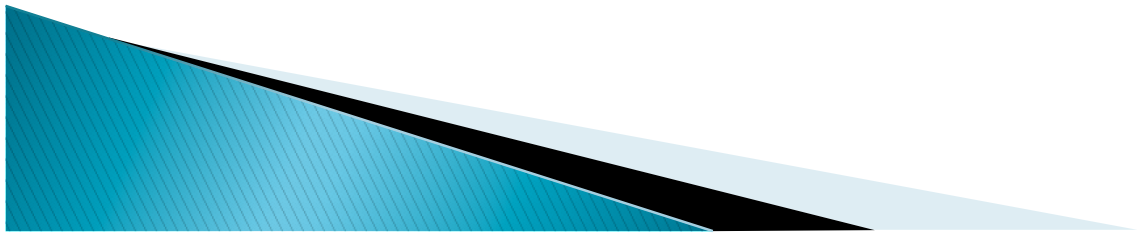


Model Structures

- Basic multinomial logit
  - Individual questions
  - Total correct answers
- Nested logit
  - 3 Nests: health, regulation, California
- Mixed logit
  - Generic intelligence factor
  - General intelligence plus three nests



Model Specification

$$V_{pollutant} = \alpha_{pollutant} + \eta\sigma + \vec{\beta}_{generic} GenericVariables + \beta^{poll}_{classes} \ln(classes)$$

$$V_{EPA} = \alpha_{EPA} + \eta\sigma + \vec{\beta}_{generic} GenericVariables + \beta^{epa}_{classes} \ln(classes)$$

$$V_{SF} = \alpha_{SF} + \eta\sigma + \vec{\beta}_{generic} GenericVariables + \beta^{SF}_{us} us$$

$$V_{obesity} = \alpha_{obesity} + \eta\sigma + \vec{\beta}_{generic} GenericVariables + \beta^{obesity}_{us} us$$

$$V_{wildfire} = \alpha_{wildfire} + \eta\sigma + \vec{\beta}_{generic} GenericVariables + \beta^{wildfire}_{classes} \ln(classes)$$

$$V_{regulation} = \alpha_{regulation} + \eta\sigma + \vec{\beta}_{generic} GenericVariables + \beta^{regulation}_{classes} \ln(classes) + \beta^{regulation}_{us} us$$

where $GenericVariables = [male \;\; econsc \;\; dis \;\; hardsci \;\; popdensity \;\; republican \;\; sparetheair]$

- Utility functions are only for correctly answered questions.
- Incorrect answers were given a utility of 0.

Final Model Results

- Estimated parameters met a priori assumptions
- ASCs indicate question difficulty
- Generic and AS parameters
- Failed to make sense of all policy-implication questions (e.g., news)
- Flexible on p-value

Name	Value	p-value
$\alpha_{pollutant}$	.762	.25
α_{EPA}	-1.81	.01
α_{SF}	-2.17	.02
$\alpha_{obesity}$	.867	.28
$\alpha_{wildfire}$	-.313	.64
$\alpha_{regulation}$	-10.8	0.0
β_{male}	.49	.04
β_{econsc}	.622	.05
β_{dis}	.126	.66
$\beta_{hardsci}$	.275	.25
$\beta_{popdensity}$	-.338	.12
$\beta_{republican}$	-.516	.22
$\beta_{sparetheair}$	.312	.24
$\beta^{poll}_{classes}$	1.38	.21
$\beta^{EPA}_{classes}$	1.85	.05
$\beta^{regulation}_{classes}$	2.04	.26
$\beta^{wildfires}_{classes}$	1.05	.24
β^{SF}_{us}	2.08	.01
$\beta^{regulation}_{us}$	7.15	0.0
$\beta^{obesity}_{us}$	-.845	.19

Final Model Results

- Hard science majors fared better
- Differences among political affiliations
- Number of environmental classes taken
- Long-term U.S. residents vs foreign students
- “Spare the Air Day”

Name	Value	p-value
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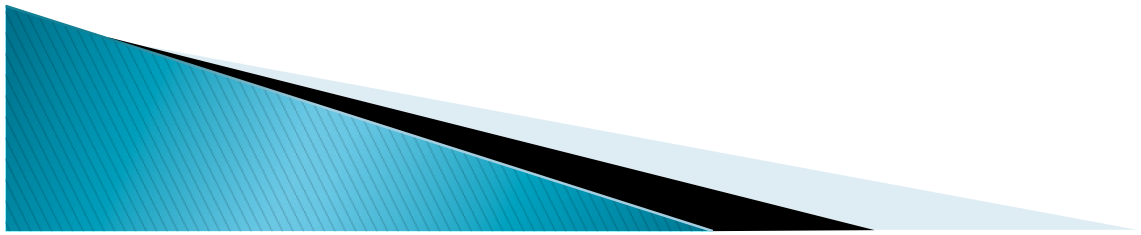
β^{SF}_{us}	2.08	.01
$\beta^{regulation}_{us}$	7.15	0.0
$\beta^{obesity}_{us}$	-.845	.19

Policy Implications

- Environmentally based classes improve student knowledge of air pollution
- Publicize “Spare the Air Day”
- Should have chosen more descriptive variable for policy recommendations

Conclusion

- Successfully implemented innovative type of behavior model
- Overall estimation met our hypothesis
- Unable to make substantial policy recommendations



Air Pollution Survey

Thank you for participating in this survey! We will be using the data collected here for a class project. We are trying to determine what factors of someone's background has the greatest influence on their knowledge of air pollution, and what can be done in the future to improve the public's awareness of the issue.

This survey should take LESS THAN 2 MINUTES. It will start with some background questions, and they will be followed by some questions to gauge your knowledge of air quality issues. Unless otherwise noted, a response to each question is required. All responses are strictly confidential.

Thank you for taking the time to complete this survey.

Background questions

What is your age?

What is your gender?

- ○ Male
- ○ Female

What is your area of study?

- ○ Business
- ○ Fine Arts (eg. Film, Art)
- ○ Engineering
- ○ Humanities (eg. History, English)
- ○ Natural Sciences (eg. Biology, Environmental Sciences)
- ○ Physical Sciences (eg. Physics, Chemistry)
- ○ Social Sciences (eg. Anthropology, Psychology)
- ○ Other:

What year are you?

- ○ Freshman
- ○ Sophomore
- ○ Junior
- ○ Senior
- ○ Graduate
- ○ Faculty
- ○ Staff

For how many years have you lived in the US.?

- ○ 0-1
- ○ 1-2
- ○ 2-3
- ○ 3-4
- ○ 4-5
- ○ More than 5

How many environment-based classes have you taken?

- ○ More than 4 classes
- ○ 2-3 classes
- ○ 1 class
- ○ None

How do you regularly get to campus?

Multiple answers acceptable

- ☐ Walk
- ☐ Bike
- ☐ Bus
- ☐ BART
- ☐ Drive
- ☐ Other:

How many hours per week do you exercise on average?

Do not consider time in transit as exercise

- ○ 0-1 hours
- ○ 1-3 hours
- ○ 3-5 hours
- ○ 5-8 hours
- ○ 8-12 hours
- ○ 12 hours or more

How frequently do you read and/or watch the news?

- ○ Daily
- ○ 4-6 times a week
- ○ 2-3 times a week
- ○ Once a week
- ○ Less than once a week

In the past week, what sources have you used to get the news?

You may select none or multiple answers

- [ ] Television
- [ ] Newspaper
- [ ] Internet
- [ ] Mobile App
- [ ] Twitter
- [ ] Other:

How frequently do you check the weather report?

- ( ) Daily
- ( ) 4-6 times a week
- ( ) 2-3 times a week
- ( ) Once a week
- ( ) Less than once a week

How frequently do you check the air quality index?

- ( ) At least once a week
- ( ) At least once a month
- ( ) At least once a year
- ( ) Never
- ( ) I don't know what the air quality index is

Do you consider yourself environmentally conscious?

- ( ) Yes
- ( ) No

Have you ever changed your daily activities due to air pollution?

- ( ) Yes
- ( ) No

What is your political affiliation?

- ( ) Democrat
- ( ) Republican
- ( ) Independent
- ( ) I don't know
- ( ) Other:

Did you go to high school in an urban, suburban, or rural area?

You may select more than one

- [ ] Urban
- [ ] Suburban
- [ ] Rural

What was your household income growing up?

- ○ $0-$39,999
- ○ $40,000-$59,999
- ○ $60,000-$79,999
- ○ $80,000-$99,999
- ○ $100,000 and over

Have you ever been diagnosed with any of the following?

You may selected more than one

- ☐ Asthma
- ☐ Respiratory disease
- ☐ Emphysema
- ☐ Bronchitis
- ☐ Cystic fibrosis
- ☐ Other breathing disorder
- ☐ None of the above

How would you rate this week's air quality?

- ○ Very good
- ○ Good
- ○ Poor
- ○ Very poor

Knowledge questions

Do all of the following air pollutants influence human health: carbon monoxide, nitrogen dioxide, and sulfur dioxide?

- ○ Yes
- ○ No
- ○ I don't know

Does the Center for Disease Control set the national air quality standards?

- ○ Yes
- ○ No
- ○ I don't know

Does San Francisco have higher levels of air pollution than Bakersfield?

- ○ Yes
- ○ No

- ○ I don't know

Is obesity a direct symptom of high air pollution?

- ○ Yes
- ○ No
- ○ I don't know

In the Bay Area, do wildfires produce more air pollution than do transportation related sources?

- ○ Yes
- ○ No
- ○ I don't know

In early 2011, did the federal government announce significant changes to its regulations regarding sulfur dioxide and carbon monoxide?

- ○ Yes
- ○ No
- ○ I don't know

Do you know what "Spare the Air Day" is?

- ○ Yes
- ○ No

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