Econ HW3

Madeline Berger & Ilayda Dinc

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1. Create a linear probability model that predicts a respondent's probability of voting 'yes' on the ballot based on their age, income, NEP score, the risk reduction offered by the program, and the cost of the program to that respondent. Show the model and interpret the regression coefficients.

```
prob_lm <- lm(vote ~ age + income + NEP + bid + risk, data = survey)

summary(prob_lm)
```

Call: lm(formula = vote ~ age + income + NEP + bid + risk, data = survey)

Residuals: Min 1Q Median 3Q Max -1.1078 -0.4242 0.1755 0.2968 0.7925

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.1196977 0.1198911 0.998 0.319
agetofifty 0.0099816 0.0633105 0.158 0.875
agetoforty -0.0201190 0.0623958 -0.322 0.747
agetosixty -0.0162261 0.0595666 -0.272 0.785
agetothirty 0.0204401 0.0578269 0.353 0.724
incomeone_percent 0.0088282 0.0598973 0.147 0.883
incomepoor 0.0027386 0.0649833 0.042 0.966
incomerich 0.0074891 0.0682176 0.110 0.913
incomevery_rich 0.0467922 0.0674876 0.693 0.488
NEP 0.0158639 0.0020887 7.595 1.58e-13 *** bid -0.0010699 0.0006585 -1.625 0.105
risk 0.0007445 0.0008363 0.890 0.374
— Signif. codes: 0 '' ***0.001*** '' *0.01* '' 0.05 '.' 0.1 '' 1

Residual standard error: 0.4291 on 488 degrees of freedom Multiple R-squared: 0.1201, Adjusted R-squared: 0.1003 F-statistic: 6.055 on 11 and 488 DF, p-value: 2.549e-09

```
y_int <- prob_lm$coefficients[1]
age50 <- prob_lm$coefficients[2]
age40 <- prob_lm$coefficients[3]
age60 <- prob_lm$coefficients[4]
age30 <- prob_lm$coefficients[5]
one_per <- prob_lm$coefficients[6]
poor <- prob_lm$coefficients[7]
rich <- prob_lm$coefficients[8]
veryrich <- prob_lm$coefficients[9]
nep <- prob_lm$coefficients[10]
bid <- prob_lm$coefficients[11]
risk <- prob_lm$coefficients[12]



avg_nep <- mean(survey$NEP)
avg_income<- mode(survey$income)
avg_age<-mode(survey$age)
```

```
stargazer(prob_lm, header = 'FALSE', type = 'latex')
```

% Error: Argument 'header' must be of type 'logical' (TRUE/FALSE)

Linear Probability Model of Voting 'yes' on the ballot:

$Probability\ of\ Voting\ Yes = (0.1197) + (0.0204)(age\ to\ 30) + (-0.0201)(age\ to\ 40) + (0.01)(age\ to\ 50) + (-0.0162)(age\ to\ 60) + (0.0027)(income:\ poor) + (0.0075)(income:\ rich) + (0.0468)(income:\ very\ rich) + (0.0088)(income:\ one\ percent) + (0.0159)(NEP) + (-0.0011)(bid) + (7 \times 10^{-4})(risk\ reduction)$

2. Based on this regression, what can you say about the value of a single prevented whale death? (Hint: Think about how risk reduction for all whales translates into the number of whale deaths avoided)

If a 20% risk reduction saves 5 whales, then we can find that a 4% reduction will save one whale. Therefore, we can solve for the change in bid (used as a proxy for willingness to pay) for an additional 4% risk reduction.

$Willingness\ to\ pay = 0.5 + 0.1197 + 0.0204(1) + 0.0088(1)0.0159(average\ NEP) - +7 \times 10^{-4}(0)/ - 0.0011$

$= 240.7713$

$Willingness\ to\ pay = 0.5 + 0.1197 + 0.0204(1) + 0.0088(1)0.0159(average\ NEP) - +7 \times 10^{-4}(4)/ - 0.0011$

$=243.5547$

$Marginal\ willingness\ to\ pay = 243.5547 - 240.7713$

The per person willingness to pay for a single whale is **$2.78**.

3. Pick three arbitrary respondents. For each of those respondents, estimate their WTP for a VSR program offering 60% risk reduction.

3 respondents were randomly chosen from the survey, with the numbers below indicating row number. Their willingness to pay was found from the equation below using their specific age, income and environmental concern:

Individual 110

$Bid = 0.5 - 0.1197 - 0.0204(1) - 0.0075(1) - 0.0159(36) - 7 \times 10^{-4} * (60)/ - 0.0011 = 246.1888$

Individual 27

$Bid = (0.5 - 0.1197 - 0.0204(1) - 0.0075(1) - 0.0159(44) - 7 \times 10^{-4} * (60)/ - 0.0011 = 366.0605$

Individual 54

$Bid = (0.5 - 0.1197 - 0.0204(1) - 0.0159(48) - 7 \times 10^{-4} * (60)/ - 0.0011 = 417.1191$

4. Now repeat this process and estimate the mean WTP for a VSR program offering 60% risk reduction among Santa Barbara County households.

$Average\ Bid = 0.5 + 0.1197 + (age\ coefficient)(age\ group) + (income\ coefficient)(income\ group) + 0.0159(average\ NEP) - +7 \times 10^{-4}(60)/ - 0.0011$

The process is repeated for 5 different age and income groups, resulting in 25 different combinations (See Table 1 below). Then, weighted average of different combinations is calculated. So, the mean willingness to pay for a VSR program offering 60% risk reduction is **$263.24**.

5. If there are 150,000 households in Santa Barbara County, estimate the total benefit of a VSR program to these households.

At the previous step, mean willingness to pay for a VSR program offering 60% risk reduction among Santa Barbara County households is calculated as $263.24.

So, if there are 150,000 households in Santa Barbara County, the total benefit of a VSR program is estimated as **$39,485,302.1**.

6. Based only on these benefits, do the benefits of the VSR program outweigh the costs?

Given that the cost of implementation is $7 million, the benefits of VSR program (~39 million) outweigh the cost.

7. Suppose the price of a carbon credit is $Z per ton, at what price Z* will the shipping industry decide to adopt the VSR for purely self-interested reasons? (Note: if ships voluntarily reduce speed, then the $7 million cost (noted above) of implementing the VSR would be avoided)

Assuming that for any ship transiting the Santa Barbara Channel, a speed reduction (that results in a 60% risk reduction) will cost the shipper $1,000, but will result in 20 fewer tons of CO2 emitted per transit. If the price of a carbon credit is more than 50 dollars per ton, the shipping industry will decide to adopt the VSR, since the cost of the shipper will be outweighed by carbon credits.

8. Now suppose the carbon credit price is exactly Z*, so all ships voluntarily reduce speed to achieve the 60% risk reduction. Approximately how many whales would be saved by this? What would be the social value of allowing ships to enter the carbon trading market?

Assuming that the reduction of risk of 20% will save at least 5 whales along the West Coast of the United States each year, if all ships voluntarily reduce speed to achieve the 60% risk reduction, approximnately 15 whales will be saved each year. The social value of 60% risk reduction is calculated in the section 4 as $263.24 which will also be created by allowing ships to enter the carbon trading market.