Youngberg

Econ 280—Bethany College

**Homework 03—Key**

Answer all the following on a ***typed, stapled*** (if applicable)separate sheet of paper. You do not need to type equations and graphs. I charge 25 cents to staple your homework. Make sure that you justify your answers, use your own words, and show your work. All questions are equally weighted.

1. Discuss a time when you faced Knightian uncertainty. Be sure to highlight how you knew it was Knightian uncertainty rather than risk.

*Whenever I turn on National Public Radio, I face risk: what program will be on? I have an idea what programs air and about when they air but I haven’t memorized the schedule. I can assign the probabilities of what will be on when pretty well.*

*But I have no idea what the content of many of these programs will be. NPR’s* This American Life *explores a tremendous variety of topics—from a century-old missing child case to how people learn to the fear of falling asleep—I face genuine uncertainty as to what the probabilities of each of the myriad of topics that could be covered.*

1. Calculate the following expected values:
   1. You get $20 if an even number is rolled on a 20-sided die.
   2. You get $100 if a “20” is rolled on a 20-sided die.
   3. You get $100 if a “20 ***or*** a “1” is rolled on a 20-sided die.
   4. You get $1 equal to the value rolled on a 10-sided die (a “1” gets you $1, a “2” gets you $2, etc).
   5. You get $50 if a “20” is rolled on a 20-sided die ***and*** a “10” is rolled on a 10-sided die. (Both dice are rolled at the same time.)
2. *0.5($20) = $10*
3. *0.05($100) = $5*
4. *0.1($100) = $10*
5. *0.1($1) + 0.1($2) + 0.1($3) + 0.1($4) + 0.1($5) + 0.1($6) + 0.1($7) + 0.1($8) + 0.1($9) +0.1($10) = $5.50*
6. *(0.05)(0.1)($50) = 0.005($50) = $0.25*
7. In class we discussed how insurance companies rely on risk-averse individuals to make money and gambling establishments rely on risk-loving individuals to make money. Provide another example of a product which clearly relies on either risk-averse individuals or risk-loving individuals to make money. Be sure to justify your example (a mathematical hypothetical like we did in class would be helpful).

*This question is trickier than it sounds. For example it’s tempting to choose something like motorcycle helmets as an industry that relies on risk aversion. But it’s not clear that expected cost of not wearing a helmet is less than the cost of a helmet. For example, if there’s a 1% chance that you’ll suffer an injury costing $200,000 to fix, that’s an expected cost of $2,000. If a helmet would prevent that injury and costs only $100, even a risk-loving person could buy one. It’s not clear that the helmet industry relies on risk aversion as damaging your head is very, very expensive, especially if there’s an accident. So an example such as this would only get you partial credit.*

*Ideally you find an industry where same firm interacts on both the certain and expected values (you don’t go to the helmet company if you’re in an accident…unless you’re suing them). These are clear cases which rely on risk-averse or risk-loving individuals to make money since they profit the difference in expected value and guaranteed value.*

*A good example is a warranty. You can often pay extra for a product and get an extended warranty. If the item breaks and you’re covered, you get a new item. The only way for this system to make money is for risk-averse people to buy it. Suppose it cost $30 for the extended warranty. Also suppose that there is a 0.1% chance that a product will break during that extended period (after the normal period but before the extended period expires). If the product cost $2,000, then the expected benefit of the warranty is $20. The cost was $30. Thus the warranty company makes $10 per warranty sold.*

*Aren’t warranties just a form of insurance? Yes, but not obviously so. We discussed car insurance in class so if you mentioned health insurance—which is obviously the same—that won’t get you many points. But warranties—since normal vernacular doesn’t even call them insurance—are less obviously an example. They are a much better answer.*

1. For each of the following errors, indicate if it is Type I or Type II error. ***Briefly***,justify your result.
   1. The CIA mistakes a school for a terrorist training camp, leading to a missile strike (and PR nightmare).
   2. Billy McDougal never considered economics for his major, a discipline he would have enjoyed a lot.
   3. The Department of Energy makes a $500,000,000 loan to Solyndra—a solar power company. Shortly thereafter the company goes bankrupt.
   4. ABC rejects the proposal for a new show called “The Sultan of Suede.” The show later becomes a big hit on another network.
   5. CEO Nwabudike Morgan doesn’t hire the brilliant scientist Prokhor Zakharov, mistakenly believing his head is too far in the clouds to do serious work.
2. *Type I. The null hypothesis for most things the CIA sees is that it is not a terrorist training camp. The null hypothesis was falsely rejected.*
3. *Type II. The null hypothesis, or status quo, for any random major is to not major in it. Billy failed to reject the null when he should have rejected it.*
4. *Type I. Presumably, the null hypothesis is to not make loans. The Department of Energy rejected the status quo when it should have failed to reject it.*
5. *Type II. The status quo for any show is to not be shown. ABC failed to reject the null but they should have rejected the null and approved the show.*
6. *Type II. Not hiring someone is the null hypothesis since people start off not being hired; it’s the status quo Morgan should have rejected but instead he failed to reject it.*
7. In July of 2012, the FDA approved an at-home HIV test. According to the *New York Times*:[[1]](#footnote-1)

Researchers found the home test accurate 99.98 percent of the time for people who do not have the virus. By comparison, they found it to be accurate 92 percent of the time in detecting people who do [have the virus].

About one in 10,000 Americans have the virus, or Pr(HIV) = 0.0001. If you take this home test and the results are positive, what are the chances you have HIV? (HINT: Use Bayes Rule.)

*Let us first review Bayes Rule:*

*We are asking, if the result is positive (+), what is the probability you are infected (HIV)?*

*Constructing a truth table is useful here. We know that* ***if*** *someone is HIV+, the test will return a positive result 92% of the time and* ***if*** *someone is HIV-, the test will return a negative result 98.98% of the time.*

|  |  |  |
| --- | --- | --- |
| *HIV Status* | *Test Result* | *Pr()* |
| *+* | *+* | *0.92* |
| *+* | *-* |  |
| *-* | *+* |  |
| *-* | *-* | *0.9998* |

*What assumption we start with matters here. Re-read the quoted passage. For one group of people, the accuracy is one value; for another group of people, the accuracy is another value. We assume HIV status for these probabilities.*

*Thus* ***if*** *someone’s HIV+, the test will give a negative result 8% and* ***if*** *someone’s HIV-, the test will give a positive result 0.02% of the time. The table is filled in as so:*

|  |  |  |
| --- | --- | --- |
| *HIV Status* | *Test Result* | *Pr()* |
| *+* | *+* | *0.92* |
| *+* | *-* | *0.08* |
| *-* | *+* | *0.0002* |
| *-* | *-* | *0.9998* |

*Now back to Bayes:*

*If someone has HIV, what is the probability the test will be positive? If someone doesn’t have HIV, what is the probability the test will be positive?*

*Now we just fill in the likelihood of having HIV and of not having HIV…*

*In other words if you get a positive result, there is only about a one-in-three chance the result is correct! This is why the makers of the drug are quick to advise that if you get a positive result to be re-tested at a doctor’s office.*

1. <http://www.nytimes.com/2012/07/04/health/oraquick-at-home-hiv-test-wins-fda-approval.html> [↑](#footnote-ref-1)