Ph 458 Evidence and Policy

WEEK 2: Evidence in 'Hard Science'; The Elements of Probability Theory; and "Inverse Probability"

READING AND STUDY QUESTIONS

1. Reading: Karl Popper 'Conjectures and Refutations'; Imre Lakatos 'Science and Pseudoscience

Contrast Lakatos's view about how scientists react to 'refutations' with those of Popper.

2. My notes on 'Probability Theory'; sections 1 and 3

What I hope will be some fairly straightforward exercises (do get others to help you with them if they seem a bit tricky):

- 1. Consider again the 'game' of drawing a card at random from a well-shuffled pack
 - (a) What's the probability of getting *either* a heart or a spade (i) in terms of basic events and (ii) by applying the addition law?
 - (b) What's the probability of getting *either* a heart or an ace (i) in terms of basic events and (ii) by applying the addition law?
 - (c) What's the probability of getting a card that is, at the same time, a spade and a face card (i) in terms of basic events and (ii) by applying the law for joint probabilities?
 - (d) (i) Are getting an ace and getting a spade probabilistically independent events? How about the events of getting a king and a face card?
 - (e) What are the *conditional probabilities* P(ace/spade), P(spade/ace), P(king/face card), P(face card/king)?
 - (f) What's the probability of getting a card that is, at the same time, a king and a face card(i) in terms of basic events and (ii) by applying the law for joint probabilities?
- 2. Let's modify the example in my **Notes** slightly: suppose again that there are two, physically indistinguishable coins in a box, again one is fair but the other is totally biased: it *always* produces a head whenever you toss it. You select one coin from the box and toss it 4 times and observe r = 4 (i.e. all 4 tosses turn up heads)
 - (a) Using Bayes' theorem, what's the probability, given this outcome, that the coin selected was the fair one?
 - (b) Using Bayes' theorem, what's the probability, given this outcome, that the coin selected was the one maximally biased in favour of heads?
 - (c) Identify the 'priors' and 'posteriors' of the two hypotheses (coin fair, coin biased) and discuss whether the changes induced by the observation r = 4 seem intuitively right.
 - (d) Suppose that the outcome of the experiment (of tossing the coin 4 times) had been r = 3 (i.e. 3 heads, 1 tail). (i) what should intuitively happen to the posteriors of the two hypotheses? (ii) what happens according to Bayes' theorem?