Stat 100a, introduction to Probability.

Outline for the day:

- 1. teams, emails, bruin.
- 2. Midterm 1 and hw2.
- 3. More luck and skill calculations. Booth and Ivey.
- 4. Facts about expected value.
- 5. Expected number trick.
- 6. More on conditional probability.

Your emails are on the course website tonight, but I will take the emails off Wed night. http://www.stat.ucla.edu/~frederic/100A/W22



1. teams, emails, bruin.

- The teams will be posted tonight at 9pm in teams.txt on the course website.
- I will post your email addresses on the course website in namesandemails.txt until Wednesday night. If you do not want yours listed for privacy reasons, please let me know by 9pm tonight and I will not list yours.

R project. teams, emails, and bruin.

The project is problem 8.2, page 249.

You need to write code to go all in or fold. In R, try:

install.packages(holdem)

library(holdem)

library(help="holdem")

gravity, timemachine, tommy, ursula, vera, william, and xena are examples.

- cards[1,1] is your higher card (2-14).
- cards[2,1] is your lower card (2-14).

cards[1,2] and cards[2,2] are suits of your higher card & lower card. help(tommy)

tommy

function (numattable, cards, board, round, currentbet, mychips, pot, roundbets, blinds, chips, ind, dealer, tablesleft)

```
\{ a = 0 \}
```

```
if (cards[1, 1] == cards[2, 1])
a = mychips
```

a

help(vera)

```
# All in with a pair, any suited cards, or if the smaller card is at least 9.
function (numattable, cards, board, round, currentbet, mychips,
    pot, roundbets, blinds, chips, ind, dealer, tablesleft) {
    a = 0
    if ((cards[1, 1] == cards[2, 1]) || (cards[1, 2] == cards[2,2]) ||
        (cards[2, 1] > 8.5)) a = mychips
        a
}
```

You need to email me your function, to <u>frederic@stat.ucla.edu</u>, by Sat Mar5, 8pm. It should be written (or cut and pasted) simply into the body of the email. If you write it in Word, save as text first, and then paste it into the email. Just submit one email per team. For instance, if your function is named "bruin", you might do:

bruin = function (numattable, cards, board, round, currentbet,

mychips, pot, roundbets, blinds, chips, ind, dealer, tablesleft) { ## all in with any pair higher than 7s, or if lower card is J or higher, ## or if you have less than 3 times the big blind

a = 0

```
if ((cards[1, 1] == cards[2, 1]) && (cards[1, 1] > 6.5)) a = mychips
if (cards[2,1] > 10.5) a = mychips
if(mychips < 3*blinds) a = mychips
a1
```

} ## end of bruin

Midterm 1 and homework 2.

Midterm 1 is one hour and 15 min, on Mon Jan31 in Haines A2. Wed Jan26 will be review, online. After that we will meet in Haines A2.

Around 14 multiple choice questions all worth the same amount.

You can use any books and notes you want, but no computers,

tablet, ipads, phones, or anything that can surf the net or do email.

Bring a calculator and a pen or pencil.

None of the above is an option but it is hardly ever the answer.

Answers are rounded to 2 decimal places.

Homework 2 is problems 4.9, 4.18, 4.21 and 5.2. 5.2 is tricky.

On problem 5.2, let Z = the time until you have been dealt a pocket pair and you have also been dealt two black cards.

Consider P(Z > k), and P(Z > k-1). These are actually easier to derive in this case than P(Z = k). Can you get P(Z = k) in terms of these?

Another luck and skill calculation.

Mike Cloud raised to 15,000 with $A \clubsuit A \diamondsuit$, Hellmuth called with $A \heartsuit K \bigstar$, Daniel Negreanu called from the big blind with $6 \diamondsuit 4 \heartsuit$, and the flop came $K \clubsuit 8 \heartsuit K \heartsuit$. Before the flop, the pot was 57,000 chips.

After the flop, all three players checked, the turn was the J♥, Negreanu checked, Cloud bet 15,000, Hellmuth called, and Negreanu folded.

The river was the 7♠, Cloud checked, Hellmuth bet 37,000, and Cloud called. How much expected profit did Hellmuth gain due to luck and how much due to skill on the river?

Answer — When the turn was dealt, Hellmuth's probability of winning in a showdown was $41/42 \sim 97.62\%$. After the betting on the turn was over, the pot was 87,000 chips. When the 7 states was revealed on the river, Hellmuth's equity increased from $97.62\% \times 87,000 = 84,929.4$ to $100\% \times 87,000$, for an increase of 2070.6 chips due to luck. Hellmuth's expected profit gained due to skill on the river is simply 37,000 chips: the pot size increased by 74,000 while Hellmuth had a 100% chance of winning, but the cost to Hellmuth was 37,000, so his profit was 37,000.

Luck and skill calculation involving Lederer and Minieri, hand 21.

Expected profit due to skill on the flop?

Minieri had 10♥ 3♦, Lederer had Q♥ J♠.

Minieri called 1000, and Lederer checked. The pot was 4000.

The flop was 8♠ 4♥ J♣.

Lederer checked, Minieri bet 2000, Lederer raised to 7500, Minieri raised to 18,500, Lederer raised all in, and Minieri folded.

Minieri needs Q9, 97, 10 10, 3 3, or 10 3.

(4*3 + 4*4 + C(3,2) + C(3,2) + 3*3) / C(45,2) = 4.34%. Minieri is 4.34% to win.

Minier's profit due to skill on the flop?

Before this betting round, Minieri had 4.34% chance of winning 4000.

4.34% x 4000 = 173.60.

After the betting, he had 0% of winning and had lost an additional 18,500.

In total he profited -173.60 - 18500 = 18673.60.

Booth and Ivey.

Facts about expected value.

For any random variable X and any constants a and b,

E(aX + b) = aE(X) + b.

Also, E(X+Y) = E(X) + E(Y),

unless $E(X) = \infty$ and $E(Y) = -\infty$, in which case E(X)+E(Y) is undefined.

Thus $\sigma^2 = E[(X-\mu)^2]$

$$= E[(X^{2} - 2\mu X + \mu^{2})]$$

= E(X²) - 2\mu E(X) + \mu^{2}
= E(X²) - 2\mu^{2} + \mu^{2}
= E(X²) - \mu^{2}.

Expected number trick.

The board consists of 5 cards. Find the expected number of clubs on the board.

Let $X_1 = 1$ if the 1st card is a club, and 0 otherwise.

Let $X_2 = 1$ if the 2nd card is a club, and 0 otherwise.

etc.

 $X = X_1 + X_2 + X_3 + X_4 + X_5.$

So $E(X) = E(X_1) + E(X_2) + E(X_3) + E(X_4) + E(X_5)$

 $= [\frac{1}{4} (1) + \frac{3}{4} (0)] \times 5 = 1.25.$

Even though X_1, X_2, X_3, X_4 , and X_5 are not independent, nevertheless $E(X_1 + X_2 + X_3 + X_4 + X_5) = E(X_1) + E(X_2) + E(X_3) + E(X_4) + E(X_5).$ Conditional probability.

When A and B are different outcomes on different collections of cards or different hands, then P(B|A) can often be found directly.

But when A and B are outcomes on the same event, or same card, then sometimes it is helpful to use the definition P(B|A) = P(AB)/P(A).

For example, let A = the event your hole cards are black, and let B = the event your hole cards are clubs.

P(B|A) = P(AB)/P(A) = C(13,2)/C(52,2) / [C(26,2)/C(52,2)].

However, if A is the event your hole cards are black and B is the event the flop cards are all black, then P(B|A) = C(24,3)/C(50,3) directly.