Homework 03, Morally due Mon Feb 22, 9:00AM

1. (0 points but if you miss the midterm that means you got this wrong retroactively and you will lose a lot of points). When is the midterm? By what day do you need to tell Dr. Gasarch that you cannot make the midterm (if you cannot and know ahead of time)?
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2. (50 points) In the country of Fredonia they play a game that is similar to what we call Poker but with a different deck of cards.

Every card has a rank from $\{1, 2, \ldots, R\}$.

Every card has a suite from $\{1, \ldots, S\}$.

Every player gets $C$ cards.

(a) (15 points) (DO NOT allow wraparound.) What is prob of a straight that is NOT a flush. We DO NOT allow wrap-around, so if $R = 10$ and $C = 7$ then 10-1-2-3-4-5-6 does NOT counts.

(b) (15 points) (DO allow wraparound.) What is prob of a straight that is NOT a flush. We DO NOT allow wrap-around, so if $R = 10$ and $C = 7$ then 10-1-2-3-4-5-6 does counts.

(c) (10 points) Give a formula which is a function of $R, S, C$ for the difference between

Prob of a straight that is NOT a flush, ALLOWING wraparound (Question b)

and

Prob of a straight that is NOT a flush NOT ALLOWING wraparound (Question a)

We call this formula $DIFF(R, S, C)$.

(d) (0 points) Write a program that will, given $R, S, C$, compute $DIFF(R, S, C)$. (You should pre-compute binomial coefficients ahead of time rather than having to keep recomputing them.)

Send your code to Emily by email. Send the actual .java/.py/ect file. You need to use your .umd email address or it will not send. In your pdf, you must have the output your code provides. You can screenshot this or type it in.

Hint: Use Python.

(e) (10 points) Run the program for all $1 \le R, S, C \le 10$. For which $R, S, C$ is the diff between the two numbers greatest? Smallest? If you want to make the diff small, which variable should you change, and in what direction?

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3. (50 points) We are again in Fredonia (see prior problem). However, we are assuming that $C$ is even and $S/2 < C < S$.

(a) (15 points) A *Full House* in Fredonia poker is when there are $C/2$ cards of the same rank, and $C/2$ cards of another rank. (Example: If $R = 10$, $C = 6$ and the suites are H,C,S,D then (2H, 2C, 2D, 8H, 8S, 8D) is a full house. What is the prob of getting a full house.

(b) (15 points) Let $k \leq S$. A *k-of-a-kind* (henceforth $k$-kind) is a hand where there are $k$ of the same rank. (Example: If $R = 10$, $C = 6$ the suites are H,C,S,D,Z,W and $k = 4$ then (3H, 3C, 3S, 3D, 9H, 10D) is a 4-kind. What is the prob of getting a $k$-kind. NOTE- we ALLOW to have the hand be even stronger. For example (3H, 3C, 3S, 3D, 9H, 9D) is fine, and even (3H, 3C, 3S, 3D, 3Z, 3W) is fine.

(c) (10 points) Give a formula which is a function of $R, S, C, k$ for the difference between

$$\text{Prob of a } k\text{-kind (Question b)}$$

and

$$\text{Prob of a full house (Question a)}$$

We call this formula $DIFF(R, S, C, k)$.

(d) (0 points) Write a program that will, given $R, S, C$  $S/2 < C < S$ and $C$ even, compute $DIFF(R, S, C, k)$. (You should pre-compute binomial coefficients ahead of time rather than having to keep recomputing them.)

Send your code to Emily by email. Send the actual .java/.py/ect file. You need to use your .umd email address or it will not send. In your pdf, you must have the output your code provides. You can screenshot this or type it in.

Hint: Use Python.

(e) (10 points) For each triple $4 \leq R, S, C \leq 10$ with $S/2 < C < S$ and $C$ even, run the program with $k = C/2, C/2+1, \ldots, S$, put it in a table, and answer the following: For which $k$ is $DIFF(R, S, C, k)$ smallest (it can be negative)? largest? Closest to 0?