Stat 19, Probability and Poker. Rick Paik Schoenberg

Outline for the day:

1. Discuss Addiction.

2. *R*.

3. Greenstein and Farha.

4. Axioms of probability.

5. Counting and combinations.

6. P(A♠ after first ace).

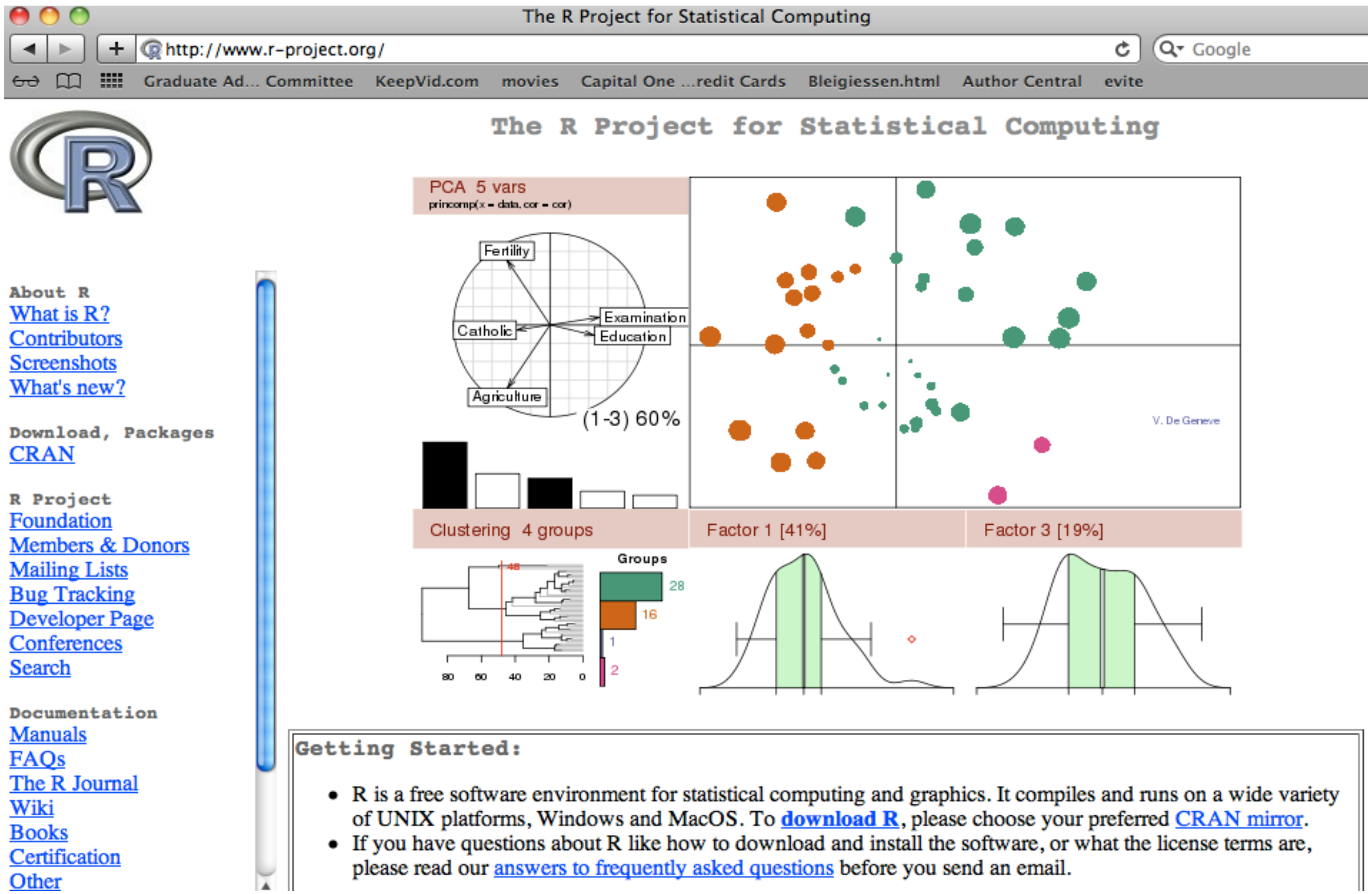
Read harrington1.pdf for next time.

Think of 1-2 questions or comments for next time.

The course website is http://www.stat.ucla.edu/~frederic/19/S24 .

2. R. To download and install *R*, start at www.r-project.org, click on "download *R*", scroll down and click on one of the mirrors closest to you.

From there, click on "download R for …", and then get the latest version.



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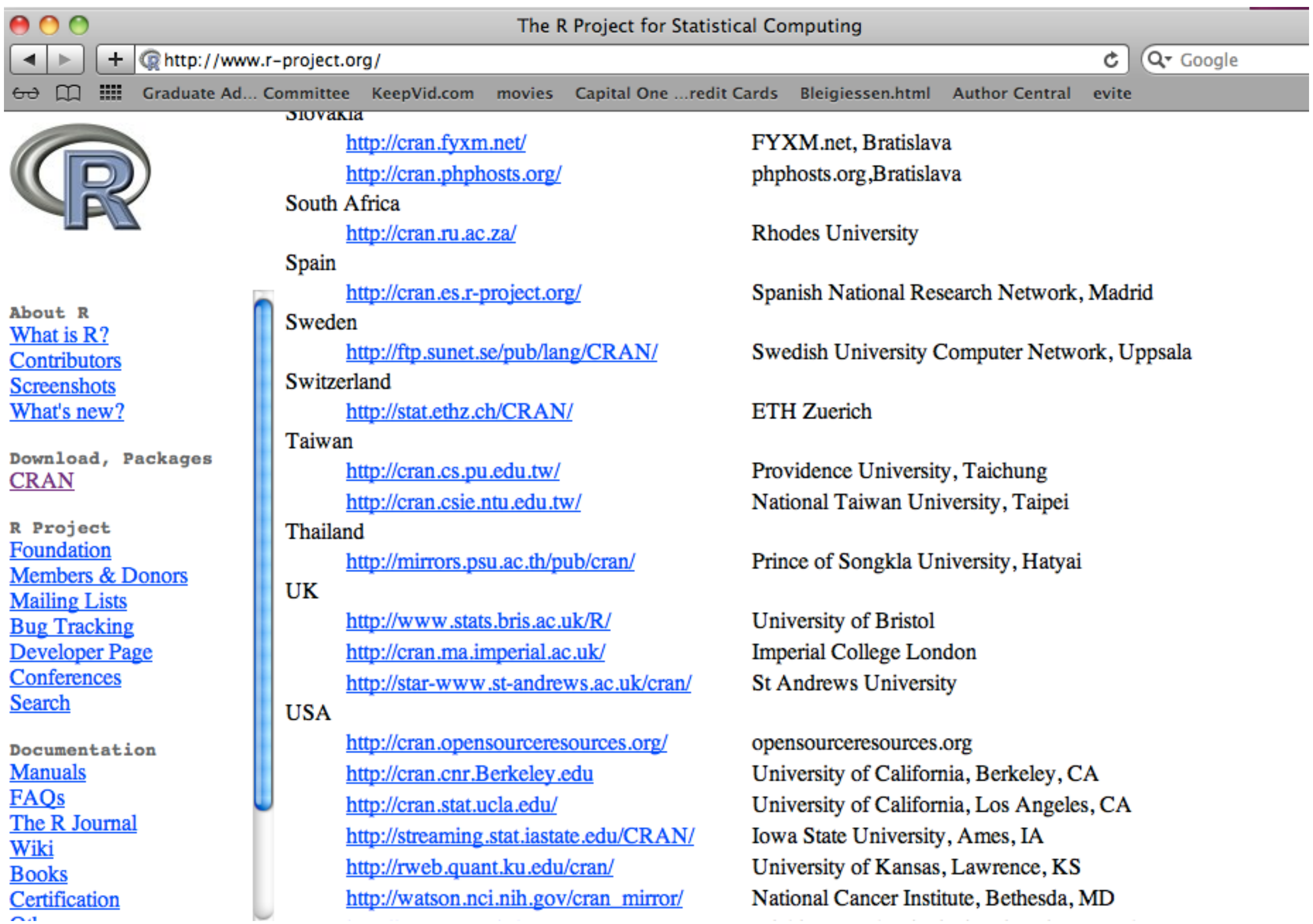

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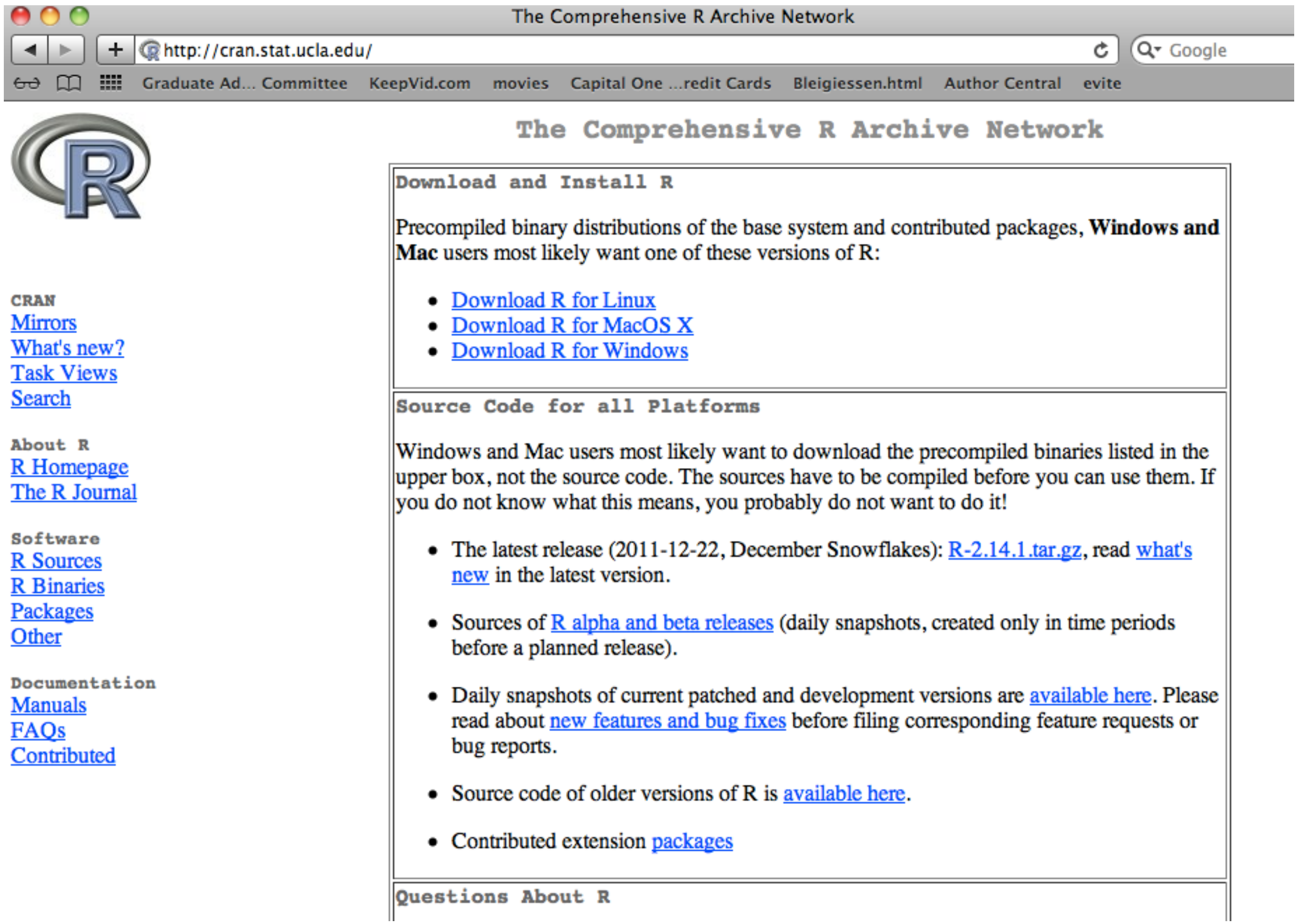

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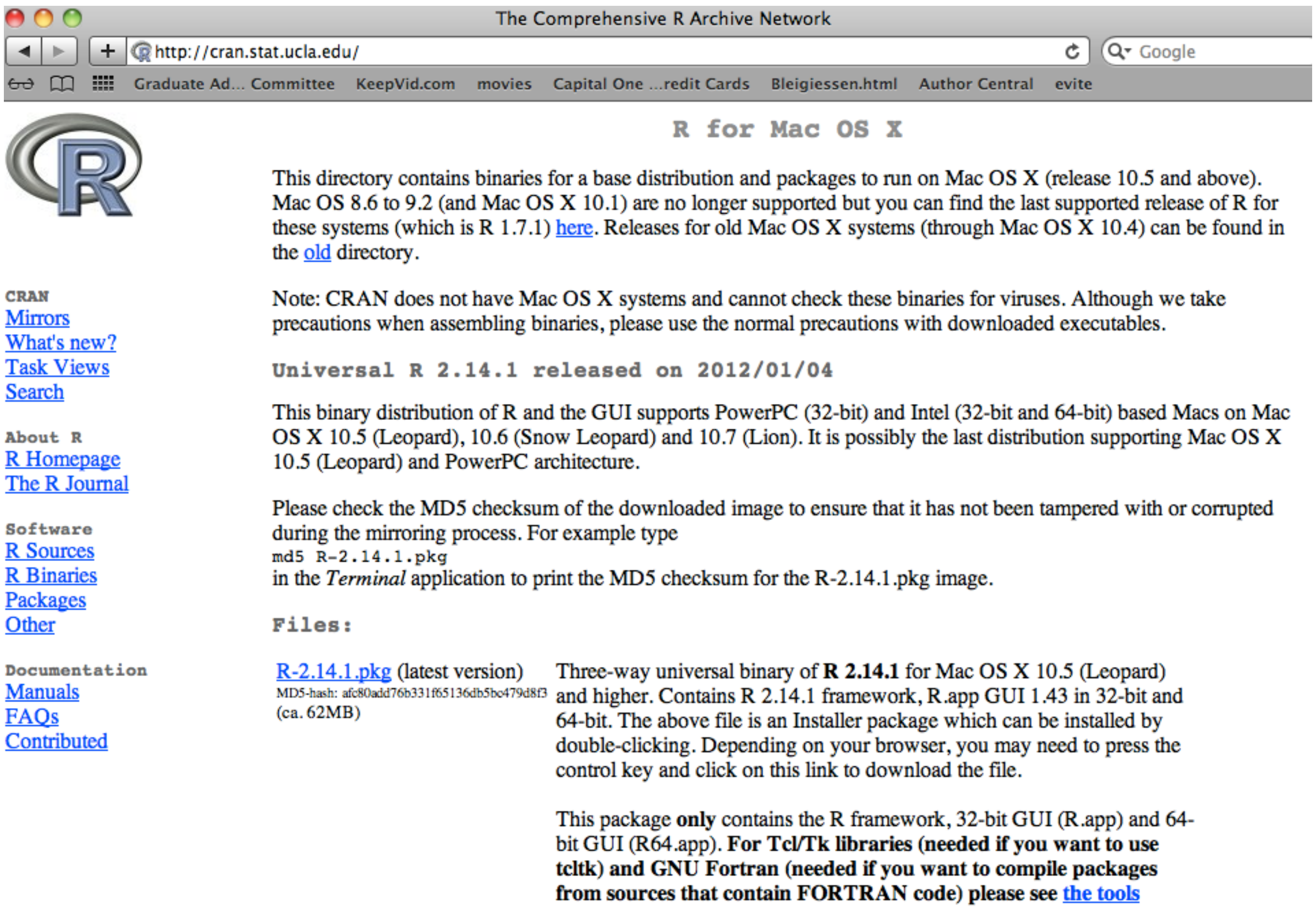


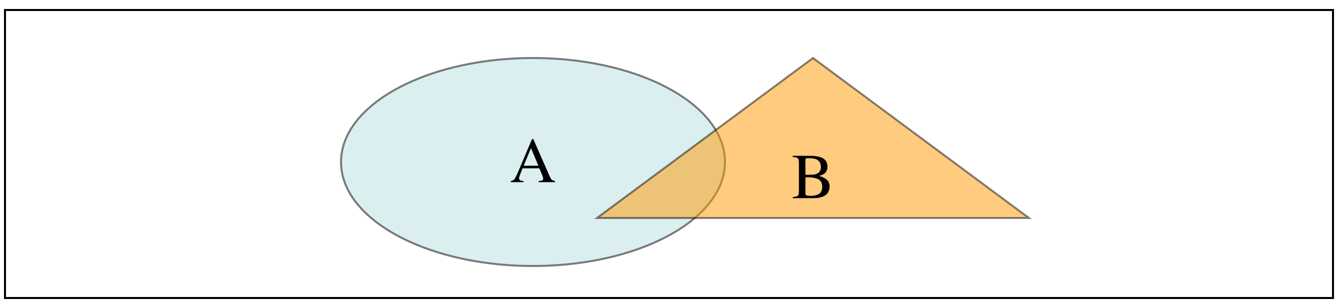
3. Greenstein and Farha.

4. Axioms (initial assumptions/rules) of probability:

1) $P(A) \geq 0$.
2) $P(A) + P(A^c) = 1$.
3) If $A_1, A_2, A_3, \ldots$ are mutually exclusive, then
   $P(A_1 \text{ or } A_2 \text{ or } A_3 \text{ or } \ldots) = P(A_1) + P(A_2) + P(A_3) + \ldots$

(#3 is sometimes called the *addition rule*)

Probability <=> Area. Measure theory, Venn diagrams



$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$.

Counting.

Fact: If $A_1, A_2, \ldots, A_n$ are equally likely & mutually exclusive,
and if $P(A_1$ or A_2 or … or $A_n) = 1$,
then $P(A_k) = 1/n$.
[So, you can *count*: $P(A_1$ or A_2 or … or $A_k) = k/n$.]

Ex. You have 76, and the board is KQ54. P(straight)?
[52-2-4=46.] P(straight) = P(8 on river OR 3 on river)
= P(8 on river) + P(3 on river) = 4/46 + 4/46.

If there are a_1 distinct possible outcomes on experiment #1, and for each of them, there are a_2 distinct possible outcomes on experiment #2, then there are $a_1 \times a_2$ distinct possible *ordered* outcomes on both.

In general, with j experiments, each with a_i possibilities,
the # of distinct outcomes *where order matters* is $a_1 \times a_2 \times \ldots \times a_j$.

Permutations and combinations.

e.g. you get 1 card, opp. gets 1 card. # of distinct possibilities?
52 x 51. [ordered: (A♣ , K♦) ≠ (K♦, A♣) .]

Each such outcome, where order matters, is called a *permutation*.

Number of permutations of the deck? 52 x 51 x … x 1 = 52!

$\sim 8.1 \times 10^{67}$

A *combination* is a collection of outcomes, where order *doesn't* matter.

e.g. in hold'em, how many *distinct* 2-card hands are possible?

52 x 51 if order matters, but then you'd be double-counting each

[since now (A♣, K♦) = (K♦, A♣)].

So, the number of *distinct* hands where *order doesn't matter* is

52 x 51 / 2.

In general, with n distinct objects, the # of ways to choose k *different* ones, *where order doesn't matter*, is

"n choose k" = $\binom{n}{k}$ = choose(n,k) = $\frac{n!}{k!\,(n-k)!}$.

k! = 1 x 2 x … x k. [convention: 0! = 1.]

Deal til first ace appears. Let X = the *next* card after the ace.

P(X = A♠)? P(X = 2♣)?