Stat 100a, Introduction to Probability. Rick Paik Schoenberg

Outline for the day:

1. Addiction.
2. Syllabus, etc.
3. Wasicka/Gold/Binger example.
4. Meaning of probability.
5. Axioms of probability.
6. Hw1 terms.
7. Basic principle of counting.
8. Permutations and combinations.
9. R.
10. A♠ vs 2♣ after first ace.

2. Syllabus, etc.

For this week:

(i) Learn the rules of Texas Hold'em.
(see http://www.fulltiltpoker.net/holdem.php
and http://www.fulltiltpoker.net/handRankHigh.php)

(ii) Read addiction handout, addiction1.pdf, on the course website,
http://www.stat.ucla.edu/~frederic/100a/S15 .

(iii) Download R and try it out.
(http://cran.stat.ucla.edu)

(iv) Read ch. 1-3 of the textbook.

Note that the CCLE website for this course is not maintained. The course website is http://www.stat.ucla.edu/~frederic/100a/S15 .

I do not give hw hints in office hours. Conceptual questions only.

If you have taken Stat 35 before, please see me after class.

Wasicka/Gold/Binger Example

Blinds: $200,000-$400,000 with $50,000 antes.

Chip Counts:

Jamie Gold	$60,000,000
Paul Wasicka	$18,000,000
Michael Binger	$11,000,000

Payouts: 3rd place: $4,123,310. 2nd place: $6,102,499. 1st place: $12,000,000.

Day 7, Hand 229. Gold: 4s 3c. Binger: Ah 10h. Wasicka: 8s 7s.

An example of the type of questions we will be addressing in this class is on the next slide. Don't worry about all the details yet.

Wasicka/Gold/Binger Example, Continued

Gold: 4♠ 3♣. Binger: A♥ 10♥. Wasicka: 8♠ 7♠.
Flop: 10♣ 6♠ 5♠. (Turn: 7♣. River: Q♠.)

Wasicka folded?!?

He had **8♠ 7♠** and the flop was **10♣ 6♠ 5♠**. Worst case scenario: suppose he were up against **9♠ 4♠** and **9♥ 9♦**. How could Wasicka win?

88	(3: 8♣ 8♦, 8♣ 8♥, 8♦ 8♥)
77	(3)
44	(3)

[Let "X" = non-49, "Y" = A2378JQK, and "n" = non-♠.]

4n Xn	(3 x 32)
9♣ 4n	(3)
9♣ Yn	(24). **Total: 132 out of 903 = 14.62%.**

4. Meaning of Probability.

Notation: "P(A) = 60%". A is an *event*.
Not "P(60%)".

Definition of probability:

Frequentist: If repeated independently under the same conditions millions and millions of times, A would happen 60% of the times.

Bayesian: Subjective feeling about how likely something seems.

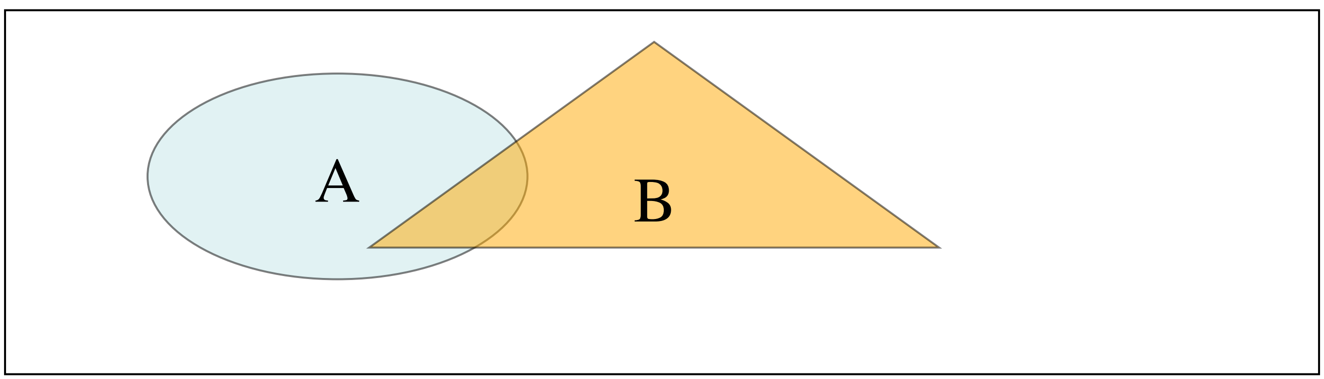
P(A *or* B) means P(A or B or both)
Mutually exclusive: P(A and B) = 0.
Independent: P(A given B) [written "P(A|B)"] = P(A).
$P(A^c)$ means P(not A).

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

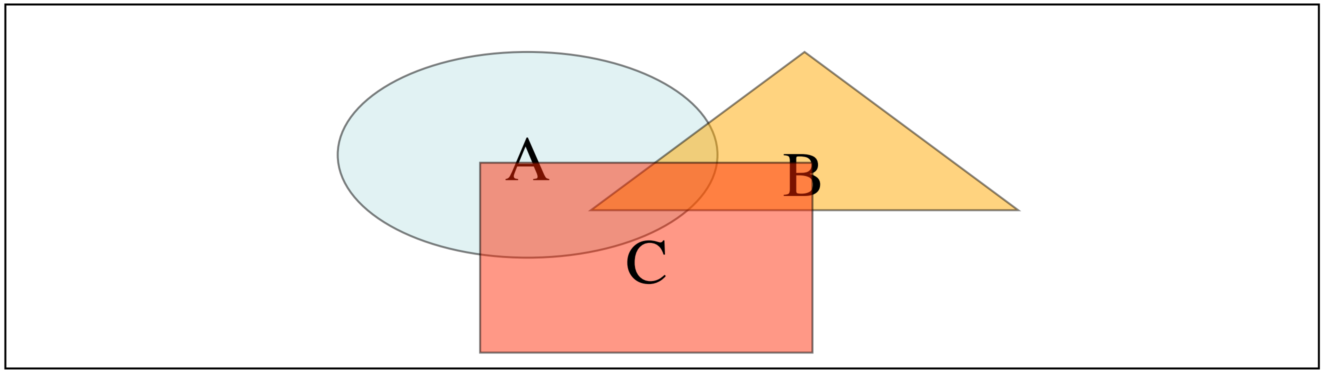
1) $P(A) \geq 0$.
2) $P(A) + P(A^c) = 1$.
3) If $A_1, A_2, A_3, \ldots$ are mutually exclusive, then
$P(A_1 \text{ or } A_2 \text{ or } A_3 \text{ or } \ldots) = P(A_1) + P(A_2) + P(A_3) + \ldots$

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

Probability <=> Area. Measure theory, Venn diagrams



P(A or B) = P(A) + P(B) - P(A and B).



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

$P(A \text{ or } B \text{ or } C) = P(A)+P(B)+P(C)-P(AB)-P(AC)-P(BC)+P(ABC)$.

Fact: If $A_1, A_2, \ldots, A_n$ are equally likely & mutually exclusive, and if $P(A_1 \text{ or } A_2 \text{ or } \ldots \text{ or } A_n) = 1$, then $P(A_k) = 1/n$.

[So, you can *count*: $P(A_1 \text{ or } A_2 \text{ or } \ldots \text{ or } A_k) = k/n$.]

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.

6. Hw1 terms. flop a flush, the nuts, pocket pair.
Let me explain a bit what I mean on 2.18.
Suppose the board is K♥ Q♣ 10♥ 6♠ 3♠ and you have A♥ J♣. Then you have the nuts, and your 5-card hand is an ace-high straight (AKQJ10). Suppose instead that the board is K♥ Q♣ 7♥ 6♠ 3♠. Then if you have 5♥ 4♣ you have the nuts, and your 5-card hand is a 7-high straight (76543). A 7-high straight is *worse* than an ace-high straight, in the sense that it is outranked by an ace-high straight in the hand rankings. Now, if the board is K♥ 10♦ 7♣ 3♥ 2♣, and you have K♣ K♠, then you have the nuts, and your 5-card hand is three kings: KKK107, which is a worse hand than a 7-high straight. This question is asking: how far can you go with this? Can you think of a different board, so that it is possible that the nuts is a 5-card hand even worse than KKK107? What is the worst possible?

7. Basic Principle of Counting.

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.

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

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

8. 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♣) .]

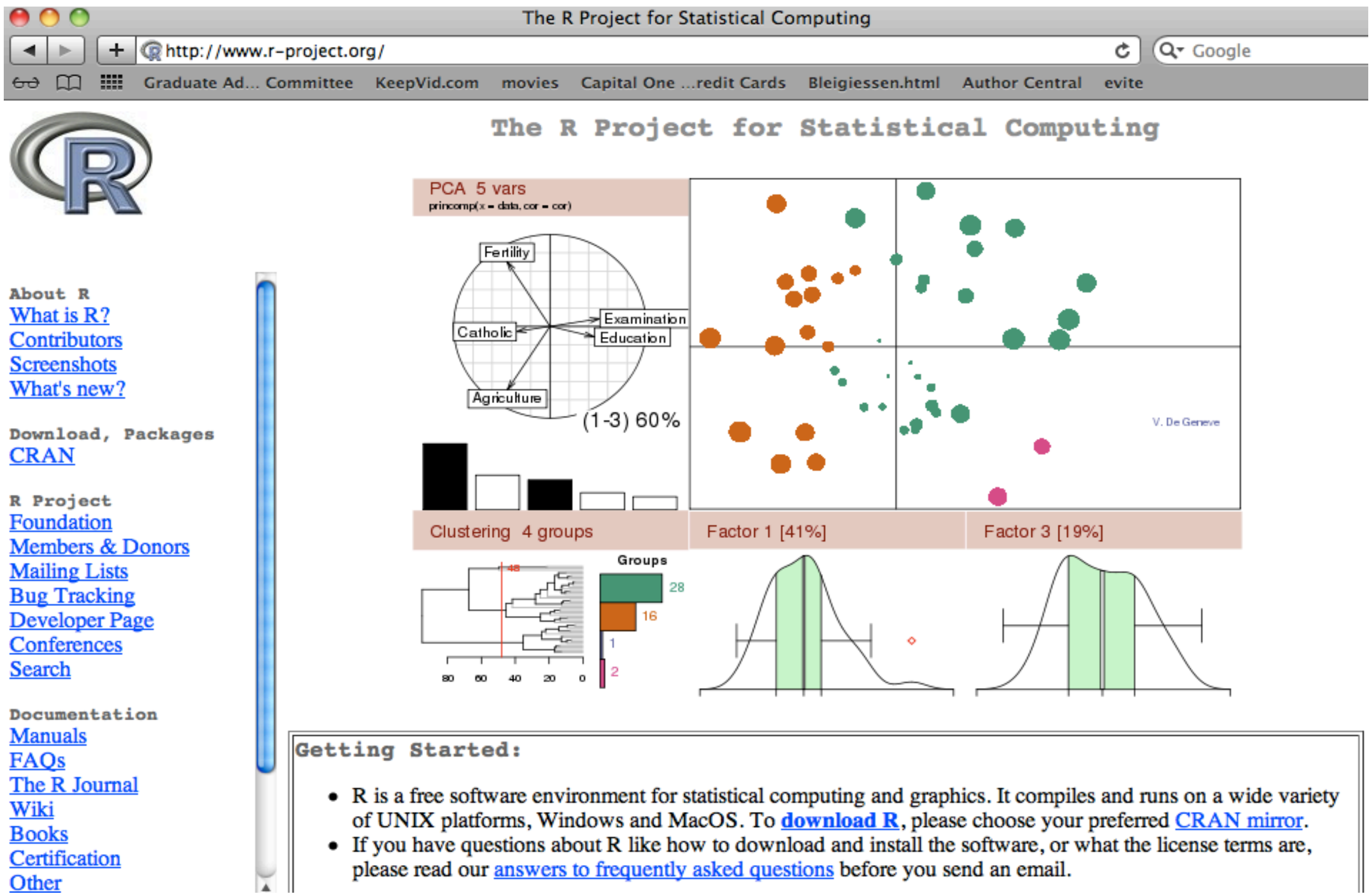
So, the number of *distinct* hands where *order doesn't matter* is

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

9. R. To download and install *R*, go directly to cran.stat.ucla.edu, or as it says in the book at the bottom of p157, you can start at www.r-project.org, in which case you click on "download *R*", scroll down to UCLA, and click on cran.stat.ucla.edu. From there, click on "download R for …", and then get the latest version.



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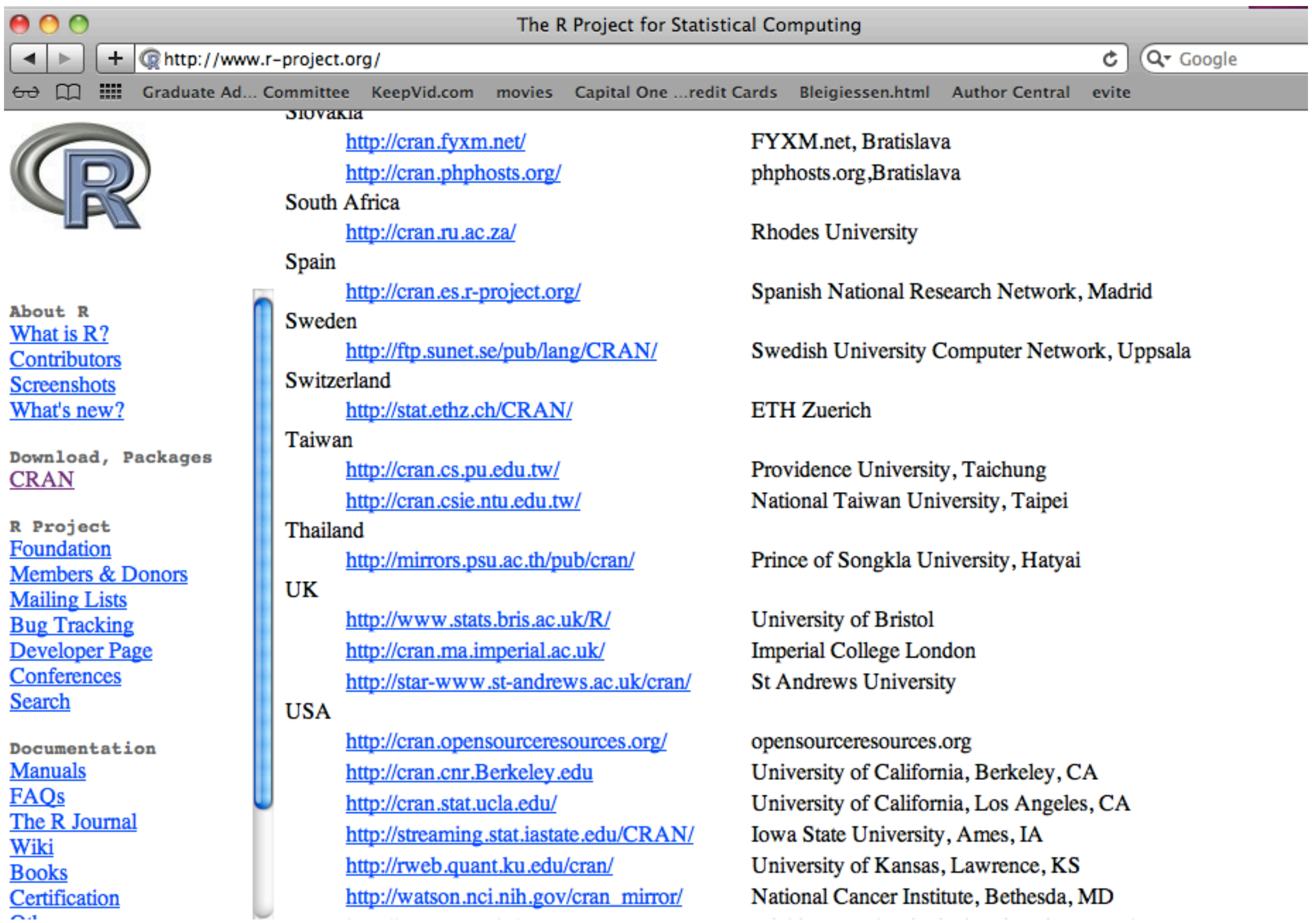

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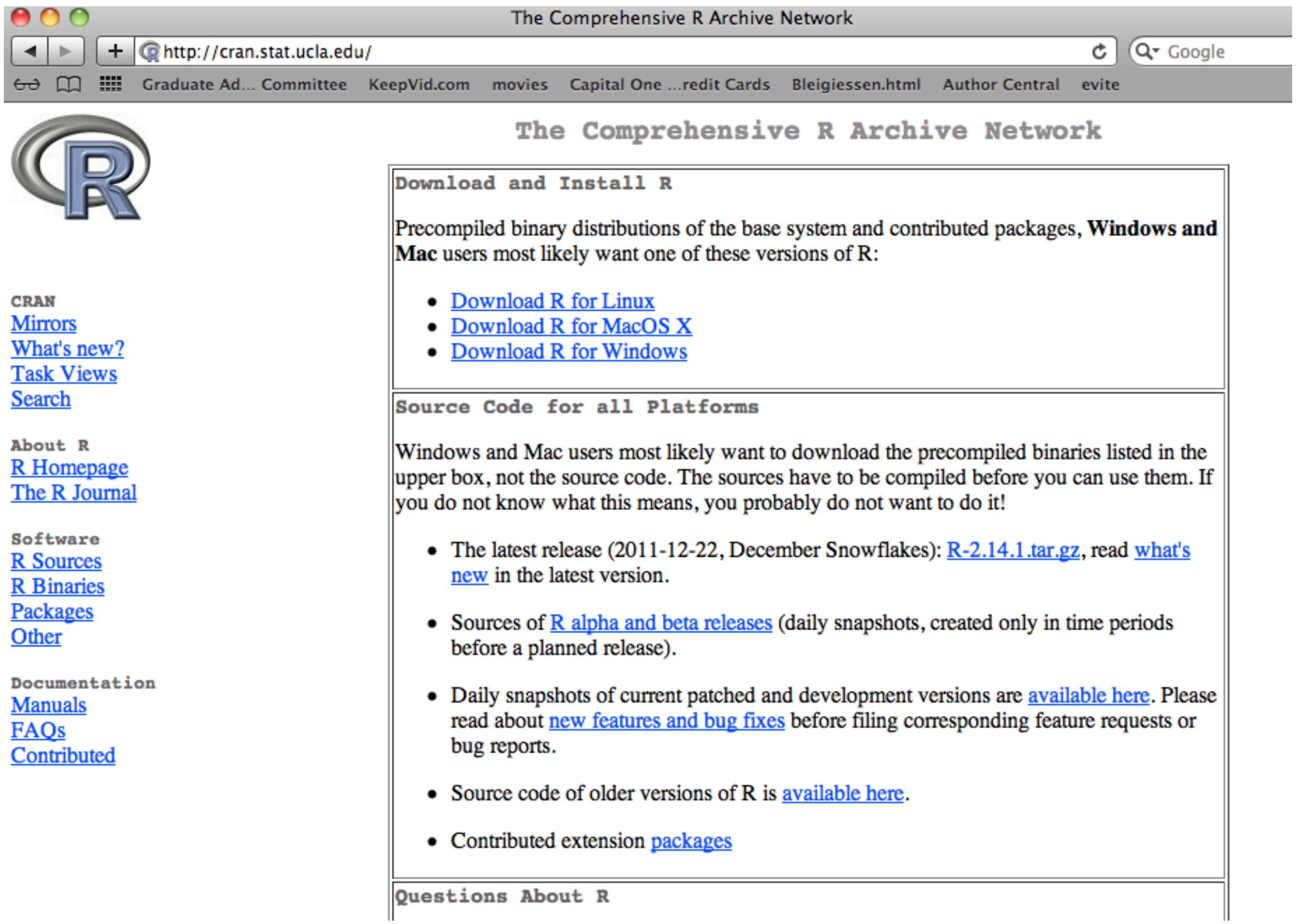

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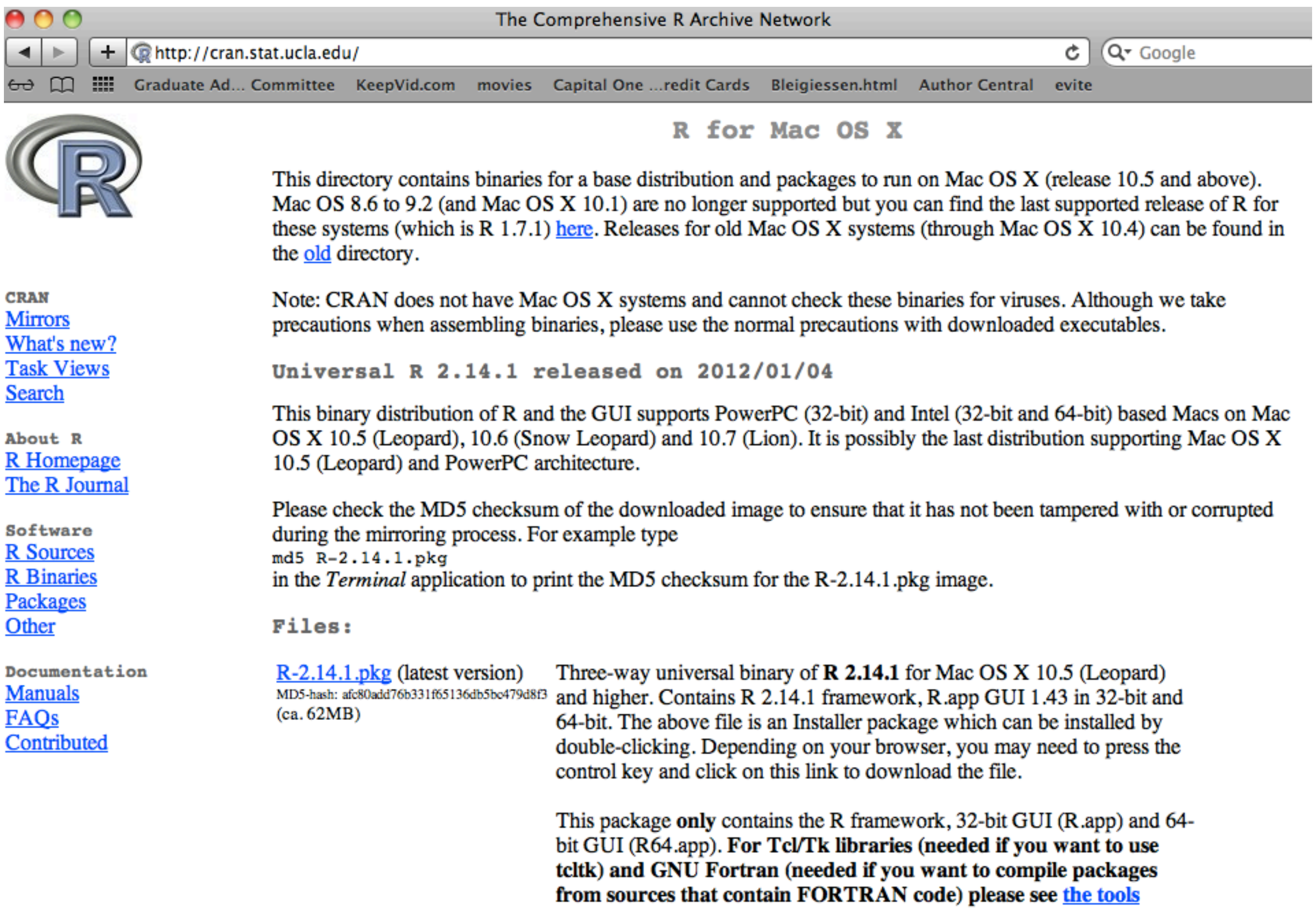

R for Mac OS X

This directory contains binaries for a base distribution and packages to run on Mac OS X (release 10.5 and above). Mac OS 8.6 to 9.2 (and Mac OS X 10.1) are no longer supported but you can find the last supported release of R for these systems (which is R 1.7.1) here. Releases for old Mac OS X systems (through Mac OS X 10.4) can be found in the old directory.

Note: CRAN does not have Mac OS X systems and cannot check these binaries for viruses. Although we take precautions when assembling binaries, please use the normal precautions with downloaded executables.

Universal R 2.14.1 released on 2012/01/04

This binary distribution of R and the GUI supports PowerPC (32-bit) and Intel (32-bit and 64-bit) based Macs on Mac OS X 10.5 (Leopard), 10.6 (Snow Leopard) and 10.7 (Lion). It is possibly the last distribution supporting Mac OS X 10.5 (Leopard) and PowerPC architecture.

Please check the MD5 checksum of the downloaded image to ensure that it has not been tampered with or corrupted during the mirroring process. For example type
`md5 R-2.14.1.pkg`
in the *Terminal* application to print the MD5 checksum for the R-2.14.1.pkg image.

Files:

R-2.14.1.pkg (latest version) MD5-hash: afc80add76b331f65136db5bc479d8f3 (ca. 62MB)	Three-way universal binary of **R 2.14.1** for Mac OS X 10.5 (Leopard) and higher. Contains R 2.14.1 framework, R.app GUI 1.43 in 32-bit and 64-bit. The above file is an Installer package which can be installed by double-clicking. Depending on your browser, you may need to press the control key and click on this link to download the file. This package **only** contains the R framework, 32-bit GUI (R.app) and 64-bit GUI (R64.app). **For Tcl/Tk libraries (needed if you want to use tcltk) and GNU Fortran (needed if you want to compile packages from sources that contain FORTRAN code) please see the tools**

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

P(X = A♠)? P(X = 2♣)?