Probability and Random Processes
ECS 315

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1 Probability and You

Office Hours:

BKD, 6th floor of Sirindhralai building

Tuesday	**9:00–10:00**
Wednesday	**14:20–15:20**
Thursday	**9:00–10:00**

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Everything we do, everything that happens around us, obeys the laws of **probability**.

We can no more escape them than we can escape gravity… "Probability," a philosopher (Bishop Butler) once said, "is the **very guide of life**."

We are all gamblers who go through life making countless bets on the outcome of countless actions.

[Gardner, 1986]

Life is random

In 2005, this statement (which is true)

Life is random

was on display all over the world…

Applications of Probability Theory

- The subject of probability can be traced back to the 17th century when it arose out of the study of **gambling games**.

- The range of applications extends beyond games into business decisions, insurance, law, **medical tests**, and the social sciences.

- The **stock market**, "the largest casino in the world," cannot do without it.

- The **telephone network**, call centers, and airline companies with their randomly fluctuating loads could not have been economically designed without probability theory.

"The Perfect Thing"
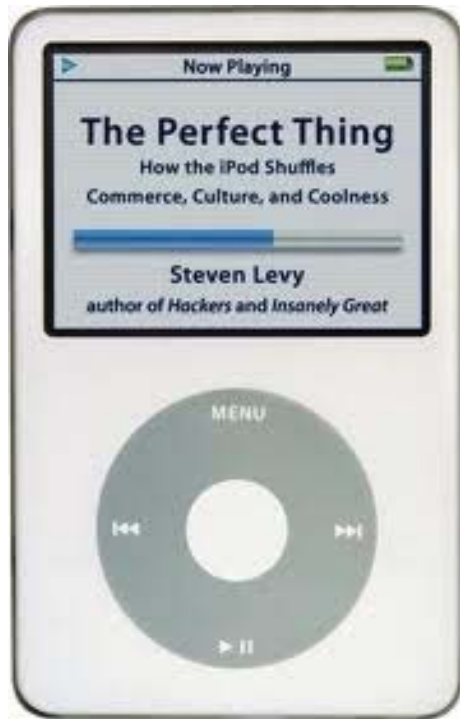
What is this?

"The Perfect Thing"

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Steven Levy
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The Perfect Thing: How the iPod Shuffles Commerce, Culture, and Coolness [Hardcover]

Steven Levy (Author)

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What about the shuffle function?

About.com iPhone / iPod
Part of The New York Times Company

iPhone / iPod | New to iPhone? | Apps | iPho

Is iTunes' Shuffle Mode Truly Random?
By Sam Costello, About.com Guide

http://ipod.about.com/od/advanceditunesuse/a/itunes-random.htm

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MP3 Players > News > iTunes: Just how random is random?

iTunes: Just how random is random?
By David Braue | March 8, 2007 | 127

http://www.cnet.com.au/itunes-just-how-random-is-random-339274094.htm

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iPod Shuffle Problems: How Random is the iPod Shuffle?

So just how random is the shuffle capability on an iPod Shuffle? Even before the device debuted in 2005, people have wondered about the shuffle function on iPods. Many complain that what they hear from

http://electronics.howstuffworks.com/ipod-shuffle2.htm

USA Currency Coins

- Penny = 1 cent
  (Abraham Lincoln)

- Nickel = 5 cents
  (Thomas Jefferson)

- Dime = 10 cents
  (Franklin D. Roosevelt)

- Quarter = 25 cents
  (George Washington)

Thai Coins

Back

[http://travel.kapook.com/view75126.html]

`randi` function

- Generate uniformly distributed **pseudorandom integers**
- `randi(imax)` returns a scalar value between 1 and `imax`.
- `randi(imax,m,n)` and `randi(imax,[m,n])` return an *m*-by-*n* matrix containing pseudorandom integer values drawn from the discrete uniform distribution on the interval [1,`imax`].
  - `randi(imax)` is the same as `randi(imax,1)`.
- `randi([imin,imax],...)` returns an array containing integer values drawn from the discrete uniform distribution on the interval [imin,imax].

randi function: examples

Coin Tosses:

```
>> randi([0,1])
ans =          T, H
     0
>> randi([0,1],10,2)
ans =
     1     0
     1     0
     1     0
     1     1
     1     1
     0     0
     1     1
     0     0
     1     0
     0     0
```

Dice Rolls

```
>> randi([1,6])
ans =
     5
>> randi([1,6],10,2)
ans =
     5     1
     2     1
     3     3
     3     6
     4     3
     5     4
     5     2
     2     5
     5     2
     4     4
```
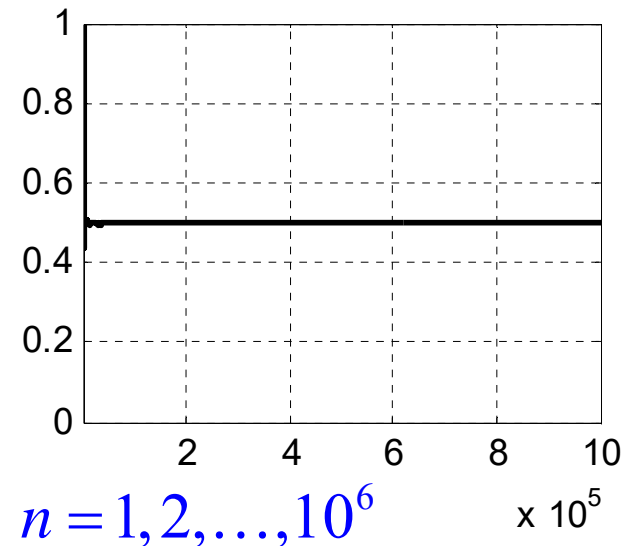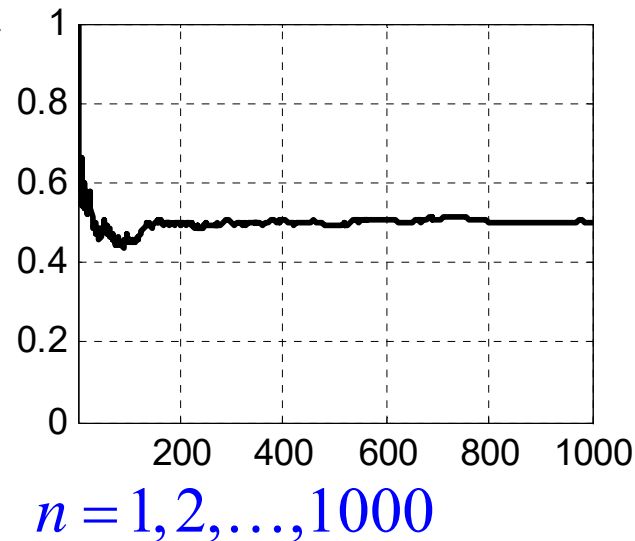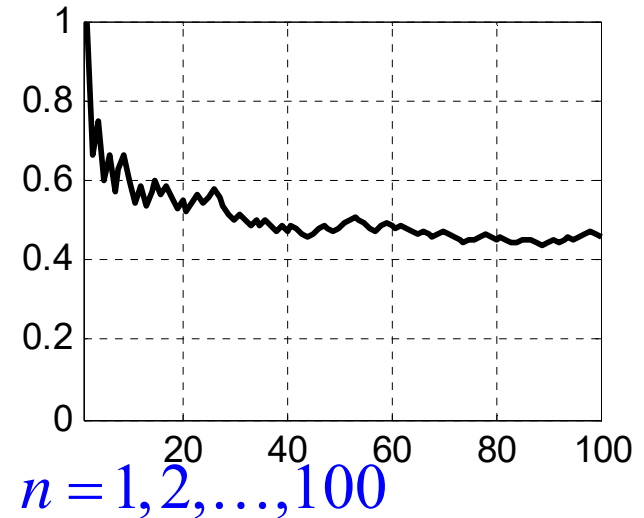
randi function: examples

Coin Tosses:

```
>> S = ['T','H']
S =
TH
>> S(randi([1,2]))
ans =
H
>> S(randi([1,2],10,2))
ans =
TT
HH
HT
TT
HT
TT
TH
HT
HH
HT
```

Coin Tossing: Relative Frequency

$$\frac{N(A,n)}{n}$$

If a fair coin is flipped a large number of times, the **proportion** of heads will tend to get closer to 1/2 as the number of tosses increases.
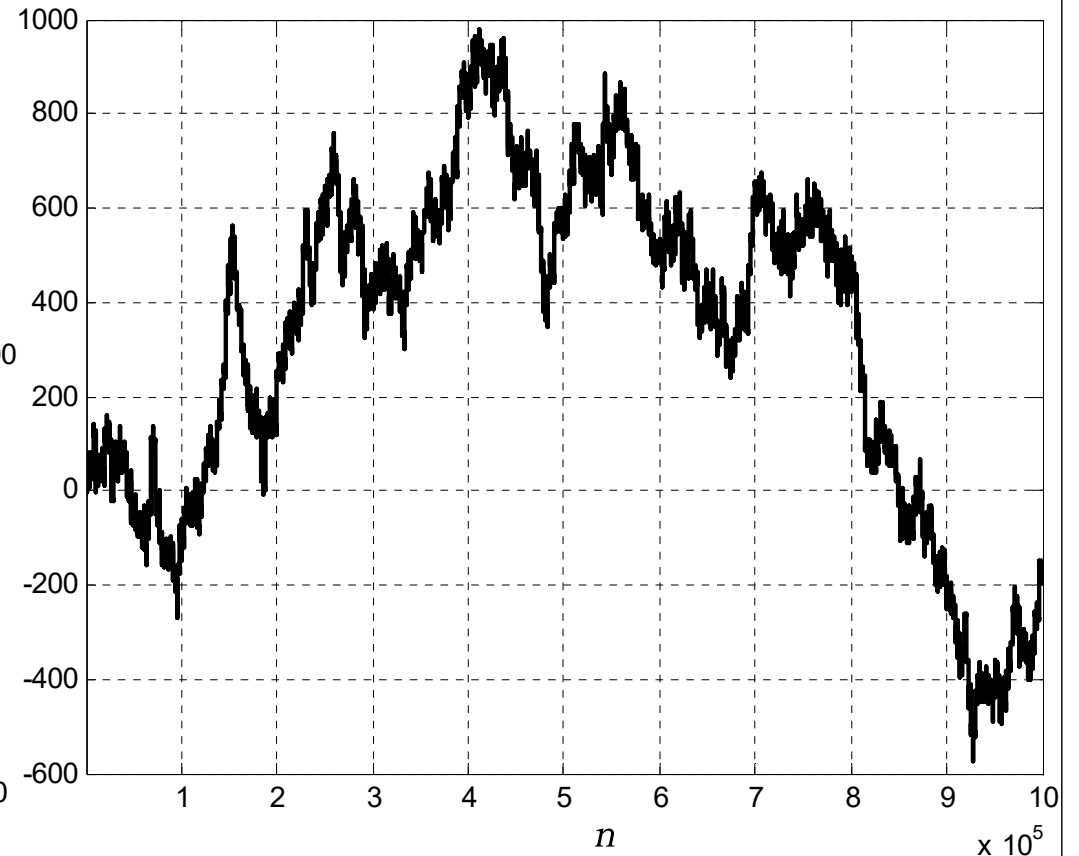

$n = 1, 2, \ldots, 10$

$n = 1, 2, \ldots, 100$

$n = 1, 2, \ldots, 1000$

$n = 1, 2, \ldots, 10^6$

x 10^5

15
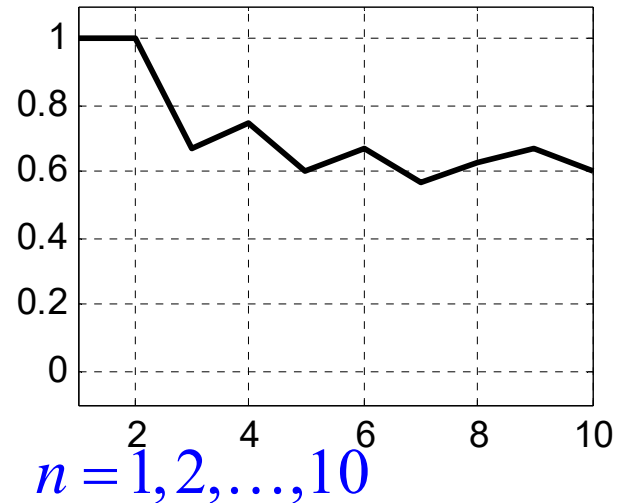
Coin Tossing: Relative Frequency

```matlab
close all; clear all;
N = 1e3; % Number of trials (number of times that the coin is tossed)
s = randi([0,1],1,N);    % Generate a sequence of N Coin Tosses.
                         % The results are saved in a row vector s.
NH = cumsum(s); % Count the number of heads
plot(NH./(1:N),'LineWidth',1.5); grid on % Plot the relative frequencies
```

Coin Tossing: Relative Freq. vs. #H-#T

This statement does not say that the difference between #H and #T will be close to 0.

If a fair coin is flipped a large number of times, the **proportion** of heads will tend to get closer to 1/2 as the number of tosses increases.
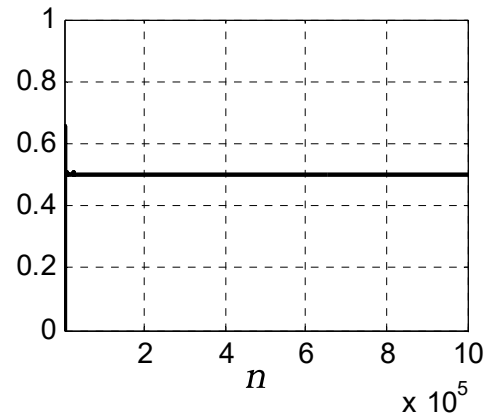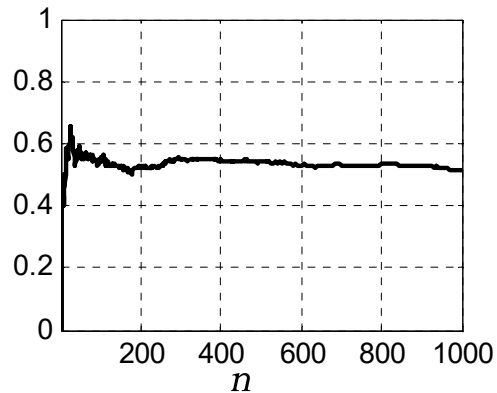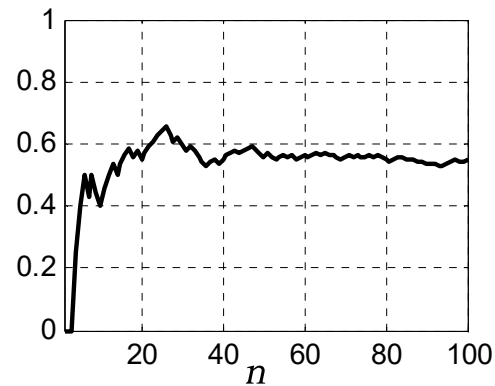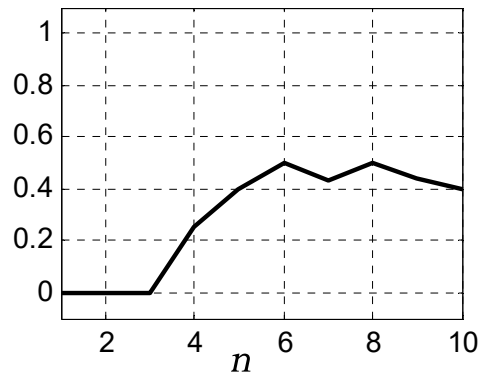
The **difference** between #H and #T will **not** converge to 0.

Another Experiment

Relative Freq.

#H-#T

Another Experiment

Relative Freq.

#H-#T