Probabilistically Exercising

Tutorial 04

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Training algebro-probabilistic skills

Show that:

- $\displaystyle\int_{-\infty}^{+\infty} \exp\left(-x^2\right) dx = \sqrt{\pi}$
- $\mathbb{E}\{X\} = \mu$ and $\mathbb{E}\left\{\left(X - \mathbb{E}\{X\}\right)^2\right\} = \sigma^2$ when $X \sim \mathcal{N}(\mu, \sigma^2)$
- $\mathbb{E}\{X\} = \dfrac{(a+b)}{2}$ and $\mathbb{E}\left\{\left(X - \mathbb{E}\{X\}\right)^2\right\} = \dfrac{(b-a)^2}{12}$ when $X \sim \mathcal{U}(a, b)$

Flip a coin experiment

Toss N times a coin that has probability p of coming up head.

Do you expect to see a sequence of 10 **heads?**

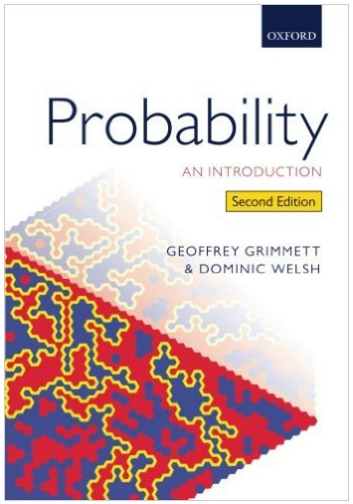
CoinFlip.m

```
clc; clear; close all

% number of tosses / head probability
Ntoss = 1000; p = 0.5;
% sequence of heads size
s = 10; Hseq = ones(1,s);
% experiment realizations (head = 1 / tail = 0)
HTexp = rand(1,Ntoss) < p;
disp('-------------------------')
disp(' Flip a Coin Experiment')
disp('-------------------------')
for i=1:Ntoss
    if HTexp(i) == 1
        disp('  H')
    else
        disp('  T')
    end
end
H = sum(HTexp); T = Ntoss-H; N_Hseq = length(strfind(HTexp,Hseq));
disp(['Heads: ',num2str(H)])
disp(['Tails: ',num2str(T)])
disp(['Sequences with ',num2str(s),' heads : ',num2str(N_Hseq)])
```

References

G. Grimmett and D. Welsh, **Probability: An Introduction**. Oxford University Press, 2 edition, 2014.



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