

## Science Lesson Plan

**Teacher:**

**Period:**

**Class:**

**Date(s):**

<b>SETTING THE STAGE</b>	
<u>Essential Question</u>	
<u>Content Objective(s)</u> (Student-friendly)	<ul style="list-style-type: none"> <li>- Review basic probability terms.</li> <li>- Conduct a basic probability experiment, and analyze the results compared to the theoretical value.</li> <li>- Observe a way of carrying the experiment to an automated approach.</li> <li>- Introduce students to Matlab scripts.</li> <li>- Gain familiarity with simulation methodology.</li> </ul>
<u>Connection to previous or future lessons</u>	This module will continue using Matlab as a computation tool. Students will see variables to count heads and tails. They used bar plots in the previous class. We will use bar graphs in this class also.
<u>Critical Thinking Questions</u>	How can variance help us from experimental results to theoretical ones?
<u>Key Vocabulary</u>	Probability, theoretical probability, experimental probability, random, variance
<u>Materials Needed/Safety</u>	
<b>ACTIVE INSTRUCTION</b>	
<ul style="list-style-type: none"> <li>• Launch (Engage)</li> </ul>	<p>Students will discuss what probability is. We will review basic probability concepts by answering questions such as:</p> <ul style="list-style-type: none"> <li>• What is the probability of getting a red fish from a fish tank which has 8 yellow and 4 red fish in it.</li> <li>• What is the probability of tomorrow's being Saturday?</li> <li>• What is the probability we are in June?</li> <li>• What is the probability of getting tails when you flip a coin?</li> </ul> <p>We will also pay attention that all probabilities for outcomes of an event adds up to be 1 (or 100%).</p>

## Science Lesson Plan

### Teacher:

<ul style="list-style-type: none"> <li>• Investigation (Explore)</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct a coin toss experiment.               <ul style="list-style-type: none"> <li>- Students are grouped in twos.</li> <li>- Each group tosses a coin ten times, records results, and finds the probabilities for Heads and Tails.</li> </ul> </li> <li>• Groups read their results, and we calculate the probabilities of Heads and Tails for the class.</li> <li>• Students copy the Matlab script to their folders.</li> <li>• The function of script is explained. Matlab “rand” call is explained.</li> <li>• Students run the script for different number of experiments. They observe the change in probability of Heads and Tails when the number of experiments increases. They are asked to repeat the test for three times for a number of experiments.</li> <li>• Students answer questions and write down their observations.</li> </ul>
<b>TIME FOR REFLECTION</b>	
<ul style="list-style-type: none"> <li>• Summarization (Explain &amp; Extend)</li> </ul>	<ul style="list-style-type: none"> <li>• The theoretical probability of Heads and Tails is <math>\frac{1}{2}</math>.</li> <li>• We observe very different probability results from theoretical probability value for coin toss experiment.</li> <li>• Our averaging the values for the classroom made it closer to the theoretical value.</li> <li>• Using our coin toss simulation, we saw that when number of experiment is small results vary for each run.</li> <li>• When we increase the number of experiments, the fluctuation in the probability results drops.</li> <li>• When we increase the number of experiments, the experimental probability value, becomes close enough to the theoretical value.</li> </ul>
<ul style="list-style-type: none"> <li>• Assessment (Evaluate)</li> </ul>	<p style="text-align: center;">Students will answer questions on calculating probability, and their observations. A worksheet will be handed for this section.</p>

**Science Lesson Plan**

**Teacher:**

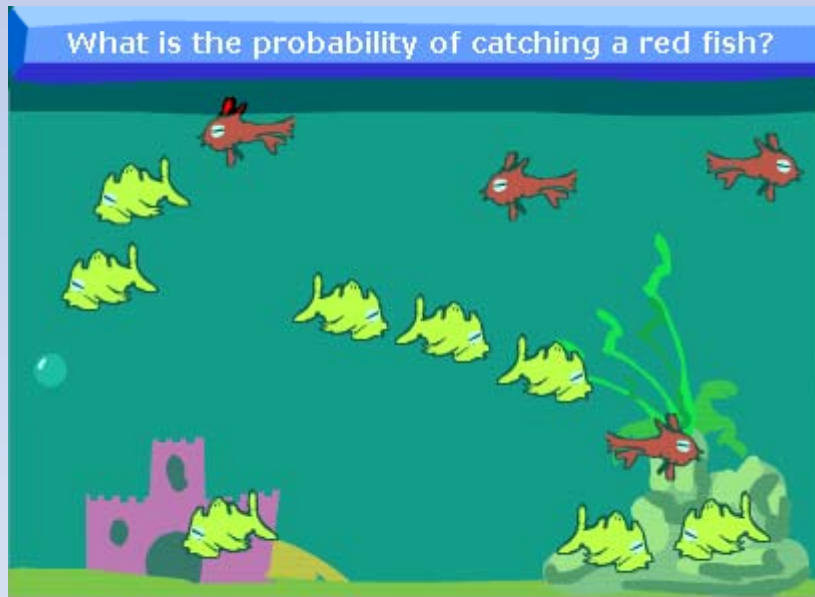
<ul style="list-style-type: none"><li>• Homework</li></ul>	None.
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# PROBABILITY

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# Probability

Probability of an event, or  $P(\text{event})$ , tells you how likely that something will occur.



# Outcome/Event

An outcome is the result of a single trial.

– Fish Tank Example:

- Possible Outcomes: Red and yellow fish

$$P(\text{red}) = 4/12 = 1/3 \quad P(\text{yellow}) = 8/12 = 2/3$$

$$P(\text{red}) + P(\text{yellow}) = 1$$

An event is any outcome or group of outcomes.

# Sample Space

Sample space is all of the possible outcomes.

– Coin Toss:



# Theoretical Probability

$P(\text{event}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}}$

Example:  $P(5)$  for die roll

Sample Space: 


$$P(5) = \frac{1}{6}$$



# Experimental Probability

$P(\text{event}) = \frac{\text{number of times an event occurs}}{\text{number of times the experiment is done}}$

Example:  $P(5)$  when die is rolled 24 times.

Outcomes: 

$$P(5) = \frac{4}{24} = \frac{1}{6}$$

# Variance

Variance of an event is a number that defines how far the values are from the mean of the distribution.

November 19, 2010

## ALGEBRA 1 / PROBABILITY

### EXERCISE I

1. Toss the coin. Record the result onto the table.
2. Repeat the experiment nine more times.

Heads	Tails

3. Calculate  $P(\text{Heads})$  of your experiment.
4. Calculate  $P(\text{Tails})$  of your experiment.
5. What is the sample space of the coin?
6. What is the theoretical probability of getting Tails?
7. What are the results for  $P(\text{Heads})$  and  $P(\text{Tails})$  for the whole classroom?

8. Are the results of experimental probability closer to the results of theoretical probability when the number of experiments increases?

## EXERCISE II

1. Go to My Computer > Q drive > Kalkan-Savoy, A.

Copy the file "coinflip.m" to your MATLAB folder in My Documents.

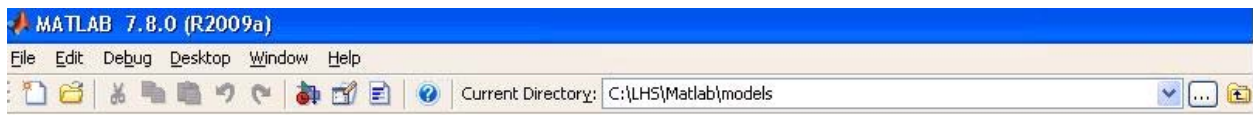
My Computer > Q drive > Kalkan-Savoy, A > coinflip.m -> My Documents > MATLAB

1. Start Matlab.

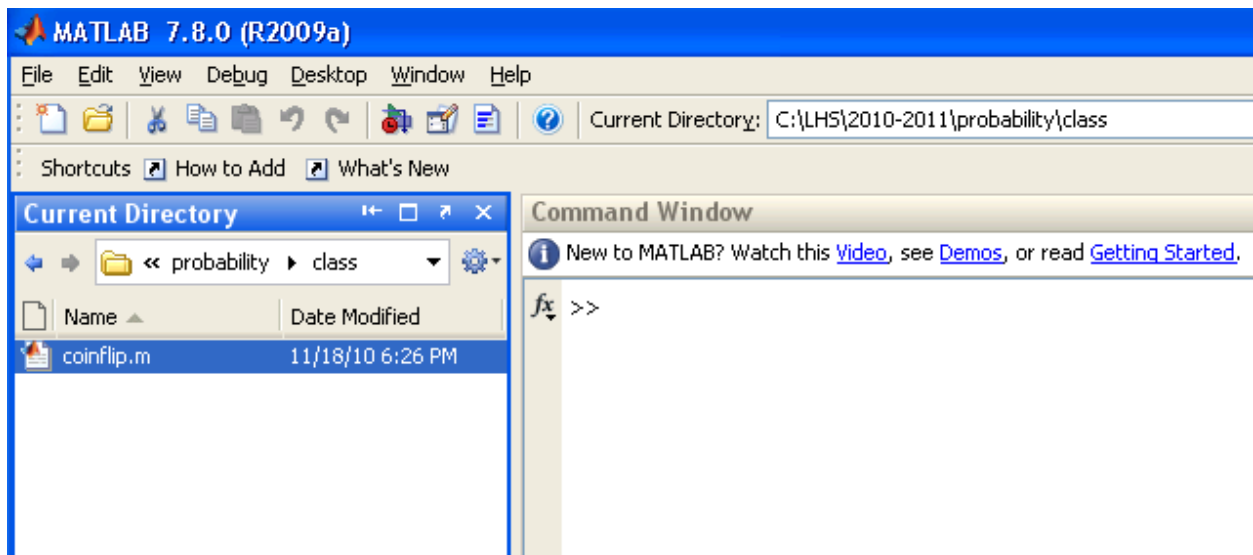
My Computer > Q drive > Matlab > MATLAB R2010b

2. Change the Matlab directory to My Documents > MATLAB.

To change the directory, use the button on top right next to the current directory field.



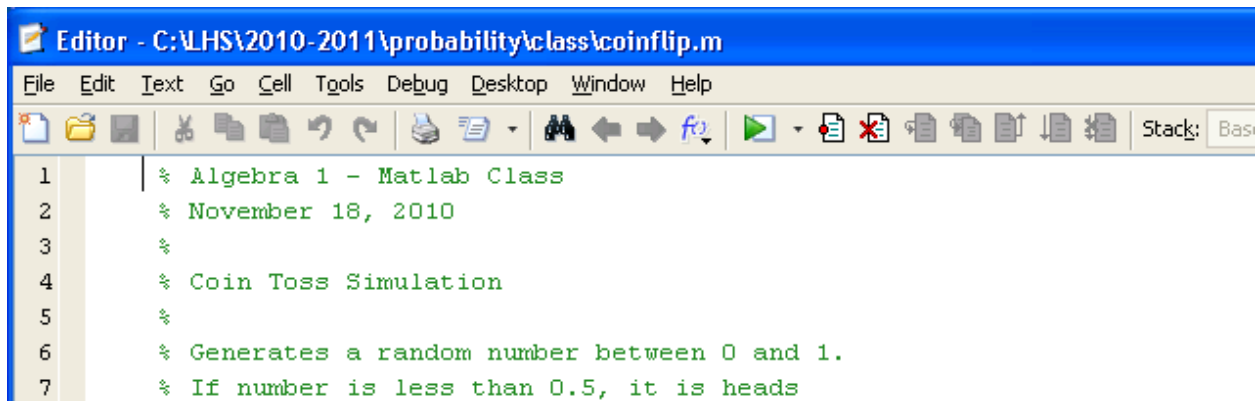
3. Open the file coinflip.m by double clicking on the file name in Current Directory window on the left top corner. You can also use the top menu, File > Open.



4. coinflip.m is a Matlab script file. When you run a script file, the line of commands will be implemented in the order they are in. The green color text after % sign is comments, and not part of the code. Any text after % sign is ignored by the software, and written to make the code understandable.

This file will simulate five coin flips, and plot the results. We are using “rand” function which generates random numbers between 0 and 1 to simulate coin flips.

Run the script by clicking the green arrow icon at the top.



```
1 % Algebra 1 - Matlab Class
2 % November 18, 2010
3 %
4 % Coin Toss Simulation
5 %
6 % Generates a random number between 0 and 1.
7 % If number is less than 0.5, it is heads
```

The number of the tails and heads will be displayed in a bar graph. What is P(heads) ?

5. Run the script two more times. Are the results very different from each other?

6. In the script, change N to 500.

```
15
16 % N: Number of experiments
17 - N = 5;
18 % Initialize heads and tails counters
19 - heads = 0;
20 - tails = 0;
21
```

Run the script. Check the results.

Run the script two more times. What did change when the number of experiments increased?

7. Change N to 50000. What are your observations?

```
% Algebra 1 - Matlab Class
% November 18, 2010
%
% Coin Toss Simulation
%
% Generates a random number between 0 and 1.
% If number is less than 0.5, it is heads
% else its is tails.
% The process is repeated for N number of times,
% and number of heads and number of tails are
% counted.
% Experiment with number of experiments to its
% effects on the results.
%
%
% N: Number of experiments
N = 5;
% Initialize heads and tails counters
heads = 0;
tails = 0;
% Loop N times to repeat the experiment
for i=1:N
    if rand < 0.5
        % Count heads
        heads = heads + 1;
    else
        % Count tails
        tails = tails + 1;
    end
end
pheads = heads/N;
ptails = tails/N;
fprintf(1,'heads: %d tails:%d H/R: %f\n',heads, tails, heads/tails)
fprintf('Probability of Heads: %f\n', pheads);
fprintf('Probability of Tails: %f\n', ptails);
% Display results in a bar graph
Y = [heads, tails];
figure(1);
```

```
bar_h = bar(Y);  
title('Heads vs Tails');  
mY = min(Y) ;  
L = mY/2;  
text(0.8,L,'Heads','FontSize',14,'Color','w');  
text(1.9, L,'Tails','FontSize',14,'Color','w');
```