1 Lecture attendance

1. To find this probability matrix, divide by the total number of students registered for the course:

```
jointProb1 = data1/sum(sum(data1)) =  [ 0.2250  0.3750
                                        0.3000  0.1000 ]

jointProb2 = data2/sum(sum(data2)) =  [ 0.4500  0.1500
                                        0.3000  0.1000 ]
```

2. ```
   [p(P) p(A)] = sum(jointProb) = [0.5250 0.4750] and [ 0.7500 0.2500 ]
   [p(M) p(F)] = sum(jointProb') = [0.6000 0.4000] for both lectures
   ```

3. We need to check whether $p(M \cap P) = p(M)p(P)$, etc. The matrix of products is given by

```
[p(M) p(F)]' * [p(P) p(A)] = [ 0.3150 0.2850    and [ 0.4500 0.1500
                               0.2100 0.1900 ]        0.3000 0.1000 ]
```

Comparing with the answer to Question 1, it can be seen that sex *is* a factor affecting lecture attendance for the 9am lecture, but not for the 10am lecture.

4. Use the formula $p(P|M) = p(P \cap M)/p(M)$, etc. The answers are:

```
[ 0.3750  0.6250    and  [ 0.7500  0.2500
  0.7500  0.2500 ]         0.7500  0.2500 ]
```

From this you would conclude that female students are equally likely to attend a 9am lecture and a 10am lecture. Male students are much less likely to attend 9am lectures than females, and are less likely to attend a 9am lecture than a 10am lecture. A student is equally likely to attend a 10am lecture, regardless of sex.
```

2 Tossing biased coins

1. Use Bayes' theorem:

$$\begin{aligned} p(B|H) &= \frac{p(B \cap H)}{p(H)} = \frac{p(H|B)p(B)}{p(H|B)p(B) + p(H|F)p(F)} \\ &= \frac{0.6 \times 0.5}{0.6 \times 0.5 + 0.5 \times 0.5} = 0.545 \end{aligned}$$

2. We can use the answer to the previous question – this is the new probability of the coin being biased, given that the previous throw was heads:

$$\begin{aligned} p(H_2|H_1) &= p(H_2 \cap B|H_1) + p(H_2 \cap F|H_1) \\ &= p(H_2|B)p(B|H_1) + p(H_2|F)p(B|H_1) \\ &= 0.6 \times 0.545 + 0.5 \times (1 - 0.545) = 0.555 \end{aligned}$$

   Note: this uses the fact that $p(H_2|B, H_1) = p(H_2|B)$, in other words, successive throws are independent of each other, if we know which coin has been chosen.

3.
```
function [prob] = CoinFlipProb(n, coinType)

 if coinType == 1  % biased
     p = 0.6
 else
     p = 0.5
 end

 prob = factorial(2*n)./factorial(n).^2 .* p.^n .* (1-p).^n;

end
```

   (The dots are just there to allow the function to be called with several different values of `n` simultaneously.)

4. Use a similar calculation to Question 1.

```
n = 0:40;
probs = CoinFlipProb(n, 1)./(CoinFlipProb(n, 1)+CoinFlipProb(n, 2));
plot(probs);
```