Week 2 Questions

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Question 1.

(a) 6 choices each time. If order of die rolls matters then $6^3 = 216$

(b) $5^3 = 125$ ways to not get a single 2. $216 - 125 = 91 =$ number of events where atleast single 2. $\frac{91}{216} = .421$ percentage of where atleast one 2.

(c)

```
function out = tripleDieRoll(reps)
    out = simulation(reps);
end

function out = dieRoll(sides,reps)
    out  = randi([1 sides],1,reps);
end


function prob = simulation(reps)
    count = 0;
    for index = 1:reps
        currentRolls = dieRoll(6,3);
        for throwno = 1:3
            if currentRolls(throwno) == 2
                count = count + 1;
                break;
            end
        end
    end
    prob = (count/reps)*100;
end
```

call with tripleDieRoll(ARBIRTARY_NUMBER_OF_SIMULATIONS)
42% ± 1% with a number of 10 million simulations.

(d) $6 + 6 + 5 = 17$ which is the only way to actually. get 17 but also can be in any order so

$$\frac{3}{216} = 0.014$$

(e) Since purely a sum we don't really need to use conditional probability we can just consider 2 dice rolls that sum to $12 - 1 = 11$

$$\{6, 5\}, \{5, 6\}$$

$$\frac{2}{(6^2)} = 0.056$$

Question 2

(a) $\frac{1}{6}$ chance of a 5 if 6 sided and $\frac{1}{20}$ if 20 sided. $\frac{1}{6}$ chance of a 1 and $\frac{5}{6}$ chance of anything else in first throw.

$$\frac{1}{6} * \frac{1}{6} + \frac{5}{6} * \frac{1}{20} = .0694$$

(b) If 6 sided die then impossible hence

$$\frac{1}{6} * 0 + \frac{5}{6} * \frac{1}{20} = 0.0417$$

Question 3

$$P(E|F) * P(F) = P(F|E) * P(E)$$

Probability of brown hair P(F) $= .2 * .4 + .6 * 1 = 0.68$
Probability of being criminal given brown hair = ?
Probability of being criminal P(E) = .6
Probability of brown hair given criminal = 1

$$\frac{.6 * 1}{.68} = 0.882$$

Question 4

Assumption is that P(Observation) is 100 which implies we know that regardless of where we are we will ping the cellphone at a set time. The alternative is to use marginalisation and say

$P(Observation) = P(Observe|Location) * P(Location) + (1 - P(Location)) * (1 - P(Observe|Loca$

Which assumes that $P(Observation|'Location) = 1 - P(Observe|Location)$ which isnt necessarily true wither hence I went with the initial assumption instead

$$P(Observe|Location) = given$$

$$P(Location) = given$$

$$P(Location|Observe) = unknown$$

$P(Observation)$ = Sum of all $P(Location) * P(Observe|Location)$ by marginalisation since all $P(Locations)$ add to 1. Assume that all tiles have same P(Observation)

$$(P(O|L) * P(L))/P(O) = P(L|O)$$

answer =

```
    0.0744    0.1885    0.0744    0.0050
    0.0050    0.1488    0.0942    0.0744
   0.0010    0.0050    0.1488    0.0942
    0.0010    0.0010    0.0099    0.0744
```

```
function resGrid = cell_tracker(locGrid, obsGivenLocGrid)
    [rowLen,colLen] = size(locGrid);
    if [rowLen,colLen] ~= size(obsGivenLocGrid)
        error("grid dimensions are different");
    end
    %Calculate P(observation)
    obs = calcObs(locGrid,obsGivenLocGrid);
    resGrid = zeros(rowLen,colLen);
    for i = 1:rowLen
        for j = 1:colLen
            resGrid(i,j) = calcCondLocProb(locGrid(i,j), ...
                obsGivenLocGrid(i,j),obs);
        end
    end
end

function res = calcCondLocProb(locProb,obsGivenLocProb,obsProb)
    res = (obsGivenLocProb*locProb)/obsProb;
end

function res = calcObs(locGrid,obsGivenLocGrid)
    [rowLen,colLen] = size(locGrid);
    res = 0;
    if [rowLen,colLen] ~= size(obsGivenLocGrid)
        error("grid dimensions are different");
    end
    for i = 1:rowLen
        for j = 1:colLen
            res = res + locGrid(i,j)*obsGivenLocGrid(i,j);
        end
    end
end
```

Iterates over both grids and applies formula given above to both grids