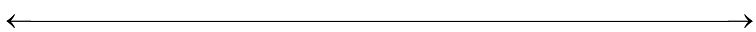
HANDOUT X
MATH 017
PROBABILITY DIAGRAMMES
M. P. M. M. MCLOUGHLIN

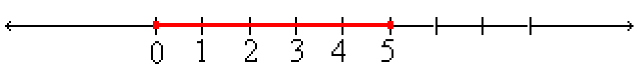
This is a handout set on the naïve or intuitive idea of probability and on geometric probability.
For the naïve or intuitive idea, incorporate both your intuitive idea of probability of an event, E, from a well-defined sample space, S, being $\frac{|E|}{|S|}$ (where E is a set from the well-defined universe S); for the geometric probability use the concept of length to compute probabilities.

If we are have S = $\mathbb{R}$, or a subset of the reals draw a line and find the probabilities using the graph of the reals:

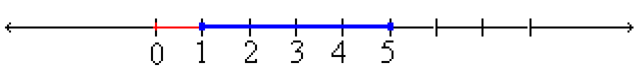


Let us say S = [0, 5] , E = [1, 5]   F = [2, 4), G = {1, 4}

S $\ell(S) = 5$

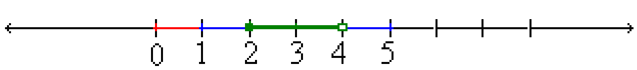


E $\ell(E) = 4$

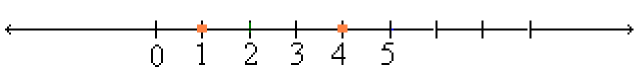


$\ell(F) = 2$

F

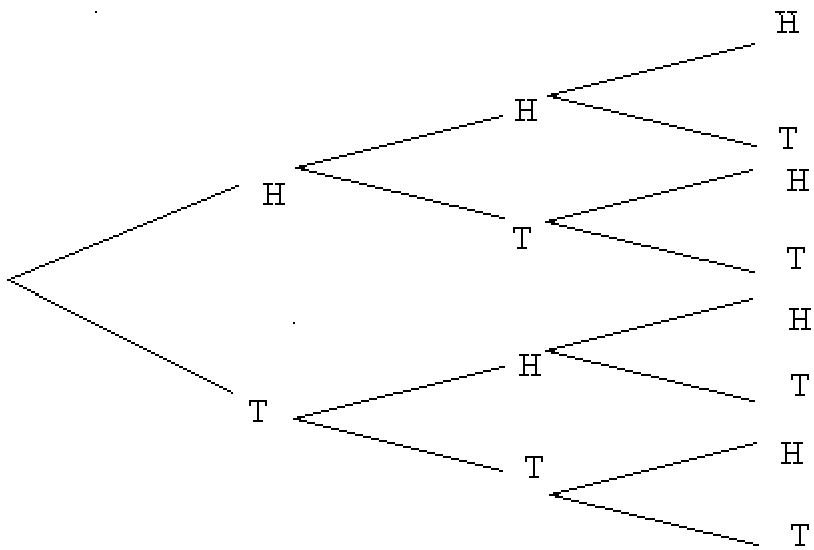


G $\ell(G) = 0$



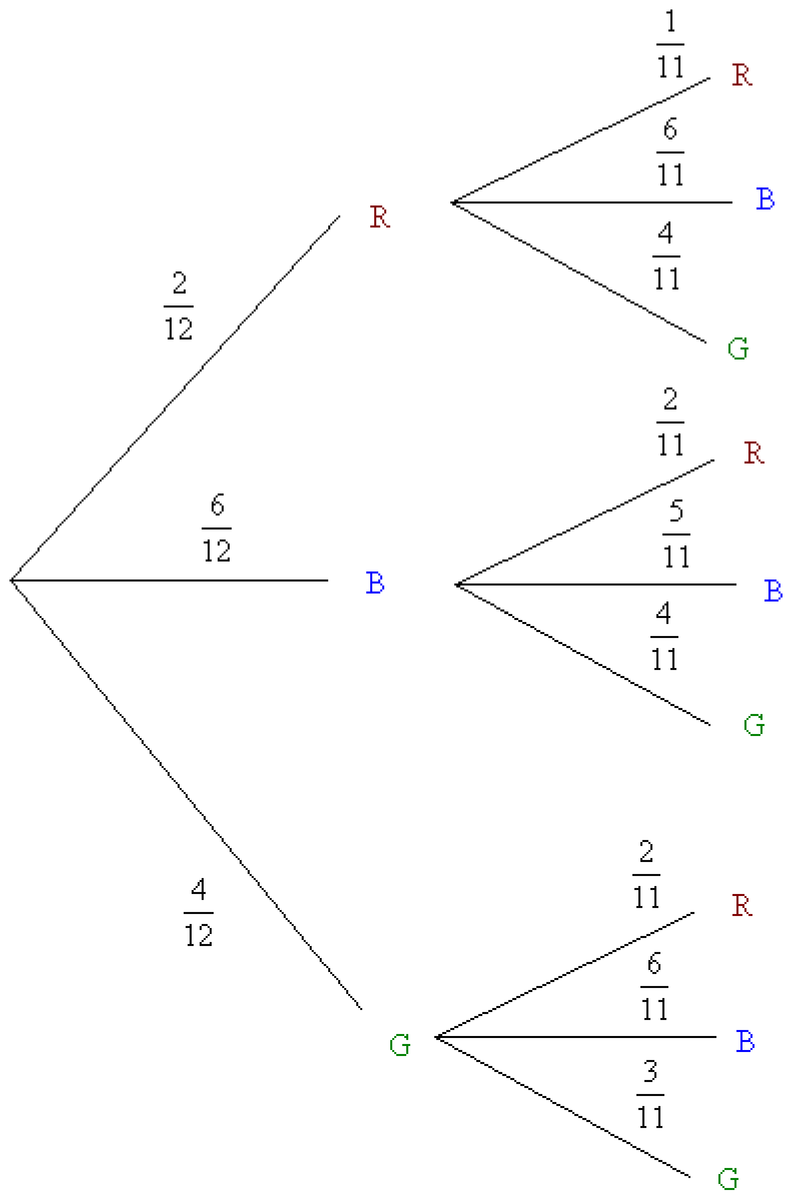
So, $\Pr(E) = \frac{4}{5}$, $\Pr(F) = \frac{2}{5}$, $\Pr(G) = \frac{0}{5} = 0$, $\Pr(F^C) = \frac{3}{5}$, etc.

In drawing a tree as discussed in class it is easy if there are not many events like flipping a coin 3 times, it is easy. We are then going to draw a tree to illustrate the experiment.



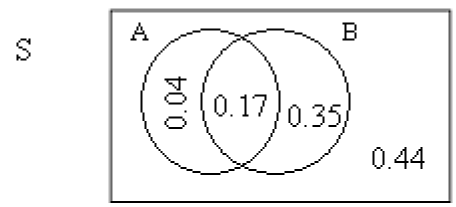
But if there are a lot of things but there aren't many stages of the experiment, then a tree is best drawn with the events and probabilities on the branches:

Let us say there is an urn with 2 red, 6 blue, $\wedge$ 4 green balls. We draw a ball then another ball from the urn. We are then going to draw a tree to illustrate the experiment.

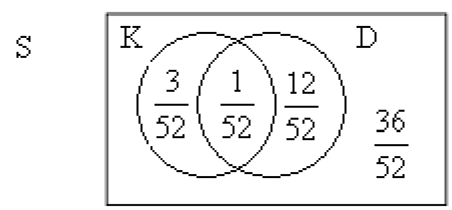

2/12
R
1/11
R
6/11
B
4/11
G
6/12
B
2/11
R
5/11
B
4/11
G
4/12
G
2/11
R
6/11
B
3/11
G

However, if the experiment is not in stages but the descriptors are multiple descriptions of things (***at the same time***) then it is best to draw a Venn diagramme with the probabilities.

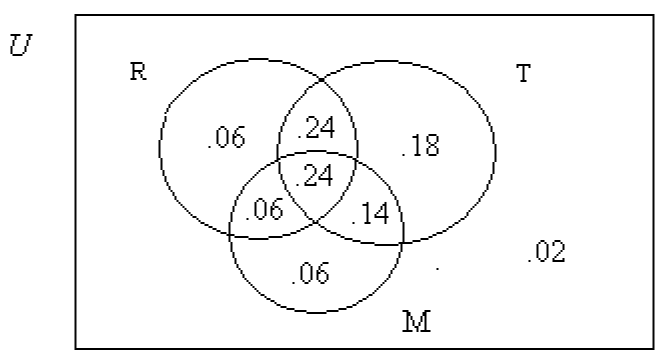
S is a well defined sample space, $Pr(A) = 0.21$, $Pr(B) = 0.52$, and $Pr(A \cap B) = 0.56$
We get:



Pick a card from a standard 52 deck of cards. Finding probability of picking a king, but not a spade: Let K be the event draw a king and D be the event draw a spade.
We get:



Or even three
S is a well defined sample space, $Pr(R) = 0.60$, $Pr(T) = 0.80$, $Pr(M) = 0.50$,
$Pr(R \cap T) = 0.48$, $Pr(R \cap M) = 0.30$, $Pr(M \cap T) = 0.38$, and $Pr(R \cap T \cap M) = 0.24$,
We get:



Notice how no matter what the Axioms of Probability hold!

<u>Axiom 1</u> S is the space $\Rightarrow Pr(S) = 1$

<u>Axiom 2</u> E is an event $\Rightarrow 0 \le Pr(E) \le 1$

<u>Axiom 3</u> Let I be an index set. The collection $\{E_i\}_{i \in I}$ being mutually exclusive

$$\Rightarrow Pr\left(\bigcup_{i \in I} E_i\right) = \sum_{i \in I} Pr(E_i)$$