

MAT 2379, Introduction to Biostatistics

2.1 Tree Diagrams

The **tree diagram** is a graphical method used to represent the outcomes of a random experiment, and calculate the associated probabilities. The idea is simple: start with a common “root” and then draw one branch of the tree for each possible situation.

Example 1. Each member of a couple has alleles for both brown (B) and blue (b) eyes. The allele B is dominant over the allele b . The 4 possible genotypes for their children are: BB, Bb, bB, bb . The tree diagram will be drawn in class.

A child of this couple has blue eyes if his/her genotype is bb , and brown eyes if the genotype is: BB, Bb or bB . The probability that a child will have blue eyes is $1/4$.

Example 2. A family has 3 children identified by sex only: male m and female f . There are 8 possible births orders: $mmm, mmf, mfm, mff, fmm, fmf, ffm, fff$. Assume that each child is just as likely to be a boy as a girl.

- a) Find the probability that this couple has only boys.
- b) Find the probability that the couple has at least one boy.
- c) Find the probability that the couple has only girls?

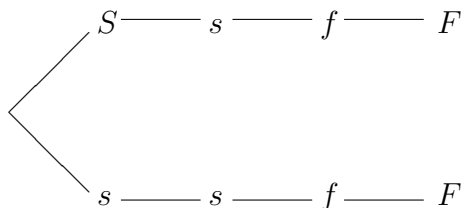
Justify your answers using a tree diagram (in class).

Example 3. In humans, the alleles for normal skin pigmentation S is dominant over that for albinism s and the alleles for free earlobes F is dominant over that for attached earlobes f .

A women has normal skin pigmentation and attached earlobes; therefore, the possible genotypes for her are $SSff$ and $Ssff$. Her husband is an albino with free year lobes; his possible genotypes are $ssFF$ and $ssFf$. There are 4 possible cases:

- (1) the women is $SSff$, her husband is $ssFF$;
- (2) the women is $SSff$, her husband is $ssFf$;
- (3) the women is $Ssff$, her husband is $ssFF$;
- (4) the women is $Ssff$, her husband is $ssFf$.

Below is the tree diagram which gives all the possible genotypes for their offspring, in case (3). In this case, the probability that their child has normal skin pigmentation and free earlobes is $1/2$.



Exercise: Draw the tree diagrams for the other cases and calculate the same probability.