BIOB480/BIOE548 notes 8/29/2024

Introduction.

- Syllabus changes: HW1 will be posted Tuesday, due the following Tuesday, so bring questions Thursday.
- Solicit thoughts on best way to learn vocab
- finish going over preliminary assessment (see `02_class_notes.pdf`).

Probability Theory

Probability Rules:

1) Possible values range from 0 (an impossible event) to 1 (a certain event)
2) The sum of probabilities for all possible outcomes is 1
3) Addition rule: the overall probability that at least one of two events occur is the the sum of their independent probabilities:

- mutually exclusive events: $P(\text{A or B}) = P(\text{A}) + P(\text{B})$
- not mutually exclusive events: $P(\text{A or B}) = P(\text{A}) + P(\text{B}) - P(\text{A and B})$

4) Multiplication rule: the probability that two events occur together is their product:

- independent events: $P(\text{A and B}) = P(\text{A}) * P(\text{B})$
- nonindependent events: $P(\text{A and B}) = P(\text{A}) * P(\text{B} \mid \text{A})$

5) Conditional probability: the probability an event happens *given* (denoted by the "|" sign) another event occurs is the probability of the two events together divided by the probability of the event that is conditioned upon:

- independent events: $P(\text{A} \mid \text{B}) = P(\text{A})$. For example, if the probability of a coin flip landing heads is 50% (event A) and landing tails is 50% (event B) and you flip two coins, knowing that the second coin landed tails (i.e., was B) gives you no new information—the probability of heads is still 50%.
- nonindependent events $P(\text{A} \mid \text{B}) = P(\text{A and B})/P(\text{B})$. For example, imagine you have a bag with six red marbles, three blue marbles, and one green marble (10 total). Event A is drawing a red marble; event B is drawing a marble that is not green. What is the probability of event B? First, we determine the joint probability of the two events ($P(\text{A and B})$; also known as their union, or $P(\text{A} \cup \text{B})$). In this case, that will be the probability of drawing a red marble that is not green. Obviously, all red marbles are not green, so this is simply the probability of drawing a red marble (6/10=0.6). Next, we calculate the probability of event B, which is again the probability of drawing a marble that is not green (9/10 = 0.9). The conditional probability will then be $P(\text{A} \mid \text{B}) = P(\text{A and B})/P(\text{B}) = 0.6/0.9 = 0.66$.

How do we study genetic diversity?

Empirical conservation genetics requires assessing genetic variation, either directly (through DNA sequences) or indirectly (through the property of phenotypes that reveal underlying sequence variation). Doing so requires a source of genetic material: typically blood, muscle, heart, liver, scat, environmental traces. Obtaining this material can either be destructive (i.e., killing the animal) or nondestructive (a blood sample). A further distinction is invasive (catching the animal and bleeding it) or noninvasive (obtaining genetic material from scat or the environment). In diploid Eurkaryotes, most cells have 2 copies each of the nuclear genome and 100-1000 copies of the mitochondrial genome. Chloroplast genomes are found in photosynthetic organelles called plastids (3-275+ copies each).

Once genetic material is obtained, laboratory methods assay variation by characterizing alleles and determining their frequency in different populations, which range from a categorical assignment of protein mobility in a gel to chromosomal inversion types to single nucleotide polymorphisms (or SNPs). Historically, these methods have included protein (allozyme) electrophoresis, RFLPs, SSCPs, minisatellites, microsatellites, and microsatellites. Contemporary genomics approaches include whole genome (re)sequencing, RADseq, and sequence capture. Polymerase chain reaction (PCR) is important to many of these methods.

(See `03_slides.pdf` for diagrams; Illumina has a nice video about their sequencers here).