DAIDD Glossary

Terms are grouped by concept. Within a definition, *italic text* denotes closely related terms that clarify or expand on the current definition, and **bold text** denotes related terms for which there is a separate entry.

model - a simplified representation of a process or phenomenon that captures essential features and that we use to gain insight into the real world

model world - a fully specified model that is intended to illuminate or provide contrast to a particular aspect of the real world; a *mathematical model* is a formal description of a model world, in the form of equations

dynamic model - a mathematical model that purports to describe how future values of quantities of interest depend on past values of those quantities, using (for example) differential or difference equations

parameter - a quantity that represents an intrinsic property of a **model world** but may take on different values in different instances of a **model world** (e.g., the value of the parameter representing the transmission probability in a Reed-Frost **model** of household transmission may be different for representing influenza versus measles)

variable - a quantity that can change over time as a result of the rules that define a **model world**

state variable - any **variable** in a **model** which captures the state of the system, such as the number of living individuals, the number of people in a particular risk category, and so forth; in a simple compartmental model, each **compartment** represents a unique **state variable**

compartment - a classification of individuals within a model, within which all individuals are treated as identical; the **state variables** of *compartmental model* keep track of the number (or density or proportion) of individuals within a given compartment but does not make any distinction between them (e.g., the SIR model classifies individuals into 3 compartments – Susceptible, Infectious, and Recovered – based on infection status/history)

process - a mechanism underlying change within a system; in the context of a mathematical model, a process may change the value of **state variables**; for example, birth is a process that increases the size of a population, and transmission is a process that decreases the number of susceptible individuals and increases the number of infected individuals by a corresponding amount

initial conditions - the starting values of **model variables** from which a **model** is run

transient dynamics - changes in the value of model **state variables** that occur early on, and typically depend on **initial conditions**

equilibrium - a set of values for all **model variables** (other than time) for which the **processes** that increase and decrease the **state variables** are balanced; for example, in a metapopulation model, colonization balances extinction at equilibrium; when a system is at *dynamic equilibrium***,** the **processes** that increase and decrease the values of some or all **model variables** (other than time) are still occurring, so individuals move between compartments while the number, density, and/or proportion of individuals in each compartment remains steady through time

continuous - taking on any real value (or any real value within a range); models that treat time as *continuous* allow the population to be updated at any moment in time; models that treat populations as *continuous* entities do not keep track of the number (count) of individuals but instead keep track of the density of individuals, the proportion of individuals, etc

discrete - taking on only particular values (usually integers); models that treat time as *discrete* only allow the population to be updated at specific (usually evenly-spaced) moments in time (e.g., annually); models that treat populations as *discrete* entities keep track of the number (count) of individuals

deterministic - proceeding without an element of chance; for a given set of initial conditions and parameter values, a *deterministic model* always gives the same outcome

stochastic - incorporating elements of randomness / chance; a *stochastic model* can produce different outcomes on different runs, even when the initial conditions and values of parameters are identical

rate - the amount of change in the value of a **variable** per specified change in time; an *instantaneous rate* is the slope (or tangent) of the relationship between time and the **variable** of interest, at a given point in time

probability - a value between 0 and 1 (inclusive) representing the chance that a specified event occurs

force of infection - the instantaneous *per capita* **rate** at which susceptible individuals acquire infection; sometimes also refers to the **probability** of infection over a discrete time interval, or $1\text{-}e^{-F(t)}$, where F(t) is the cumulative force of infection (integrated over the time interval)

reproduction number (R) - average number of infections caused by a "typical" infected individual; also known as the *effective reproduction number* (R_E); an infectious agent can spread when R >1; the *basic reproduction number* (R_0) is the reproduction number when one primary case is introduced into a completely susceptible population

herd immunity - the collective ability to clear an existing, or resist an invading, epidemic even when some individuals are fully susceptible; epidemics are not expected to occur when the fraction protected is sufficient to reduce the effective **reproduction number** (R_E) below 1

linear - describing a proportional relationship between two quantities; for example, treating 20% of the infective population with effective anti-TB drugs would reduce expected TB mortality by 20%; the term *nonlinear* is commonly used for relationships that are not linear (e.g., vaccination of 40% of dogs in the Dynamical Fever exercise leads to an 80% reduction in dog DF cases)

heterogeneity - the state of being heterogenous, where elements are defined to be non-identical or exhibiting variation; for instance, if we say that we assume that host risk behavior is heterogeneous, we mean that we are assuming that some hosts exhibit lower/higher risk than others; by contrast, *homogeneity* is the state of 'sameness', so in this example, host risk behavior would be identical

endemic - an infection that is commonly or typically present in a region; reference to the *endemic level of disease* denotes the baseline or expected incidence and usually indicates that the incidence remains consistent through time; an increase in incidence above this level is often referred to as an outbreak or **epidemic**

epidemic - an increased rate of infection above what is expected in a specific area over a specific time period, often thought of as characteristically increasing to a peak before declining

incidence - the number of new cases that occur within a given population and period of time; sometimes stated as a raw number of cases per time window, such as 1000 cases of influenza in a month needing handling at a major hospital; for comparison of incidence between populations (or within a population that is changing in size), incidence should be standardized (e.g., on a *per capita* basis or per 100,000 population)

prevalence - proportion of the population with infection or disease at a given time point

p-value - the probability of getting data as extreme as or more extreme than your observed data under the null hypothesis