Ecology and Population Biology 314 Data Set 2:
Sickle cell and resistance to Malaria

Background:

As you learned in lecture, a mutation at a single amino acid in the beta chain of the Hemoglobin gene can lead to changes in the structure of red blood cells. As you saw in the last lab, the frequency of this sickle cell allele (S) varies widely within human populations and appears to be too high in some regions to be explained by a simple balance between mutation and selection. Because regions where the frequency of the allele (S) is elevated are often those where Malaria is frequent, it has been hypothesized that heterozygous individuals (AS) are more resistant to Malaria. If heterozygous individuals benefit from increased resistance to Malaria, we would expect overdominant selection in areas where Malaria is frequent and thus elevated frequencies of the (S) allele.

Although the Malaria hypothesis is logically compelling and consistent with your findings in the previous lab, support for the Malaria hypothesis could be strengthened. Specifically, finding evidence that resistance to Malaria, as opposed to infectious disease in general, is greater in heterozygous (AS) individuals than in homozygous (AA) individuals, would provide valuable support for the Malaria hypothesis.

You task:

Using the background information above and the data on non-malarial and malarial infections for patients with known genotypes compiled in the file DataSet2.xls, evaluate support for the Malaria hypothesis. Be sure to provide appropriate citations within your report for any additional sources you use to justify your conclusions.

The file, DataSet2.xls contains re-synthesized data collected as part of a study conducted in the Kilifi District of coastal Kenya (Williams et al. 2005). In brief, 323 children were included in the study, all between the ages of 0-5. Data on infections was collected at a dedicated research clinic and genotype information was collected after the study ended. Data in the file "DataSet2.xls" was re-synthesized from the original data reported in Table 1.

References:

Williams, T.N., T.W. Mwangi, S. Wambua, N.D. Alexander, M. Kortok, R.W. Snow, and K. Marsh. 2005. Sickle Cell Trait and the Risk of *Plasmodium falciparum* Malaria and Other Childhood Diseases. *Journal of Infectious Disease* 192:178-186.