Quiz 1 – Winslow Marion Pang

**Question 1: Positive and Negative Predictive Values**

a.

From the above formula, we can calculate the prevalence in adults:

The prevalence of septic shock in children is 3 times lower, thus we obtain

b.

From before, using the same values

We can calculate the prevalence in adults:

The prevalence of septic shock in children is 3 times lower, thus we obtain

c. The following features were used in the model to calculate the possibility of septic shock: Lactate, Cardiovascular SOFA, GCS, HR (bpm), PaO2 (mmHg), FiO2. However, these features often vary greatly from adults to children. For example, a child’s heart typically beats fasting that an adult’s – while a healthy adult’s heart rate can range from 60 to 100 bpm during rest, a child’s can range from as low as 60bpm to as high as 220bpm.

In addition, GCS (Glasgow Coma Scale) which is used to record a person’s state of consciousness differs so completely between children and adults that a completely different scale known as the PGCS (Pediatric Glasgow Coma Scale) is used instead.

More importantly, fixed blood lactate levels differ greatly between just prepubertal (2.5 mmol/L) and teenage/adult males (4.0mmol/L). Since the model relies greatly on the lactate blood level feature for its predictions, we need to account for this difference and re-train the model to identify if there will still be 4 specific clusters.

**Question 2: Maximum Likelihood Estimation**

We assume that the number of arrhythmias per unit per unit time is distributed as a Poisson random variable. Thus, within the time interval of seconds, the probability of observing N arrhythmias is:

Where is the rate of the Poisson process (arrhythmia rate per second). In s, we have

We seek to find the maximum likelihood estimate of such that is maximized.

This can be done by maximizing the log of the likelihood (as the logarithm is an increasing monotonic function).

For iid Poisson random variables will have a joint frequency function We can then find the log likelihood:

We find the maximum by taking the derivative:

Thus, the maximum likelihood estimate of the arrhythmia rate for each minute is simply .