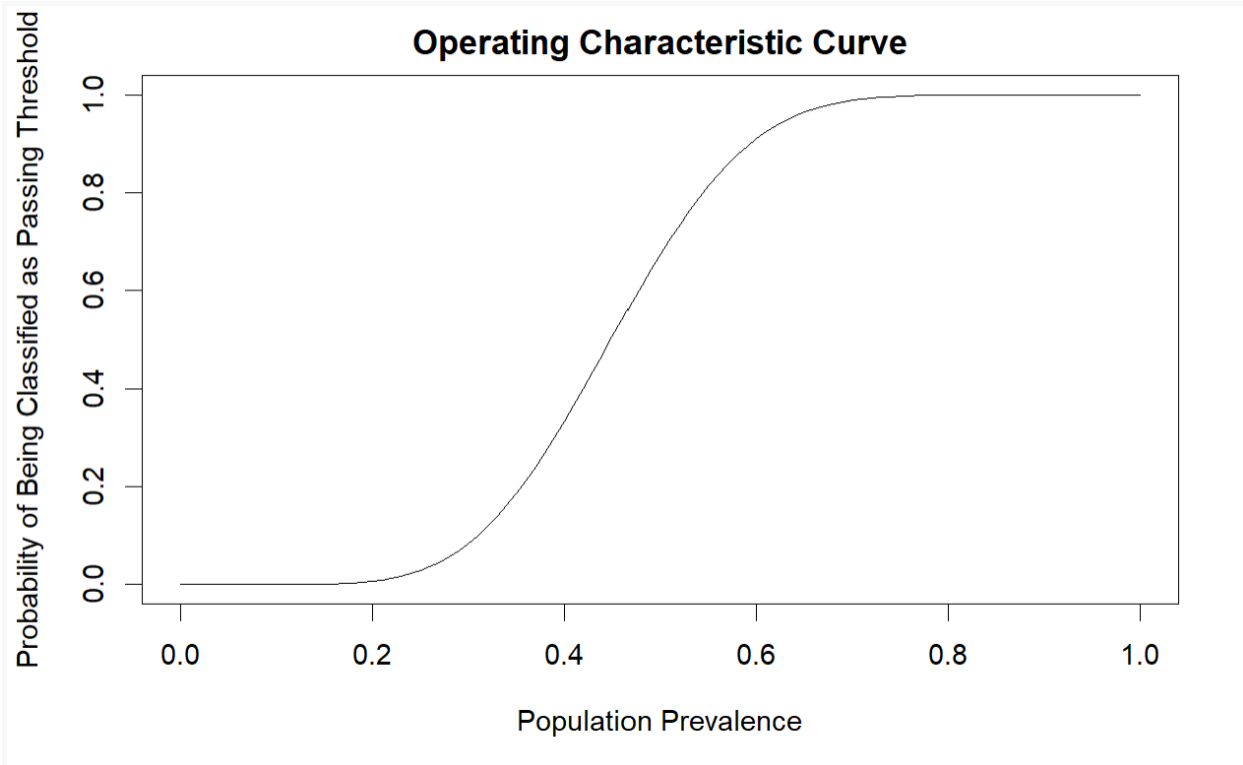


Question A

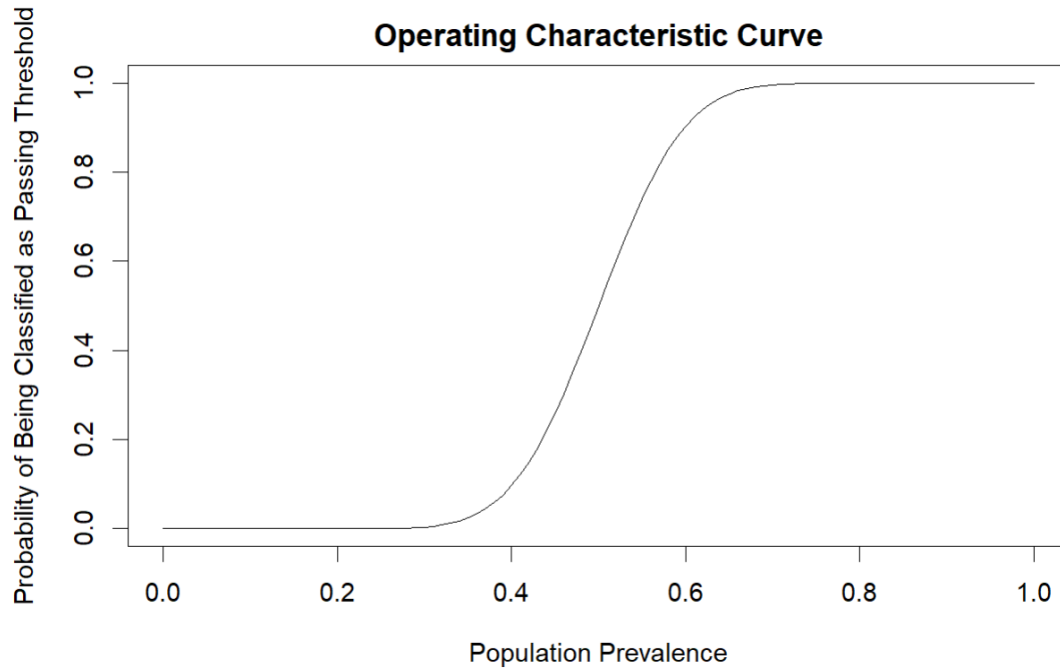
Method 1

$$\begin{aligned}p_u &= 60\%, p_l = 30\% \\ \alpha &= 10\%, \beta = 10\% \\ n &= 19 \\ d &= 9\end{aligned}$$



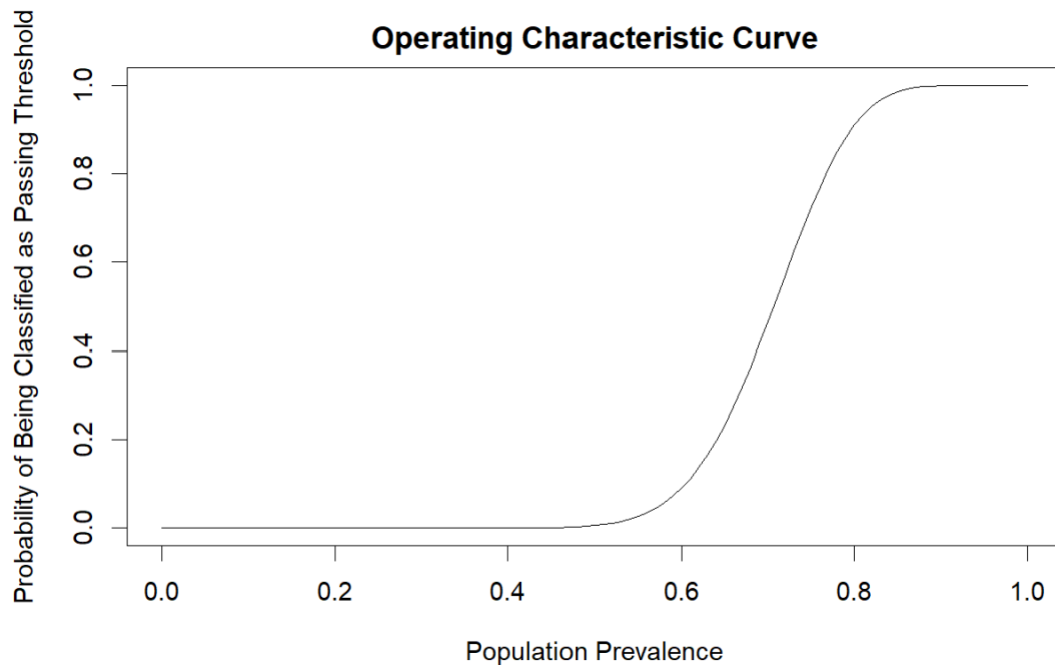
Method 2

$$\begin{aligned}p_u &= 60\%, p_l = 40\% \\ \alpha &= 10\%, \beta = 10\% \\ n &= 41 \\ d &= 21\end{aligned}$$



Method 3

$$\begin{aligned}p_u &= 80\%, p_l = 60\% \\ \alpha &= 10\%, \beta = 10\% \\ n &= 36 \\ d &= 26\end{aligned}$$



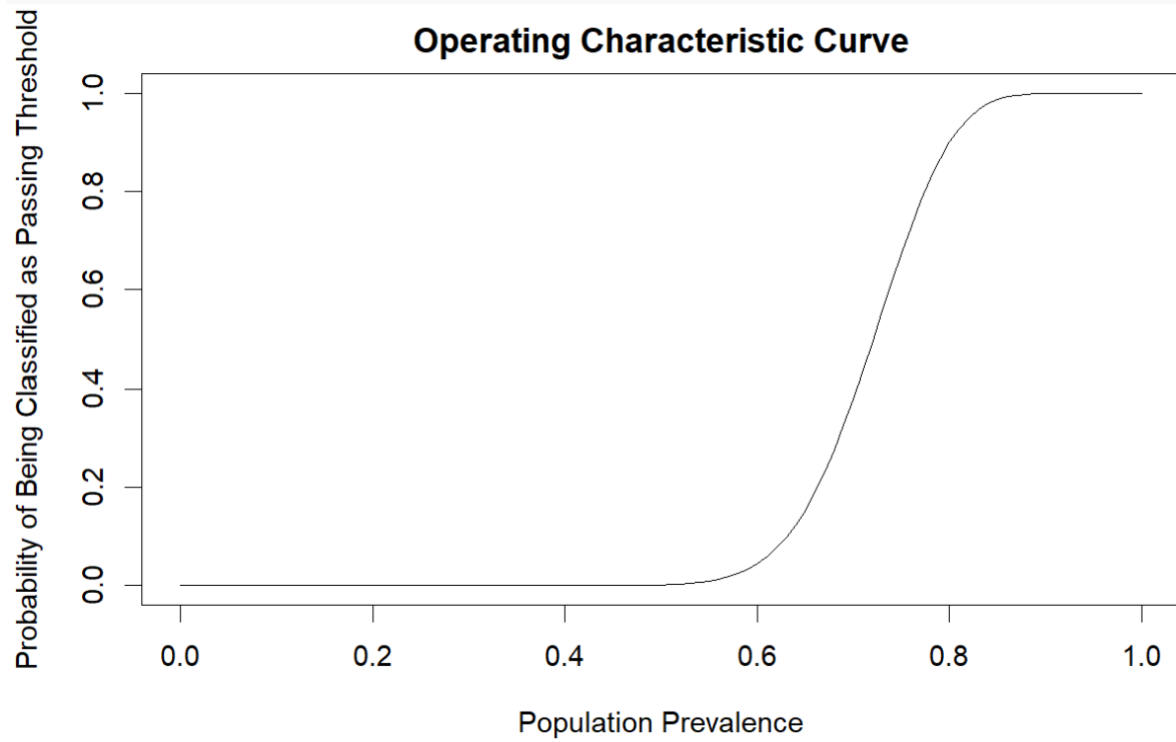
Method 4

$$p_u = 80\%, p_l = 60\%$$

$$\alpha = 10\%, \beta = 5\%$$

$$n = 43$$

$$d = 33$$



Question B

Method 1

Strength smallest sample size needed, easiest to implement

Weakness This method has the largest window of uncertainty, so health centers whose true prevalence are between 30%-60% have a fairly large chance of being misclassified. Compared to the other methods, 9 out of 19 is the lowest prevalence of 47.37%. That leaves a large possibility of centers who pass the threshold even if their true prevalence isn't an acceptable level of ANC uptake, leading to them not receiving needed interventions.

Method 2

Strength smaller grey zone of possible misclassification than Method 1

Weakness The sample size needed for this method is twice as large than Method 1, which will be more expensive to implement. This method also has greater α and β -errors than Method 1 so will have slightly larger chances of misclassification.

Method 3

Strength A smaller sample size is needed than Method 2, which is easier to implement. This method also has higher constraints of what will pass the threshold than Method 1 and 2, which is great for being certain of classifying health centers whose true prevalence is over 80% as passing the threshold.

Weakness Fewer health centers will be classified as passing threshold, leading to decision of spending more money on health centers even if they truly do have an acceptable level of uptake of ANC services

Method 4

Strength smallest α and β -errors, most accurate classification system

Weakness This methods needs the largest sample size, so will be the most expensive to implement. Even fewer health centers will be classified as passing threshold than Method 3, leading to decision of spending more money on health centers even if they truly do have enough uptake of ANC services

Question C

I would recommend Option 2, performing LQAS in all 20 health centers of each of the 7 regions. LQAS can be used for classification at the health-center level and be part of a complex sampling method by pooling all the data. In this case, the data from each health center can be clumped to get prevalence estimates on a regional and national scale, which meets the objective of the program of estimating the national uptake of antenatal care. Plotting the prevalences in each region on a map can help visualize patterns and help policy makers decide which regions are in need of more education and campaigns.

One drawback of this recommended design is that it will be expensive and time-consuming to go to all 140 health centers in the country. Option 1 would be easier and cheaper because only 56 health centers are sampled. Another limitation is that LQAS is takes only a small sample size from each health center, which may not be representative of the local population of pregnant women.