

Suppose you are a regional manager overseeing the implementation of the national Antenatal Care (ANC) program. Baseline data from your region estimates the uptake of ANC services amongst pregnant women to be 70%.

You propose LQAS as a system to evaluate the uptake of ANC services in the 20 different health center catchment areas in your region. The system would result in two classifications: areas classified as having *high* ANC coverage would continue as currently exist, areas classified as *low* ANC coverage would receive extensive education and media campaigns, estimated at \$7,000 per health center catchment area.

You are currently considering four LQAS classification systems:

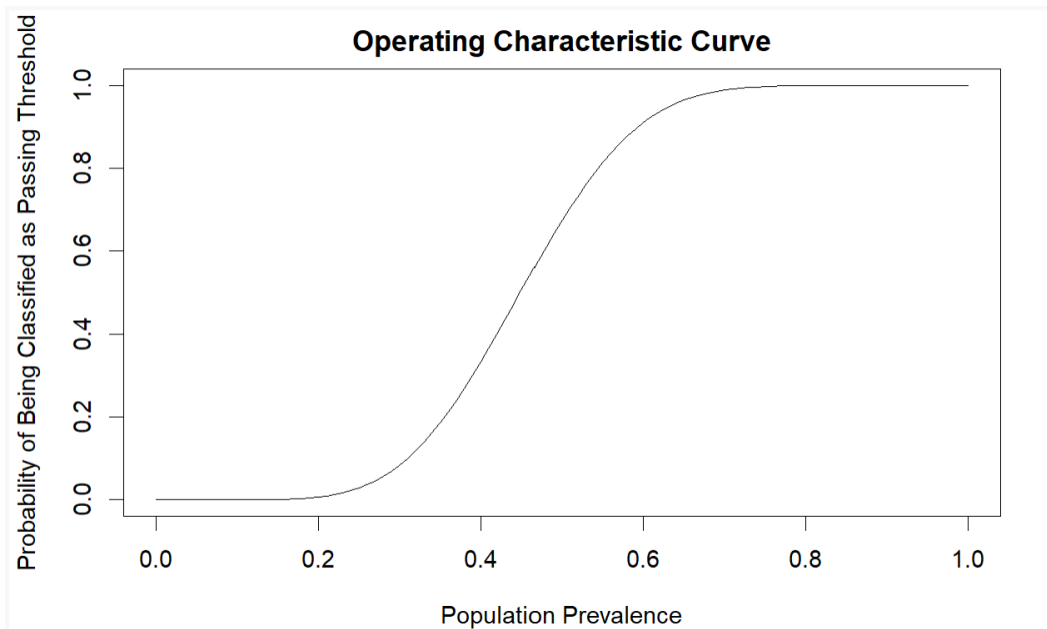
1.  $p_u=60\%$ ,  $p_l=30\%$ ,  $\alpha=10\%$ , and  $\beta=10\%$
2.  $p_u=60\%$ ,  $p_l=40\%$ ,  $\alpha=10\%$ , and  $\beta=10\%$
3.  $p_u=80\%$ ,  $p_l=60\%$ ,  $\alpha=10\%$ , and  $\beta=10\%$
4.  $p_u=80\%$ ,  $p_l=60\%$ ,  $\alpha=10\%$ , and  $\beta=5\%$

### Question 1

For each proposed LQAS system, calculate the optimal sample size and corresponding decision rule. For this optimal sample size and decision rule, present the operating characteristic curve. Optimal means the smallest sample size that will meet the specified constraints. Anything less than the decision rule is classified as low and anything greater or equal to the decision rule is classified as high.

#### Method 1

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



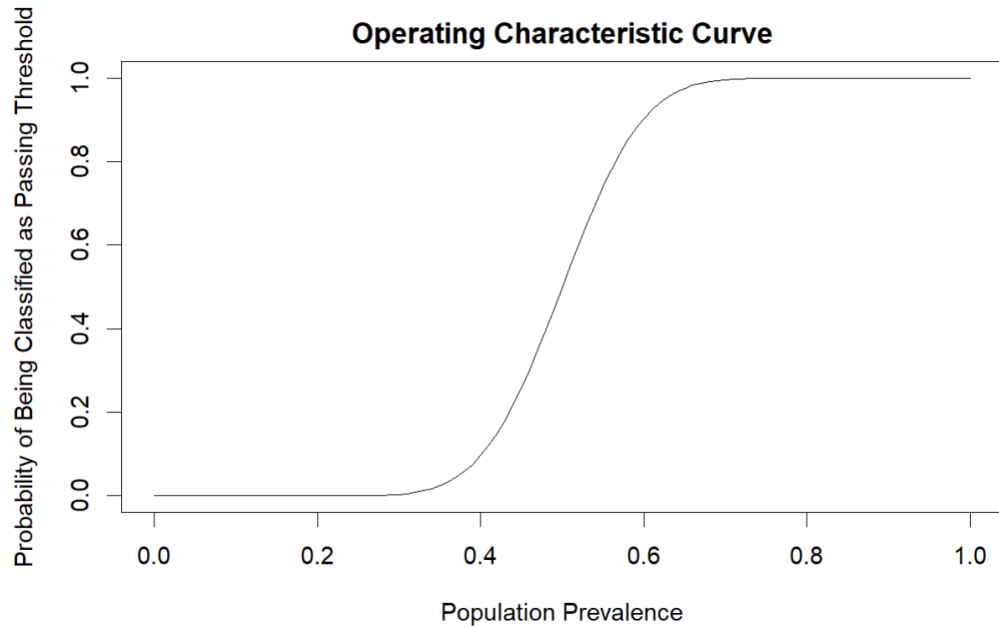
## Method 2

$$p_u = 60\%, p_l = 40\%$$

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

$$n = 41$$

$$d = 21$$



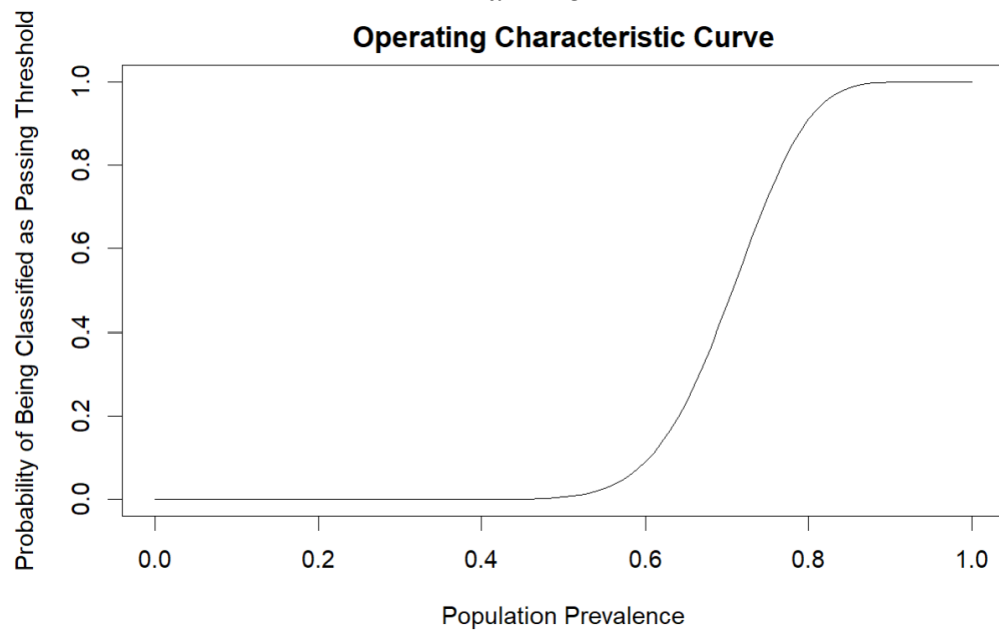
## Method 3

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

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

$$n = 36$$

$$d = 26$$



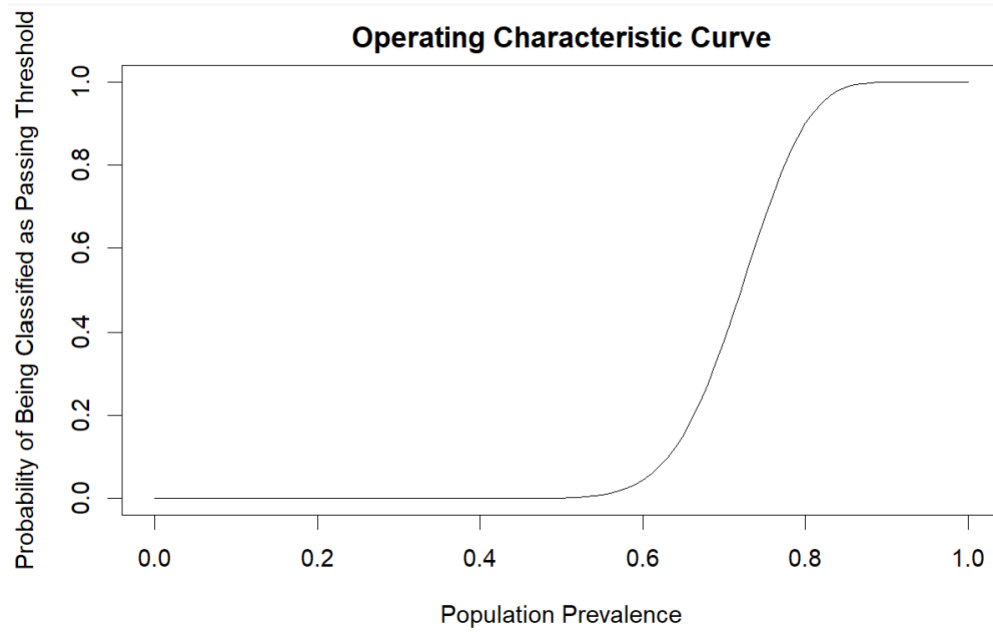
#### Method 4

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

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

$$n = 43$$

$$d = 33$$



## Question 2

For each proposed system, discuss the strengths and weaknesses for your evaluation. Think about both the costs of implementing the LQAS system, the costs of the resulting interventions based on the classifications, and the consequences of not intervening in certain areas.

Method 1 requires the smallest sample size so is the easiest to implement. However, it 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 has a smaller grey zone of possible misclassification than Method 1. However, the sample size needed is twice as large than Method 1, which will be more expensive to implement. Method 2 also has greater  $\alpha$  and  $\beta$ -errors than Method 1 so will have slightly larger chances of misclassification.

Method 3 requires a smaller sample size than Method 2, so is easier to implement. Method 3 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. However, 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 has the smallest  $\alpha$  and  $\beta$ -errors so is the most accurate classification system. However, this method 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 3

Now suppose you are approached by the minister of health for the entire country. You are to be part of a larger effort to estimate the uptake ANC nationwide. The minister of health wants your input on how this will be designed. There are seven regions in the country with approximately 20 health center catchment areas each. There are two study designs that are being considered:

- Option 1: Do a stratified sample in each region. Select 4 urban and 4 rural health center areas in each region and perform the LQAS sample at each health center.
- Option 2: Go into all the health centers in the country and perform LQAS at each.

What do you recommend and why? How does your recommendation meet the objectives of the program? What might be limitation(s) of your recommended design?

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 takes only a small sample size from each health center, which may not be representative of the local population of pregnant women.