1. Suppose we had a logistic model with intercept $\beta_o = -3$ and slope $\beta_1 = -1$. For each of the following use SAS to produce a plot that has the probability form of this original logistic curve and the logistic curve for the stated modification. (Each plot will have two curves, one for $\beta_o = -3$ and $\beta_1 = -1$ and one for a curve with the value of β_o and/or β_1 changed.) Compare the two curves and explain what happened to the plot when the values were changed.
   a. The slope β_1 decreases to -2.
   b. The intercept increases to -1.
   c. The slope β_1 increases to -0.5.
   d. The intercept decreases to -4.
   e. Both the intercept and slope change signs ($\beta_o = 3$ and $\beta_1 = 1$).

2. In the following there are nine logistic regression curves plotted based on nine pairs of parameters (intercepts and slopes). Each set of parameters used was in the following list of ordered pairs (intercept, slope): (-3,-2), (-3,0), (-3,2), (0,-2), (0,0), (0,2), (3,-2), (3,0), (3,2). Match each ordered pair with its corresponding logistic curve.
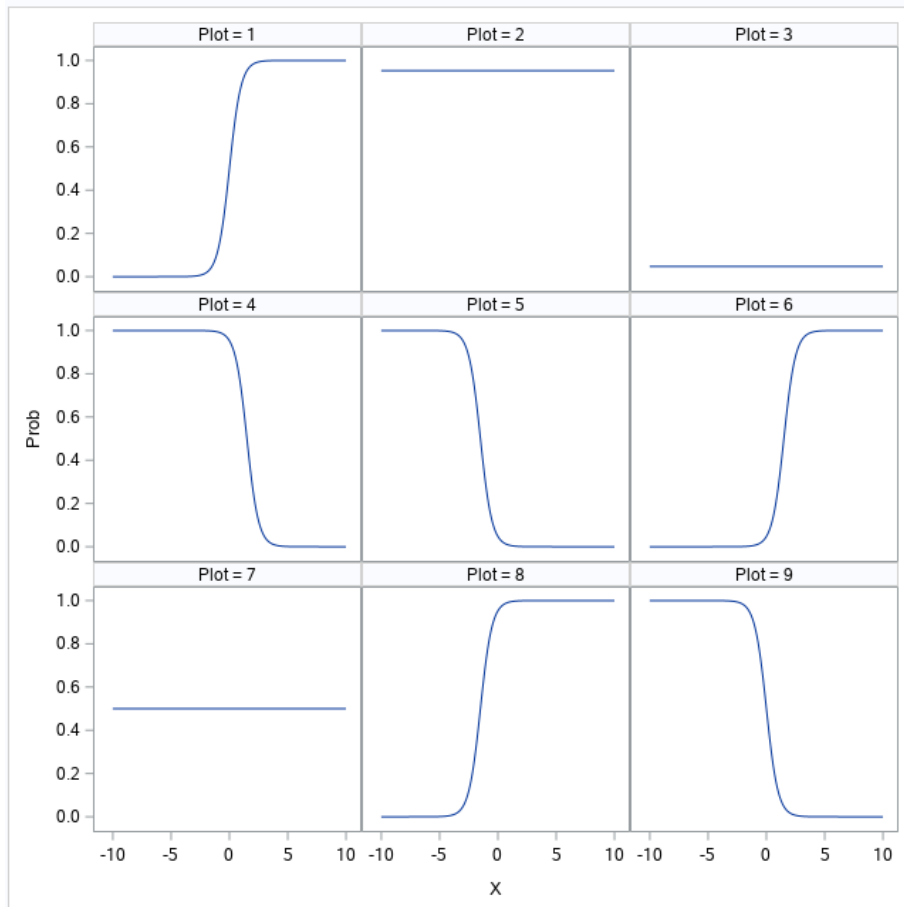
By hand just list which intercept/slope pair goes with plot number (1, 2, ..., 9) corresponding to the given plot.

3. Twenty heart attack patients were observed to see if a second heart attack occurred. Each patient was evaluated for anxiety on a 0 to 100 scale. Overall, nine had a second heart attack making the estimated overall probability of a second occurrence as 9/20 = 0.45. The predictor variable, *Anxiety*, was used to predict the specific probability of a second occurrence. A fitted logistic regression model is

$$\log\left(\frac{\pi}{1-\pi}\right) = -7.0 + 0.12 \; Anxiety$$

a. Use SAS to draw the logistic curve (probability form) for the above model. Comment on its shape. (Note: You may need to change the range of the Do Loop values to properly plot the curve.)

You may complete the following parts by hand or in SAS, whichever is convenient.

b. Use this model to estimate the odds of a second heart attack, $\pi/(1-\pi)$, if the anxiety index was 50.
c. Use this model to predict the probability of a second heart attack, π, if the anxiety index was 50.
d. How much do the estimated odds change if the anxiety index changes from 50 to 51? Provide and interpret the odds ratio.
e. How much does the estimated probability, π, change if the anxiety index increases from 50 to 51?
f. What does the anxiety index need to be for the estimated probability of a second heart attack to be $\pi=0.2$?

4. A study was conducted on 85 brands of candy to see what factors affect their popularity. The file *Candy.txt* contains two variables, *PricePct* and *Popular*. *PricePct* is the predictor variable which is a measure of how expensive the candy is. *PricePct* is on a 0 to 1 scale based on percentiles (1 = most expensive). *Popular* is a binary variable used as the response where 0 means the brand is not in popular (less than 50% head-to-head wins) and 1 means the brand is popular.

a. Use PROC SGPLOT to create a loess smooth of the plot of *PricePct* vs. *Popular*. Use a smoothing parameter of $\lambda = 0.7$. Examining this plot only, what do you conclude about the relationship between the popularity and its cost?
b. Use PROC LOGISTIC to model the response *Popular* based on the variable *PricePct*. Does there seem to be a statistically significant relationship here? Explain and provide supporting SAS output.
c. What is the direction of the relationship? Does this seem logical? Explain.
d. Use the appropriate parameters from the SAS PROC LOGISTIC output in another SAS program that will plot the probability form of the logistic curve for this model. Providing the plot, use this plot only to roughly estimate the probability of being popular for a candy brand whose percentile rank is 0.75. (Hint: You may need to change the range of the do loop from the plotting code given in class to get the plot to display properly.)