(Do not use 1.702 in the logistic model calculation except for Q1-part (c))

1. a. Plot the following two items using the **normal ogive** model over the range [-3.0, 3.0] in increment of .1 ($\Delta\theta = .1$). Show your computations.

$$\beta = 1.0 \qquad \alpha = 1.0$$
$$\beta = -.5 \qquad \alpha = .5957$$

   b. Plot the following two items using a **logistic model** over the range [-3.0, 3.0] in increment of .1 ($\Delta\theta = .1$). Show your computations.

$$\beta = 1.0 \qquad \alpha = 1.0$$
$$\beta = -.5 \qquad \alpha = .5957$$

   c. Compare the two plots in (b) with the two plots in part (a). What do you find? You may use the scaling factor 1.702 to establish a relationship between the plots from normal ogive and logistic models.

2. Let the difficulty parameters of five items be

$$\boldsymbol{\beta} = \{\beta_1, \beta_2, \beta_3, \beta_4, \beta_5\}' = \{-2.0, -1.0, -0.5, 0.5, 1.0\}'$$

   a. Plot the ICCs of the five items in the θ – interval $[-3.0, 3.0]$. Use an increment of 0.1 ($\Delta\theta = .1$).
   b. Compare the probabilities of correct response for Items 1 and 4 across the θ continuum.
   c. Which of the five items is easiest? Which item is most difficult? Are these statements true for all θ?
   d. For each θ, find the sum of the probabilities of correct response across the five items to form the test characteristic curve (TCC). Plot the TCC against θ.
   e. TCC also represents the expected number of correct responses. Find the expected number of correct responses for $\theta = -1.0$ and $\theta = 1.0$.

For Problems 3 & 4, you can use statistical software (e.g., SPSS) to conduct the analyses.

3. Twelve items were administered to two groups of examinees. The responses of 100 examinees to Item 6 and the total score from each group can be found in **hw1_3.xls**. We wish to analyze Item 6 using CTT indices.

   a. Find the mean of Item 6 and its correlation with the total for each group (i.e., item difficulty & discrimination in CTT).
   b. Do the indices remain the same across the two groups? What can you conclude regarding the invariance of the classical item indices?
   c. Which group has higher ability?

4. Responses to three items at a fixed ability level can be found in **hw1_4.xls**. Using a χ^2-test of independence, determine whether pairwise local independence holds for these three items. That is, for each of the three item pairs, construct a 2×2 table of correct and incorrect responses, and perform the χ^2-test of independence. Your tables should look something like this:

		Item Y	
		Correct	Incorrect
Item X	Correct		
	Incorrect		

Summarize the results of your analyses (i.e., determine which pairs are locally independent at this fixed ability level) and draw a conclusion.

5. Using the logistic model, plot the following three items over the range, $-3 \le \theta \le 3$ in increments of $\Delta\theta = .1$. Show your computations (Don't use 1.702 scaling factor in the model).

   a. $\beta = .5$ (Rasch model)

   b. $\alpha = 1.5$, $\beta = .5$

   c. $\alpha = 1.5$, $\beta = .5$, $c = .15$

6. For the three-parameter logistic model, show that the probability of a correct response $P(\theta)$ at $\theta = \beta$ is $P(\theta) = \dfrac{1+c}{2}$.