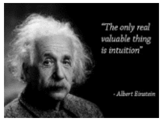
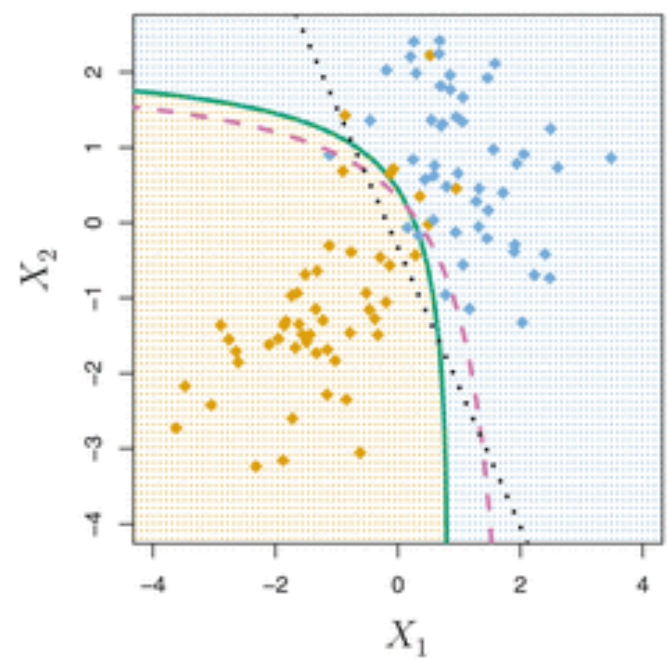
Quadratic Discriminant Analysis

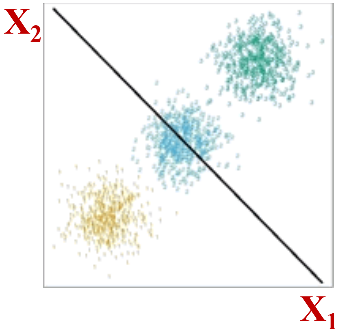


Quadratic Discriminant Analysis (QDA): Intuition

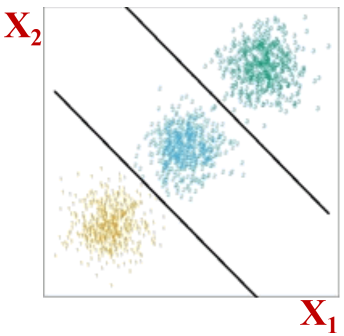
- **QDA** is simply using a **non-linear discriminant function**
- The graph illustrates a simple model with an outcome variable Y with $K=2$ classes and $p=2$ predictors X_1 and X_2
- The **dotted** line shows the **LDA** discriminant function
- The **QDA** method tries various quadratic discriminant functions (e.g., dotted curve) and selects the one that provides the **most accurate** classification
- As with polynomial regression models QDA has better training fit, more over-fitting problems, and more variance
- But it is a more flexible classifier



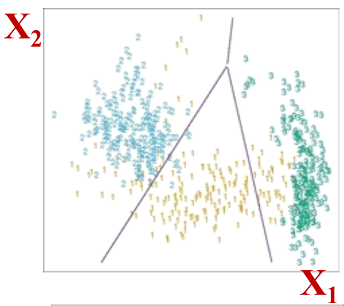
LDA Illustration



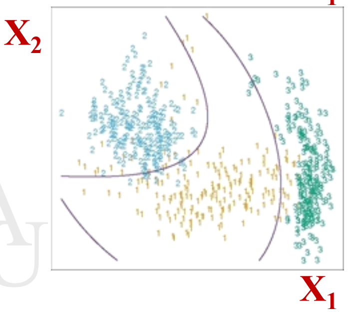
Logistic regression model with 3 categorical outcomes (color coded) variable and 2 predictors → observations in the middle category are not well differentiated



Same data, model estimated with **LDA** → the linear boundaries do a better job at classifying the observations



Less differentiate data with **LDA** model → the linear boundaries do an OK job at classifying observations but a few points are misclassified



Same data with **Quadratic DA** model → does better at classifying observations, but the flexibility of the curve makes the model more over-fitted with higher variance

R Tips

`lda(){MASS}` → "Linear Discriminant Analysis" function in the `{MASS}` "Modern Applied Statistics with S" package to fit LDA models

`lda.fit=lda(y~x1+x2+etc.,data=dataName)` → Fits an LDA model

`qda(){MASS}` → "Quadratic Discriminant Analysis" function in the `{MASS}` "Modern Applied Statistics with S" package to fit QDA models. The syntax is identical to the `lda()` function.

`lda.fit=qda(y~x1+x2+etc.,data=dataName)` → Fits a QDA model

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