Multivariate Analysis Techniques Exercise Session

BABAR Analysis School
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Lecture 3

- In the next 60 minutes we will try and use some of the techniques that have been covered in the past lectures.

    - You will need access to a SLAC computing account.

    - Make a new release.

    - Know how to start root in a BABAR release:

        bbrroot –l

    - Run the example macro:

        .x tmva_example_a51.cc

    - The other macros in this example can be modified in order to inspect the results (Use the TBrowser to inspect your results)

If you have access to root on a non-SLAC machine, then just make a working directory, cd into this, and start root in the usual way.

This tutorial requires ROOT version 5.14.00e. It may work with more recent versions with varying degrees of success.

Lecture 3

- In the next 60 minutes we will try and use some of the techniques that have been covered in the past lectures.

  - Alternatively … you will need access to a computer with ROOT installed.

  - The example macro has been tested with ROOT 5.24.

  - Start ROOT:

    root –l

  - Run the example macro:

    .x tmva_example.cc

  - The other macros in this

    example can be used to

    inspect the results

Example: Charmless B decays

- Using release 24 data from BaBar:
    - Problem: Large background (continuum dominates).

      Small signal.

      Other backgrounds (mis-reconstructed B decays that look more like signal than background).

We want to be able to develop a discriminating variable that distinguishes between signal-like and continuum-like events to use in a multi-dimensional fit with m_{ES} and ΔE.

This should be relatively simple, easy to parameterize when included in a maximum-likelihood fit. It should be:

- A powerful discriminator.
- Smoothly varying to simplify making a PDF for a fit.

Example: Charmless B decays

- The variables you will find in the sample data files are:

bCosTBTR   Cosine of the angle between the B and rest of even thrust axes.

sumPtR   Sum of tranverse momenta for the rest of the event.

lgdr0P1n   Monomial- 0th moment for neutral particles (L_0).

lgdr0P1c   Monomial - 0th moment for charged particles (L_0).

lgdr2P1n   Monomial - 2nd moment for neutral particles (L_2).

lgdr2P1c   Monomial - 2nd moment for charged particles (L_2).

bCosBZ: Cosine of the angle between the B and Z direction in CM frame.

bCosBTR: Cosine of the angle between the B and the thrust axis of the rest of the event.

Not included in the default set of variables for training.... why?

bCosTBZ: Polar angle of B thrust axis with respect to the Z axis.

Example: Charmless B decays

- Sample files:
  - The sample data files required for this exercise can be downloaded from the tarball on the same agenda item as this talk. They will also appear at: http://pprc.qmul.ac.uk/~bevan/BAS.

  - Use TMVA to try and find a classifier that can give the best separation between signal and continuum events.

  - Q) What possible factors could you take into account when making your choice?

  - Q) How does the constraint of wanting to include this classifier distribution as a variable in a maximum-likelihood fit affect your decision?