Supporting Plots Asked during the Dissertation Endorsement based on the $H \rightarrow \tau\tau \rightarrow \mu\mu$ Analysis

Vallary Bhopatkar (Florida Tech)
## Training and Testing events

### 0-Jet
- Total number of events in 0-jet category that passed the selection cuts: **3044**
- Split the number of events in half for training and testing:
  - No. events used for training: **1522**
  - No. of events used for testing and analysis: **1522**

### Boosted
- Total number of events in boosted category that passed the selection cuts: **4063**
- Split the number of events in half for training and testing:
  - No. events used for training: **2031**
  - No. of events used for testing and analysis: **2032**

### VBF
- Total number of events in boosted category that passed the selection cuts: **2621**
- Split the number of events in half for training and testing:
  - No. events used for training: **1310**
  - No. of events used for testing and analysis: **1311**
Overtraining Check BDT training

0-Jet

boosted

VBF

TMVA overtraining check for classifier: BDT

Kolmogorov-Smirnov test: signal (background) probability = 0.122 (0.392)

U/O-flow (S,B): (0.0, 0.0)% / (0.0, 0.0)%

TMVA overtraining check for classifier: BDT

Kolmogorov-Smirnov test: signal (background) probability = 0.212 (0.063)

U/O-flow (S,B): (0.0, 0.0)% / (0.0, 0.0)%

TMVA overtraining check for classifier: BDT

Kolmogorov-Smirnov test: signal (background) probability = 0.019 (0.186)

U/O-flow (S,B): (0.0, 0.0)% / (0.0, 0.0)%

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ROC Curves

0-Jet  
boosted  
VBF

Background rejection versus Signal efficiency

MVA Method: BDT

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## Prefit Uncertainties

<table>
<thead>
<tr>
<th>Source of uncertainties</th>
<th>Prefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jet Energy Scale (JES)</td>
<td>Depending on $p_T$ and $\eta$</td>
</tr>
<tr>
<td>$p_T^{miss}$ Energy Scale</td>
<td>Depending on $p_T$ and $\eta$</td>
</tr>
<tr>
<td>$Z \rightarrow \tau \tau / \ell \ell$ Estimation</td>
<td>Normalization 10%</td>
</tr>
<tr>
<td>$W +$ Jets Estimation</td>
<td>Normalization 15%</td>
</tr>
<tr>
<td>QCD Multijet Estimation</td>
<td>Normalization 20%</td>
</tr>
<tr>
<td>Diboson Normalization</td>
<td>15%</td>
</tr>
<tr>
<td>Single Top normalization</td>
<td>15%</td>
</tr>
<tr>
<td>$t\bar{t}$ Estimation</td>
<td>Normalization 7%</td>
</tr>
<tr>
<td>Integrated luminosity</td>
<td>2.6%</td>
</tr>
<tr>
<td>b-tag Jet rejection</td>
<td>3.5%</td>
</tr>
<tr>
<td>Limited number of events</td>
<td>Statistical uncertainty in individual bin</td>
</tr>
</tbody>
</table>
Pulls and Impact (combine) Page1

CMS Internal

\[ \hat{r} = -1.05 \pm 1.67 \]

Pulls and Impact (combine) Page1

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\[ \hat{r} = -1.05 \pm 1.67 \]

Pulls and Impact (combine) Page1

CMS Internal

\[ \hat{r} = -1.05 \pm 1.67 \]
Pulls and Impact (combine) Page 3

CMS Internal

\( \hat{r} = -1.05 \pm 1.67 \)

- Pull
- +1\( \sigma \) Impact
- -1\( \sigma \) Impact

\( \frac{\theta - \theta_0}{\Delta \theta} \)

CMS_mistag_b_13TeV
CMS_scale_m_13TeV
CMS_htt_dyShape_boosted_13TeV
CMS_mistag_b_13TeV
CMS_scale_m_13TeV
CMS_htt_dyShape_boosted_13TeV

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