Cut flow tables for SUS-15-005: Updates II

By Eshwen Bhal, Tai Sakuma, Dominic Smith

13/02/2017

Progress so far

- Preliminary cut flow table has been created for 2016 SMS model (as an example).
- Using Tai's method of Python dictionaries to store selections, and classes to execute them.
- Code located at https://github.com/eshwen/cutflowirl (master branch).
- Most of the code was written by Tai, I added some of the selections and tailored it for the 2015 analysis.

Code and event selection

- The event selections are written in twirl_mktbl.py (L86-114).
- The selections – as skimmer names (bDPhiSkimmer, defaultSkimmer, etc.) – were given as output from Dom's AlphaTools branch (v1.6.12_Approval_151210_cutflow).
- The skimmer names were then translated into meaningful cuts and the applied in Tai's cutflowirl repo.
- One function is needed to create and order the event selections.

Code and event selection (contd.)

- Minimal working example of function:

```
path_cfg = dict(All = ('ev : ev.nJet40[0] >= 2',
                       'ev : ev.ht40[0] >= 200',
))
```

Code and event selection (contd.)

- Minimal working example of function:

```
path_cfg = dict(All = ('ev : ev.nJet40[0] >= 2',
                       'ev : ev.ht40[0] >= 200',
))
```

Several selections can be added, and nested if needed. Selections are separated by commas.

Python dictionary. Entries are in the form of a tuple

Function to create cut flow

Python class demands that all selections must pass to return `True`

Event selections in Python code. Can be replaced by aliases (as long as it's defined in a dictionary somewhere)

Output

- The code is run on the command line, with the path of flat trees produced by Heppy (only few loose cuts are applied in tree making) given in the file twirl_mktbl.py.

- Output is given in the form of a table in a text file with the names of the cuts, and the number of events that pass each cut.

- I then manually LaTeX it to make it more presentable.

Output (contd.)

component	depth	class	name	pass	total
SMS_T1tttt_madgraphMLM	1	EventSelectionAllCount	All	859	30799443
SMS_T1tttt_madgraphMLM	2	LambdaStr	"ev : ev.smsmass1[0] == 1300"	768345	30799443
SMS_T1tttt_madgraphMLM	2	LambdaStr	"ev : ev.smsmass2[0] == 1050"	39074	768345
SMS_T1tttt_madgraphMLM	2	EventSelectionAllCount	All	859	39074
SMS_T1tttt_madgraphMLM	3	LambdaStr	"ev : ev.nJet40[0] >= 1"	39074	39074
SMS_T1tttt_madgraphMLM	3	LambdaStr	"ev : ev.nJet40Fwd[0] == 0"	35488	39074
SMS_T1tttt_madgraphMLM	3	LambdaStr	"ev : ev.nJet40failedId[0] == 0"	35488	35488
SMS_T1tttt_madgraphMLM	3	LambdaStr	"ev : ev.jet_chHEF[0] >= 0.1"	34605	35488
SMS_T1tttt_madgraphMLM	3	LambdaStr	"ev : -2.5 < ev.jet_eta[0] < 2.5"	34457	34605
SMS_T1tttt_madgraphMLM	3	LambdaStr	cutflow_Signal	15295	34457
SMS_T1tttt_madgraphMLM	3	LambdaStr	isoTrackVeto	12017	15295
SMS_T1tttt_madgraphMLM	3	LambdaStr	nJet100	7971	12017
SMS_T1tttt_madgraphMLM	3	LambdaStr	ht40	7837	7971
SMS_T1tttt_madgraphMLM	3	LambdaStr	mht	4818	7837
SMS_T1tttt_madgraphMLM	3	LambdaStr	"ev : ev.MhtOverMet[0] < 1.25"	4050	4818
SMS_T1tttt_madgraphMLM	3	EventSelectionAnyCount	Any	2863	4050
SMS_T1tttt_madgraphMLM	4	EventSelectionAllCount	All	28	4050
SMS_T1tttt_madgraphMLM	5	LambdaStr	htbin_200	48	4050
SMS_T1tttt_madgraphMLM	5	LambdaStr	alphaT	28	48
SMS_T1tttt_madgraphMLM	4	EventSelectionAllCount	All	22	4022
SMS_T1tttt_madgraphMLM	5	LambdaStr	htbin_250	112	4022
SMS_T1tttt_madgraphMLM	5	LambdaStr	alphaT	22	112
SMS_T1tttt_madgraphMLM	4	EventSelectionAllCount	All	90	4000
SMS_T1tttt_madgraphMLM	5	LambdaStr	htbin_300	170	4000
SMS_T1tttt_madgraphMLM	5	LambdaStr	alphaT	90	170
SMS_T1tttt_madgraphMLM	4	EventSelectionAllCount	All	137	3910
SMS_T1tttt_madgraphMLM	5	LambdaStr	htbin_350	228	3910
SMS_T1tttt_madgraphMLM	5	LambdaStr	alphaT	137	228
SMS_T1tttt_madgraphMLM	4	EventSelectionAllCount	All	663	3773
SMS_T1tttt_madgraphMLM	5	LambdaStr	htbin_400	1129	3773
SMS_T1tttt_madgraphMLM	5	LambdaStr	alphaT	663	1129
SMS_T1tttt_madgraphMLM	4	EventSelectionAllCount	All	515	3110
SMS_T1tttt_madgraphMLM	5	LambdaStr	htbin_600	955	3110
SMS_T1tttt_madgraphMLM	5	LambdaStr	alphaT	515	955
SMS_T1tttt_madgraphMLM	4	EventSelectionAllCount	All	1408	2595
SMS_T1tttt_madgraphMLM	5	LambdaStr	htbin_800	1408	2595
SMS_T1tttt_madgraphMLM	3	LambdaStr	biasedDPhi	859	2863

Nested conditions (i.e., the event selections). The `All` row shows the number of events that pass all of the conditions, and the following rows give a breakdown.

Cut flow table

** = couldn't find concise descriptions of these in the paper

Event Selection	Model (sample)		
	$\widetilde{g}\widetilde{g} \to t\bar{t}t\bar{t}\widetilde{\chi}_1^0\widetilde{\chi}_1^0$ ($m_{\mathrm{SUSY}} = 1300$, $m_{\mathrm{LSP}} = 1050$)		
	Events passed	Inclusive efficiency (%)	Exclusive efficiency (%)
–	39074	100	100
$n_{\mathrm{jet}} \geq 2$ ($p_{\mathrm{T}}^{\mathrm{j}} > 40$ GeV)	39074	100	100
Forward jet veto	35488	90.82	90.82
nJet40failedId = 0**	35488	90.82	100
jet chHEF ≥ 0.1**	34605	88.56	97.51
$\lvert\eta^{\mathrm{j1}}\rvert < 2.5$	34457	88.18	99.57
Isolated track veto	12017	30.75	34.88
$n_{\mathrm{jet}} \geq 1$ ($p_{\mathrm{T}} > 100$ GeV)	7971	20.40	66.33
$H_{\mathrm{T}} \geq 200$ GeV ($p_{\mathrm{T}}^{\mathrm{j}} > 40$ GeV)	7837	20.06	98.32
$H_{\mathrm{T}}^{\mathrm{miss}} \geq 130$ GeV ($p_{\mathrm{T}}^{\mathrm{j}} > 40$ GeV)	4818	12.33	61.48
$H_{\mathrm{T}}^{\mathrm{miss}} / E_{\mathrm{T}}^{\mathrm{miss}} < 1.25$	4050	10.36	84.06
α_{T} H_{T}-dependent cuts	2863	7.33	70.69
$\Delta\phi_{\mathrm{min}}^{*} > 0.5$	859	2.20	30.00

Notes and clarifications

- The sample used was SMS_T1tttt_madgraphMLM (2016 signal Monte Carlo).
- 30,799,443 events in the sample, reduced to 39,074 after cuts on m_{SUSY} and m_{LSP} were made.
- Values are for *unweighted* events. With some time and effort, weights be included if necessary.
- The cuts comprise all of the *relevant* selections that were implemented for the benchmark models in the 2015 analysis.

All cuts applied in Heppy/AlphaTools

<Skimmer name, as detailed in Dom's AlphaTools branch>—<event selection> — <necessary for benchmark model cut flows?>

defaultSkim — alphaT HT-dependent cuts; HTmiss > 130 (for jets with pT > 40); HT > 200 (for jets with pT > 40); njets with pT > 40 is > 1; njets with pT > 100 is 1— Y

bDPhiSkim—bDphi > 0.5—Y

objectSkimmer— Miss out the cut flows that aren't specified — N

primaryDatasetSkimmer— no cut, specifies parent sample if data— N

cutFlowSkimmer — determine type of data for cut flows (data, control region, MC, signal region MC)— Y

mllSkimmer—66.2 < mll < 116.2— N

minDRJetSkimmer—R > 0.5 — N

JSONSkimmer — Checks if sample is MC, or if run/lumi pair is in JSON file if data — N

badMCEventSkimmer — Returns True if sample is data. If MC, checks for "bad" events — Y

relIsoSkimmer— Cut on relative isolation of leptons— N

eleEtaSkimmer— asserts that letal for ALL electrons < 1.479— N

promptPhotonSkimmer—if sample is data, return True (no cut). If not data, want 0 photons — N

ttJetsSkimmer — if sample is data, return True. If parent sample is not TTJets,
return True. Else, lots of conditions — N

photonPtSkimmer— cut on photon momentum— N

triggerSkimmer— Trigger cuts (only affects data and control region MC) — N

filterSkimmer— If signal (benchmark model), return True — N

fwdJetSkimmer— Forward jet veto— Y

tighterJetIdSkimmer— jet_chHEF 0.1 — Y

leadJetEtaSkimmer—leta_j1l < — Y

mhtDivMetSkimmer—HTmiss / ETmiss < 1.25— Y

OddJetSkimmer — if inclusiveJet.newId == 0 and inclusiveJet.pt > 40 : return False— N

mtSkimmer—30 < MT < 125— N

IsoTrackSkimmer— Isolated track veto— Y

A neater version of this is detailed in my lab book. Please request if needed.

Potential modifications

- Please review the table and email me (cc Tai and Dom) regarding anything that needs changing; order of cuts, names of cuts, etc.

- The timescale for producing the raw cut flow table from a tree is $\mathcal{O}$(hour), slightly longer when polishing is taken into account.

- Values in columns will need to be aligned.

- It would be possible (with some adjustments) to create cut flow tables in Heppy directly from miniAOD files rather than from the trees.