reg_AIC_multInteraction

April 26, 2024

[1]:
```
# Kristina Fauss
# April 19, 2024
# model selection by AIC testing all 1st order interactions

import warnings
warnings.filterwarnings("ignore")

import pandas as pd
import statsmodels.formula.api as smf

from ols_mixedef_custom import *
```

[2]:
```
fp = '/Users/kristinafauss/BackupToBox/Git/lab-flammability-testing-2022/data/
 ↪processed-data/main_dataset.csv'

flamog = pd.read_csv(fp)

# drop na's for flam metrics
print(len(flamog))
for col in ['fh', 'fd', 'pfg', 'temp_change', 'heat_flux_change']:
    flamog.dropna(subset=col, inplace=True)
print(len(flamog))

flamog['plant_id']=[str(a)+'_'+str(b) for a,b in zip(flamog['plant'],␣
 ↪flamog['species'])]

# report
print(flamog.columns)
flamog.head()
```

```
172
171
Index(['Unnamed: 0', 'species', 'plant', 'date', 'total_branch_mass',
       'total_leaf_mass', 'stem_mass_ratio', 'leaf_mass_ratio', 'leaf_lfm',
       'thickness', 'leaf_wet_mass', 'leaf_dry_mass', 'stem_lfm', 'stem_width',
       'stem_wet_mass', 'stem_dry_mass', 'stem_sav', 'lfm', 'leaf_dmc',
       'stem_dmc', 'dmc', 'leaf_area', 'leaf_sav', 'LMA', 'SLA', 'rep',
       'branch_length', 'branch_width', 'branch_height', 'sample_wt',
```

```
       'no_branches', 'mpa', 'notes_on_plant_char', 'start_time',
       'ambient_temp', 'ambient_humidity', 'pre_ignition_glow',
       'first_glow_time', 'ignition', 'primary_ignition',
       'primary_time_of_flame_end', 'secondary_ignition',
       'secondary_time_of_flame_end', 'third_ignition',
       'third_time_of_ignition_flame_end', 'time_fh', 'fh', 'time_of_glow_end',
       'end_time', 'thermocoupler_height', 'hotplate_height',
       'notes_on_flam_data', 'fd', 'tti', 'pfg', 'max_temp',
       'time_at_max_temp', 'max_temp_sensor', 'start_temp',
       'start_temp_sensor', 'stable_avg_temp', 'temp_change', 'avg_temp_ch3',
       'max_heat_flux_loessCH7', 'time_at_max_heat_flux_loessCH7',
       'max_heat_flux_loessCH8', 'time_at_max_heat_flux_loessCH8',
       'avg_heat_flux_stableCH7', 'avg_heat_flux_stableCH8',
       'heat_flux_change', 'prop_ig', 'wet_mass', 'dry_mass', 'gdw_gfw',
       'dw_flam_sample', 'ww_flam_sample', 'branch_volume', 'branching',
       'sample_density', 'dw_sppdev', 'plant_id'],
      dtype='object')
```

[2]:

	Unnamed: 0	species	plant	date	total_branch_mass	total_leaf_mass	\
0	1	ARCDEN	1	2022-08-10	20.347	19.505	
1	2	ARCDEN	1	2022-08-10	20.347	19.505	
2	3	ARCDEN	1	2022-08-10	20.347	19.505	
3	4	ARCDEN	1	2022-08-10	20.347	19.505	
4	5	ARCDEN	1	2022-08-10	20.347	19.505	

	stem_mass_ratio	leaf_mass_ratio	leaf_lfm	thickness	…	wet_mass	\
0	0.510564	0.489436	251.06912	0.514	…	1.151	
1	0.510564	0.489436	251.06912	0.514	…	1.151	
2	0.510564	0.489436	251.06912	0.514	…	1.151	
3	0.510564	0.489436	251.06912	0.514	…	1.151	
4	0.510564	0.489436	251.06912	0.514	…	1.151	

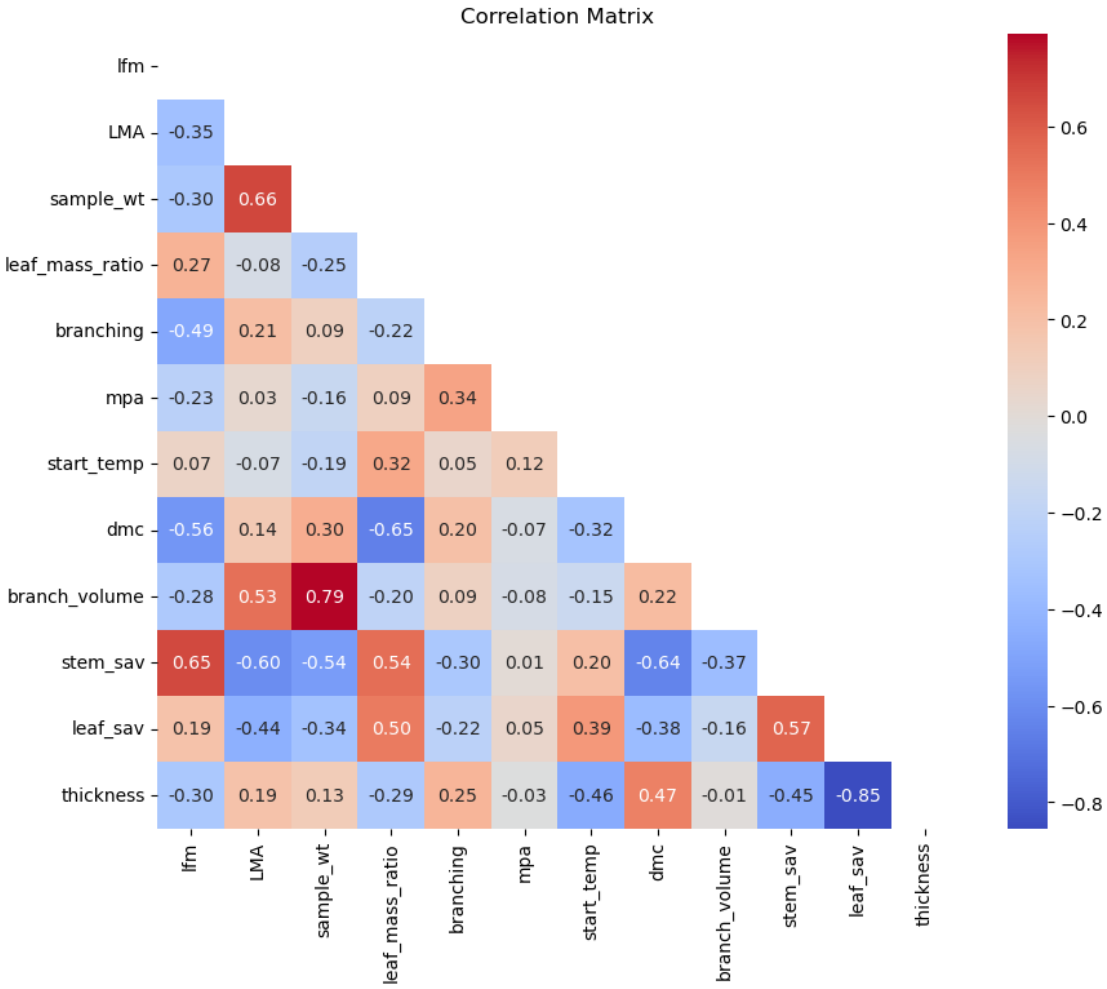
	dry_mass	gdw_gfw	dw_flam_sample	ww_flam_sample	branch_volume	\
0	0.3683	0.242414	1.291195	4.035205	1082.04	
1	0.3683	0.242414	1.429372	4.467028	1370.20	
2	0.3683	0.242414	1.283923	4.012477	682.04	
3	0.3683	0.242414	1.283923	4.012477	1262.25	
4	0.3683	0.242414	0.811215	2.535185	819.00	

	branching	sample_density	dw_sppdev	plant_id
0	0.416667	0.004923	0.923122	1_ARCDEN
1	0.322581	0.004303	1.348152	1_ARCDEN
2	0.294118	0.007766	0.900752	1_ARCDEN
3	0.466667	0.004196	0.900752	1_ARCDEN
4	0.500000	0.004086	-0.553297	1_ARCDEN

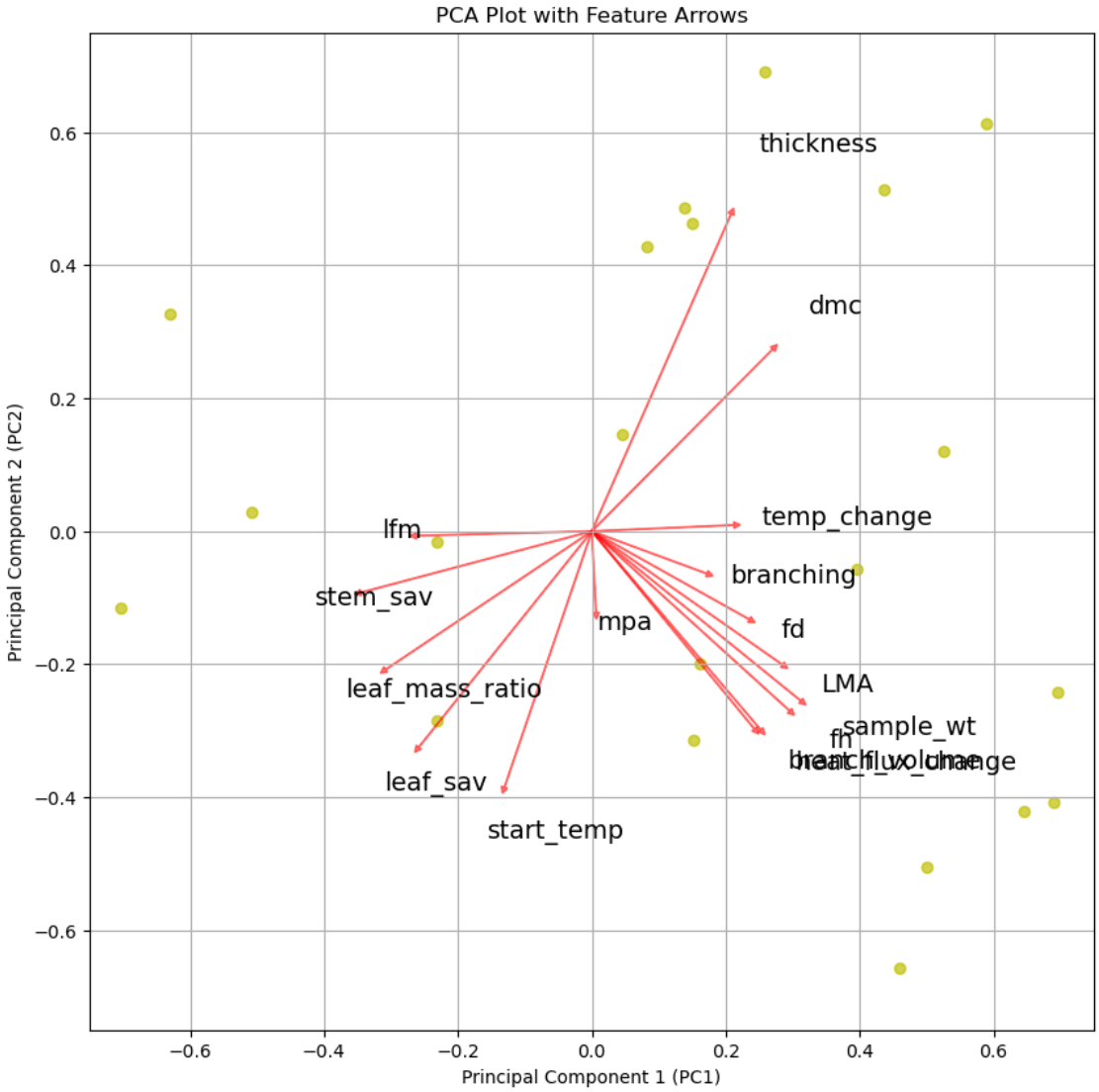
[5 rows x 81 columns]

1 Examine Correlation & Structure in Num. Var's

[3]:
```
cols_num_use = ['lfm', 'LMA', 'sample_wt', 'leaf_mass_ratio', 'branching',␣
↪'mpa', 'start_temp', 'dmc', 'branch_volume', 'stem_sav', 'leaf_sav',␣
↪'thickness']

corrplot(flamog, cols_num_use)
```



[4]:
```
PCAplot(flamog, cols_num_use+['fh','fd','temp_change','heat_flux_change'])
```



2 Modeling Preprocessing

[5]:
```
# scale and center
cols_all = ['fh', 'fd', 'temp_change', 'heat_flux_change'] + cols_num_use
flam = scale_and_center(flamog, cols_all, cols_no_change=['plant_id',␣
 ↪'species', 'ignition'])

# declare as factors
flam['species'] = pd.Categorical(flam['species'])
flam['plant_id'] = pd.Categorical(flam['plant_id'])
flam['ignition'] = pd.Categorical(flam['ignition'])
```

```
# drop na's
print(len(flam))
cols_all_dpna = cols_all + ['plant_id', 'species', 'ignition']
flam.dropna(subset=cols_all_dpna, inplace=True)
print(len(flam))

# declare all possible IV cols to model
cols_use = cols_num_use + ['species']
print(cols_use)
```

```
167
162
['lfm', 'LMA', 'sample_wt', 'leaf_mass_ratio', 'branching', 'mpa', 'start_temp',
'dmc', 'branch_volume', 'stem_sav', 'leaf_sav', 'thickness', 'species']
```

3 Run Model Selector

3.0.1 NOTE: Random effect is simply `plant_id`

- NO nested effects
- NO 'species'

It was not possible to test all combinations. Therefore, only combinations of significnt interaction terms and all singletons will be tested.

[6]:
```
mxs = 4 #5
mns = 1
mxi = 1 #5
mni = 1
```

4 Flame Height

[7]:
```
AIC_iterator(flam, cols_use, Y_VAR='fh',
             minnumsingle=mns, maxnumsingle=mxs, minnumint=mni, maxnumint=mxi)
```

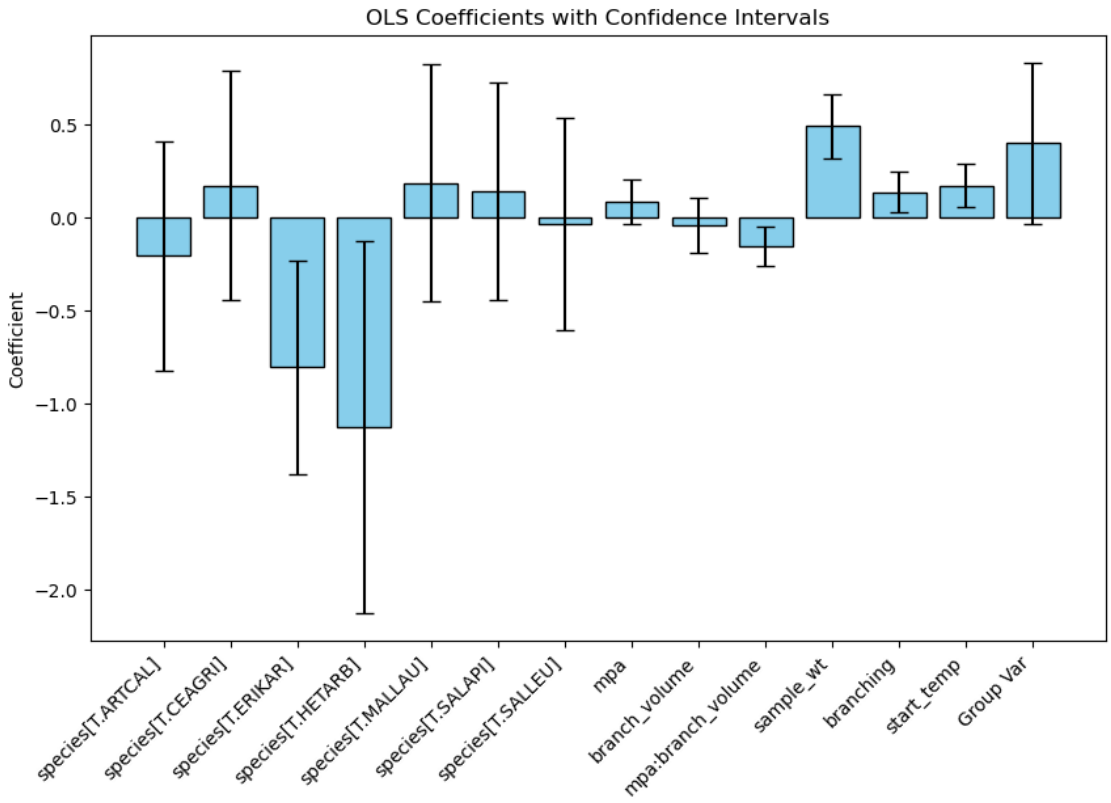
```
ERROR: Formula model error: fh ~ leaf_sav*thickness

Columns present in sig. interaction terms: {'branching', 'branch_volume',
'sample_wt', 'lfm', 'mpa', 'species', 'start_temp', 'leaf_mass_ratio',
'leaf_sav', 'dmc', 'LMA', 'thickness'}

Total Num. Cols : Num. Sig. Int. Cols;  13 : 12

Significant Interactions:
('lfm', 'dmc')
('lfm', 'branch_volume')
('lfm', 'leaf_sav')
```

```
('lfm', 'thickness')
('LMA', 'dmc')
('LMA', 'species')
('sample_wt', 'species')
('leaf_mass_ratio', 'dmc')
('leaf_mass_ratio', 'leaf_sav')
('leaf_mass_ratio', 'thickness')
('branching', 'dmc')
('branching', 'leaf_sav')
('branching', 'thickness')
('branching', 'species')
('mpa', 'branch_volume')
('mpa', 'species')
('start_temp', 'dmc')
('start_temp', 'species')
('dmc', 'branch_volume')
('dmc', 'leaf_sav')
('dmc', 'thickness')
('leaf_sav', 'species')
('thickness', 'species')

Number of formulas: 12926
ERROR: Formula model error: fh ~ LMA*species + start_temp
ERROR: Formula model error: fh ~ LMA*species + lfm + sample_wt + branching
ERROR: Formula model error: fh ~ LMA*species + lfm + leaf_mass_ratio + thickness
ERROR: Formula model error: fh ~ LMA*species + lfm + stem_sav + leaf_sav
ERROR: Formula model error: fh ~ LMA*species + sample_wt + leaf_mass_ratio +
branch_volume
ERROR: Formula model error: fh ~ LMA*species + sample_wt + leaf_mass_ratio +
leaf_sav
ERROR: Formula model error: fh ~ LMA*species + sample_wt + mpa + thickness
ERROR: Formula model error: fh ~ LMA*species + leaf_mass_ratio + mpa +
branch_volume
ERROR: Formula model error: fh ~ LMA*species + leaf_mass_ratio + mpa + leaf_sav
ERROR: Formula model error: fh ~ LMA*species + leaf_mass_ratio + dmc + leaf_sav
ERROR: Formula model error: fh ~ LMA*species + branching + branch_volume +
leaf_sav
ERROR: Formula model error: fh ~ LMA*species + start_temp + dmc + leaf_sav
ERROR: Formula model error: fh ~ LMA*species + dmc + leaf_sav + thickness
ERROR: Formula model error: fh ~ LMA*species + lfm + sample_wt + stem_sav +
leaf_sav
ERROR: Formula model error: fh ~ LMA*species + lfm + leaf_mass_ratio + mpa +
thickness
ERROR: Formula model error: fh ~ LMA*species + lfm + leaf_mass_ratio + dmc +
branch_volume
ERROR: Formula model error: fh ~ LMA*species + lfm + leaf_mass_ratio +
branch_volume + leaf_sav
ERROR: Formula model error: fh ~ LMA*species + lfm + start_temp + stem_sav +
```

```
leaf_sav
ERROR: Formula model error: fh ~ LMA*species + lfm + dmc + branch_volume +
thickness
ERROR: Formula model error: fh ~ LMA*species + sample_wt + leaf_mass_ratio +
leaf_sav + thickness
ERROR: Formula model error: fh ~ LMA*species + sample_wt + branching + mpa +
leaf_sav
ERROR: Formula model error: fh ~ LMA*species + sample_wt + mpa + dmc + leaf_sav
ERROR: Formula model error: fh ~ LMA*species + sample_wt + start_temp +
branch_volume + leaf_sav
ERROR: Formula model error: fh ~ LMA*species + mpa + dmc + branch_volume +
leaf_sav
ERROR: Formula model error: fh ~ LMA*species + start_temp + dmc + leaf_sav +
thickness
ERROR: Formula model error: fh ~ LMA*species + start_temp + branch_volume +
leaf_sav + thickness
ERROR: Formula model error: fh ~ branching*species + LMA
ERROR: Formula model error: fh ~ branching*species + start_temp
ERROR: Formula model error: fh ~ branching*species + dmc
ERROR: Formula model error: fh ~ branching*species + stem_sav
ERROR: Formula model error: fh ~ branching*species + lfm + stem_sav
ERROR: Formula model error: fh ~ branching*species + lfm + thickness
ERROR: Formula model error: fh ~ branching*species + LMA + mpa
ERROR: Formula model error: fh ~ branching*species + LMA + dmc
ERROR: Formula model error: fh ~ branching*species + LMA + branch_volume
ERROR: Formula model error: fh ~ branching*species + LMA + stem_sav
ERROR: Formula model error: fh ~ branching*species + sample_wt + stem_sav
ERROR: Formula model error: fh ~ branching*species + leaf_mass_ratio + dmc
ERROR: Formula model error: fh ~ branching*species + leaf_mass_ratio + stem_sav
ERROR: Formula model error: fh ~ branching*species + mpa + stem_sav
ERROR: Formula model error: fh ~ branching*species + start_temp + thickness
ERROR: Formula model error: fh ~ branching*species + dmc + stem_sav
ERROR: Formula model error: fh ~ branching*species + lfm + sample_wt + mpa
ERROR: Formula model error: fh ~ branching*species + lfm + leaf_mass_ratio +
stem_sav
ERROR: Formula model error: fh ~ branching*species + lfm + mpa + stem_sav
ERROR: Formula model error: fh ~ branching*species + lfm + mpa + leaf_sav
ERROR: Formula model error: fh ~ branching*species + lfm + dmc + stem_sav
ERROR: Formula model error: fh ~ branching*species + lfm + stem_sav + leaf_sav
ERROR: Formula model error: fh ~ branching*species + LMA + sample_wt + stem_sav
ERROR: Formula model error: fh ~ branching*species + LMA + leaf_mass_ratio +
stem_sav
ERROR: Formula model error: fh ~ branching*species + LMA + mpa + stem_sav
ERROR: Formula model error: fh ~ branching*species + LMA + start_temp + stem_sav
ERROR: Formula model error: fh ~ branching*species + LMA + dmc + branch_volume
ERROR: Formula model error: fh ~ branching*species + sample_wt + dmc + stem_sav
ERROR: Formula model error: fh ~ branching*species + sample_wt + stem_sav +
leaf_sav
```

```
ERROR: Formula model error: fh ~ branching*species + leaf_mass_ratio + mpa + dmc
ERROR: Formula model error: fh ~ branching*species + leaf_mass_ratio + mpa +
stem_sav
ERROR: Formula model error: fh ~ branching*species + leaf_mass_ratio + dmc +
stem_sav
ERROR: Formula model error: fh ~ branching*species + leaf_mass_ratio + stem_sav
+ leaf_sav
ERROR: Formula model error: fh ~ branching*species + leaf_mass_ratio + leaf_sav
+ thickness
ERROR: Formula model error: fh ~ branching*species + mpa + start_temp + stem_sav
ERROR: Formula model error: fh ~ branching*species + mpa + stem_sav + leaf_sav
ERROR: Formula model error: fh ~ branching*species + mpa + leaf_sav + thickness
ERROR: Formula model error: fh ~ branching*species + start_temp + dmc +
thickness
ERROR: Formula model error: fh ~ branching*species + lfm + LMA + sample_wt +
branch_volume
ERROR: Formula model error: fh ~ branching*species + lfm + LMA + leaf_mass_ratio
+ branch_volume
ERROR: Formula model error: fh ~ branching*species + lfm + LMA + mpa + dmc
ERROR: Formula model error: fh ~ branching*species + lfm + LMA + mpa + stem_sav
ERROR: Formula model error: fh ~ branching*species + lfm + sample_wt + dmc +
stem_sav
ERROR: Formula model error: fh ~ branching*species + lfm + leaf_mass_ratio + mpa
+ start_temp
ERROR: Formula model error: fh ~ branching*species + lfm + leaf_mass_ratio + mpa
+ dmc
ERROR: Formula model error: fh ~ branching*species + lfm + leaf_mass_ratio + mpa
+ stem_sav
ERROR: Formula model error: fh ~ branching*species + lfm + leaf_mass_ratio +
branch_volume + stem_sav
ERROR: Formula model error: fh ~ branching*species + lfm + mpa + start_temp +
stem_sav
ERROR: Formula model error: fh ~ branching*species + lfm + mpa + start_temp +
thickness
ERROR: Formula model error: fh ~ branching*species + lfm + mpa + dmc + stem_sav
ERROR: Formula model error: fh ~ branching*species + lfm + mpa + dmc + leaf_sav
ERROR: Formula model error: fh ~ branching*species + lfm + dmc + stem_sav +
leaf_sav
ERROR: Formula model error: fh ~ branching*species + lfm + stem_sav + leaf_sav +
thickness
ERROR: Formula model error: fh ~ branching*species + LMA + sample_wt + dmc +
stem_sav
ERROR: Formula model error: fh ~ branching*species + LMA + leaf_mass_ratio + mpa
+ dmc
ERROR: Formula model error: fh ~ branching*species + LMA + mpa + dmc + stem_sav
ERROR: Formula model error: fh ~ branching*species + sample_wt + leaf_mass_ratio
+ mpa + stem_sav
ERROR: Formula model error: fh ~ branching*species + sample_wt + start_temp +
```

```
branch_volume + stem_sav
ERROR: Formula model error: fh ~ branching*species + sample_wt + stem_sav +
leaf_sav + thickness
ERROR: Formula model error: fh ~ branching*species + leaf_mass_ratio + mpa +
start_temp + thickness
ERROR: Formula model error: fh ~ branching*species + leaf_mass_ratio +
start_temp + dmc + thickness
ERROR: Formula model error: fh ~ branching*species + mpa + start_temp + dmc +
thickness
ERROR: Formula model error: fh ~ branching*species + mpa + dmc + stem_sav +
thickness
ERROR: Formula model error: fh ~ branching*species + mpa + dmc + leaf_sav +
thickness


fh ~ mpa*branch_volume + sample_wt + branching + start_temp + species


           Mixed Linear Model Regression Results
============================================================
Model:               MixedLM  Dependent Variable:  fh
No. Observations:    162      Method:              ML
No. Groups:          54       Scale:               0.2199
Min. group size:     1        Log-Likelihood:      -126.8658
Max. group size:     11       Converged:           Yes
Mean group size:     3.0
------------------------------------------------------------
                  Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept          0.146    0.252  0.579 0.563 -0.348  0.640
species[T.ARTCAL] -0.208    0.314 -0.662 0.508 -0.824  0.408
species[T.CEAGRI]  0.169    0.314  0.540 0.589 -0.445  0.784
species[T.ERIKAR] -0.806    0.293 -2.749 0.006 -1.380 -0.231
species[T.HETARB] -1.130    0.509 -2.219 0.026 -2.127 -0.132
species[T.MALLAU]  0.183    0.325  0.564 0.572 -0.453  0.820
species[T.SALAPI]  0.139    0.298  0.468 0.640 -0.444  0.723
species[T.SALLEU] -0.037    0.291 -0.128 0.898 -0.607  0.532
mpa                0.084    0.061  1.372 0.170 -0.036  0.203
branch_volume     -0.046    0.075 -0.612 0.541 -0.193  0.101
mpa:branch_volume -0.160    0.054 -2.979 0.003 -0.265 -0.055
sample_wt          0.490    0.089  5.533 0.000  0.316  0.664
branching          0.135    0.057  2.379 0.017  0.024  0.246
start_temp         0.170    0.060  2.834 0.005  0.053  0.288
Group Var          0.088    0.104
============================================================
```



5 Flame Duration

[8]:
```
AIC_iterator(flam, cols_use, Y_VAR='fd',
             minnumsingle=mns, maxnumsingle=mxs, minnumint=mni, maxnumint=mxi)
```

```
Columns present in sig. interaction terms: {'branching', 'sample_wt', 'mpa',
'lfm', 'branch_volume', 'thickness', 'stem_sav', 'species', 'leaf_mass_ratio',
'leaf_sav', 'dmc', 'LMA'}

Total Num. Cols : Num. Sig. Int. Cols;  13 : 12

Significant Interactions:
('lfm', 'LMA')
('lfm', 'sample_wt')
('lfm', 'leaf_mass_ratio')
('lfm', 'stem_sav')
('lfm', 'species')
('LMA', 'leaf_sav')
('LMA', 'thickness')
('LMA', 'species')
```

```
('sample_wt', 'dmc')
('sample_wt', 'leaf_sav')
('sample_wt', 'species')
('leaf_mass_ratio', 'dmc')
('branching', 'stem_sav')
('mpa', 'branch_volume')

Number of formulas: 7868
ERROR: Formula model error: fd ~ LMA*species + sample_wt
ERROR: Formula model error: fd ~ LMA*species + lfm + leaf_mass_ratio
ERROR: Formula model error: fd ~ LMA*species + sample_wt + leaf_mass_ratio
ERROR: Formula model error: fd ~ LMA*species + leaf_mass_ratio + mpa
ERROR: Formula model error: fd ~ LMA*species + leaf_mass_ratio + dmc
ERROR: Formula model error: fd ~ LMA*species + leaf_mass_ratio + leaf_sav
ERROR: Formula model error: fd ~ LMA*species + branching + dmc
ERROR: Formula model error: fd ~ LMA*species + start_temp + stem_sav
ERROR: Formula model error: fd ~ LMA*species + dmc + stem_sav
ERROR: Formula model error: fd ~ LMA*species + leaf_sav + thickness
ERROR: Formula model error: fd ~ LMA*species + lfm + sample_wt + start_temp
ERROR: Formula model error: fd ~ LMA*species + lfm + leaf_mass_ratio + dmc
ERROR: Formula model error: fd ~ LMA*species + lfm + mpa + stem_sav
ERROR: Formula model error: fd ~ LMA*species + sample_wt + leaf_mass_ratio +
branch_volume
ERROR: Formula model error: fd ~ LMA*species + sample_wt + branching + mpa
ERROR: Formula model error: fd ~ LMA*species + sample_wt + mpa + dmc
ERROR: Formula model error: fd ~ LMA*species + sample_wt + mpa + branch_volume
ERROR: Formula model error: fd ~ LMA*species + sample_wt + mpa + leaf_sav
ERROR: Formula model error: fd ~ LMA*species + sample_wt + mpa + thickness
ERROR: Formula model error: fd ~ LMA*species + sample_wt + start_temp + leaf_sav
ERROR: Formula model error: fd ~ LMA*species + sample_wt + leaf_sav + thickness
ERROR: Formula model error: fd ~ LMA*species + leaf_mass_ratio + mpa + dmc
ERROR: Formula model error: fd ~ LMA*species + leaf_mass_ratio + mpa +
branch_volume
ERROR: Formula model error: fd ~ LMA*species + leaf_mass_ratio + dmc + stem_sav
ERROR: Formula model error: fd ~ LMA*species + branching + mpa + start_temp
ERROR: Formula model error: fd ~ LMA*species + branching + branch_volume +
stem_sav
ERROR: Formula model error: fd ~ LMA*species + branching + branch_volume +
leaf_sav
ERROR: Formula model error: fd ~ LMA*species + start_temp + dmc + leaf_sav
ERROR: Formula model error: fd ~ LMA*species + start_temp + dmc + thickness
ERROR: Formula model error: fd ~ LMA*species + lfm + sample_wt + leaf_mass_ratio
+ branching
ERROR: Formula model error: fd ~ LMA*species + lfm + sample_wt + mpa + dmc
ERROR: Formula model error: fd ~ LMA*species + lfm + sample_wt + branch_volume +
stem_sav
ERROR: Formula model error: fd ~ LMA*species + lfm + leaf_mass_ratio + mpa + dmc
ERROR: Formula model error: fd ~ LMA*species + lfm + mpa + dmc + branch_volume
```

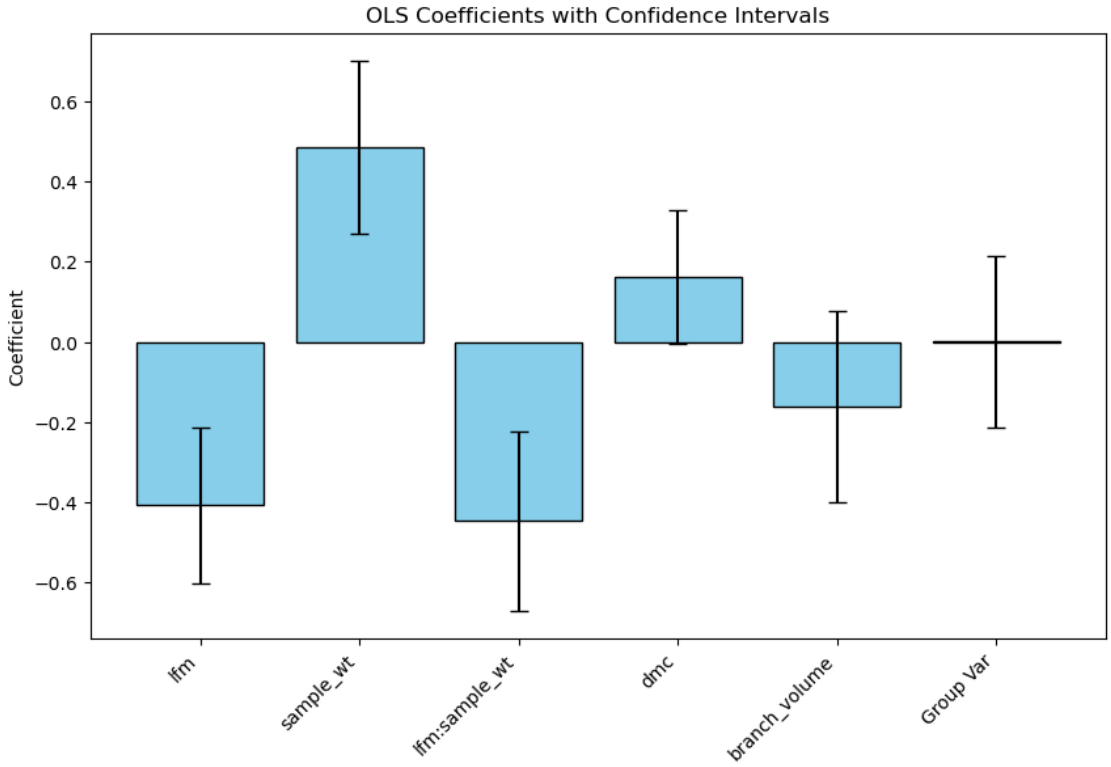
```
ERROR: Formula model error: fd ~ LMA*species + lfm + mpa + branch_volume +
stem_sav
ERROR: Formula model error: fd ~ LMA*species + lfm + dmc + branch_volume +
thickness
ERROR: Formula model error: fd ~ LMA*species + sample_wt + leaf_mass_ratio + mpa
+ leaf_sav
ERROR: Formula model error: fd ~ LMA*species + sample_wt + leaf_mass_ratio + dmc
+ thickness
ERROR: Formula model error: fd ~ LMA*species + sample_wt + leaf_mass_ratio +
leaf_sav + thickness
ERROR: Formula model error: fd ~ LMA*species + sample_wt + branching + mpa + dmc
ERROR: Formula model error: fd ~ LMA*species + sample_wt + branching + mpa +
stem_sav
ERROR: Formula model error: fd ~ LMA*species + sample_wt + mpa + start_temp +
dmc
ERROR: Formula model error: fd ~ LMA*species + sample_wt + mpa + branch_volume +
leaf_sav
ERROR: Formula model error: fd ~ LMA*species + sample_wt + dmc + stem_sav +
thickness
ERROR: Formula model error: fd ~ LMA*species + leaf_mass_ratio + branch_volume +
leaf_sav + thickness
ERROR: Formula model error: fd ~ LMA*species + mpa + start_temp + branch_volume
+ leaf_sav
ERROR: Formula model error: fd ~ LMA*species + mpa + start_temp + branch_volume
+ thickness
ERROR: Formula model error: fd ~ LMA*species + mpa + dmc + stem_sav + thickness
ERROR: Formula model error: fd ~ LMA*species + start_temp + branch_volume +
leaf_sav + thickness


fd ~ lfm*sample_wt + dmc + branch_volume
fd ~ lfm*sample_wt + dmc
fd ~ lfm*sample_wt + start_temp + dmc + branch_volume
fd ~ lfm*sample_wt + leaf_mass_ratio + dmc + branch_volume + stem_sav
fd ~ lfm*sample_wt + leaf_mass_ratio + dmc + branch_volume + species
fd ~ lfm*sample_wt + leaf_mass_ratio + dmc + species
fd ~ lfm*sample_wt + leaf_mass_ratio + dmc + branch_volume
fd ~ lfm*sample_wt + start_temp + dmc
fd ~ lfm*sample_wt + branching + dmc
fd ~ lfm*sample_wt + leaf_mass_ratio + dmc
fd ~ lfm*sample_wt + LMA + leaf_mass_ratio + dmc + species
fd ~ lfm*sample_wt + dmc + branch_volume + stem_sav
fd ~ lfm*sample_wt + branching + dmc + branch_volume
fd ~ lfm*sample_wt + leaf_mass_ratio + mpa + dmc + species
fd ~ lfm*sample_wt + LMA + dmc + branch_volume
fd ~ lfm*sample_wt + dmc + leaf_sav
fd ~ lfm*sample_wt + leaf_mass_ratio + dmc + stem_sav
fd ~ lfm*sample_wt + dmc + stem_sav
```

```
fd ~ lfm*sample_wt + dmc + branch_volume + leaf_sav
fd ~ lfm*sample_wt + LMA + leaf_mass_ratio + dmc + branch_volume
fd ~ lfm*sample_wt + leaf_mass_ratio + dmc + stem_sav + species
fd ~ lfm*sample_wt + leaf_mass_ratio + start_temp + dmc + branch_volume
fd ~ lfm*sample_wt + leaf_mass_ratio + dmc + branch_volume + leaf_sav
fd ~ lfm*sample_wt + leaf_mass_ratio + dmc + leaf_sav
fd ~ lfm*sample_wt + branch_volume + stem_sav
fd ~ lfm*sample_wt + leaf_mass_ratio + branching + dmc + branch_volume
fd ~ lfm*sample_wt + leaf_mass_ratio + branching + dmc
fd ~ lfm*sample_wt + start_temp + dmc + branch_volume + stem_sav
fd ~ lfm*sample_wt + start_temp + dmc + branch_volume + leaf_sav
fd ~ lfm*sample_wt + mpa + dmc + branch_volume
fd ~ lfm*sample_wt + dmc + thickness
fd ~ lfm*sample_wt + LMA + dmc
fd ~ lfm*sample_wt + LMA + dmc + species
fd ~ lfm*sample_wt + dmc + branch_volume + thickness
```

Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	fd
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.6276
Min. group size:	1	Log-Likelihood:	-192.1855
Max. group size:	11	Converged:	No
Mean group size:	3.0		

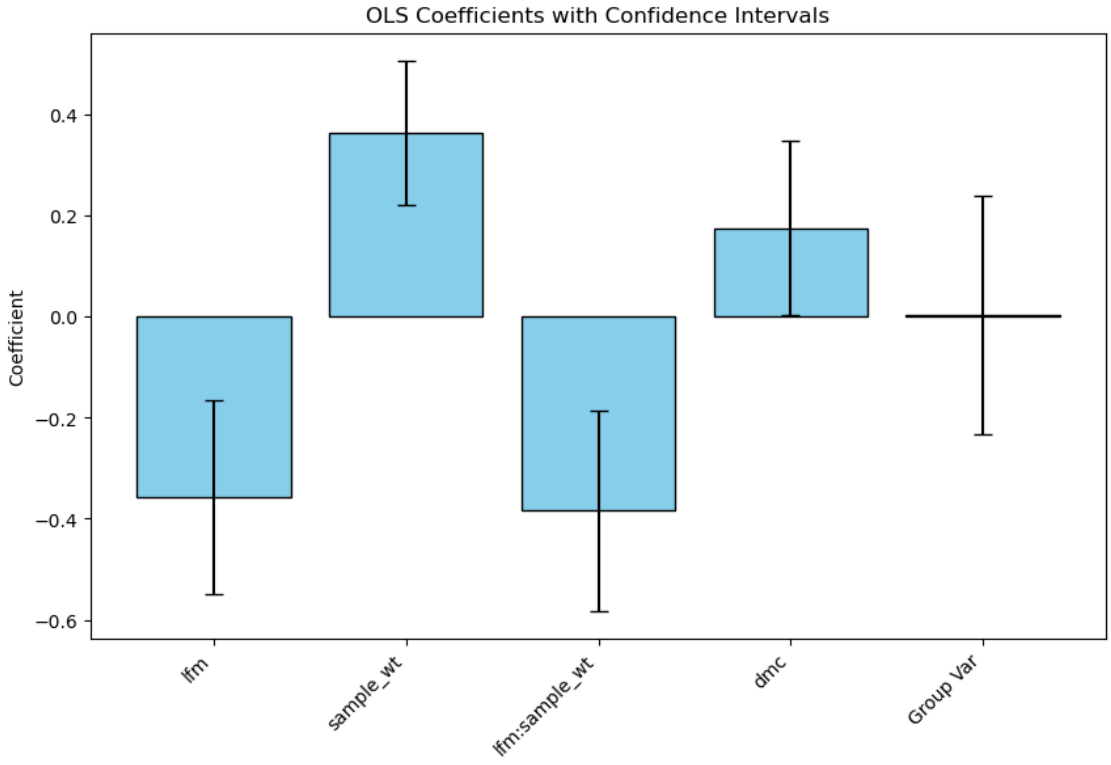
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.089	0.069	-1.287	0.198	-0.224	0.046
lfm	-0.409	0.100	-4.099	0.000	-0.604	-0.213
sample_wt	0.486	0.110	4.403	0.000	0.270	0.703
lfm:sample_wt	-0.448	0.114	-3.925	0.000	-0.672	-0.224
dmc	0.162	0.086	1.888	0.059	-0.006	0.330
branch_volume	-0.163	0.122	-1.336	0.182	-0.402	0.076
Group Var	0.000	0.087				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	fd
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.6342
Min. group size:	1	Log-Likelihood:	-193.2160
Max. group size:	11	Converged:	No
Mean group size:	3.0		

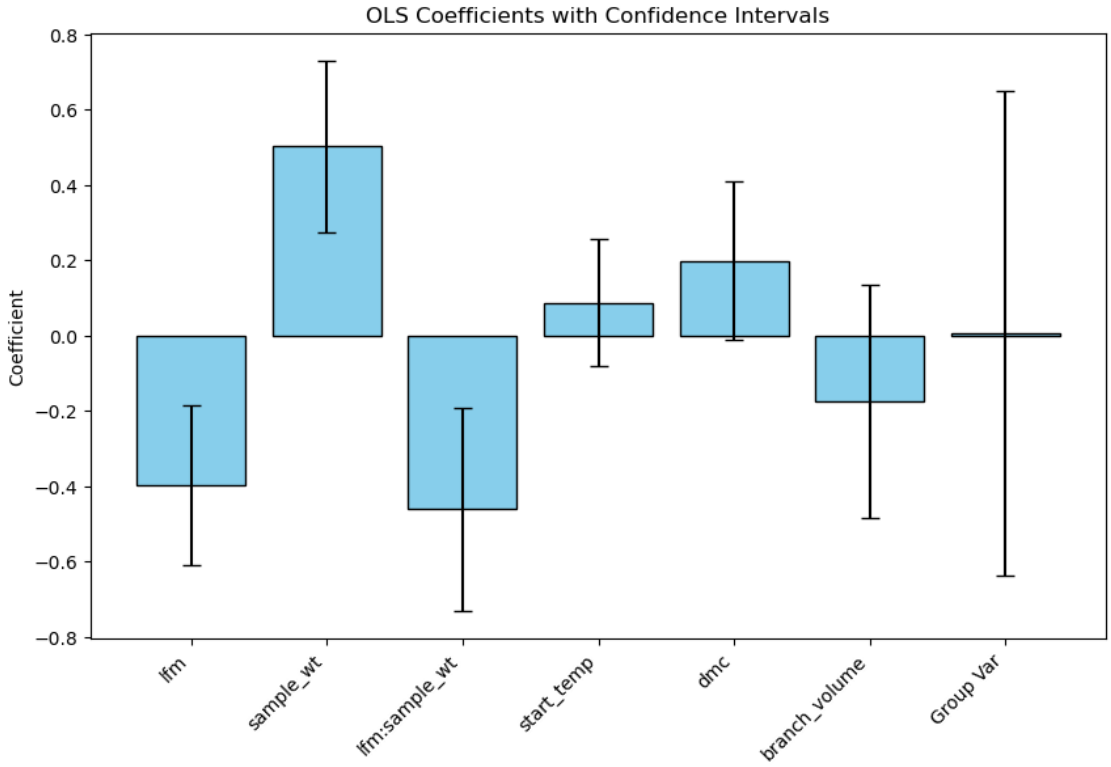
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.074	0.068	-1.075	0.282	-0.208	0.061
lfm	-0.357	0.098	-3.645	0.000	-0.549	-0.165
sample_wt	0.364	0.073	5.008	0.000	0.222	0.507
lfm:sample_wt	-0.384	0.101	-3.792	0.000	-0.582	-0.185
dmc	0.175	0.088	1.998	0.046	0.003	0.347
Group Var	0.002	0.096				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	fd
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.6186
Min. group size:	1	Log-Likelihood:	-191.4590
Max. group size:	11	Converged:	No
Mean group size:	3.0		

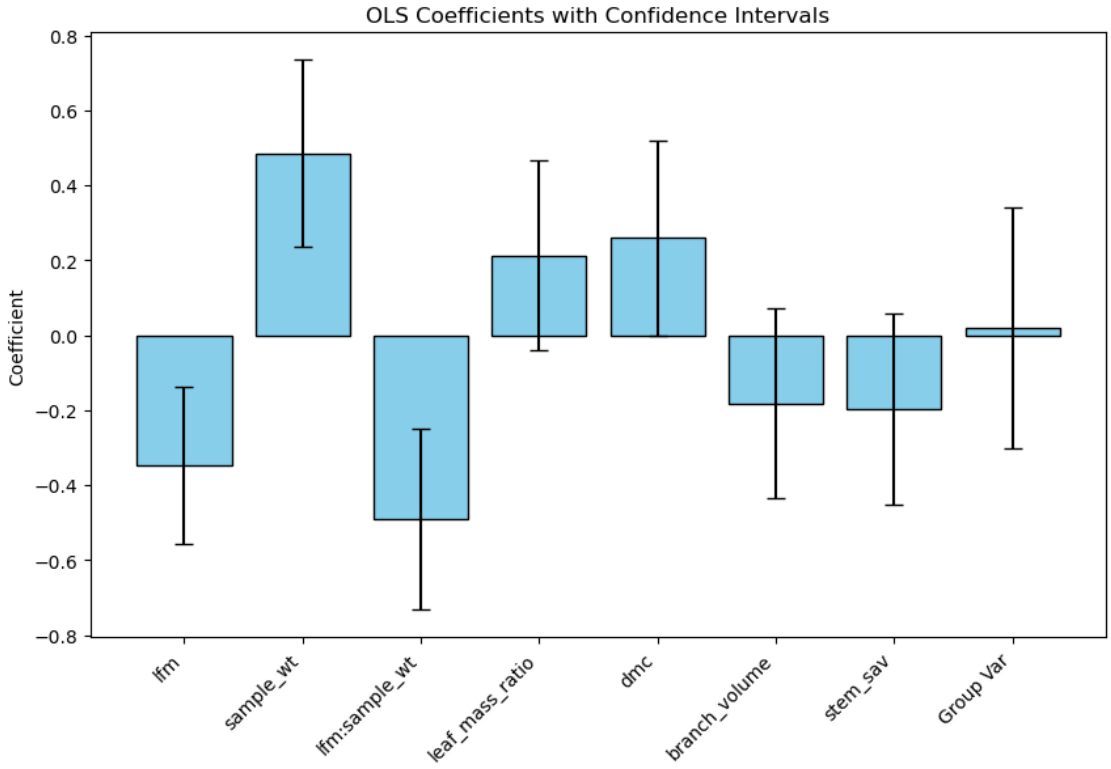
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.095	0.085	-1.124	0.261	-0.261	0.071
lfm	-0.397	0.108	-3.660	0.000	-0.610	-0.184
sample_wt	0.502	0.116	4.324	0.000	0.274	0.730
lfm:sample_wt	-0.460	0.138	-3.343	0.001	-0.730	-0.190
start_temp	0.086	0.086	1.004	0.316	-0.082	0.255
dmc	0.198	0.108	1.840	0.066	-0.013	0.410
branch_volume	-0.175	0.158	-1.107	0.268	-0.484	0.135
Group Var	0.004	0.258				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	fd
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.6032
Min. group size:	1	Log-Likelihood:	-190.4814
Max. group size:	11	Converged:	No
Mean group size:	3.0		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.100	0.072	-1.397	0.162	-0.240	0.040
lfm	-0.346	0.107	-3.241	0.001	-0.555	-0.137
sample_wt	0.484	0.127	3.802	0.000	0.235	0.734
lfm:sample_wt	-0.492	0.123	-3.997	0.000	-0.733	-0.251
leaf_mass_ratio	0.213	0.129	1.648	0.099	-0.040	0.467
dmc	0.259	0.132	1.958	0.050	-0.000	0.519
branch_volume	-0.182	0.129	-1.413	0.158	-0.433	0.070
stem_sav	-0.197	0.130	-1.521	0.128	-0.451	0.057
Group Var	0.012	0.128				

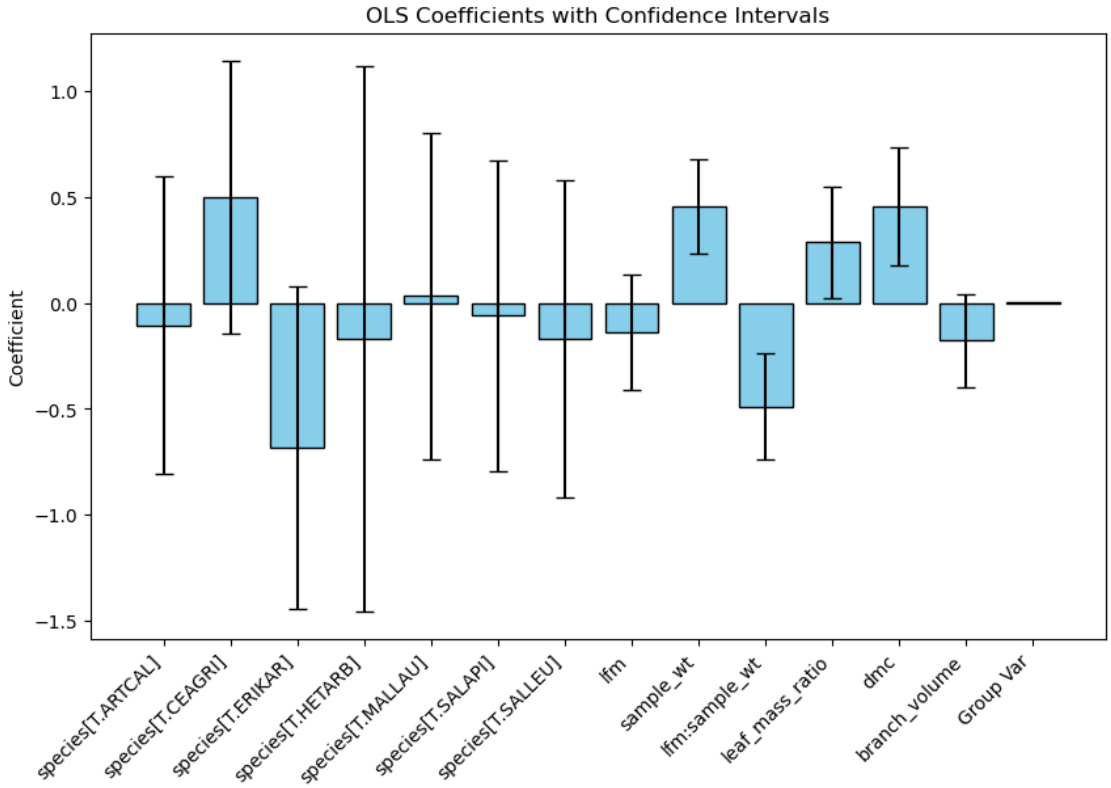


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	fd
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.5690
Min. group size:	1	Log-Likelihood:	-184.5169
Max. group size:	11	Converged:	Yes
Mean group size:	3.0		

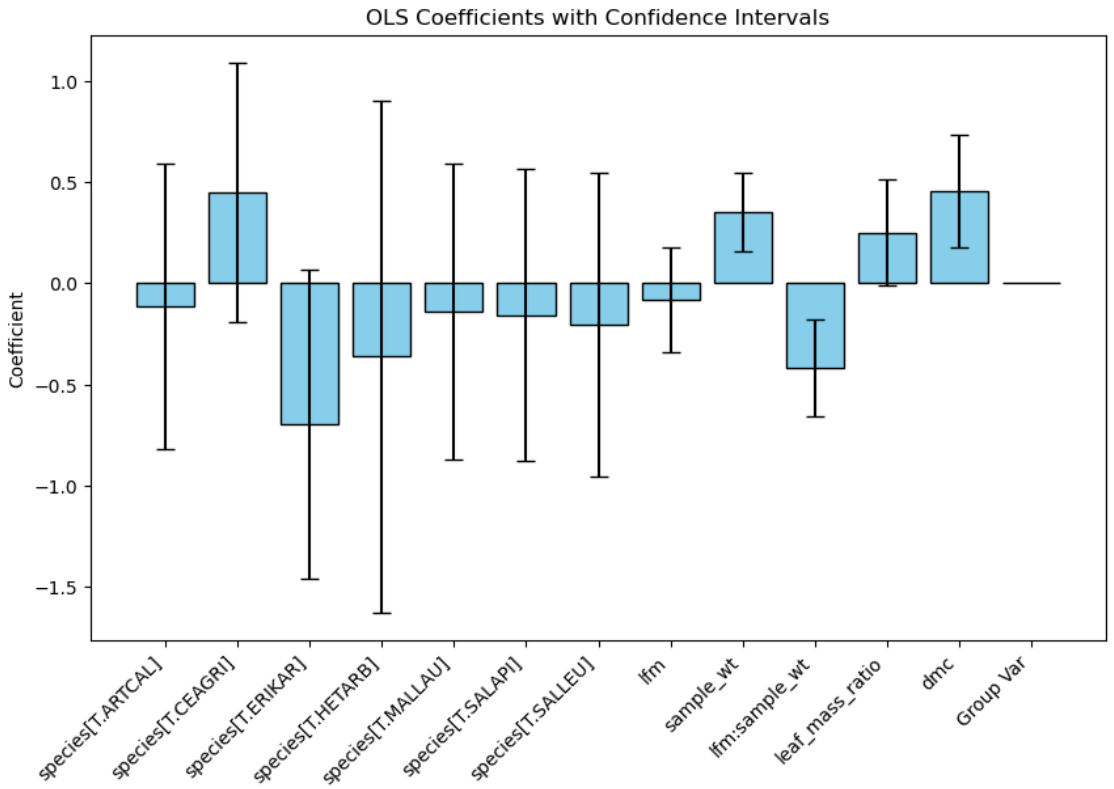
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	0.005	0.288	0.018	0.985	-0.559	0.569
species[T.ARTCAL]	-0.107	0.358	-0.298	0.766	-0.809	0.596
species[T.CEAGRI]	0.499	0.329	1.519	0.129	-0.145	1.143
species[T.ERIKAR]	-0.682	0.388	-1.757	0.079	-1.442	0.079
species[T.HETARB]	-0.169	0.656	-0.258	0.797	-1.454	1.116
species[T.MALLAU]	0.032	0.393	0.082	0.935	-0.738	0.802
species[T.SALAPI]	-0.060	0.375	-0.161	0.872	-0.795	0.674
species[T.SALLEU]	-0.169	0.383	-0.442	0.658	-0.920	0.581
lfm	-0.141	0.139	-1.019	0.308	-0.414	0.131
sample_wt	0.454	0.115	3.956	0.000	0.229	0.679
lfm:sample_wt	-0.489	0.127	-3.845	0.000	-0.738	-0.240
leaf_mass_ratio	0.285	0.134	2.130	0.033	0.023	0.548

```
dmc                0.456    0.142  3.214 0.001  0.178  0.734
branch_volume     -0.177    0.112 -1.582 0.114 -0.397  0.042
Group Var          0.002
============================================================
```



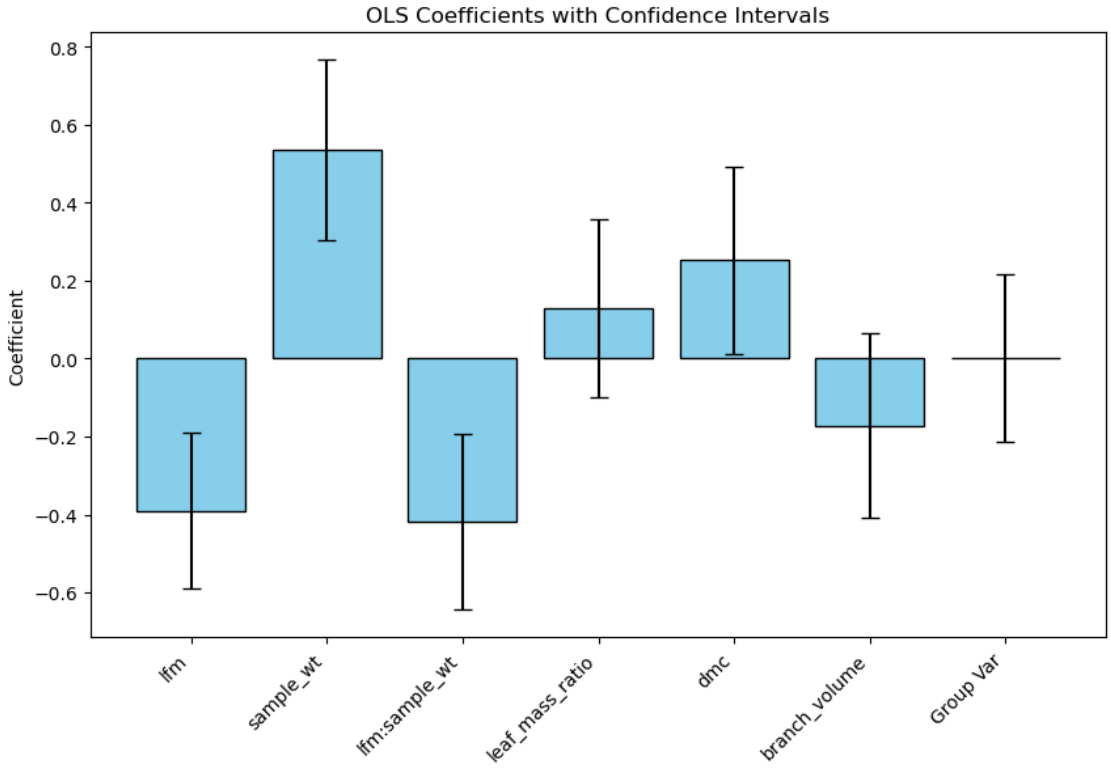

```
           Mixed Linear Model Regression Results
============================================================
Model:               MixedLM  Dependent Variable:  fd
No. Observations:    162      Method:              ML
No. Groups:          54       Scale:               0.5781
Min. group size:     1        Log-Likelihood:      -185.5763
Max. group size:     11       Converged:           No
Mean group size:     3.0
------------------------------------------------------------
                  Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept          0.080    0.284  0.281 0.779 -0.477  0.636
species[T.ARTCAL] -0.114    0.360 -0.317 0.751 -0.820  0.591
species[T.CEAGRI]  0.449    0.328  1.368 0.171 -0.194  1.091
species[T.ERIKAR] -0.697    0.389 -1.792 0.073 -1.460  0.065
species[T.HETARB] -0.364    0.645 -0.564 0.573 -1.627  0.900
```

```
species[T.MALLAU] -0.140    0.373 -0.376 0.707 -0.872  0.591
species[T.SALAPI] -0.157    0.368 -0.427 0.669 -0.878  0.564
species[T.SALLEU] -0.204    0.383 -0.533 0.594 -0.956  0.547
lfm               -0.082    0.131 -0.625 0.532 -0.338  0.175
sample_wt          0.351    0.099  3.543 0.000  0.157  0.545
lfm:sample_wt     -0.420    0.122 -3.450 0.001 -0.659 -0.181
leaf_mass_ratio    0.251    0.132  1.897 0.058 -0.008  0.510
dmc                0.454    0.143  3.176 0.001  0.174  0.734
Group Var          0.001
============================================================
```



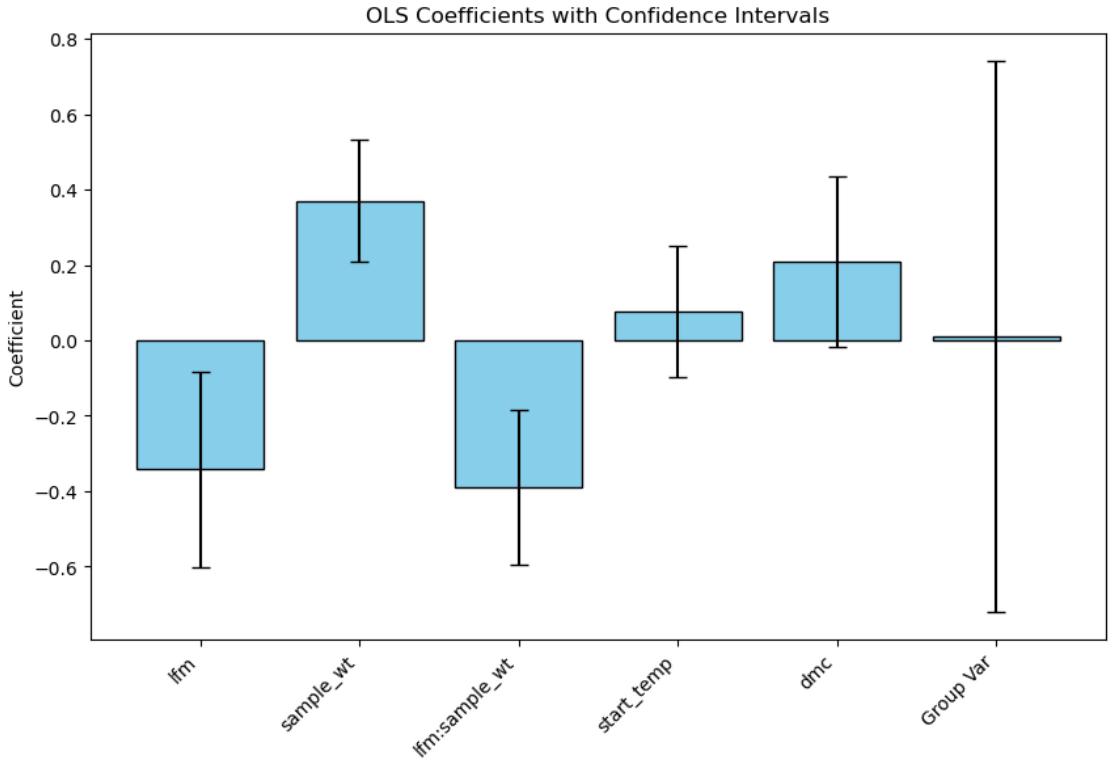

```
          Mixed Linear Model Regression Results
============================================================
Model:             MixedLM  Dependent Variable:  fd
No. Observations:  162      Method:              ML
No. Groups:        54       Scale:               0.6231
Min. group size:   1        Log-Likelihood:      -191.5794
Max. group size:   11       Converged:           Yes
Mean group size:   3.0
------------------------------------------------------------
                Coef.  Std.Err.    z    P>|z| [0.025 0.975]
```

```
------------------------------------------------------------
Intercept       -0.080    0.069 -1.166 0.244 -0.215  0.055
lfm             -0.391    0.102 -3.843 0.000 -0.590 -0.191
sample_wt        0.534    0.118  4.526 0.000  0.303  0.765
lfm:sample_wt   -0.419    0.115 -3.636 0.000 -0.645 -0.193
leaf_mass_ratio  0.128    0.117  1.097 0.273 -0.101  0.357
dmc              0.253    0.122  2.065 0.039  0.013  0.493
branch_volume   -0.173    0.121 -1.431 0.152 -0.409  0.064
Group Var        0.000    0.086
============================================================
```



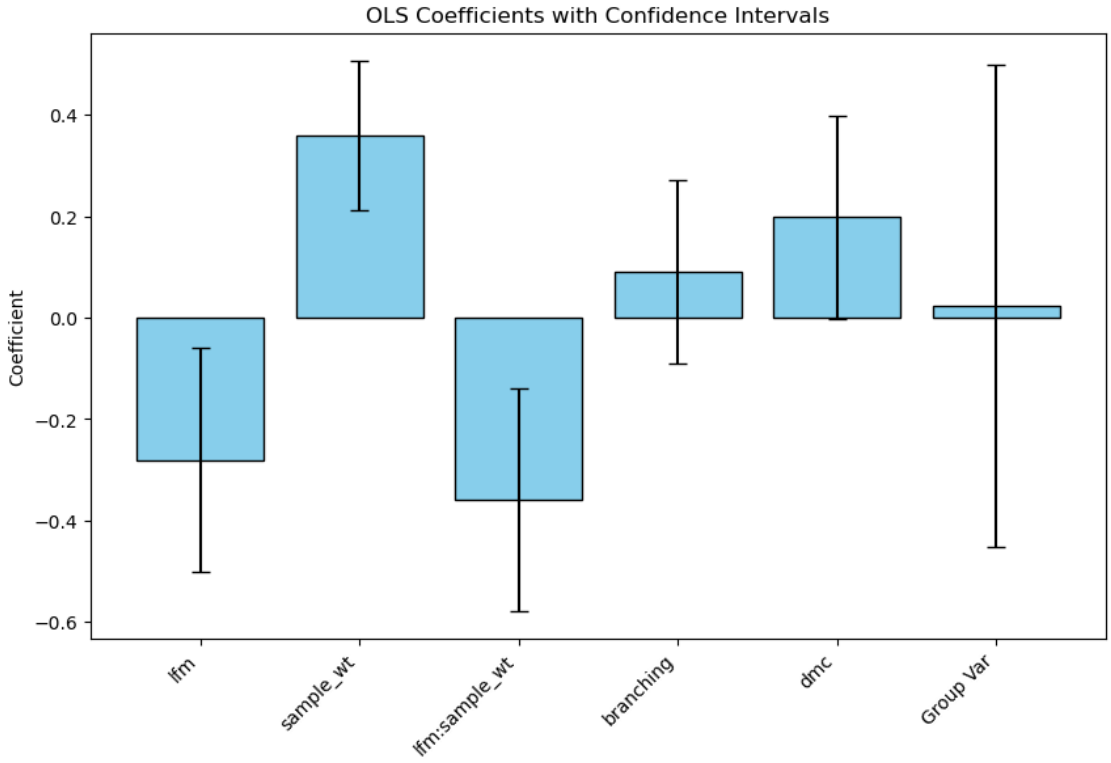

```
         Mixed Linear Model Regression Results
============================================================
Model:             MixedLM Dependent Variable: fd
No. Observations:  162     Method:             ML
No. Groups:        54      Scale:              0.6246
Min. group size:   1       Log-Likelihood:     -192.6937
Max. group size:   11      Converged:          No
Mean group size:   3.0
------------------------------------------------------------
              Coef.  Std.Err.    z    P>|z| [0.025 0.975]
------------------------------------------------------------
```

```
Intercept     -0.079    0.084 -0.947 0.344 -0.243  0.085
lfm           -0.342    0.133 -2.579 0.010 -0.601 -0.082
sample_wt      0.370    0.082  4.492 0.000  0.209  0.532
lfm:sample_wt -0.390    0.105 -3.713 0.000 -0.596 -0.184
start_temp     0.078    0.089  0.881 0.378 -0.096  0.252
dmc            0.210    0.116  1.814 0.070 -0.017  0.436
Group Var      0.007    0.295
============================================================
```



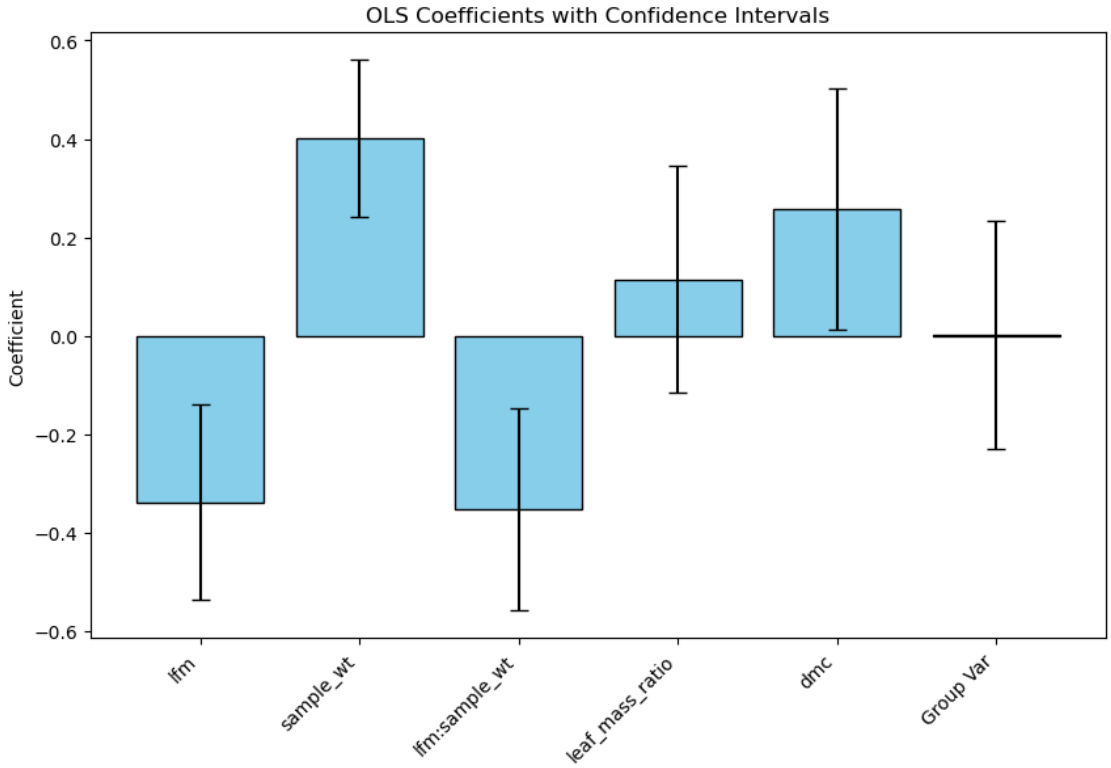

```
         Mixed Linear Model Regression Results
============================================================
Model:             MixedLM Dependent Variable: fd
No. Observations:  162     Method:             ML
No. Groups:        54      Scale:              0.6179
Min. group size:   1       Log-Likelihood:     -192.7140
Max. group size:   11      Converged:          No
Mean group size:   3.0
------------------------------------------------------------
              Coef.  Std.Err.    z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept     -0.071    0.072 -0.989 0.323 -0.213  0.070
lfm           -0.281    0.113 -2.490 0.013 -0.502 -0.060
```

```
sample_wt      0.360    0.075  4.785 0.000  0.213  0.508
lfm:sample_wt -0.359    0.112 -3.218 0.001 -0.578 -0.140
branching      0.091    0.092  0.985 0.325 -0.090  0.271
dmc            0.198    0.102  1.942 0.052 -0.002  0.398
Group Var      0.015    0.191
============================================================
```



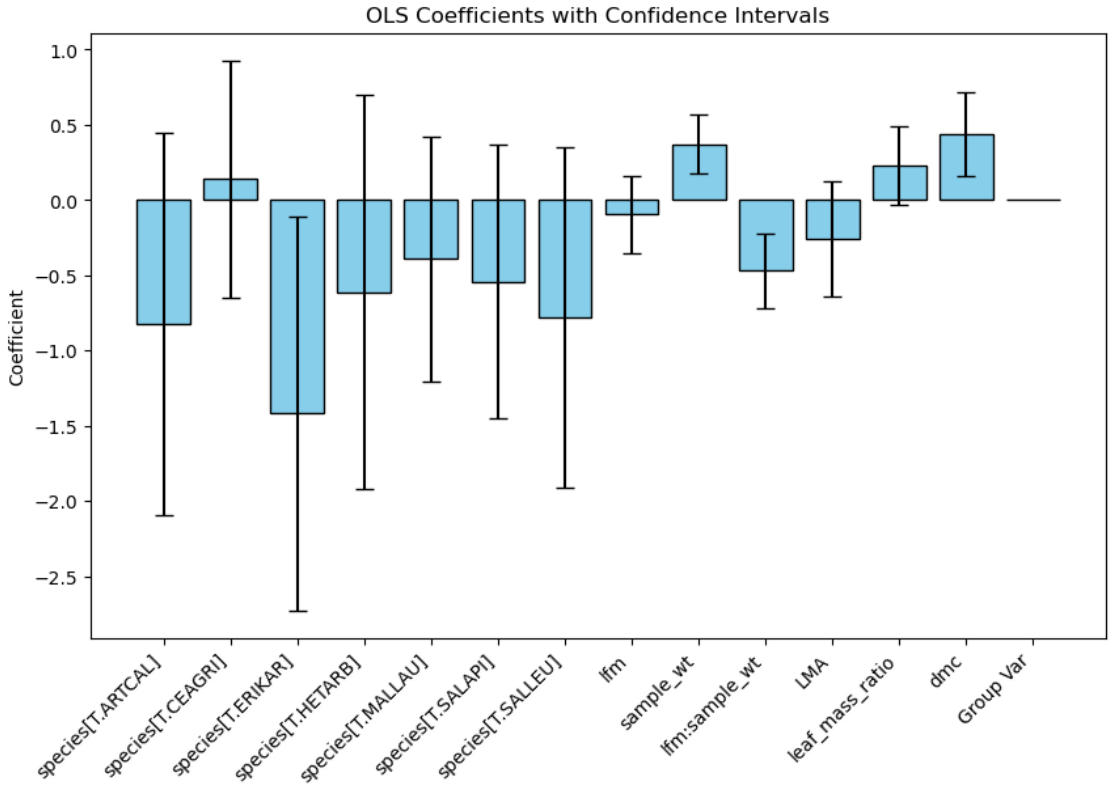

```
          Mixed Linear Model Regression Results
============================================================
Model:             MixedLM  Dependent Variable:  fd
No. Observations:  162      Method:              ML
No. Groups:        54       Scale:               0.6311
Min. group size:   1        Log-Likelihood:      -192.7247
Max. group size:   11       Converged:           Yes
Mean group size:   3.0
------------------------------------------------------------
               Coef.  Std.Err.    z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept      -0.065    0.068 -0.952 0.341 -0.199  0.069
lfm            -0.338    0.101 -3.349 0.001 -0.536 -0.140
sample_wt       0.401    0.081  4.937 0.000  0.242  0.560
lfm:sample_wt  -0.354    0.105 -3.380 0.001 -0.559 -0.149
```

```
leaf_mass_ratio  0.115    0.118  0.976 0.329 -0.116  0.345
dmc              0.257    0.125  2.053 0.040  0.012  0.502
Group Var        0.001    0.094
============================================================
```



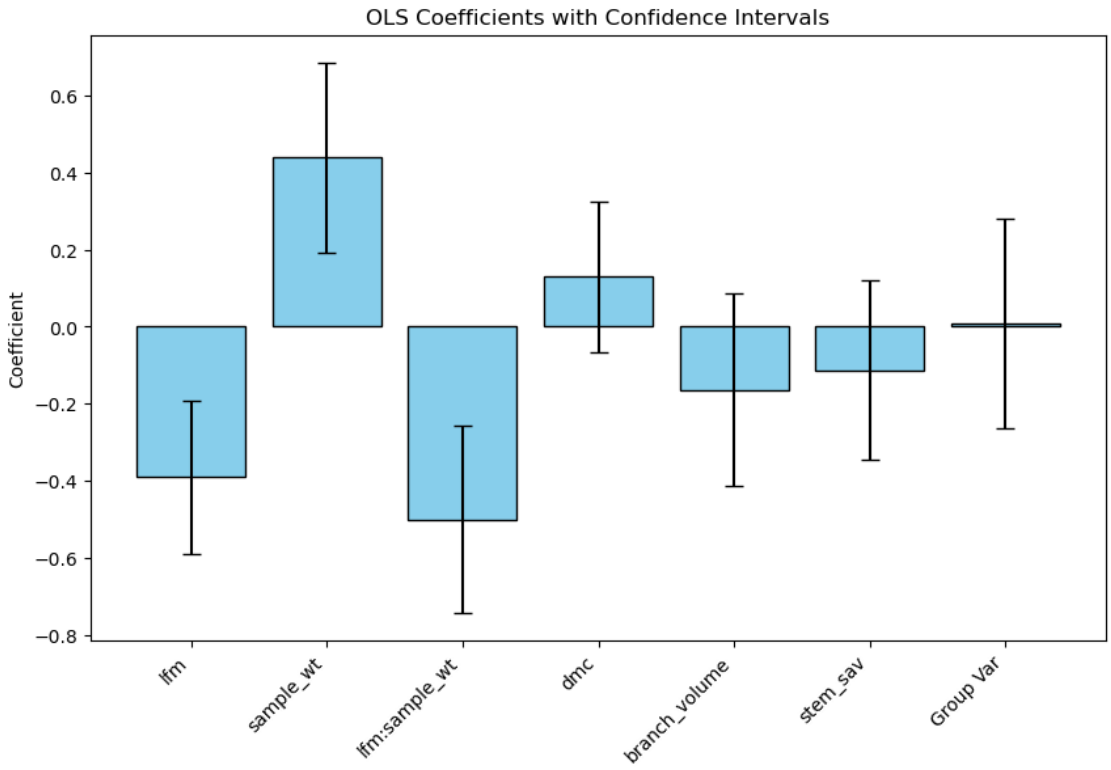

```
           Mixed Linear Model Regression Results
============================================================
Model:               MixedLM  Dependent Variable:  fd
No. Observations:    162      Method:              ML
No. Groups:          54       Scale:               0.5718
Min. group size:     1        Log-Likelihood:      -184.7321
Max. group size:     11       Converged:           No
Mean group size:     3.0
------------------------------------------------------------
                  Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept          0.524    0.437  1.198 0.231 -0.333  1.381
species[T.ARTCAL] -0.824    0.647 -1.273 0.203 -2.092  0.444
species[T.CEAGRI]  0.140    0.402  0.349 0.727 -0.648  0.928
species[T.ERIKAR] -1.417    0.668 -2.121 0.034 -2.727 -0.107
species[T.HETARB] -0.611    0.667 -0.917 0.359 -1.917  0.696
species[T.MALLAU] -0.392    0.414 -0.948 0.343 -1.203  0.419
```

```
species[T.SALAPI] -0.543    0.465 -1.170 0.242 -1.454  0.367
species[T.SALLEU] -0.782    0.578 -1.354 0.176 -1.915  0.350
lfm               -0.097    0.133 -0.733 0.464 -0.357  0.163
sample_wt          0.370    0.100  3.697 0.000  0.174  0.565
lfm:sample_wt     -0.471    0.127 -3.709 0.000 -0.720 -0.222
LMA               -0.258    0.194 -1.325 0.185 -0.639  0.124
leaf_mass_ratio    0.228    0.132  1.727 0.084 -0.031  0.488
dmc                0.437    0.143  3.061 0.002  0.157  0.718
Group Var          0.001
============================================================
```



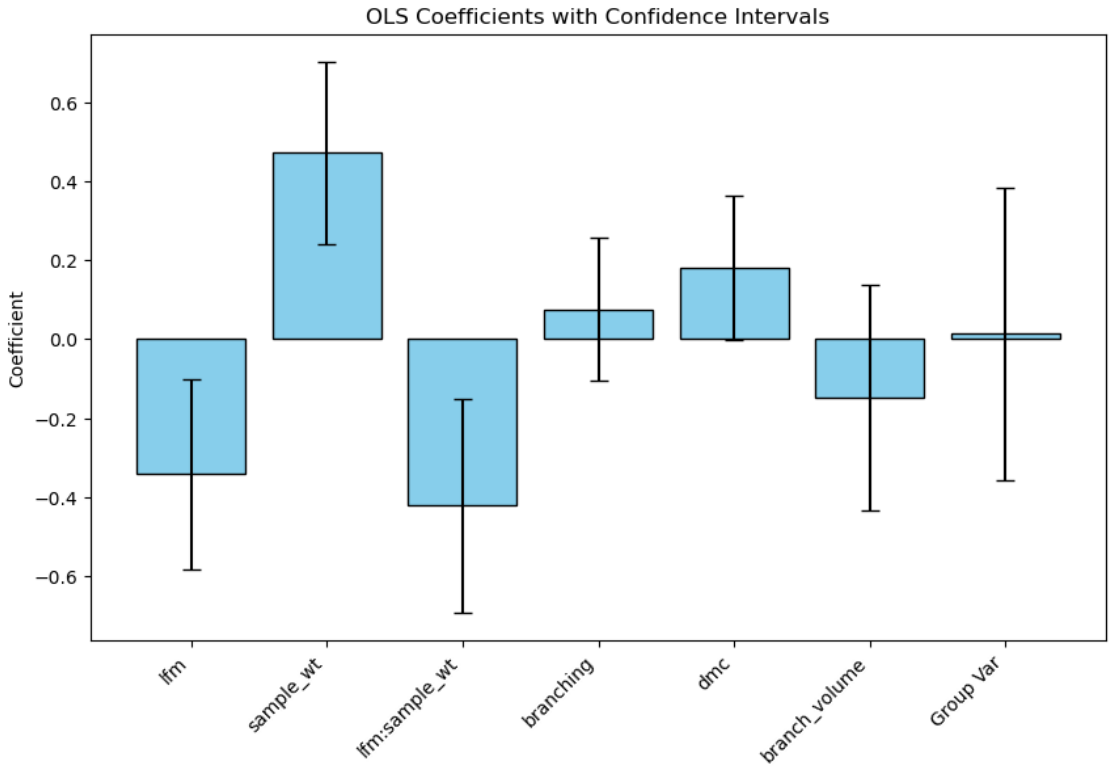

```
         Mixed Linear Model Regression Results
============================================================
Model:             MixedLM Dependent Variable: fd
No. Observations:  162     Method:             ML
No. Groups:        54      Scale:              0.6197
Min. group size:   1       Log-Likelihood:     -191.7419
Max. group size:   11      Converged:          No
Mean group size:   3.0
------------------------------------------------------------
              Coef.  Std.Err.    z    P>|z| [0.025 0.975]
```

```
------------------------------------------------------
Intercept     -0.103    0.071 -1.453 0.146 -0.242  0.036
lfm           -0.391    0.101 -3.867 0.000 -0.590 -0.193
sample_wt      0.440    0.126  3.494 0.000  0.193  0.686
lfm:sample_wt -0.501    0.124 -4.047 0.000 -0.743 -0.258
dmc            0.129    0.100  1.292 0.196 -0.067  0.326
branch_volume -0.164    0.128 -1.278 0.201 -0.414  0.087
stem_sav      -0.113    0.119 -0.946 0.344 -0.346  0.121
Group Var      0.005    0.109
======================================================
```



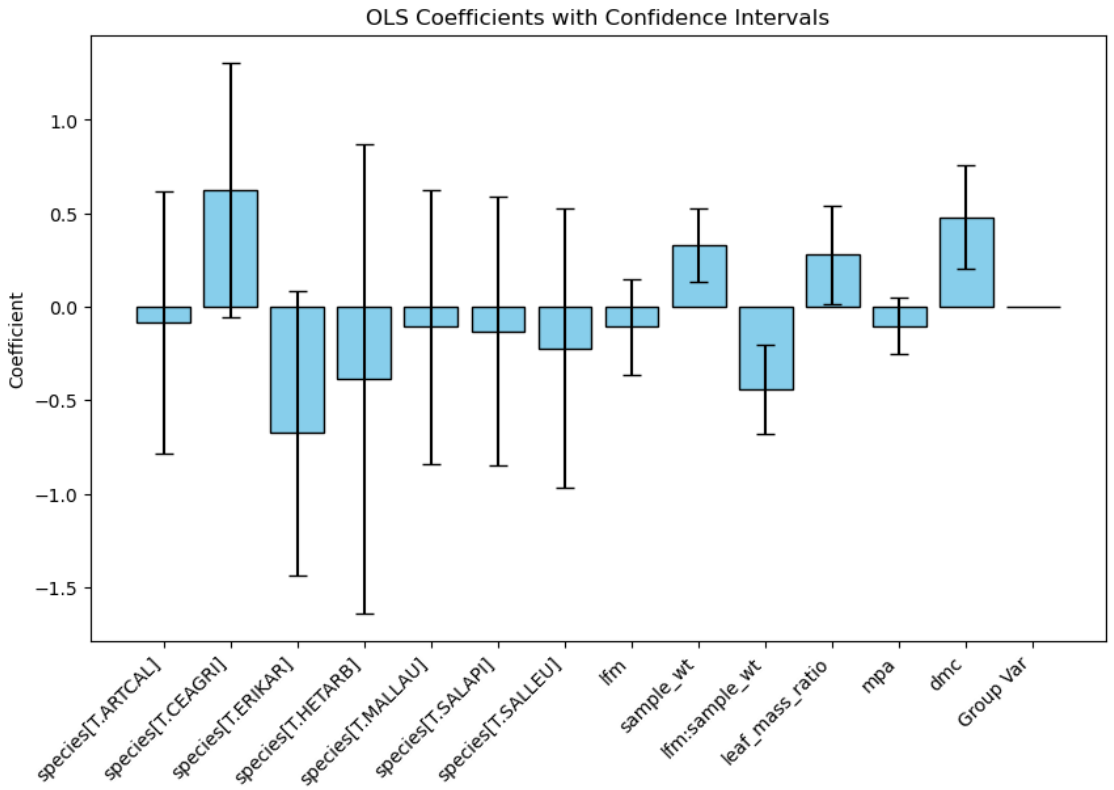

```
         Mixed Linear Model Regression Results
=========================================================
Model:             MixedLM Dependent Variable: fd
No. Observations:  162     Method:             ML
No. Groups:        54      Scale:              0.6168
Min. group size:   1       Log-Likelihood:     -191.7708
Max. group size:   11      Converged:          Yes
Mean group size:   3.0
---------------------------------------------------------
              Coef.  Std.Err.    z    P>|z| [0.025 0.975]
---------------------------------------------------------
```

```
Intercept     -0.085    0.073 -1.170 0.242 -0.227  0.057
lfm           -0.342    0.123 -2.787 0.005 -0.582 -0.101
sample_wt      0.471    0.118  3.999 0.000  0.240  0.702
lfm:sample_wt -0.422    0.138 -3.054 0.002 -0.692 -0.151
branching      0.075    0.092  0.815 0.415 -0.106  0.256
dmc            0.181    0.093  1.949 0.051 -0.001  0.363
branch_volume -0.147    0.146 -1.012 0.311 -0.433  0.138
Group Var      0.008    0.149
============================================================
```



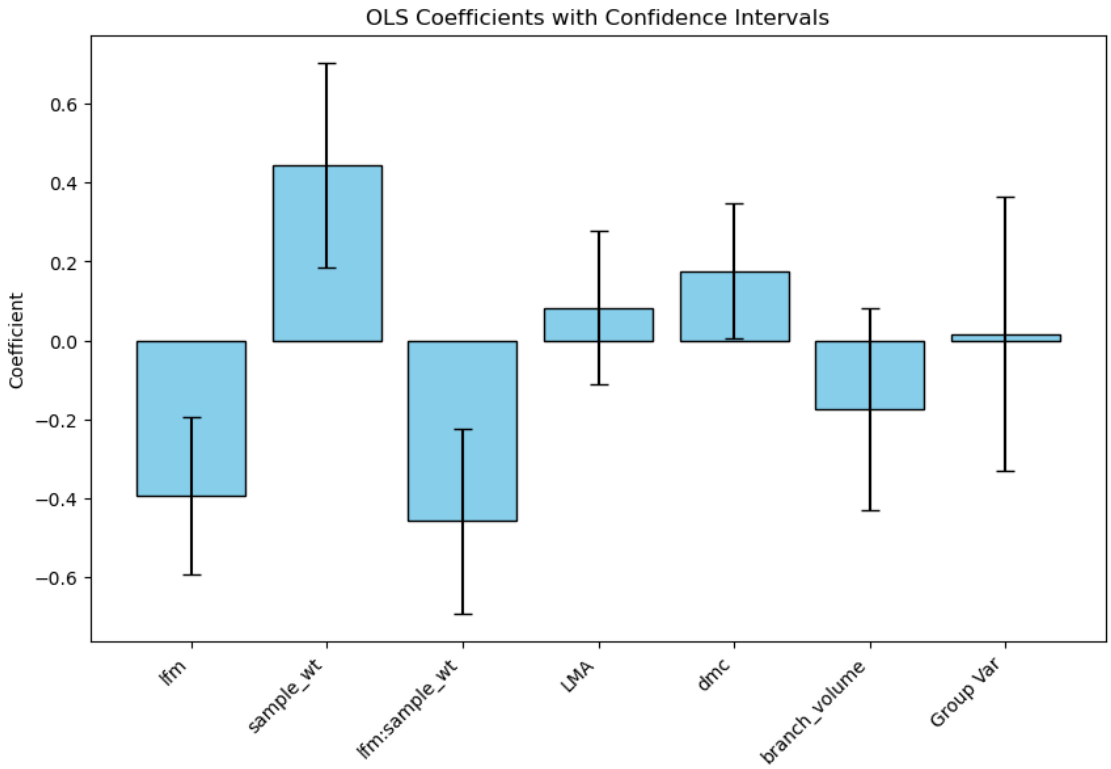

```
           Mixed Linear Model Regression Results
============================================================
Model:               MixedLM  Dependent Variable:  fd
No. Observations:    162      Method:              ML
No. Groups:          54       Scale:               0.5717
Min. group size:     1        Log-Likelihood:      -184.7924
Max. group size:     11       Converged:           No
Mean group size:     3.0
------------------------------------------------------------
                 Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept         0.032    0.286  0.111 0.912 -0.529  0.592
```

```
species[T.ARTCAL] -0.082    0.358 -0.230 0.818 -0.785  0.620
species[T.CEAGRI]  0.624    0.348  1.790 0.073 -0.059  1.307
species[T.ERIKAR] -0.675    0.388 -1.738 0.082 -1.436  0.086
species[T.HETARB] -0.383    0.641 -0.599 0.549 -1.639  0.872
species[T.MALLAU] -0.109    0.372 -0.292 0.770 -0.839  0.621
species[T.SALAPI] -0.130    0.366 -0.356 0.722 -0.847  0.587
species[T.SALLEU] -0.223    0.381 -0.584 0.559 -0.970  0.525
lfm               -0.107    0.131 -0.816 0.414 -0.363  0.150
sample_wt          0.328    0.101  3.260 0.001  0.131  0.526
lfm:sample_wt     -0.442    0.122 -3.616 0.000 -0.682 -0.202
leaf_mass_ratio    0.278    0.134  2.078 0.038  0.016  0.540
mpa               -0.105    0.077 -1.361 0.173 -0.255  0.046
dmc                0.479    0.142  3.362 0.001  0.200  0.758
Group Var          0.001
============================================================
```



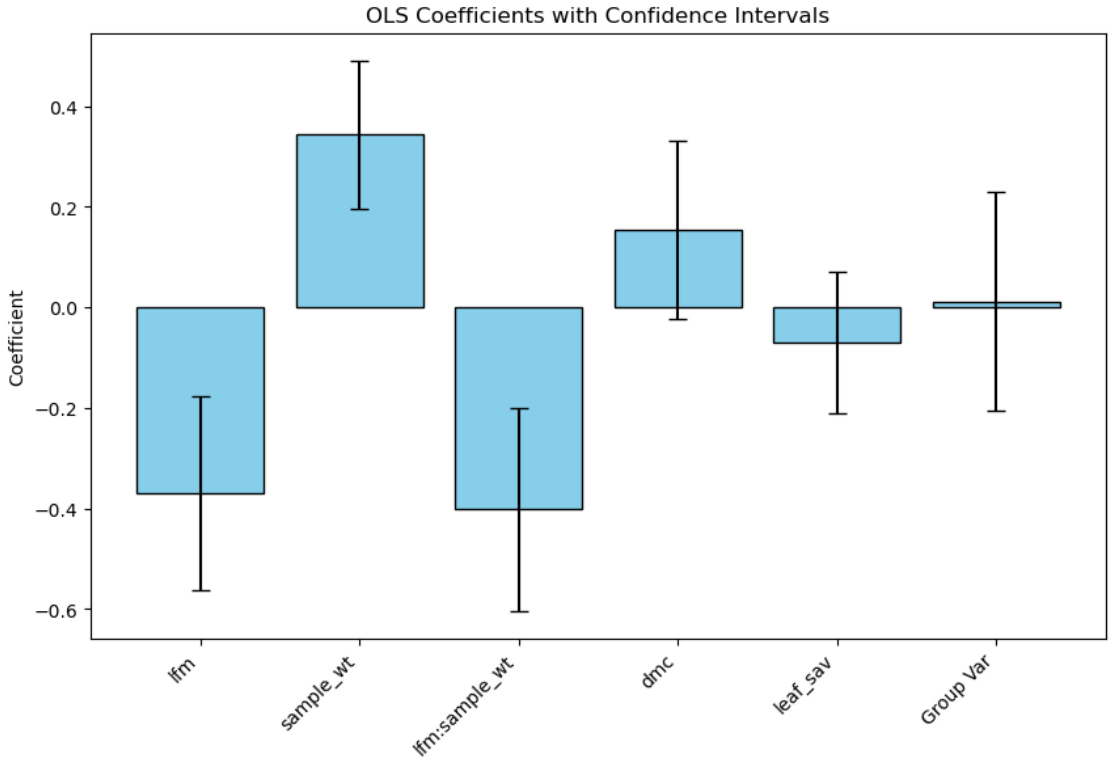

```
         Mixed Linear Model Regression Results
============================================================
Model:             MixedLM Dependent Variable: fd
No. Observations:  162     Method:             ML
No. Groups:        54      Scale:              0.6159
```

```
Min. group size:   1       Log-Likelihood:     -191.8216
Max. group size:   11      Converged:          Yes
Mean group size:   3.0
------------------------------------------------------------
              Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept     -0.089    0.073 -1.224 0.221 -0.232  0.054
lfm           -0.395    0.101 -3.900 0.000 -0.593 -0.196
sample_wt      0.446    0.132  3.368 0.001  0.186  0.705
lfm:sample_wt -0.460    0.119 -3.846 0.000 -0.694 -0.225
LMA            0.083    0.100  0.830 0.407 -0.113  0.279
dmc            0.176    0.088  2.001 0.045  0.004  0.348
branch_volume -0.176    0.131 -1.342 0.180 -0.433  0.081
Group Var      0.010    0.139
============================================================
```



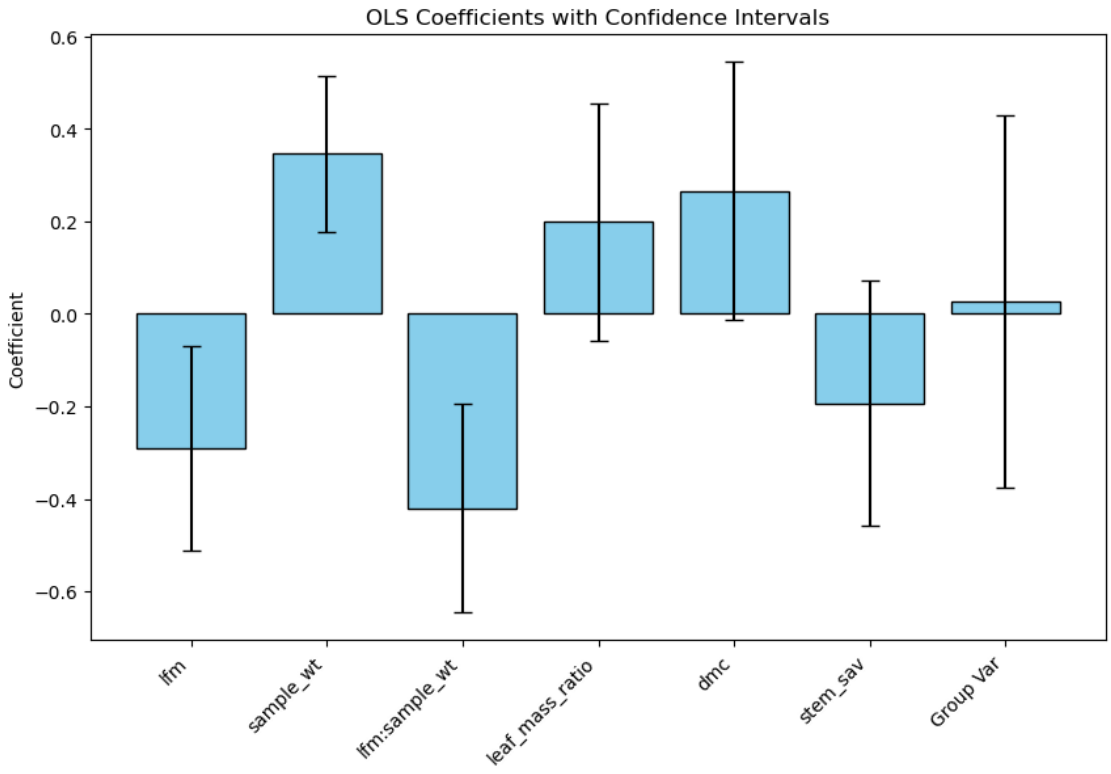

```
          Mixed Linear Model Regression Results
============================================================
Model:             MixedLM Dependent Variable: fd
No. Observations:  162     Method:             ML
No. Groups:        54      Scale:              0.6257
Min. group size:   1       Log-Likelihood:     -192.8294
```

```
Max. group size:   11      Converged:          No
Mean group size:   3.0
-----------------------------------------------------------
              Coef.  Std.Err.    z    P>|z| [0.025 0.975]
-----------------------------------------------------------
Intercept     -0.078    0.068 -1.136 0.256 -0.212  0.056
lfm           -0.370    0.099 -3.754 0.000 -0.563 -0.177
sample_wt      0.344    0.075  4.563 0.000  0.196  0.491
lfm:sample_wt -0.402    0.103 -3.910 0.000 -0.603 -0.200
dmc            0.154    0.090  1.709 0.087 -0.023  0.331
leaf_sav      -0.069    0.072 -0.963 0.336 -0.210  0.072
Group Var      0.007    0.088
===========================================================
```




```
          Mixed Linear Model Regression Results
============================================================
Model:             MixedLM  Dependent Variable:  fd
No. Observations:  162      Method:              ML
No. Groups:        54       Scale:               0.6096
Min. group size:   1        Log-Likelihood:      -191.8441
Max. group size:   11       Converged:           No
Mean group size:   3.0
```

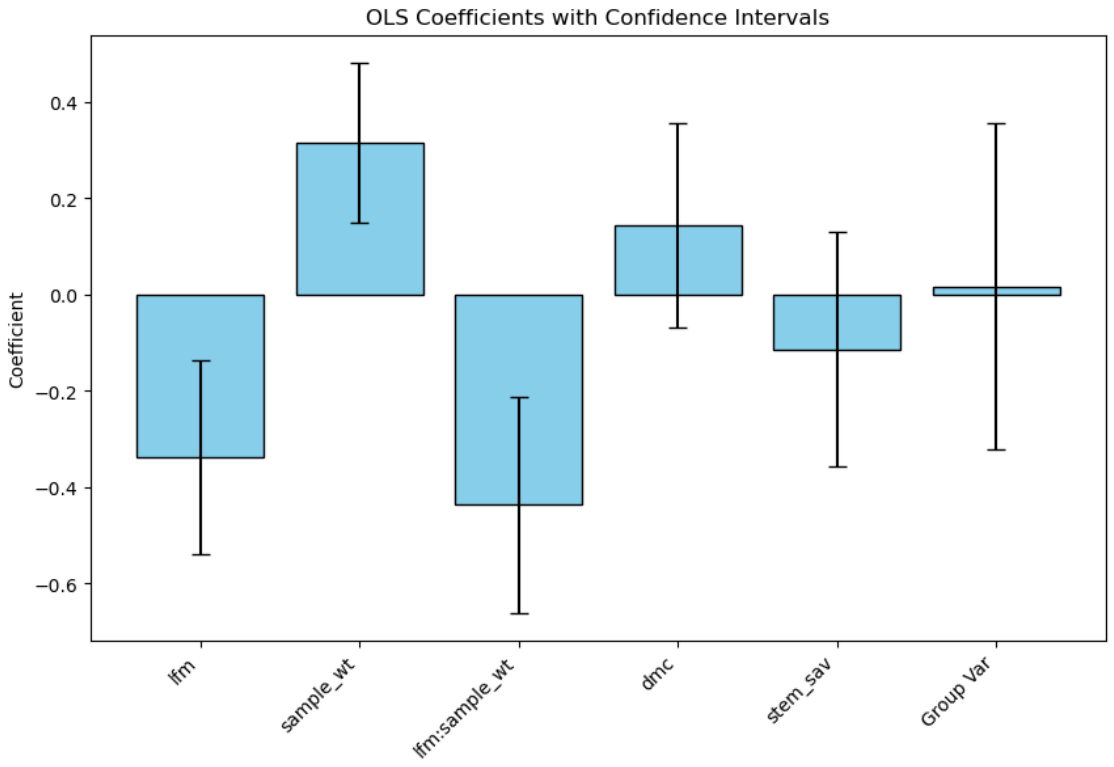
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.085	0.072	-1.177	0.239	-0.225	0.056
lfm	-0.290	0.113	-2.565	0.010	-0.511	-0.068
sample_wt	0.346	0.087	3.991	0.000	0.176	0.516
lfm:sample_wt	-0.421	0.115	-3.661	0.000	-0.647	-0.196
leaf_mass_ratio	0.199	0.131	1.520	0.129	-0.058	0.456
dmc	0.266	0.142	1.871	0.061	-0.013	0.544
stem_sav	-0.193	0.136	-1.425	0.154	-0.459	0.072
Group Var	0.016	0.161				



Mixed Linear Model Regression Results

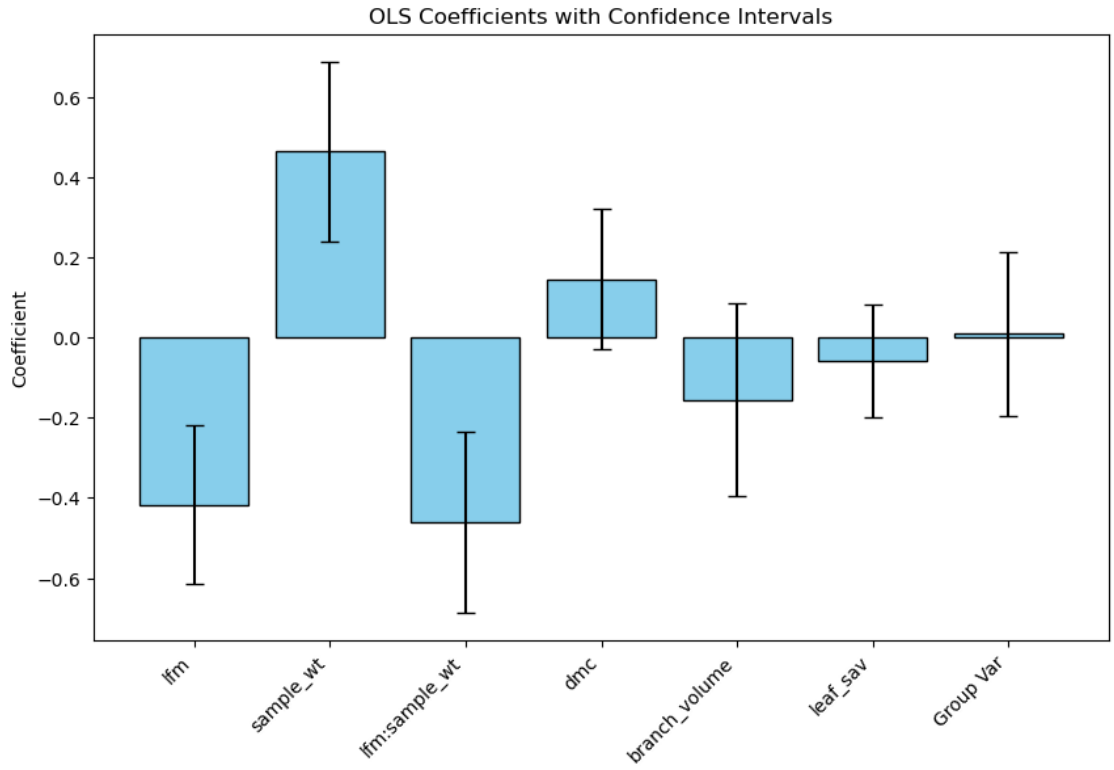
Model:	MixedLM	Dependent Variable:	fd
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.6229
Min. group size:	1	Log-Likelihood:	-192.8732
Max. group size:	11	Converged:	No
Mean group size:	3.0		

```
              Coef.  Std.Err.    z    P>|z| [0.025 0.975]
-------------------------------------------------------------
Intercept     -0.089    0.071 -1.249 0.212 -0.228  0.051
lfm           -0.337    0.102 -3.298 0.001 -0.538 -0.137
sample_wt      0.316    0.085  3.736 0.000  0.150  0.482
lfm:sample_wt -0.436    0.114 -3.824 0.000 -0.660 -0.213
dmc            0.144    0.109  1.328 0.184 -0.069  0.357
stem_sav      -0.114    0.124 -0.915 0.360 -0.358  0.130
Group Var      0.011    0.137
=============================================================
```



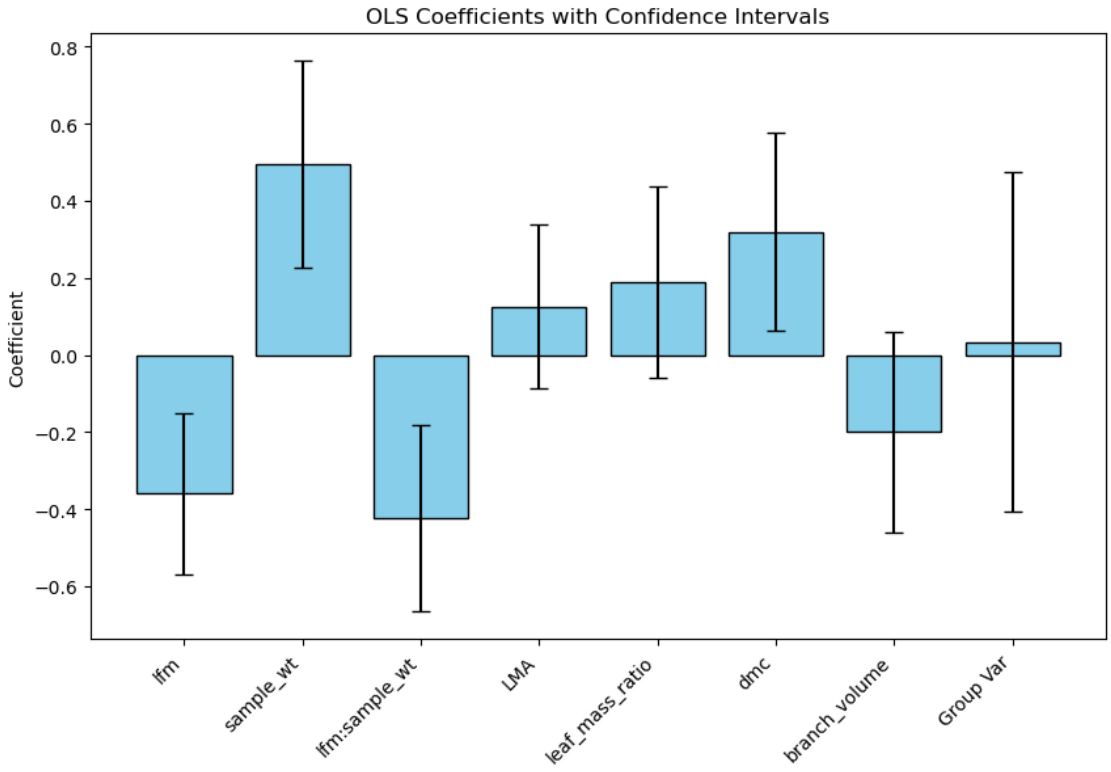

```
         Mixed Linear Model Regression Results
============================================================
Model:             MixedLM Dependent Variable: fd
No. Observations:  162     Method:             ML
No. Groups:        54      Scale:              0.6205
Min. group size:   1       Log-Likelihood:     -191.8895
Max. group size:   11      Converged:          No
Mean group size:   3.0
------------------------------------------------------------
              Coef.  Std.Err.    z    P>|z| [0.025 0.975]
------------------------------------------------------------
```

```
Intercept     -0.091    0.069 -1.330 0.184 -0.226  0.043
lfm           -0.417    0.101 -4.148 0.000 -0.615 -0.220
sample_wt      0.463    0.114  4.045 0.000  0.239  0.688
lfm:sample_wt -0.461    0.115 -4.021 0.000 -0.686 -0.236
dmc            0.145    0.089  1.639 0.101 -0.028  0.319
branch_volume -0.155    0.123 -1.268 0.205 -0.396  0.085
leaf_sav      -0.058    0.071 -0.813 0.416 -0.198  0.082
Group Var      0.005    0.082
============================================================
```



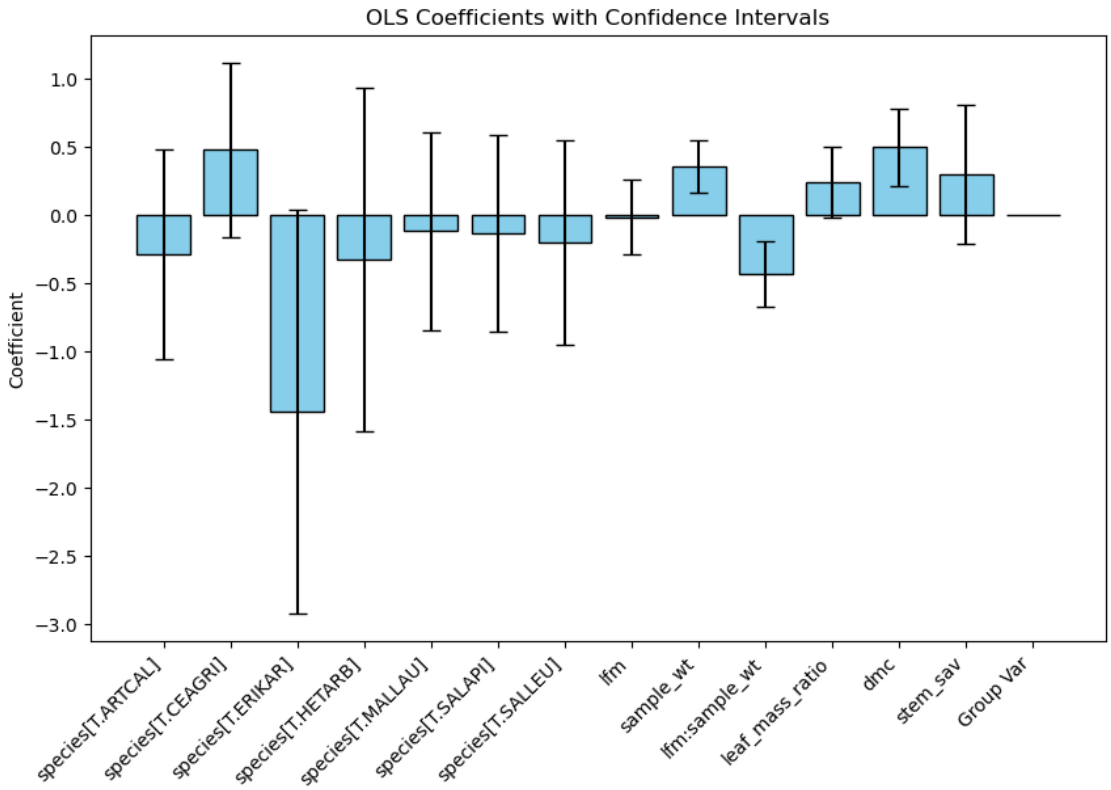

```
          Mixed Linear Model Regression Results
============================================================
Model:             MixedLM  Dependent Variable:  fd
No. Observations:  162      Method:              ML
No. Groups:        54       Scale:               0.5986
Min. group size:   1        Log-Likelihood:      -190.8994
Max. group size:   11       Converged:           No
Mean group size:   3.0
------------------------------------------------------------
               Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept      -0.079    0.076 -1.034 0.301 -0.228  0.070
```

```
lfm             -0.359    0.107 -3.363 0.001 -0.568 -0.150
sample_wt        0.495    0.136  3.635 0.000  0.228  0.762
lfm:sample_wt   -0.424    0.123 -3.442 0.001 -0.666 -0.183
LMA              0.126    0.108  1.166 0.244 -0.086  0.338
leaf_mass_ratio  0.188    0.127  1.482 0.138 -0.061  0.436
dmc              0.319    0.131  2.433 0.015  0.062  0.575
branch_volume   -0.199    0.133 -1.499 0.134 -0.459  0.061
Group Var        0.021    0.174
============================================================
```



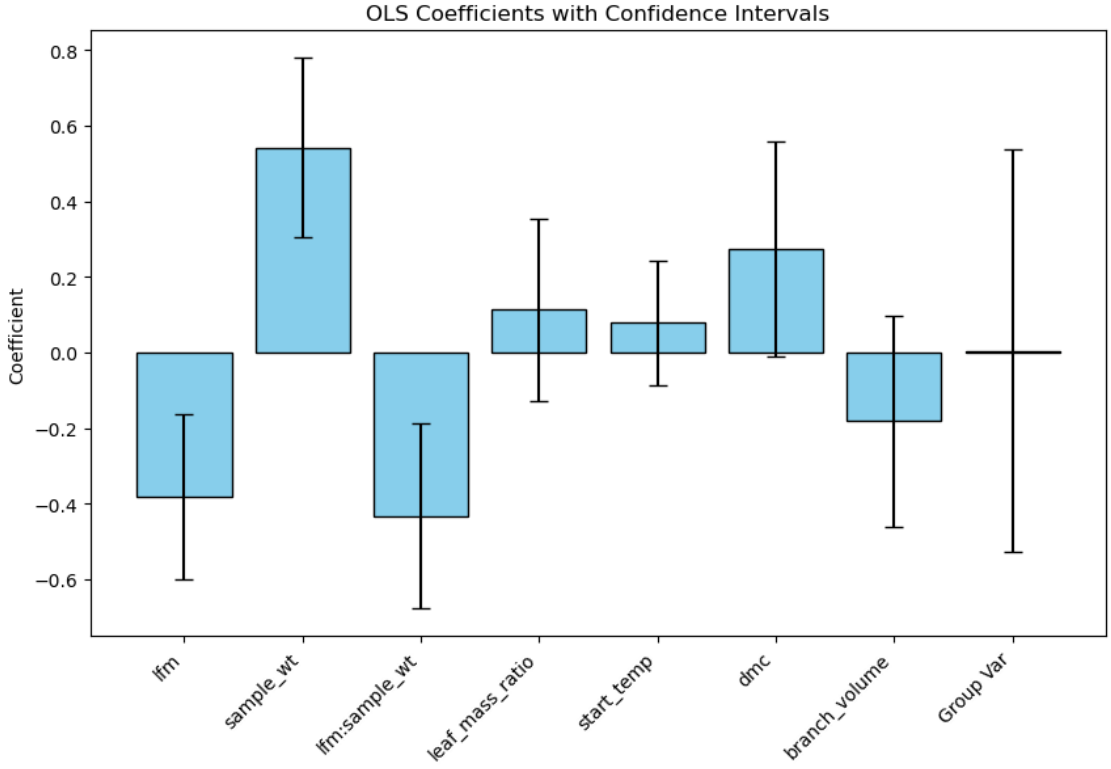

```
           Mixed Linear Model Regression Results
============================================================
Model:               MixedLM  Dependent Variable:  fd
No. Observations:    162      Method:              ML
No. Groups:          54       Scale:               0.5737
Min. group size:     1        Log-Likelihood:      -184.9574
Max. group size:     11       Converged:           No
Mean group size:     3.0
------------------------------------------------------------
                 Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept         0.244    0.315  0.773 0.439 -0.374  0.861
```

```
species[T.ARTCAL] -0.290    0.392 -0.739 0.460 -1.059  0.479
species[T.CEAGRI]  0.477    0.327  1.457 0.145 -0.164  1.118
species[T.ERIKAR] -1.444    0.755 -1.913 0.056 -2.923  0.035
species[T.HETARB] -0.329    0.643 -0.511 0.609 -1.590  0.932
species[T.MALLAU] -0.121    0.373 -0.326 0.745 -0.852  0.609
species[T.SALAPI] -0.139    0.368 -0.378 0.705 -0.860  0.582
species[T.SALLEU] -0.206    0.382 -0.539 0.590 -0.955  0.543
lfm               -0.016    0.139 -0.115 0.909 -0.288  0.256
sample_wt          0.351    0.098  3.566 0.000  0.158  0.543
lfm:sample_wt     -0.437    0.122 -3.582 0.000 -0.677 -0.198
leaf_mass_ratio    0.241    0.132  1.828 0.068 -0.017  0.500
dmc                0.496    0.146  3.400 0.001  0.210  0.782
stem_sav           0.298    0.260  1.147 0.252 -0.211  0.807
Group Var          0.001
============================================================
```



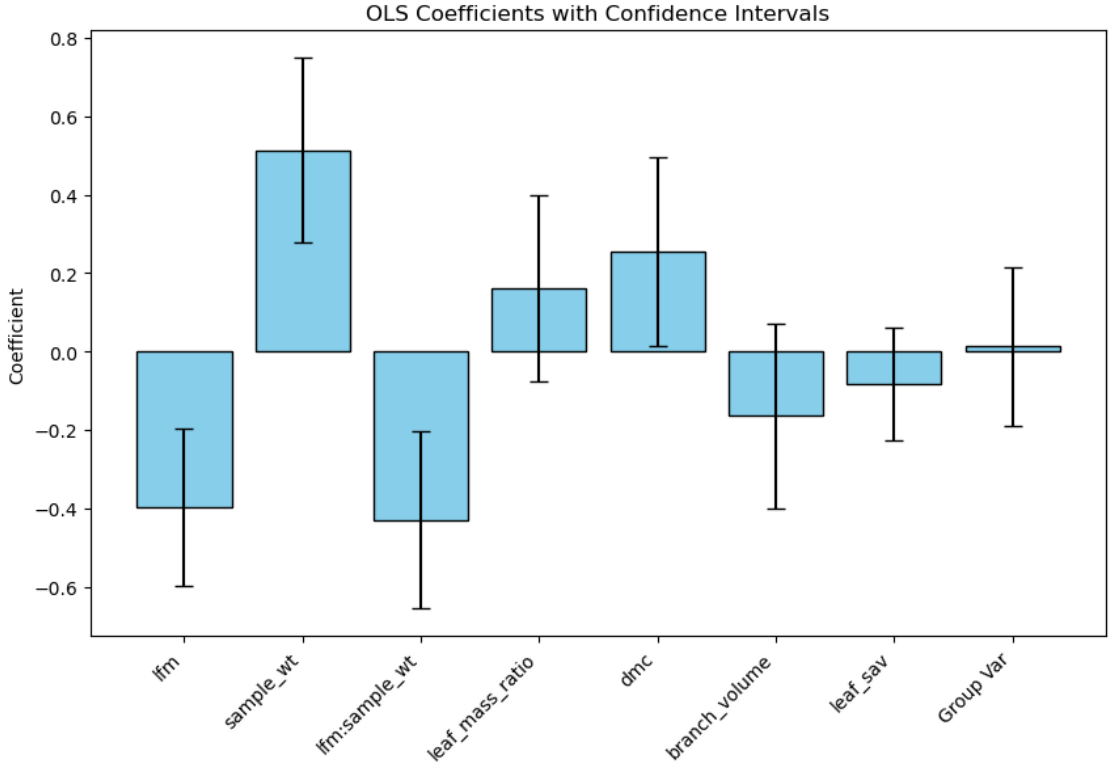

```
          Mixed Linear Model Regression Results
============================================================
Model:             MixedLM  Dependent Variable:  fd
No. Observations:  162      Method:              ML
No. Groups:        54       Scale:               0.6158
```

```
Min. group size:   1        Log-Likelihood:      -190.9815
Max. group size:   11       Converged:           Yes
Mean group size:   3.0
------------------------------------------------------------
                Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept       -0.087    0.077 -1.122 0.262 -0.238  0.065
lfm             -0.382    0.112 -3.423 0.001 -0.601 -0.163
sample_wt        0.542    0.121  4.500 0.000  0.306  0.779
lfm:sample_wt   -0.433    0.125 -3.470 0.001 -0.678 -0.188
leaf_mass_ratio  0.113    0.123  0.921 0.357 -0.128  0.354
start_temp       0.079    0.084  0.940 0.347 -0.085  0.242
dmc              0.275    0.145  1.897 0.058 -0.009  0.560
branch_volume   -0.182    0.142 -1.283 0.199 -0.459  0.096
Group Var        0.003    0.213
============================================================
```



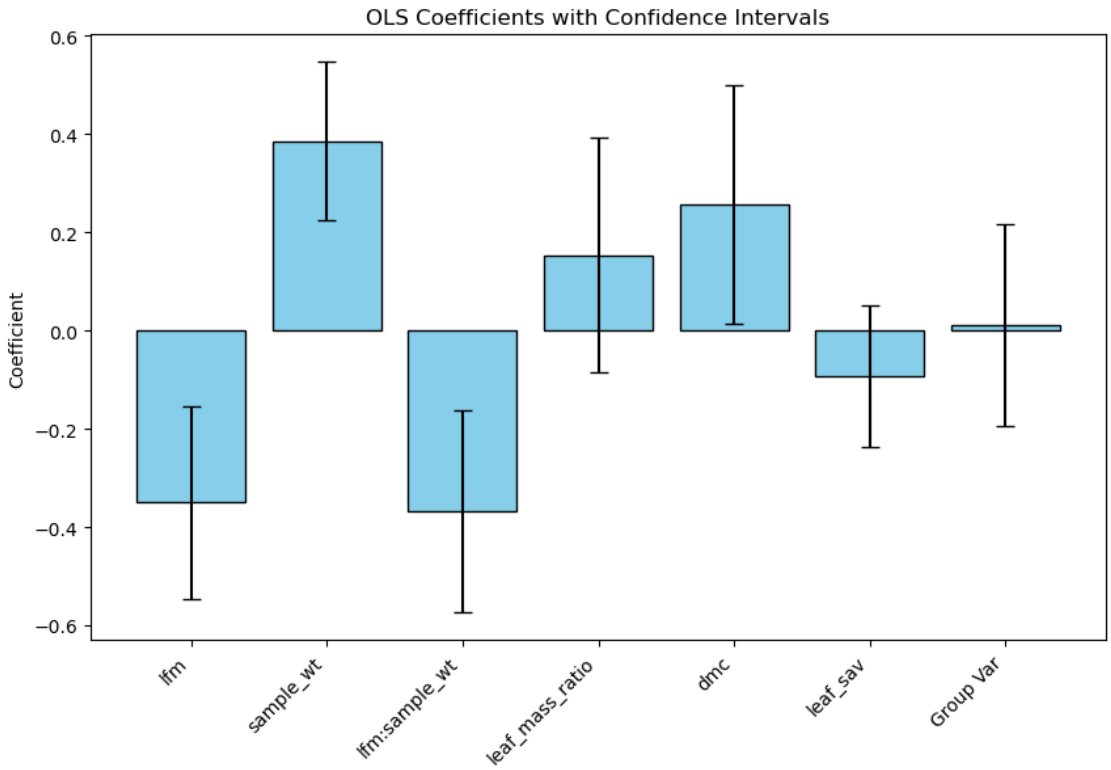

```
          Mixed Linear Model Regression Results
============================================================
Model:             MixedLM  Dependent Variable:  fd
No. Observations:  162      Method:              ML
No. Groups:        54       Scale:               0.6113
```

```
Min. group size:   1        Log-Likelihood:      -191.0167
Max. group size:   11       Converged:           No
Mean group size:   3.0
------------------------------------------------------------
                Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept       -0.082    0.069 -1.185 0.236 -0.217  0.053
lfm             -0.397    0.102 -3.886 0.000 -0.598 -0.197
sample_wt        0.513    0.120  4.293 0.000  0.279  0.748
lfm:sample_wt   -0.429    0.115 -3.717 0.000 -0.655 -0.203
leaf_mass_ratio  0.162    0.121  1.339 0.181 -0.075  0.400
dmc              0.255    0.122  2.081 0.037  0.015  0.494
branch_volume   -0.164    0.121 -1.362 0.173 -0.401  0.072
leaf_sav        -0.082    0.074 -1.115 0.265 -0.227  0.062
Group Var        0.008    0.081
============================================================
```



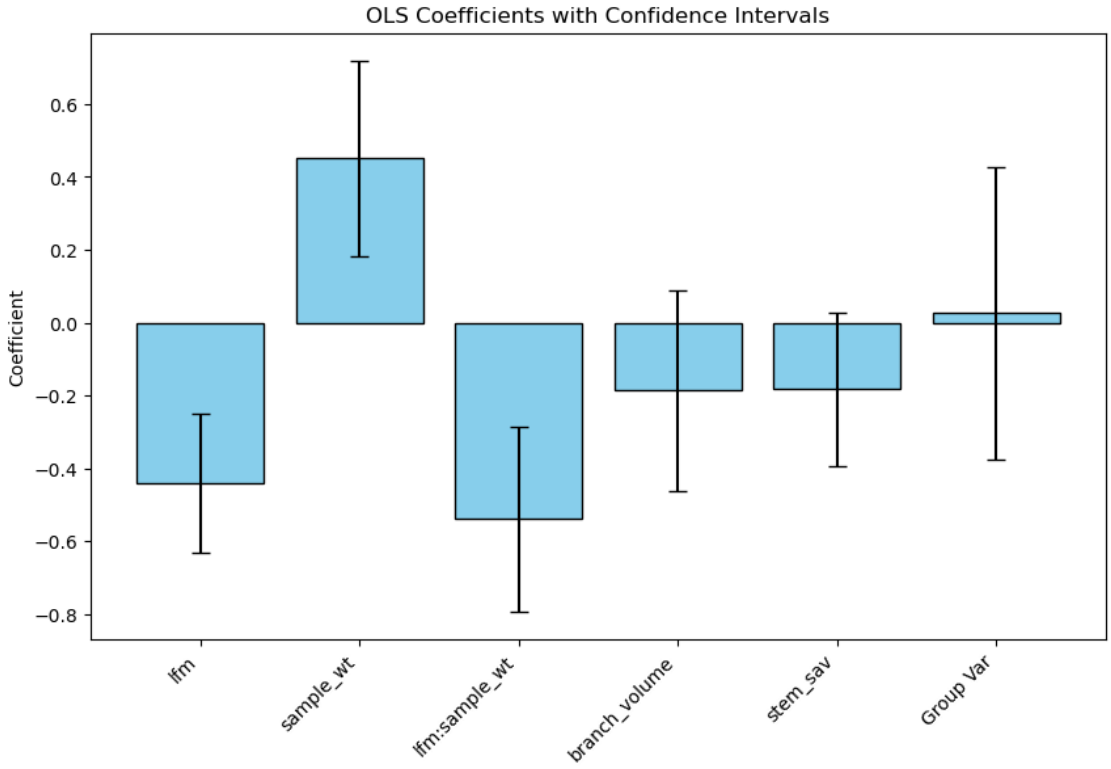

```
          Mixed Linear Model Regression Results
============================================================
Model:             MixedLM  Dependent Variable:  fd
No. Observations:  162      Method:              ML
No. Groups:        54       Scale:               0.6196
```

```
Min. group size:   1        Log-Likelihood:      -192.0257
Max. group size:   11       Converged:           No
Mean group size:   3.0
------------------------------------------------------------
                Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept       -0.067    0.068 -0.987 0.323 -0.201  0.066
lfm             -0.349    0.100 -3.484 0.000 -0.546 -0.153
sample_wt        0.386    0.082  4.700 0.000  0.225  0.546
lfm:sample_wt   -0.368    0.105 -3.493 0.000 -0.574 -0.161
leaf_mass_ratio  0.154    0.122  1.264 0.206 -0.085  0.393
dmc              0.257    0.124  2.077 0.038  0.015  0.500
leaf_sav        -0.092    0.074 -1.249 0.212 -0.237  0.053
Group Var        0.007    0.082
============================================================
```



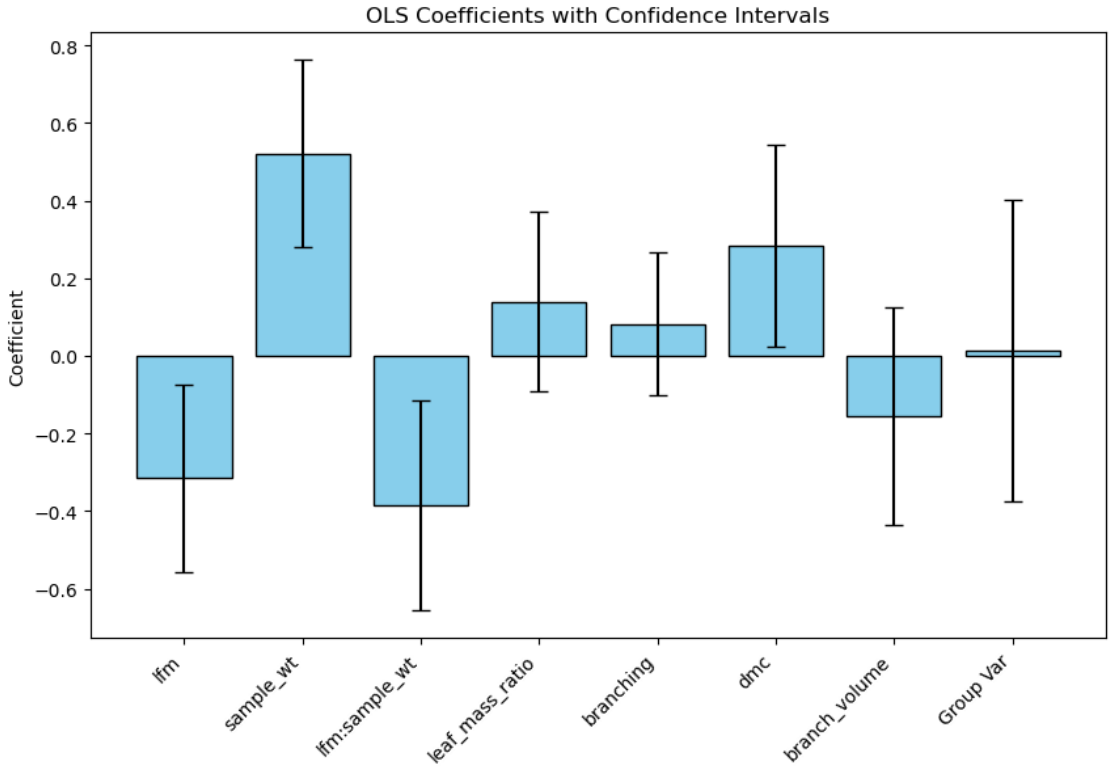

```
         Mixed Linear Model Regression Results
============================================================
Model:             MixedLM Dependent Variable: fd
No. Observations:  162     Method:             ML
No. Groups:        54      Scale:              0.6195
Min. group size:   1       Log-Likelihood:     -193.0601
```

```
Max. group size:   11      Converged:          No
Mean group size:   3.0
------------------------------------------------------------
              Coef.  Std.Err.    z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept     -0.112    0.077 -1.464 0.143 -0.262  0.038
lfm           -0.441    0.097 -4.540 0.000 -0.632 -0.251
sample_wt      0.450    0.137  3.282 0.001  0.181  0.719
lfm:sample_wt -0.540    0.129 -4.170 0.000 -0.793 -0.286
branch_volume -0.186    0.140 -1.326 0.185 -0.461  0.089
stem_sav      -0.183    0.108 -1.698 0.089 -0.395  0.028
Group Var      0.016    0.161
============================================================
```




```
          Mixed Linear Model Regression Results
============================================================
Model:             MixedLM  Dependent Variable:  fd
No. Observations:  162      Method:              ML
No. Groups:        54       Scale:               0.6106
Min. group size:   1        Log-Likelihood:      -191.0817
Max. group size:   11       Converged:           Yes
Mean group size:   3.0
```

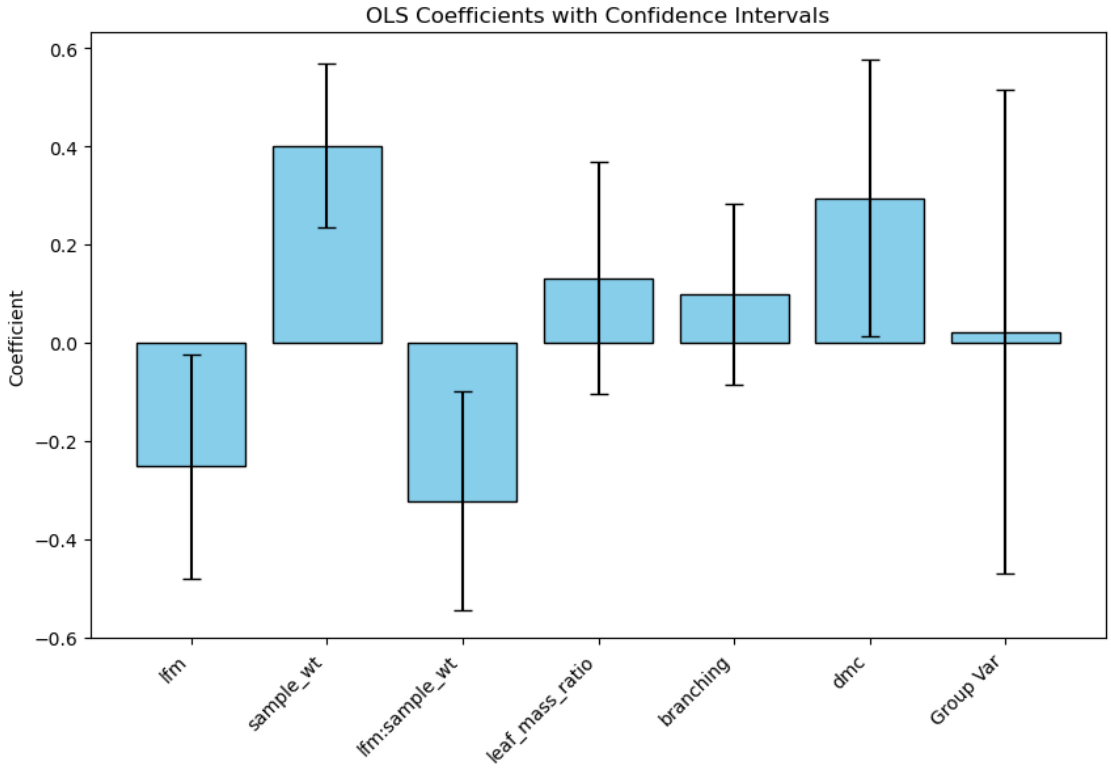
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.075	0.072	-1.039	0.299	-0.217	0.067
lfm	-0.315	0.123	-2.559	0.011	-0.556	-0.074
sample_wt	0.521	0.123	4.241	0.000	0.280	0.762
lfm:sample_wt	-0.387	0.138	-2.806	0.005	-0.657	-0.117
leaf_mass_ratio	0.140	0.119	1.181	0.238	-0.092	0.372
branching	0.082	0.094	0.881	0.378	-0.101	0.266
dmc	0.283	0.132	2.138	0.033	0.024	0.543
branch_volume	-0.156	0.144	-1.087	0.277	-0.437	0.125
Group Var	0.009	0.155				



Mixed Linear Model Regression Results

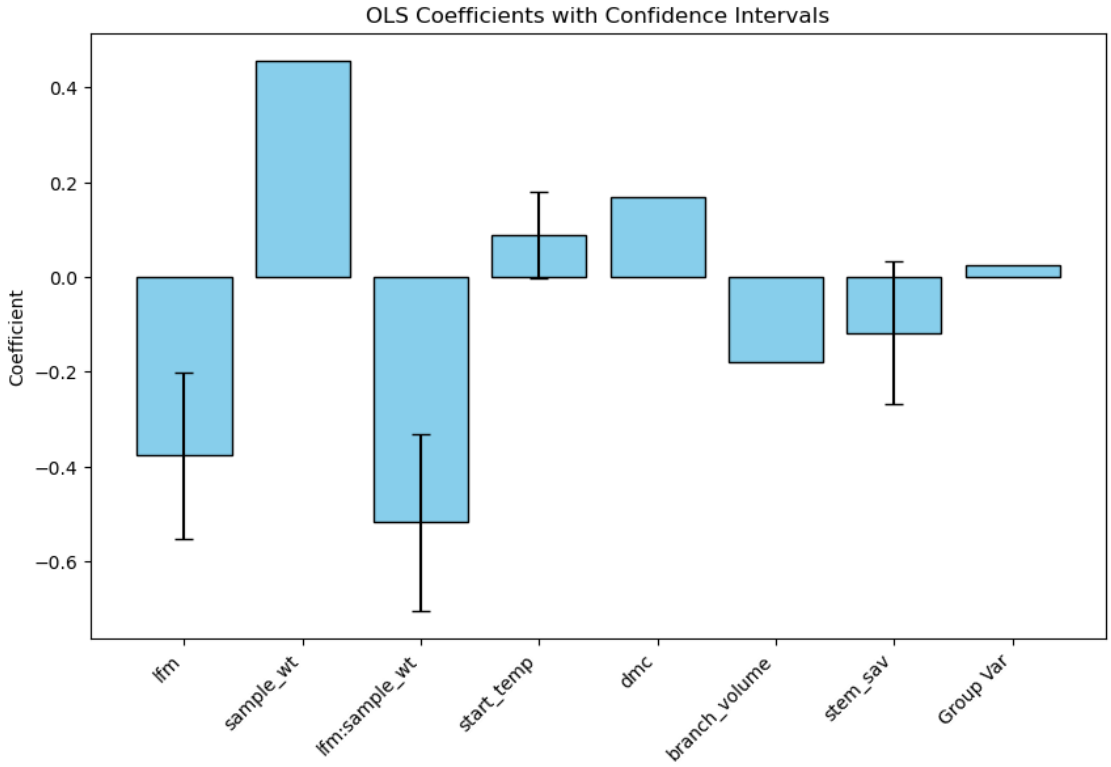
Model:	MixedLM	Dependent Variable:	fd
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.6140
Min. group size:	1	Log-Likelihood:	-192.0874
Max. group size:	11	Converged:	No
Mean group size:	3.0		

```
------------------------------------------------------------
                Coef.  Std.Err.    z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept       -0.061    0.072 -0.851 0.395 -0.202  0.080
lfm             -0.252    0.116 -2.166 0.030 -0.481 -0.024
sample_wt        0.401    0.085  4.722 0.000  0.235  0.568
lfm:sample_wt   -0.323    0.114 -2.827 0.005 -0.546 -0.099
leaf_mass_ratio  0.132    0.120  1.092 0.275 -0.104  0.368
branching        0.099    0.094  1.051 0.293 -0.086  0.284
dmc              0.294    0.144  2.048 0.041  0.013  0.575
Group Var        0.014    0.197
============================================================
```




```
         Mixed Linear Model Regression Results
============================================================
Model:             MixedLM Dependent Variable: fd
No. Observations:  162     Method:             ML
No. Groups:        54      Scale:              0.6055
Min. group size:   1       Log-Likelihood:     -191.1116
Max. group size:   11      Converged:          No
Mean group size:   3.0
------------------------------------------------------------
```

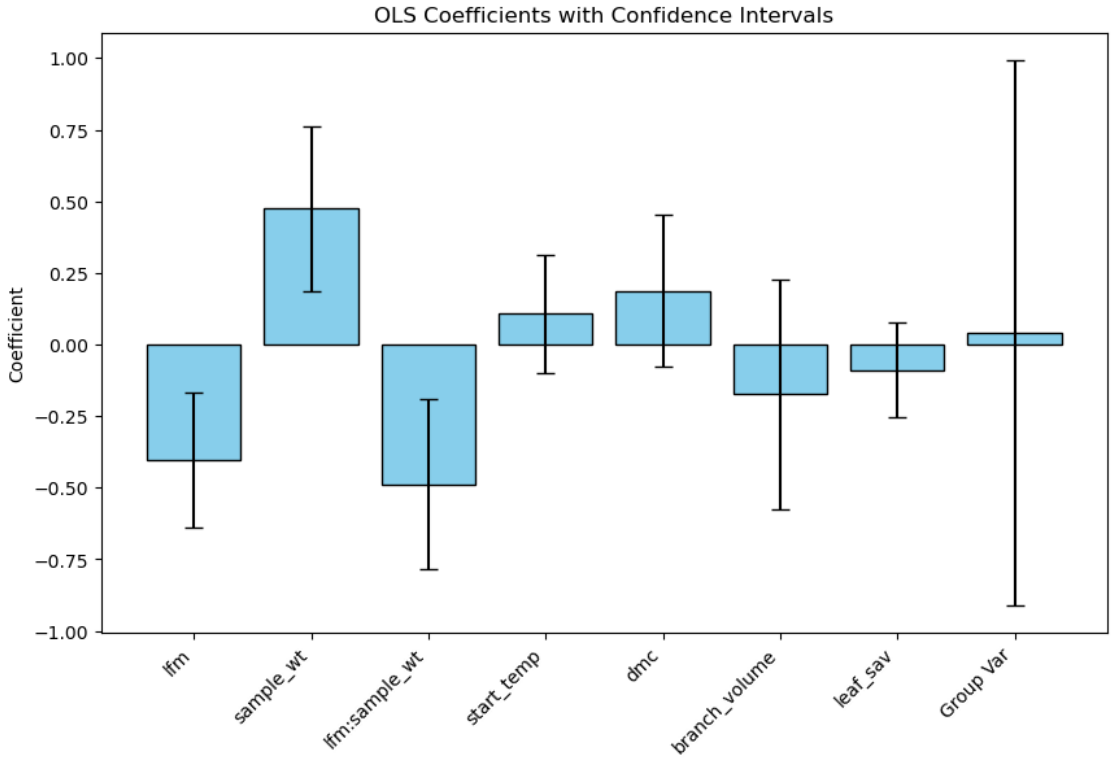
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.112	0.031	-3.667	0.000	-0.172	-0.052
lfm	-0.377	0.090	-4.204	0.000	-0.553	-0.201
sample_wt	0.457					
lfm:sample_wt	-0.518	0.095	-5.446	0.000	-0.704	-0.331
start_temp	0.088	0.046	1.908	0.056	-0.002	0.179
dmc	0.167					
branch_volume	-0.179					
stem_sav	-0.118	0.076	-1.541	0.123	-0.268	0.032
Group Var	0.015					



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	fd
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.5963
Min. group size:	1	Log-Likelihood:	-191.1116
Max. group size:	11	Converged:	No
Mean group size:	3.0		

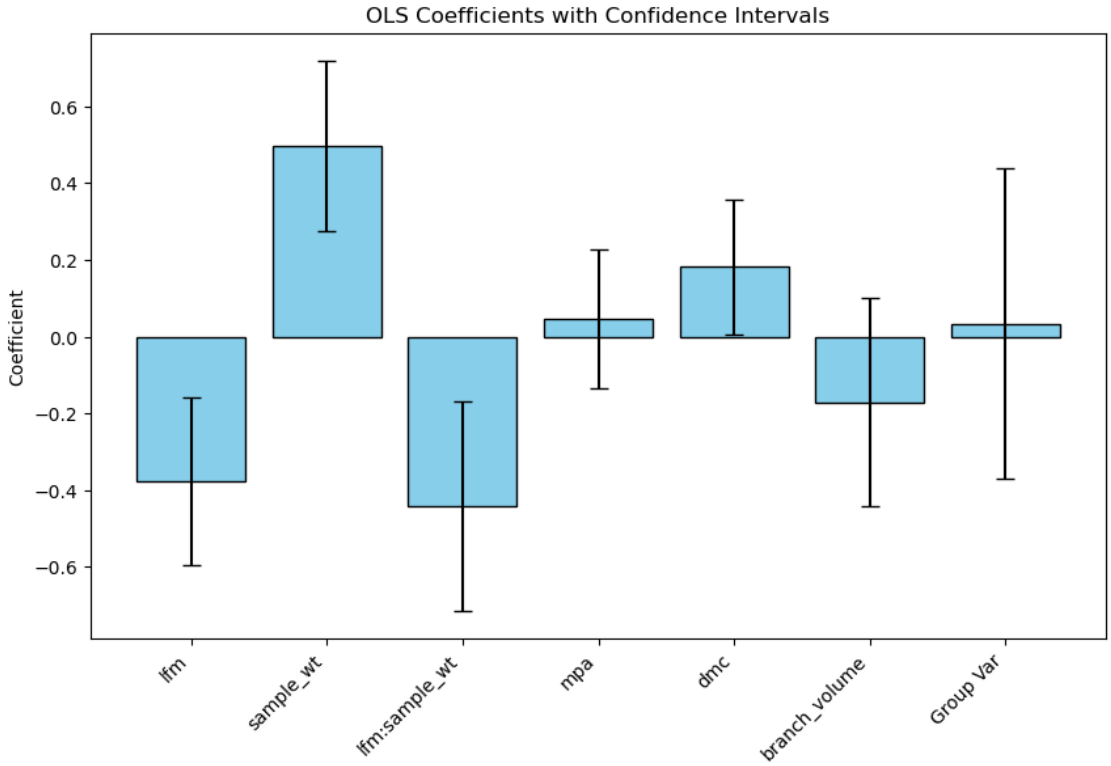
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.103	0.085	-1.214	0.225	-0.270	0.063
lfm	-0.404	0.120	-3.363	0.001	-0.640	-0.169
sample_wt	0.475	0.147	3.241	0.001	0.188	0.762
lfm:sample_wt	-0.488	0.151	-3.228	0.001	-0.784	-0.192
start_temp	0.107	0.105	1.015	0.310	-0.100	0.314
dmc	0.187	0.135	1.382	0.167	-0.078	0.452
branch_volume	-0.174	0.204	-0.851	0.394	-0.574	0.226
leaf_sav	-0.090	0.085	-1.062	0.288	-0.256	0.076
Group Var	0.025	0.375				



Mixed Linear Model Regression Results

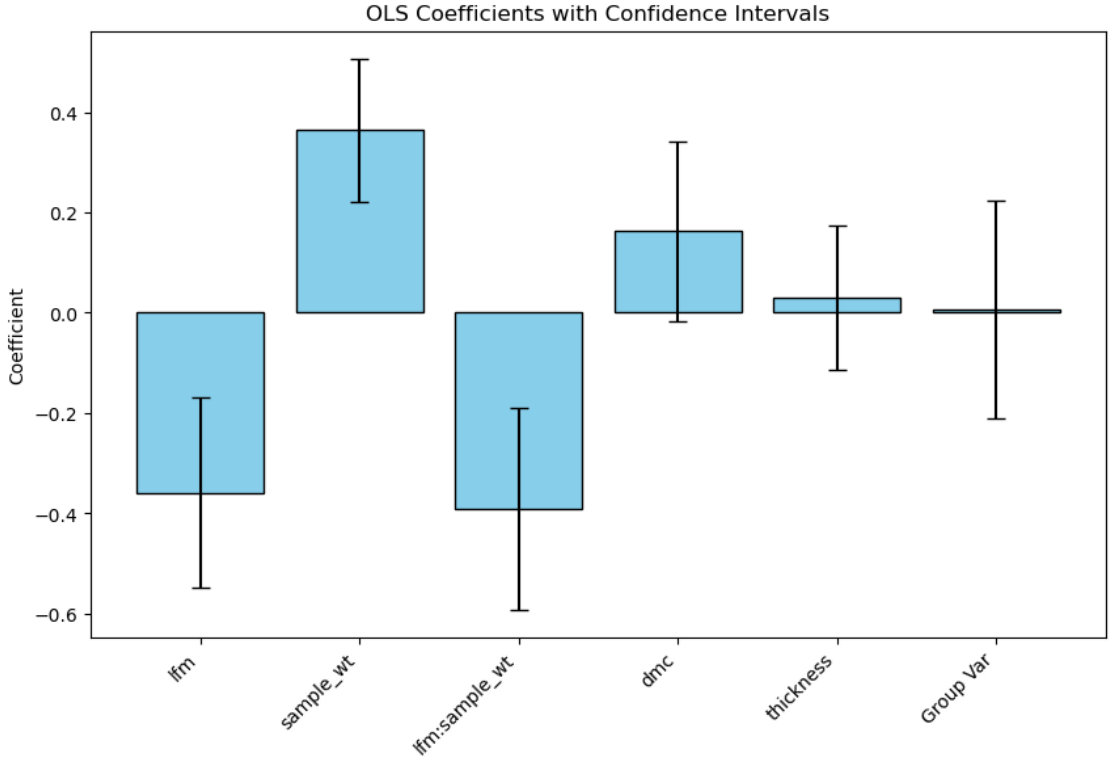
Model:	MixedLM	Dependent Variable:	fd
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.6083
Min. group size:	1	Log-Likelihood:	-192.1450
Max. group size:	11	Converged:	No
Mean group size:	3.0		

```
                Coef.  Std.Err.    z    P>|z| [0.025 0.975]
-------------------------------------------------------------
Intercept      -0.089    0.076 -1.172 0.241 -0.238  0.060
lfm            -0.377    0.111 -3.386 0.001 -0.596 -0.159
sample_wt       0.497    0.113  4.385 0.000  0.275  0.719
lfm:sample_wt  -0.442    0.139 -3.176 0.001 -0.714 -0.169
mpa             0.046    0.092  0.501 0.616 -0.134  0.226
dmc             0.183    0.090  2.038 0.042  0.007  0.358
branch_volume  -0.171    0.139 -1.238 0.216 -0.443  0.100
Group Var       0.020    0.161
=============================================================
```



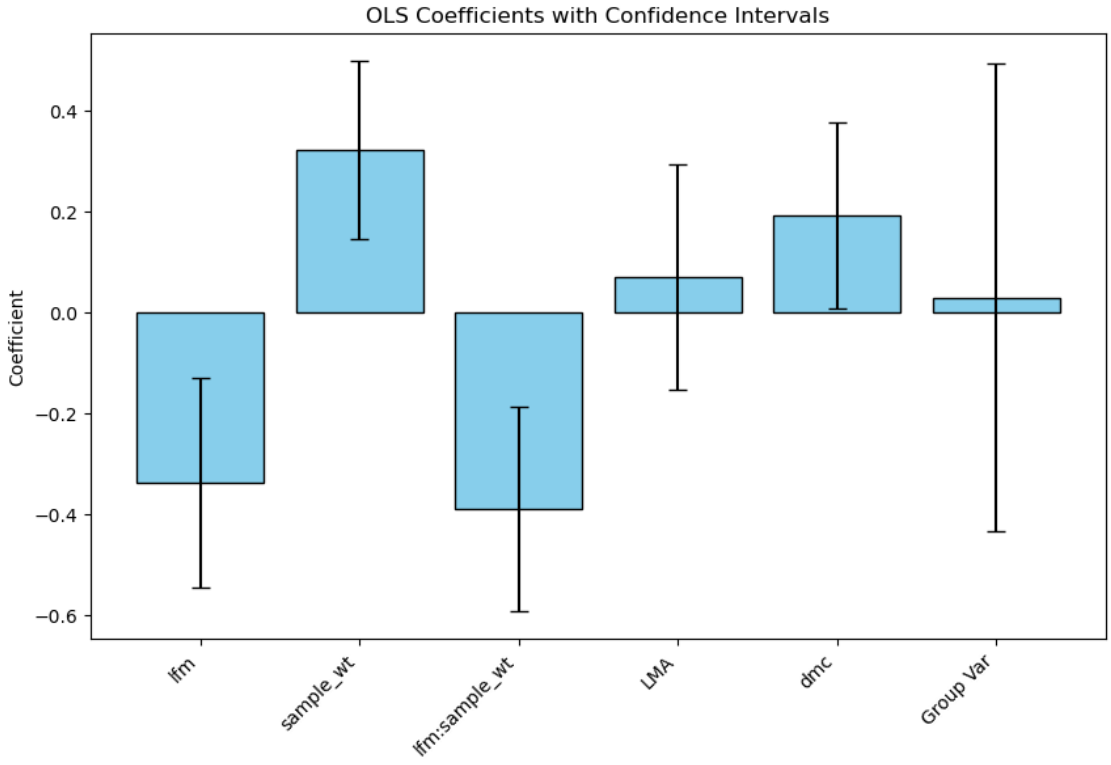

```
         Mixed Linear Model Regression Results
============================================================
Model:             MixedLM Dependent Variable: fd
No. Observations:  162     Method:             ML
No. Groups:        54      Scale:              0.6315
Min. group size:   1       Log-Likelihood:     -193.1613
Max. group size:   11      Converged:          No
Mean group size:   3.0
------------------------------------------------------------
                Coef.  Std.Err.    z    P>|z| [0.025 0.975]
```

```
------------------------------------------------------
Intercept     -0.075    0.068 -1.103 0.270 -0.209  0.058
lfm           -0.359    0.097 -3.690 0.000 -0.549 -0.168
sample_wt      0.364    0.073  5.009 0.000  0.222  0.507
lfm:sample_wt -0.391    0.103 -3.807 0.000 -0.592 -0.190
dmc            0.162    0.092  1.766 0.077 -0.018  0.342
thickness      0.030    0.074  0.408 0.684 -0.114  0.174
Group Var      0.004    0.088
======================================================
```



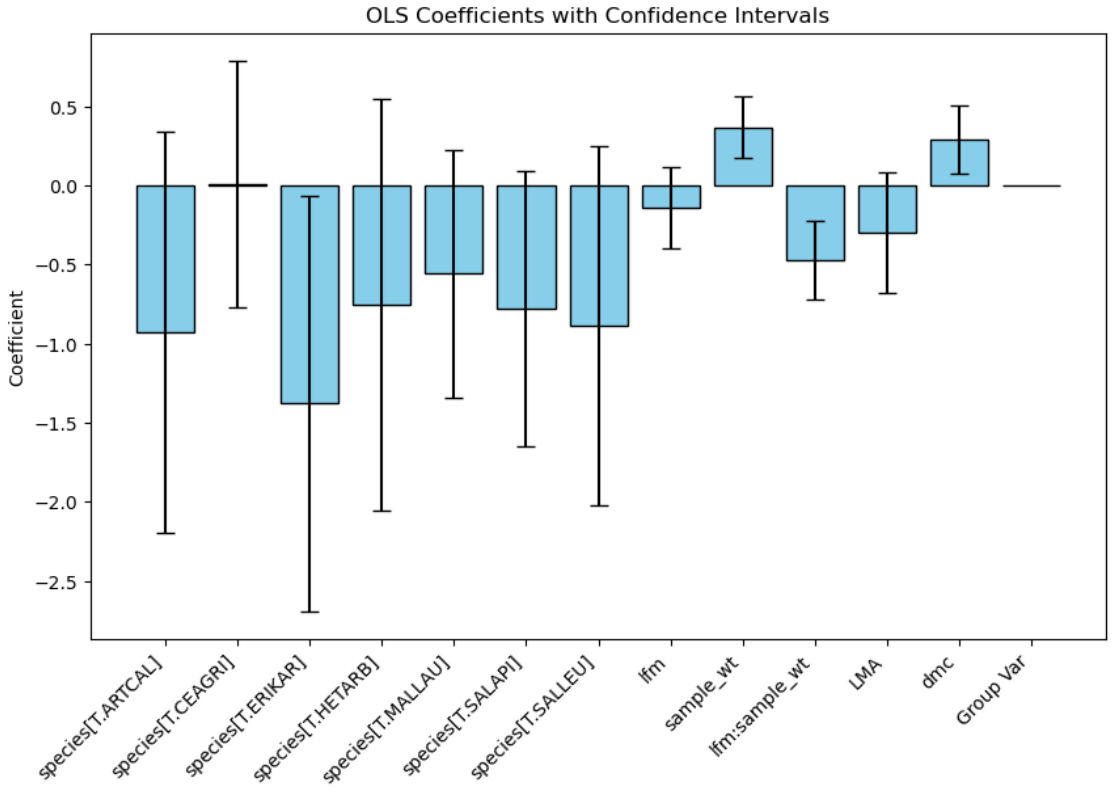

```
          Mixed Linear Model Regression Results
======================================================
Model:             MixedLM Dependent Variable: fd
No. Observations:  162     Method:             ML
No. Groups:        54      Scale:              0.6185
Min. group size:   1       Log-Likelihood:     -193.1615
Max. group size:   11      Converged:          No
Mean group size:   3.0
------------------------------------------------------
              Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------
Intercept     -0.075    0.075 -1.001 0.317 -0.221  0.072
```

```
lfm            -0.339    0.105 -3.209 0.001 -0.545 -0.132
sample_wt       0.321    0.091  3.547 0.000  0.144  0.499
lfm:sample_wt  -0.390    0.103 -3.774 0.000 -0.592 -0.187
LMA             0.070    0.114  0.616 0.538 -0.153  0.293
dmc             0.190    0.094  2.022 0.043  0.006  0.375
Group Var       0.018    0.186
============================================================
```



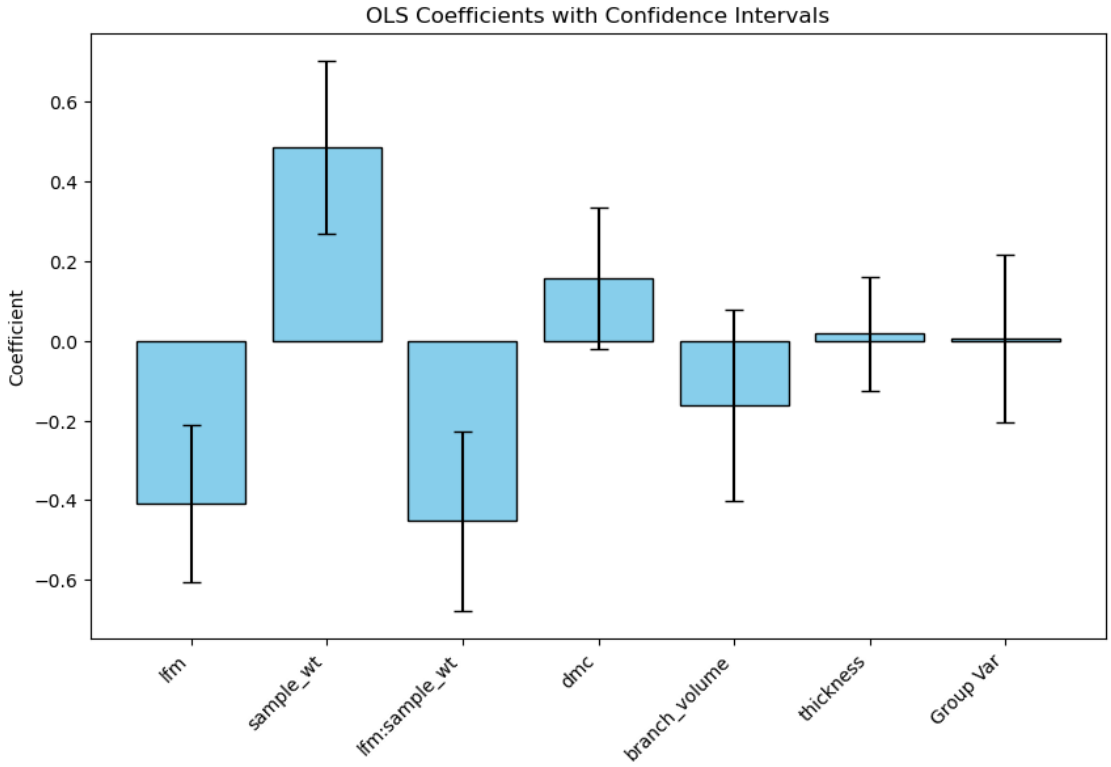

```
           Mixed Linear Model Regression Results
============================================================
Model:               MixedLM  Dependent Variable:  fd
No. Observations:    162      Method:              ML
No. Groups:          54       Scale:               0.5827
Min. group size:     1        Log-Likelihood:      -186.1692
Max. group size:     11       Converged:           No
Mean group size:     3.0
------------------------------------------------------------
                  Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept          0.619    0.435  1.423 0.155 -0.233  1.471
species[T.ARTCAL] -0.929    0.647 -1.435 0.151 -2.198  0.340
species[T.CEAGRI]  0.009    0.398  0.022 0.983 -0.771  0.789
```

```
species[T.ERIKAR] -1.378    0.670 -2.056 0.040 -2.691 -0.065
species[T.HETARB] -0.753    0.665 -1.134 0.257 -2.056  0.549
species[T.MALLAU] -0.559    0.400 -1.397 0.162 -1.342  0.225
species[T.SALAPI] -0.779    0.445 -1.752 0.080 -1.650  0.093
species[T.SALLEU] -0.890    0.579 -1.537 0.124 -2.024  0.245
lfm               -0.142    0.130 -1.097 0.273 -0.396  0.112
sample_wt          0.366    0.100  3.668 0.000  0.171  0.562
lfm:sample_wt     -0.476    0.127 -3.747 0.000 -0.724 -0.227
LMA               -0.301    0.193 -1.557 0.120 -0.680  0.078
dmc                0.288    0.111  2.592 0.010  0.070  0.506
Group Var          0.000
============================================================
```




```
          Mixed Linear Model Regression Results
============================================================
Model:             MixedLM Dependent Variable: fd
No. Observations:  162     Method:             ML
No. Groups:        54      Scale:              0.6250
Min. group size:   1       Log-Likelihood:     -192.1753
Max. group size:   11      Converged:          No
Mean group size:   3.0
```

```
------------------------------------------------------
              Coef.  Std.Err.    z    P>|z| [0.025 0.975]
------------------------------------------------------
Intercept     -0.090    0.069 -1.300 0.194 -0.225  0.046
lfm           -0.409    0.100 -4.090 0.000 -0.605 -0.213
sample_wt      0.485    0.111  4.373 0.000  0.267  0.702
lfm:sample_wt -0.452    0.115 -3.938 0.000 -0.677 -0.227
dmc            0.155    0.091  1.712 0.087 -0.022  0.333
branch_volume -0.161    0.122 -1.320 0.187 -0.401  0.078
thickness      0.017    0.073  0.235 0.815 -0.126  0.160
Group Var      0.003    0.085
======================================================
```



6 Temp Change

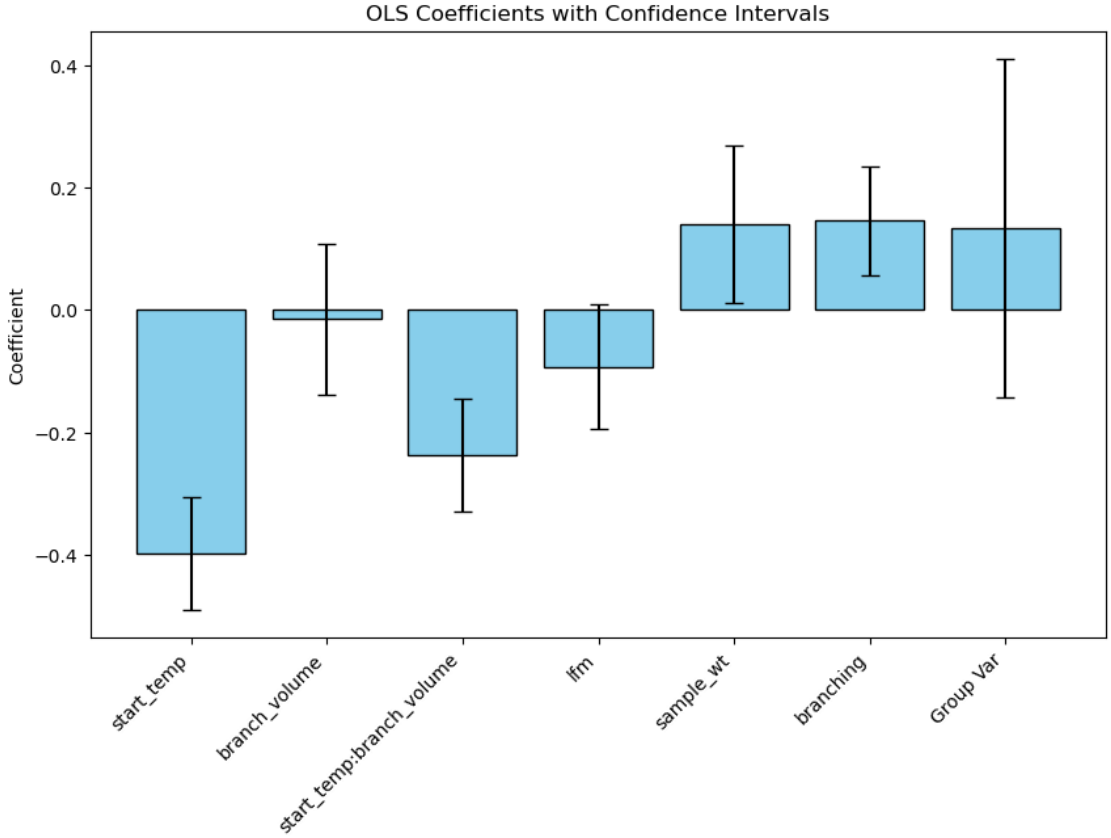
[9]:
```
AIC_iterator(flam, cols_use, Y_VAR='temp_change',
             minnumsingle=mns, maxnumsingle=mxs, minnumint=mni, maxnumint=mxi)
```

```
Columns present in sig. interaction terms: {'branching', 'sample_wt',
'branch_volume', 'lfm', 'mpa', 'thickness', 'species', 'start_temp',
```

```
'leaf_mass_ratio', 'leaf_sav', 'dmc', 'LMA'}

Total Num. Cols : Num. Sig. Int. Cols;  13 : 12

Significant Interactions:
('lfm', 'start_temp')
('lfm', 'dmc')
('LMA', 'sample_wt')
('sample_wt', 'branching')
('sample_wt', 'start_temp')
('sample_wt', 'branch_volume')
('leaf_mass_ratio', 'branch_volume')
('branching', 'start_temp')
('branching', 'branch_volume')
('mpa', 'thickness')
('start_temp', 'branch_volume')
('start_temp', 'leaf_sav')
('start_temp', 'thickness')
('start_temp', 'species')
('thickness', 'species')

Number of formulas: 8430


temp_change ~ start_temp*branch_volume + lfm + sample_wt + branching
temp_change ~ start_temp*branch_volume + sample_wt + branching
temp_change ~ start_temp*branch_volume + lfm + LMA + sample_wt + branching
temp_change ~ start_temp*branch_volume + LMA + sample_wt + branching + stem_sav
temp_change ~ sample_wt*start_temp + lfm + branching
temp_change ~ start_temp*branch_volume + lfm + sample_wt + branching + mpa
temp_change ~ start_temp*branch_volume + sample_wt + branching + stem_sav
temp_change ~ sample_wt*start_temp + branching + stem_sav
temp_change ~ start_temp*leaf_sav + lfm + branching + thickness
temp_change ~ start_temp*branch_volume + lfm + sample_wt + branching + dmc
temp_change ~ start_temp*branch_volume + lfm + sample_wt + branching + thickness
temp_change ~ start_temp*branch_volume + lfm + sample_wt + leaf_mass_ratio +
branching
temp_change ~ start_temp*branch_volume + sample_wt + leaf_mass_ratio + branching
temp_change ~ start_temp*branch_volume + sample_wt + branching + mpa
temp_change ~ start_temp*branch_volume + branching + stem_sav
temp_change ~ start_temp*branch_volume + lfm + sample_wt + branching + stem_sav
temp_change ~ start_temp*branch_volume + lfm + sample_wt + branching + leaf_sav


               Mixed Linear Model Regression Results
================================================================
Model:                MixedLM    Dependent Variable:    temp_change
No. Observations:     162        Method:                ML
```

No. Groups:	54	Scale:	0.1985
Min. group size:	1	Log-Likelihood:	-107.5538
Max. group size:	11	Converged:	Yes
Mean group size:	3.0		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.071	0.044	-1.604	0.109	-0.157	0.016
start_temp	-0.398	0.047	-8.492	0.000	-0.490	-0.306
branch_volume	-0.015	0.063	-0.239	0.811	-0.138	0.108
start_temp:branch_volume	-0.236	0.047	-5.026	0.000	-0.328	-0.144
lfm	-0.093	0.052	-1.768	0.077	-0.195	0.010
sample_wt	0.140	0.066	2.130	0.033	0.011	0.269
branching	0.146	0.046	3.199	0.001	0.057	0.236
Group Var	0.027	0.063				

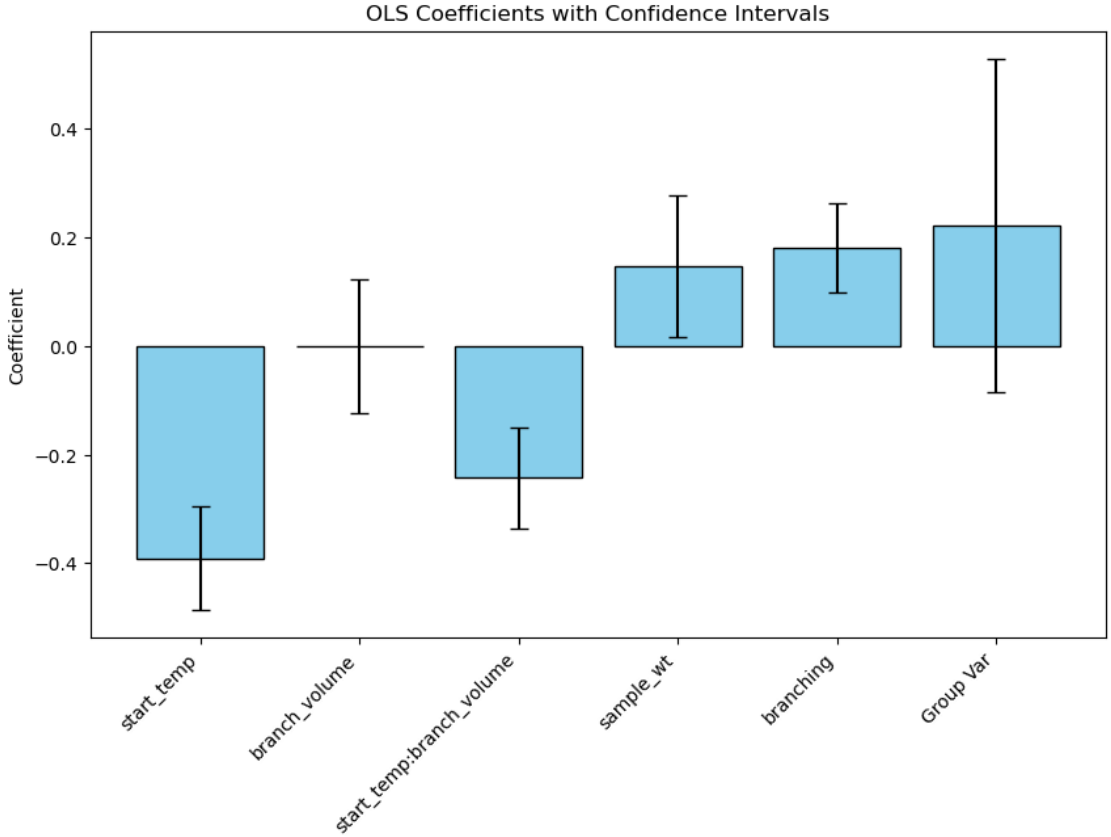


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change

No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.1918
Min. group size:	1	Log-Likelihood:	-108.9730
Max. group size:	11	Converged:	Yes
Mean group size:	3.0		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.071	0.048	-1.492	0.136	-0.164	0.022
start_temp	-0.391	0.048	-8.085	0.000	-0.485	-0.296
branch_volume	-0.002	0.063	-0.027	0.978	-0.125	0.122
start_temp:branch_volume	-0.243	0.047	-5.112	0.000	-0.336	-0.150
sample_wt	0.146	0.067	2.183	0.029	0.015	0.277
branching	0.181	0.042	4.325	0.000	0.099	0.263
Group Var	0.042	0.068				

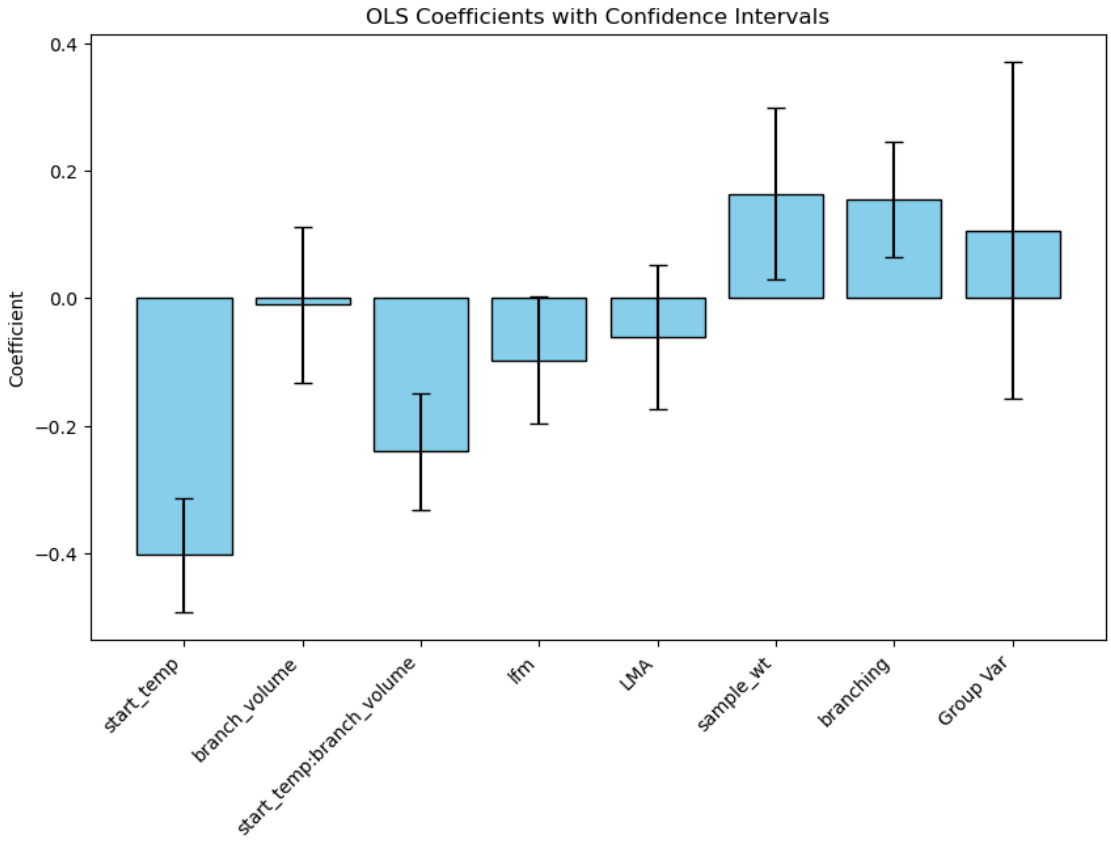


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change

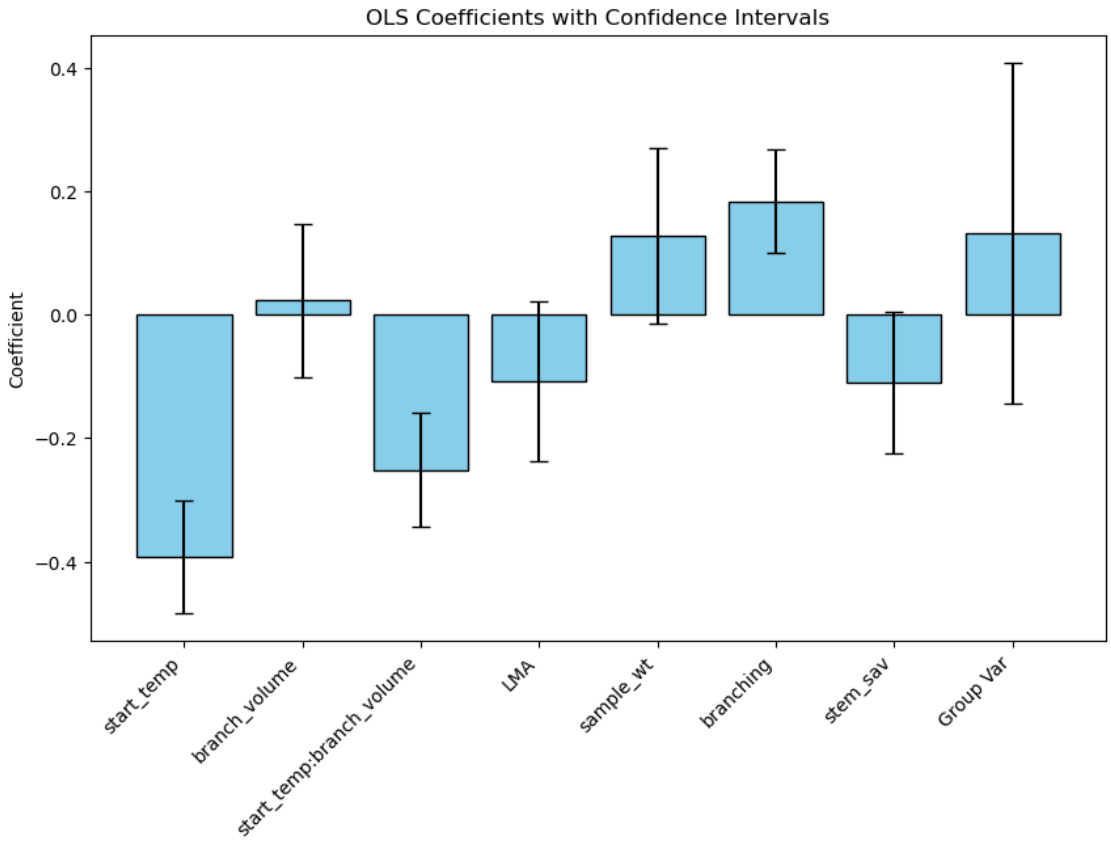
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.2008
Min. group size:	1	Log-Likelihood:	-106.9989
Max. group size:	11	Converged:	Yes
Mean group size:	3.0		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.074	0.043	-1.701	0.089	-0.158	0.011
start_temp	-0.403	0.046	-8.811	0.000	-0.492	-0.313
branch_volume	-0.010	0.062	-0.155	0.877	-0.132	0.113
start_temp:branch_volume	-0.240	0.047	-5.118	0.000	-0.332	-0.148
lfm	-0.098	0.051	-1.918	0.055	-0.197	0.002
LMA	-0.062	0.058	-1.067	0.286	-0.175	0.051
sample_wt	0.164	0.069	2.379	0.017	0.029	0.300
branching	0.156	0.046	3.370	0.001	0.065	0.247
Group Var	0.021	0.061				



Mixed Linear Model Regression Results

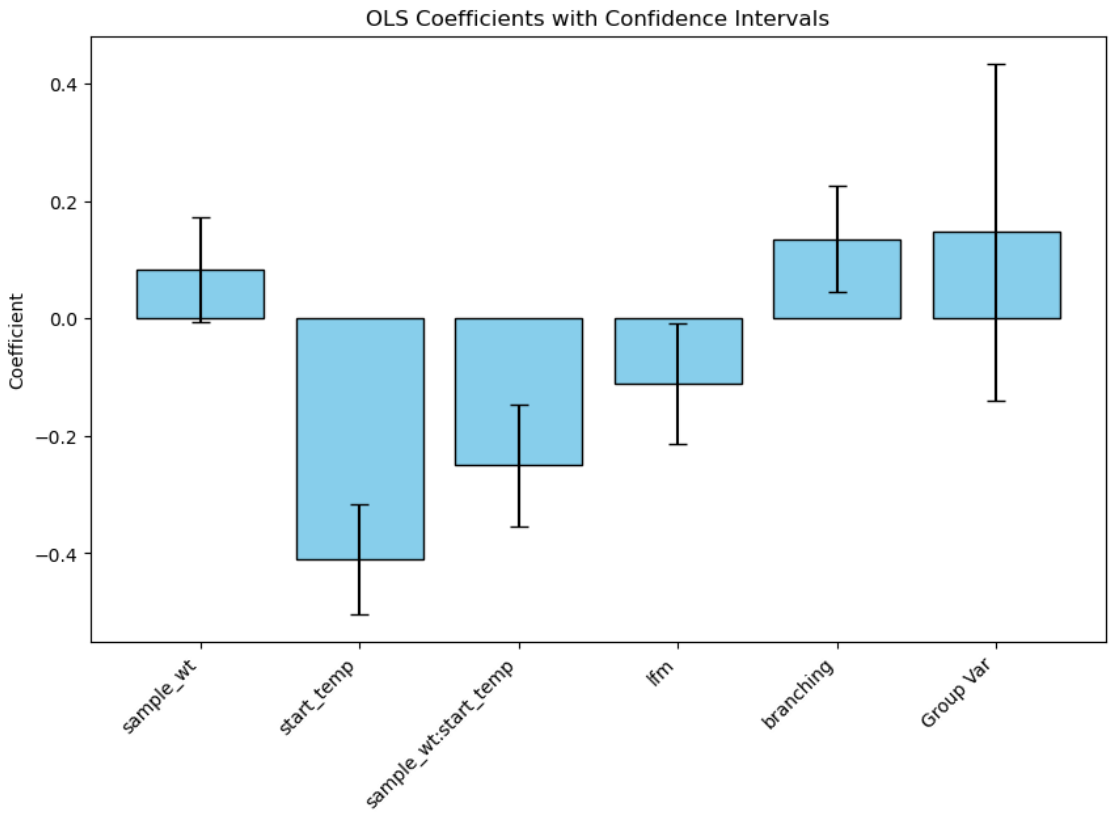
```
=================================================================
Model:                MixedLM    Dependent Variable:    temp_change
No. Observations:     162        Method:                ML
No. Groups:           54         Scale:                 0.1974
Min. group size:      1          Log-Likelihood:        -107.0378
Max. group size:      11         Converged:             Yes
Mean group size:      3.0
-----------------------------------------------------------------
                          Coef.  Std.Err.   z    P>|z| [0.025 0.975]
-----------------------------------------------------------------
Intercept                -0.080    0.044 -1.804 0.071 -0.166  0.007
start_temp               -0.392    0.047 -8.407 0.000 -0.484 -0.301
branch_volume             0.023    0.063  0.371 0.711 -0.100  0.147
start_temp:branch_volume -0.252    0.047 -5.326 0.000 -0.344 -0.159
LMA                      -0.108    0.066 -1.643 0.100 -0.237  0.021
sample_wt                 0.128    0.072  1.776 0.076 -0.013  0.270
branching                 0.184    0.042  4.345 0.000  0.101  0.267
stem_sav                 -0.109    0.059 -1.859 0.063 -0.224  0.006
Group Var                 0.026    0.063
=================================================================
```



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.2007
Min. group size:	1	Log-Likelihood:	-109.1525
Max. group size:	11	Converged:	Yes
Mean group size:	3.0		

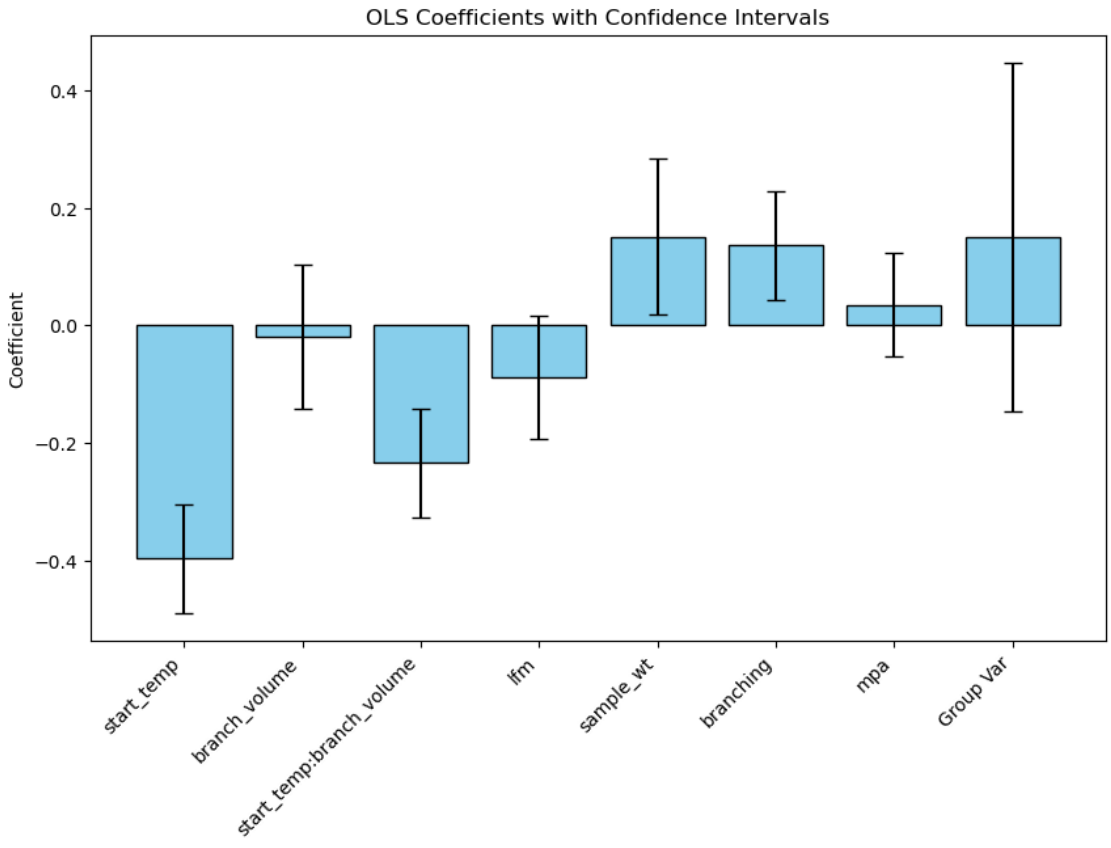
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.092	0.046	-1.997	0.046	-0.183	-0.002
sample_wt	0.083	0.045	1.839	0.066	-0.005	0.172
start_temp	-0.410	0.048	-8.583	0.000	-0.503	-0.316
sample_wt:start_temp	-0.250	0.053	-4.689	0.000	-0.355	-0.146
lfm	-0.111	0.052	-2.121	0.034	-0.213	-0.008
branching	0.136	0.046	2.955	0.003	0.046	0.225
Group Var	0.030	0.066				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.1956
Min. group size:	1	Log-Likelihood:	-107.2478
Max. group size:	11	Converged:	Yes
Mean group size:	3.0		

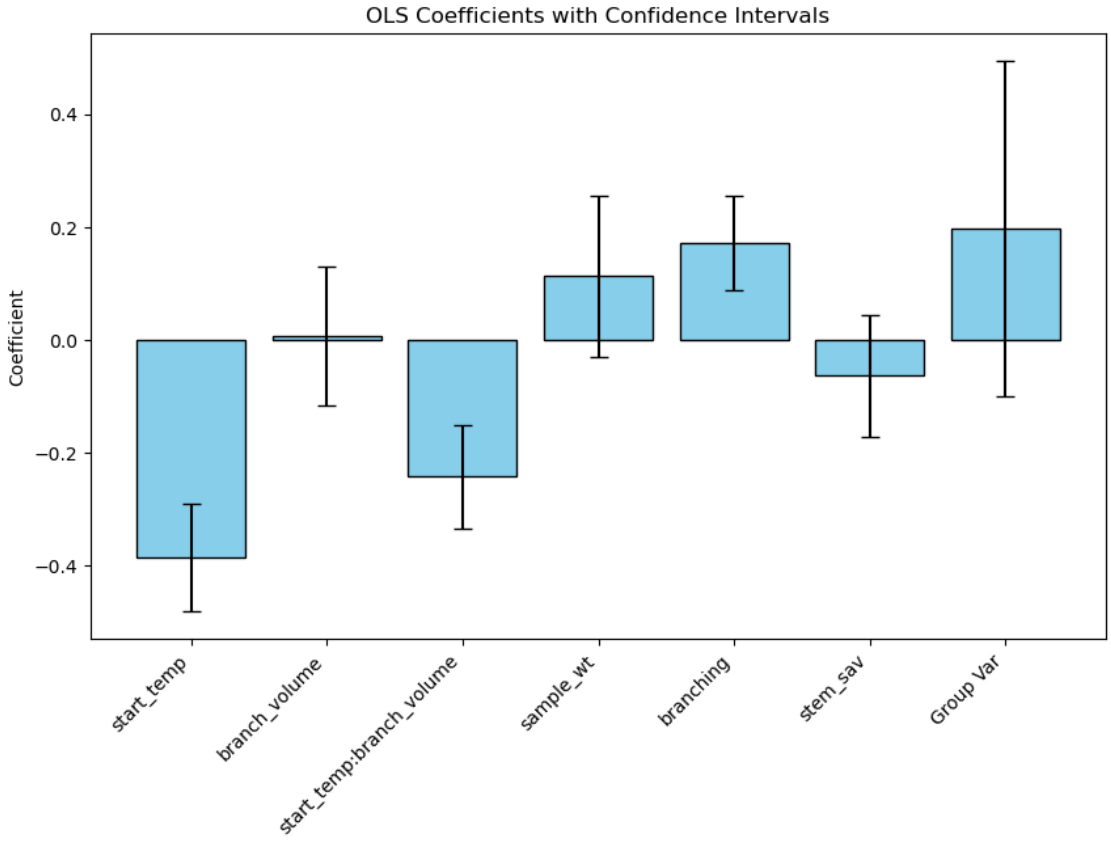
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.069	0.045	-1.538	0.124	-0.157	0.019
start_temp	-0.397	0.047	-8.357	0.000	-0.490	-0.304
branch_volume	-0.019	0.063	-0.302	0.763	-0.142	0.104
start_temp:branch_volume	-0.234	0.047	-4.943	0.000	-0.326	-0.141
lfm	-0.088	0.053	-1.641	0.101	-0.192	0.017
sample_wt	0.152	0.068	2.245	0.025	0.019	0.284
branching	0.137	0.047	2.895	0.004	0.044	0.229
mpa	0.035	0.045	0.777	0.437	-0.053	0.123
Group Var	0.030	0.067				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.1928
Min. group size:	1	Log-Likelihood:	-108.3091
Max. group size:	11	Converged:	Yes
Mean group size:	3.0		

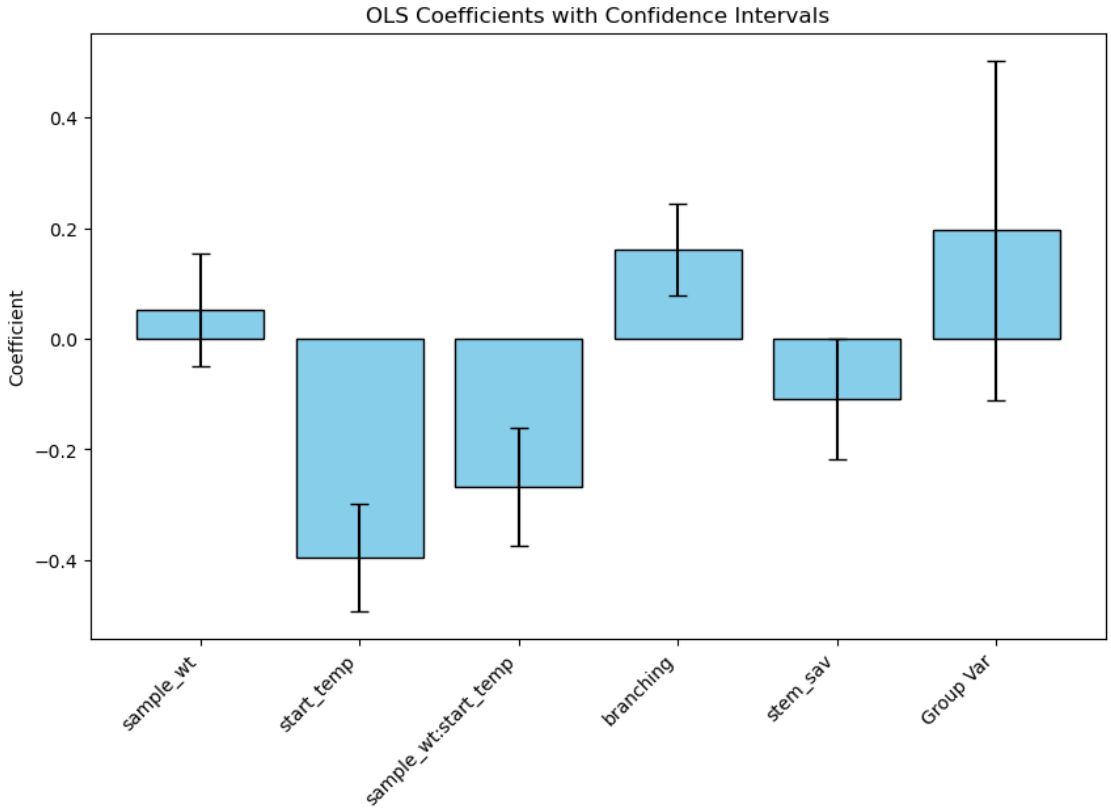
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.074	0.047	-1.589	0.112	-0.165	0.017
start_temp	-0.386	0.048	-7.986	0.000	-0.481	-0.291
branch_volume	0.006	0.063	0.092	0.927	-0.118	0.129
start_temp:branch_volume	-0.243	0.047	-5.141	0.000	-0.336	-0.150
sample_wt	0.113	0.073	1.552	0.121	-0.030	0.255
branching	0.171	0.042	4.059	0.000	0.089	0.254
stem_sav	-0.064	0.055	-1.165	0.244	-0.172	0.044
Group Var	0.038	0.067				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.1953
Min. group size:	1	Log-Likelihood:	-109.3407
Max. group size:	11	Converged:	Yes
Mean group size:	3.0		

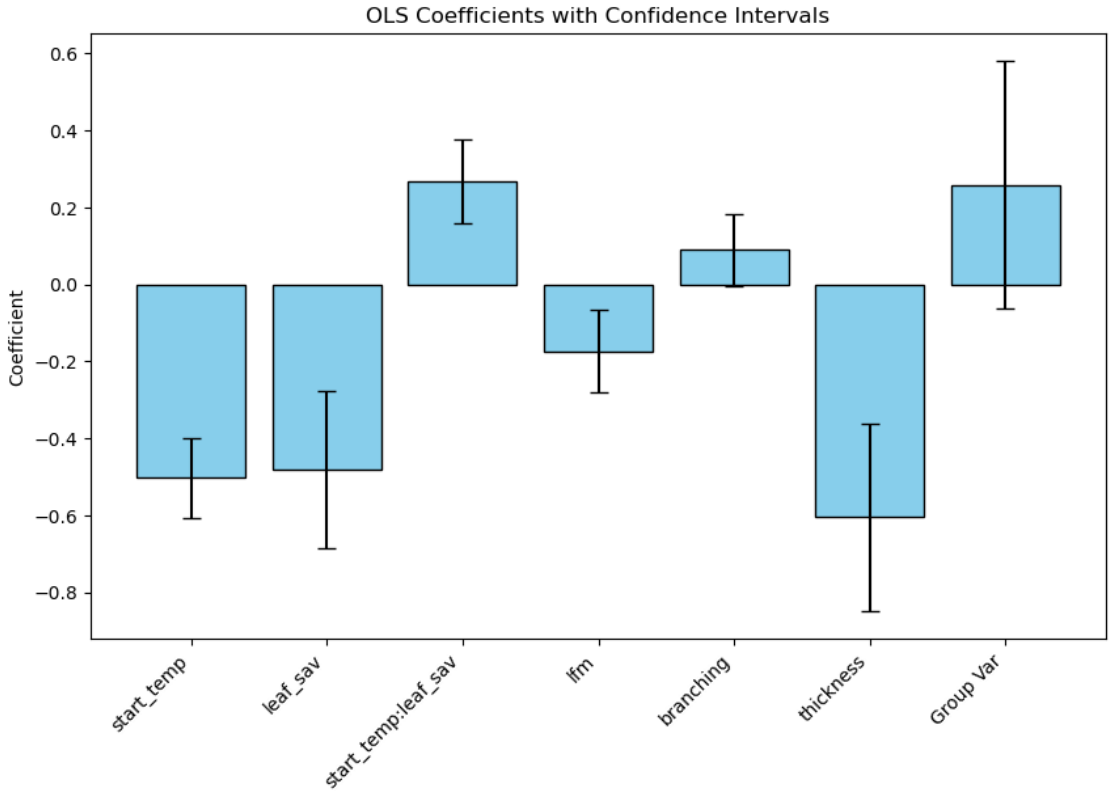
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.101	0.048	-2.097	0.036	-0.195	-0.007
sample_wt	0.051	0.052	0.988	0.323	-0.051	0.153
start_temp	-0.396	0.049	-8.038	0.000	-0.492	-0.299
sample_wt:start_temp	-0.268	0.055	-4.912	0.000	-0.375	-0.161
branching	0.161	0.042	3.809	0.000	0.078	0.244
stem_sav	-0.109	0.056	-1.960	0.050	-0.218	0.000
Group Var	0.038	0.069				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.1866
Min. group size:	1	Log-Likelihood:	-108.3743
Max. group size:	11	Converged:	Yes
Mean group size:	3.0		

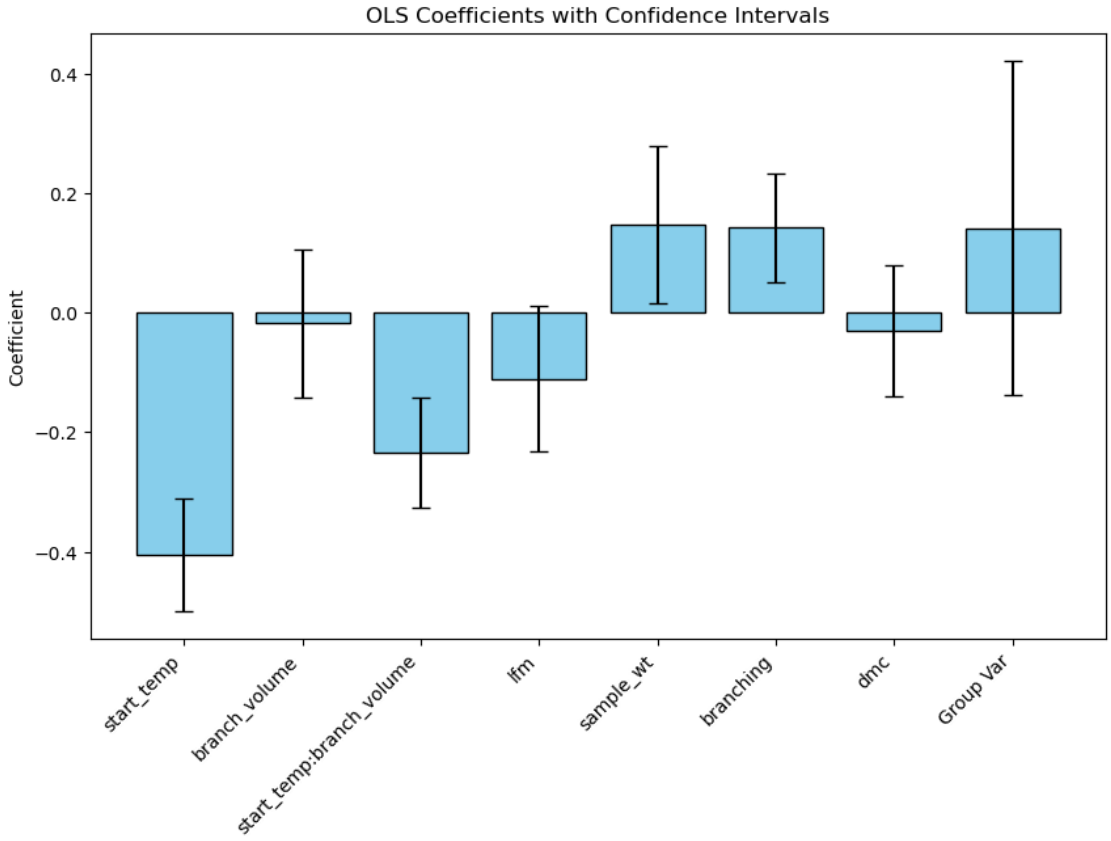
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.141	0.053	-2.687	0.007	-0.245	-0.038
start_temp	-0.503	0.053	-9.458	0.000	-0.607	-0.399
leaf_sav	-0.482	0.104	-4.611	0.000	-0.687	-0.277
start_temp:leaf_sav	0.268	0.055	4.855	0.000	0.160	0.377
lfm	-0.174	0.055	-3.186	0.001	-0.282	-0.067
branching	0.090	0.048	1.884	0.060	-0.004	0.184
thickness	-0.605	0.125	-4.856	0.000	-0.849	-0.361
Group Var	0.048	0.071				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.1972
Min. group size:	1	Log-Likelihood:	-107.3965
Max. group size:	11	Converged:	Yes
Mean group size:	3.0		

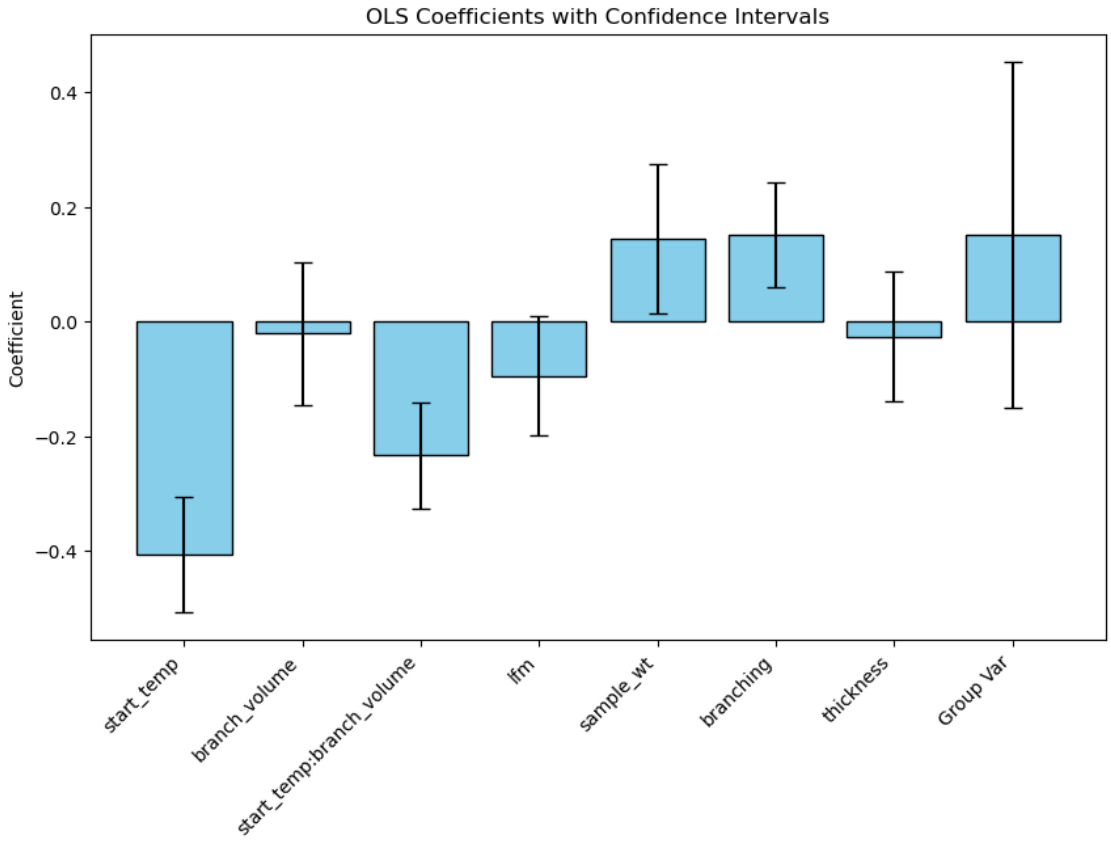
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.070	0.044	-1.567	0.117	-0.157	0.017
start_temp	-0.405	0.048	-8.385	0.000	-0.499	-0.310
branch_volume	-0.018	0.063	-0.290	0.772	-0.141	0.105
start_temp:branch_volume	-0.234	0.047	-4.967	0.000	-0.326	-0.142
lfm	-0.111	0.062	-1.795	0.073	-0.232	0.010
sample_wt	0.148	0.067	2.200	0.028	0.016	0.280
branching	0.142	0.046	3.057	0.002	0.051	0.232
dmc	-0.031	0.056	-0.559	0.576	-0.141	0.078
Group Var	0.028	0.063				



Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.1960
Min. group size:	1	Log-Likelihood:	-107.4483
Max. group size:	11	Converged:	Yes
Mean group size:	3.0		

	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.071	0.045	-1.582	0.114	-0.158	0.017
start_temp	-0.407	0.051	-7.970	0.000	-0.507	-0.307
branch_volume	-0.020	0.064	-0.320	0.749	-0.145	0.104
start_temp:branch_volume	-0.233	0.047	-4.924	0.000	-0.326	-0.141
lfm	-0.095	0.053	-1.788	0.074	-0.200	0.009
sample_wt	0.145	0.067	2.171	0.030	0.014	0.275
branching	0.151	0.047	3.217	0.001	0.059	0.243
thickness	-0.026	0.058	-0.453	0.650	-0.140	0.087
Group Var	0.030	0.068				

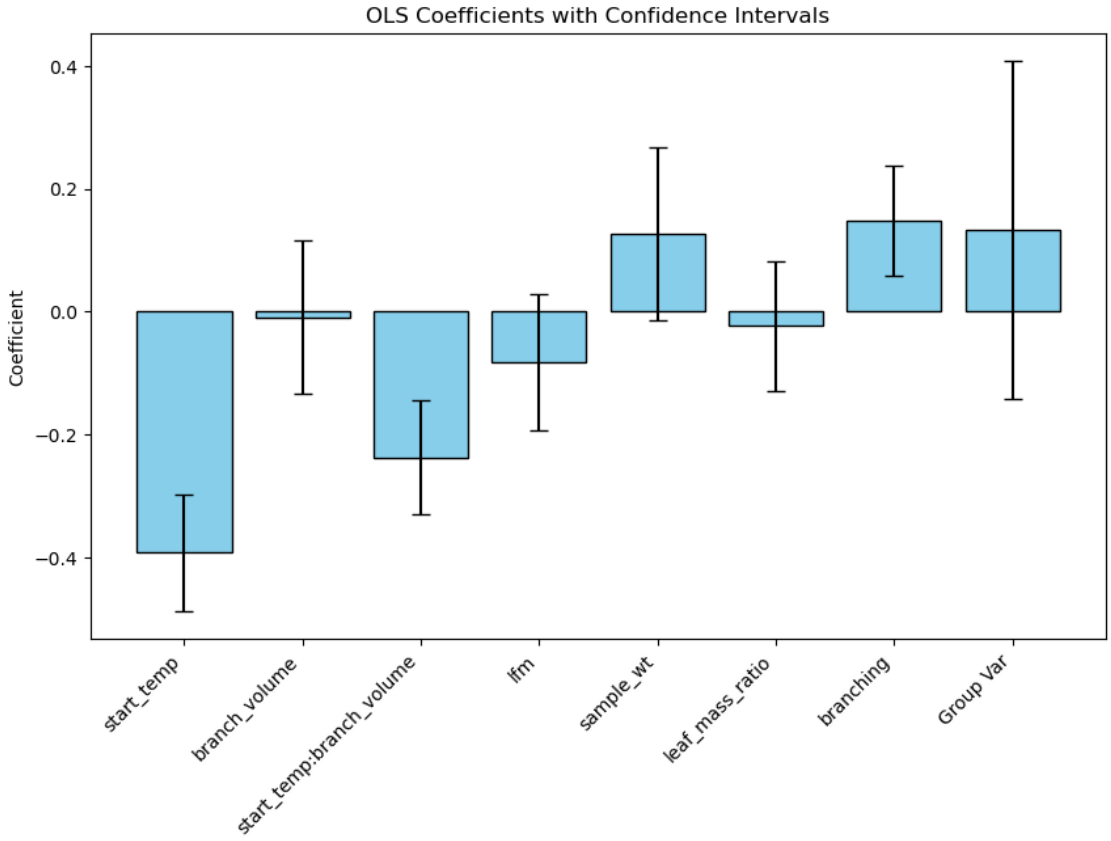


Mixed Linear Model Regression Results

Model:	MixedLM	Dependent Variable:	temp_change
No. Observations:	162	Method:	ML
No. Groups:	54	Scale:	0.1984
Min. group size:	1	Log-Likelihood:	-107.4563
Max. group size:	11	Converged:	Yes
Mean group size:	3.0		

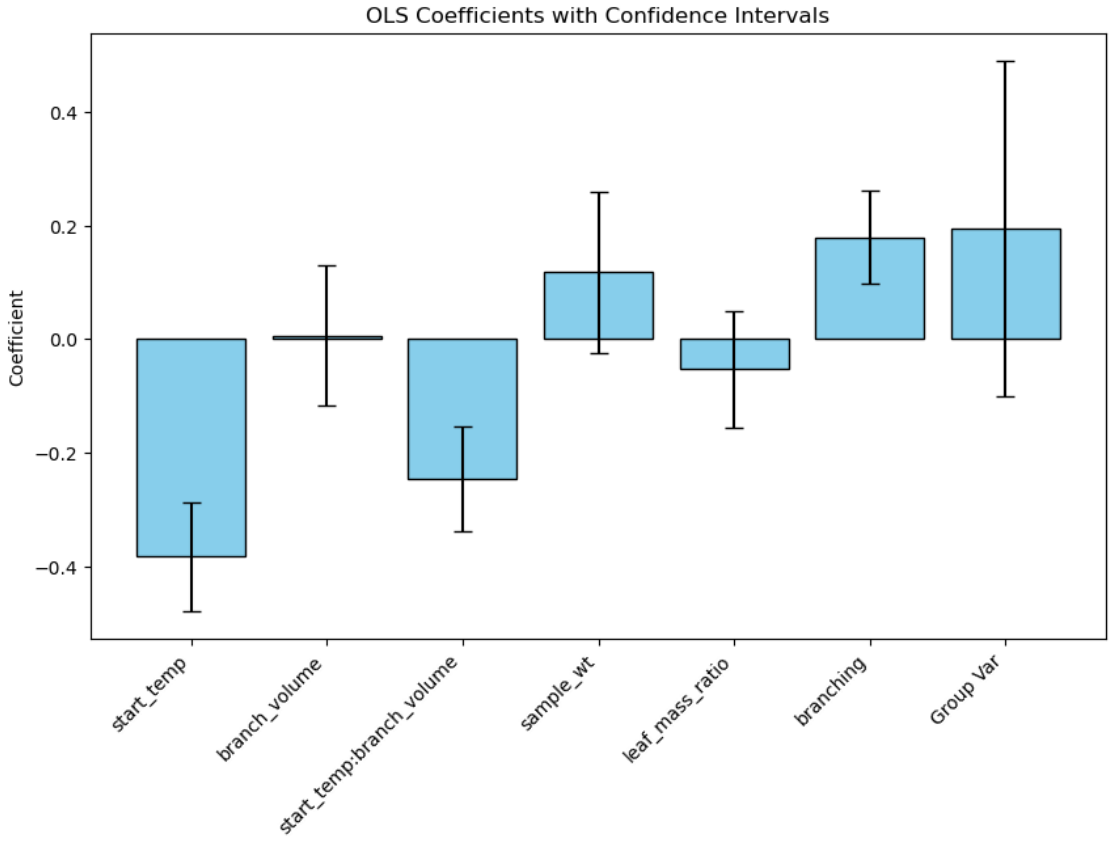
	Coef.	Std.Err.	z	P>|z|	[0.025	0.975]
Intercept	-0.072	0.044	-1.631	0.103	-0.159	0.015
start_temp	-0.393	0.048	-8.129	0.000	-0.488	-0.298
branch_volume	-0.010	0.064	-0.151	0.880	-0.135	0.115
start_temp:branch_volume	-0.238	0.047	-5.050	0.000	-0.330	-0.146
lfm	-0.083	0.057	-1.471	0.141	-0.194	0.028
sample_wt	0.127	0.072	1.770	0.077	-0.014	0.268
leaf_mass_ratio	-0.024	0.054	-0.442	0.659	-0.130	0.082
branching	0.148	0.046	3.230	0.001	0.058	0.238

```
Group Var                   0.026    0.063
=====================================================================
```



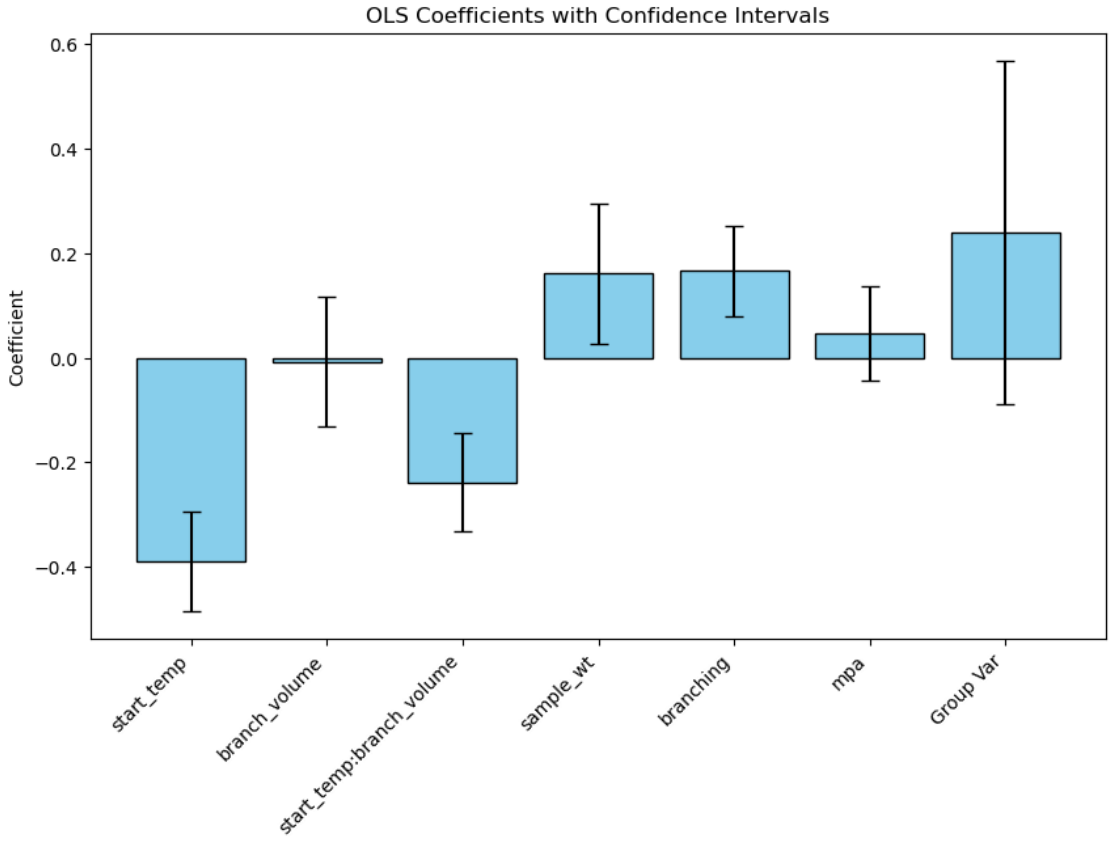

```
                Mixed Linear Model Regression Results
=====================================================================
Model:                MixedLM    Dependent Variable:    temp_change
No. Observations:     162        Method:                ML
No. Groups:           54         Scale:                 0.1934
Min. group size:      1          Log-Likelihood:        -108.4688
Max. group size:      11         Converged:             Yes
Mean group size:      3.0
---------------------------------------------------------------------
                          Coef.  Std.Err.   z    P>|z| [0.025 0.975]
---------------------------------------------------------------------
Intercept                -0.074    0.047 -1.582 0.114 -0.165  0.018
start_temp               -0.381    0.049 -7.813 0.000 -0.477 -0.286
branch_volume             0.007    0.063  0.109 0.913 -0.117  0.131
start_temp:branch_volume -0.245    0.047 -5.174 0.000 -0.337 -0.152
sample_wt                 0.117    0.073  1.620 0.105 -0.025  0.260
leaf_mass_ratio          -0.053    0.052 -1.015 0.310 -0.154  0.049
```

```
branching                  0.179    0.041   4.331 0.000   0.098   0.260
Group Var                  0.038    0.066
=============================================================================
```



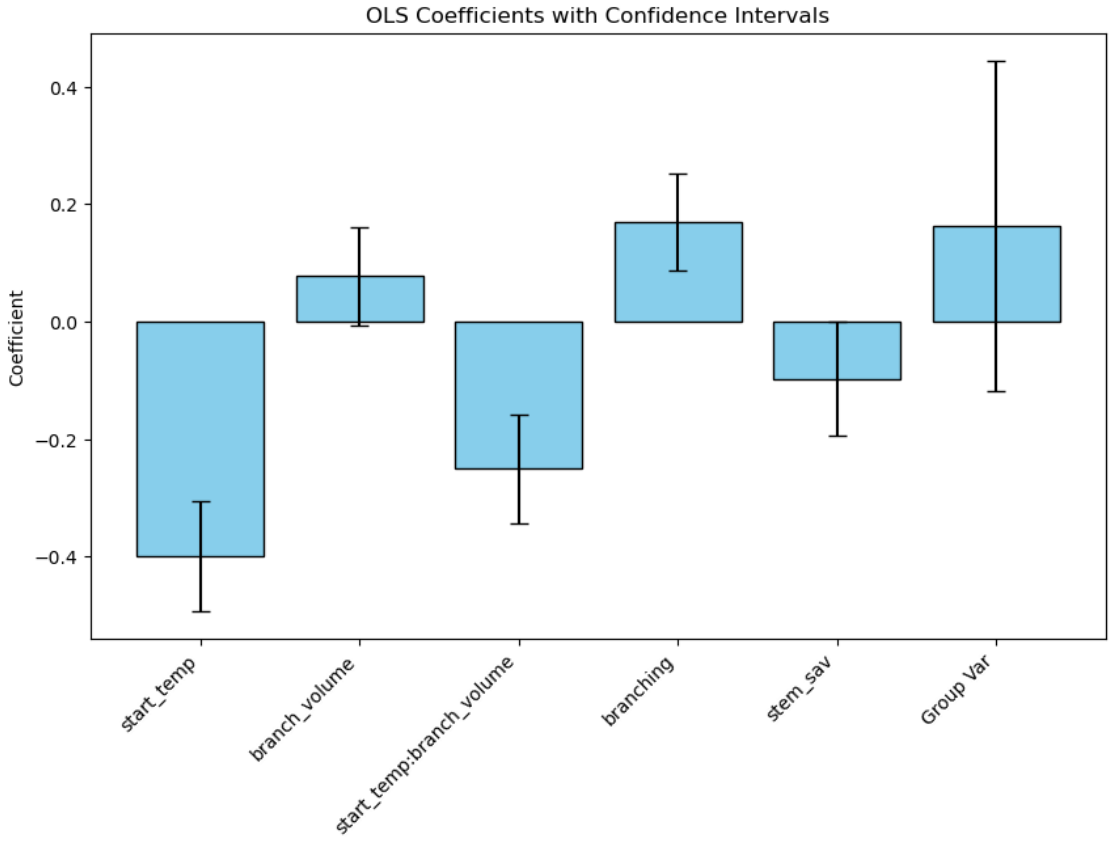

```
            Mixed Linear Model Regression Results
=============================================================================
Model:                MixedLM    Dependent Variable:    temp_change
No. Observations:     162        Method:                ML
No. Groups:           54         Scale:                 0.1886
Min. group size:      1          Log-Likelihood:        -108.4726
Max. group size:      11         Converged:             Yes
Mean group size:      3.0
-----------------------------------------------------------------------------
                          Coef.  Std.Err.    z    P>|z| [0.025 0.975]
-----------------------------------------------------------------------------
Intercept                -0.068    0.048 -1.415 0.157 -0.163  0.026
start_temp               -0.389    0.049 -7.971 0.000 -0.484 -0.293
branch_volume            -0.008    0.063 -0.124 0.901 -0.131  0.116
start_temp:branch_volume -0.238    0.048 -4.989 0.000 -0.332 -0.145
sample_wt                 0.161    0.069  2.346 0.019  0.026  0.295
```

```
branching                  0.167    0.044  3.764 0.000  0.080  0.253
mpa                        0.046    0.046  0.995 0.320 -0.045  0.136
Group Var                  0.045    0.073
================================================================
```



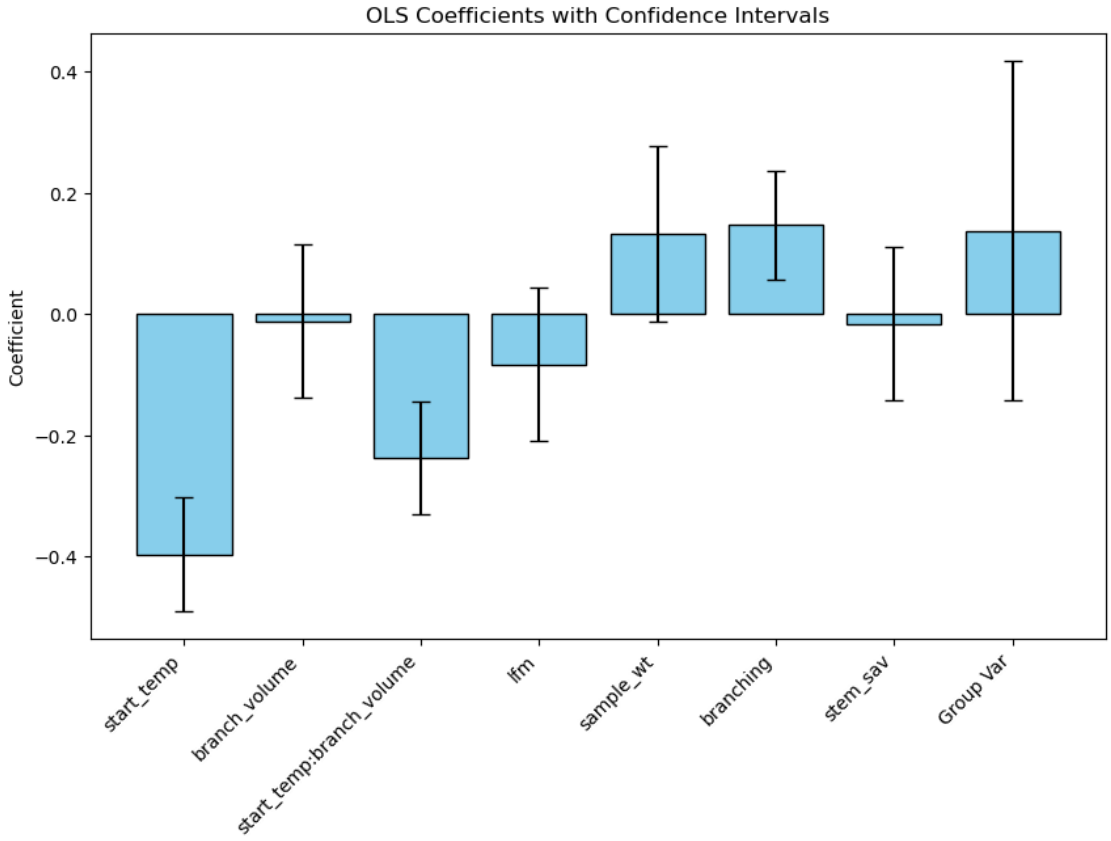

```
                Mixed Linear Model Regression Results
================================================================
Model:                MixedLM    Dependent Variable:    temp_change
No. Observations:     162        Method:                ML
No. Groups:           54         Scale:                 0.1997
Min. group size:      1          Log-Likelihood:        -109.5095
Max. group size:      11         Converged:             Yes
Mean group size:      3.0
----------------------------------------------------------------
                          Coef.  Std.Err.   z    P>|z| [0.025 0.975]
----------------------------------------------------------------
Intercept                -0.075    0.046 -1.648 0.099 -0.165  0.014
start_temp               -0.399    0.048 -8.398 0.000 -0.492 -0.306
branch_volume             0.078    0.043  1.820 0.069 -0.006  0.162
start_temp:branch_volume -0.251    0.047 -5.289 0.000 -0.344 -0.158
```

```
branching                  0.171    0.042  4.041 0.000  0.088  0.253
stem_sav                  -0.097    0.050 -1.942 0.052 -0.195  0.001
Group Var                  0.032    0.064
=============================================================================
```




```
                Mixed Linear Model Regression Results
=============================================================================
Model:                MixedLM    Dependent Variable:    temp_change
No. Observations:     162        Method:                ML
No. Groups:           54         Scale:                 0.1980
Min. group size:      1          Log-Likelihood:        -107.5230
Max. group size:      11         Converged:             Yes
Mean group size:      3.0
-----------------------------------------------------------------------------
                          Coef.  Std.Err.    z    P>|z| [0.025 0.975]
-----------------------------------------------------------------------------
Intercept                -0.071    0.044 -1.613 0.107 -0.158  0.015
start_temp               -0.396    0.048 -8.314 0.000 -0.490 -0.303
branch_volume            -0.012    0.064 -0.181 0.856 -0.137  0.114
start_temp:branch_volume -0.237    0.047 -5.029 0.000 -0.330 -0.145
```

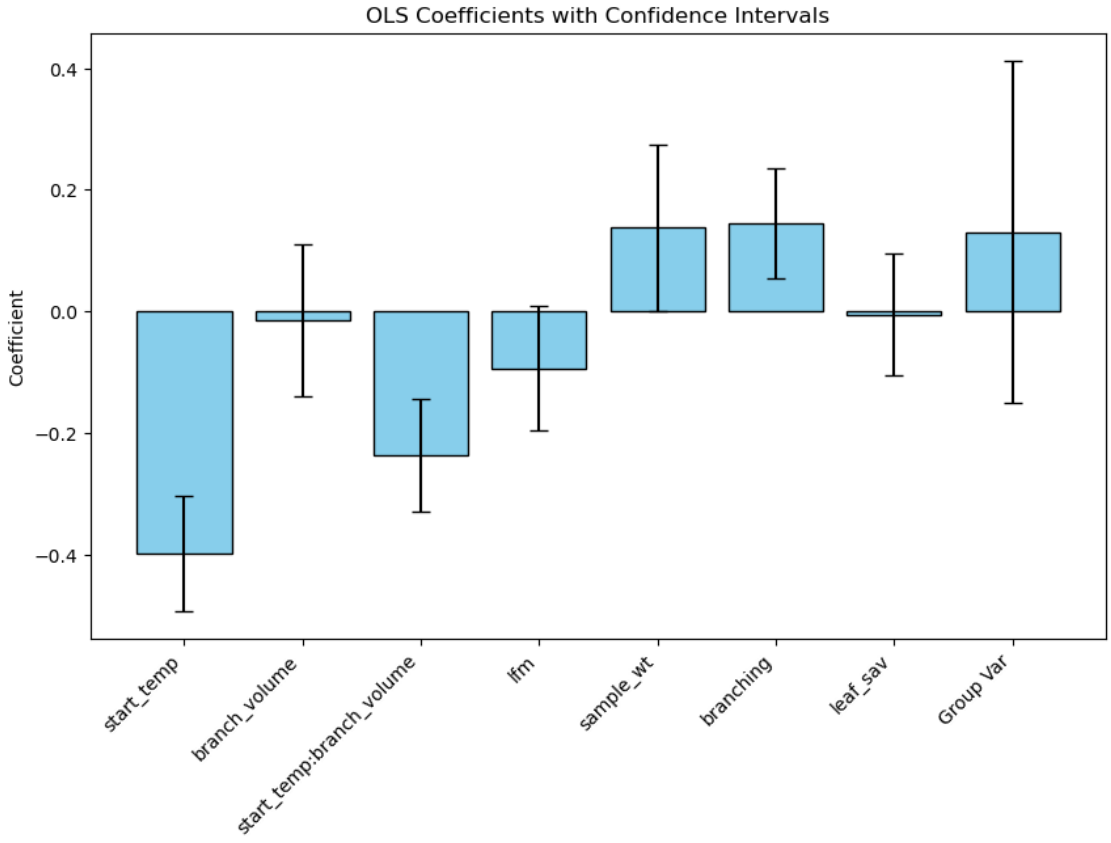
```
lfm                      -0.083    0.064 -1.293 0.196 -0.210  0.043
sample_wt                 0.132    0.074  1.793 0.073 -0.012  0.276
branching                 0.147    0.046  3.206 0.001  0.057  0.237
stem_sav                 -0.016    0.065 -0.248 0.804 -0.143  0.111
Group Var                 0.027    0.064
=================================================================
```



Mixed Linear Model Regression Results

```
=================================================================
Model:               MixedLM    Dependent Variable:    temp_change
No. Observations:    162        Method:                ML
No. Groups:          54         Scale:                 0.1989
Min. group size:     1          Log-Likelihood:        -107.5494
Max. group size:     11         Converged:             Yes
Mean group size:     3.0
-----------------------------------------------------------------
                        Coef.  Std.Err.   z    P>|z| [0.025 0.975]
-----------------------------------------------------------------
Intercept               -0.071    0.044 -1.608 0.108 -0.157  0.016
start_temp              -0.397    0.048 -8.203 0.000 -0.492 -0.302
```

```
branch_volume             -0.014    0.063 -0.220 0.826 -0.138  0.110
start_temp:branch_volume -0.236    0.047 -5.026 0.000 -0.329 -0.144
lfm                       -0.093    0.052 -1.774 0.076 -0.195  0.010
sample_wt                  0.138    0.069  1.987 0.047  0.002  0.274
branching                  0.145    0.047  3.120 0.002  0.054  0.236
leaf_sav                  -0.005    0.051 -0.094 0.925 -0.105  0.096
Group Var                  0.026    0.064
================================================================
```



7 Heat Flux Change

[10]:
```
AIC_iterator(flam, cols_use, Y_VAR='heat_flux_change',
             minnumsingle=mns, maxnumsingle=mxs, minnumint=mni, maxnumint=mxi)
```

```
Columns present in sig. interaction terms: {'sample_wt', 'mpa', 'lfm',
'branch_volume', 'thickness', 'stem_sav', 'species', 'start_temp',
'leaf_mass_ratio', 'leaf_sav', 'dmc', 'LMA'}
```

```
Total Num. Cols : Num. Sig. Int. Cols;  13 : 12

Significant Interactions:
('lfm', 'start_temp')
('lfm', 'thickness')
('LMA', 'dmc')
('sample_wt', 'leaf_mass_ratio')
('sample_wt', 'start_temp')
('sample_wt', 'dmc')
('sample_wt', 'stem_sav')
('leaf_mass_ratio', 'mpa')
('leaf_mass_ratio', 'branch_volume')
('leaf_mass_ratio', 'thickness')
('mpa', 'start_temp')
('mpa', 'branch_volume')
('start_temp', 'branch_volume')
('start_temp', 'leaf_sav')
('start_temp', 'species')
('dmc', 'branch_volume')
('dmc', 'stem_sav')
('dmc', 'leaf_sav')
('dmc', 'thickness')
('branch_volume', 'stem_sav')

Number of formulas: 11240


heat_flux_change ~ start_temp*leaf_sav + LMA + sample_wt + leaf_mass_ratio +
branch_volume


            Mixed Linear Model Regression Results
============================================================
Model:            MixedLM Dependent Variable: heat_flux_change
No. Observations: 162     Method:             ML
No. Groups:       54      Scale:              0.1566
Min. group size:  1       Log-Likelihood:     -138.6045
Max. group size:  11      Converged:          Yes
Mean group size:  3.0
------------------------------------------------------------
                    Coef.  Std.Err.   z    P>|z| [0.025 0.975]
------------------------------------------------------------
Intercept           -0.117    0.105 -1.112 0.266 -0.322  0.089
start_temp           0.147    0.069  2.112 0.035  0.011  0.283
leaf_sav             0.042    0.109  0.390 0.697 -0.171  0.256
start_temp:leaf_sav  0.276    0.060  4.593 0.000  0.158  0.393
LMA                  0.352    0.120  2.921 0.003  0.116  0.588
sample_wt            0.791    0.083  9.571 0.000  0.629  0.953
```

```
leaf_mass_ratio      0.210    0.095  2.217 0.027  0.024  0.396
branch_volume       -0.166    0.073 -2.277 0.023 -0.309 -0.023
Group Var            0.495    0.374
============================================================
```