Supplementary Material Two

December 13, 2022

1 Overview

This is a python notebook to present all the model diagnostics of bayseian models used in Examining the Longitudinal Trajectory of Biopsychosocial Difficulties in Anorexia Nervosa Within a Bayesian Framework paper.

For more information on how the data was pre-processed and how the models where built please see https://github.com/WMDA/BB_data/

1.1 Content

Section 1: Overview of notebook

Section 2: All the linear and mixed regression models, libraries and data maniputaion needed for this notbook to run.

Section 3: A heatmap plot

Section 4: Kernel Density Estimation (KDE) and trace plots for the linear regression models

Section 5: KDE and trace plots for the mixed effects models

Section 6: Autocorrelation plots

2 Data manipulation and model fitting

This section can be skipped if model diagnostics is all that is wanted

[1]:
```
from functions.data_functions import load_data, save_pickle, load_pickle
import seaborn as sns
sns.set_style('darkgrid')
import matplotlib.pyplot as plt
import pandas as pd
import warnings
warnings.filterwarnings(action='ignore')
import bambi as bmb
import arviz as az
```

2.1 Read in and preprocess data

[3]:
```
pca_df = load_data('BEACON', 'pca_df')
comp = ['comp_1', 'comp_2','comp_3']
```

Demean the data

[4]:
```
for component in comp:
    pca_df[f'{component}_t1_demean'] = pca_df[f'{component}_t1'] -␣
 ↪pca_df[f'{component}_t1'].mean()

pca_df['group_ind'] = pca_df['group'].apply(lambda group: 0 if group =='HC'␣
 ↪else 1)
```

2.2 Linear regresions to test for differences at time point one

This is defining and fitting the linear regression models

[ ]:
```
t1_models = {}

for component in comp:
    ttest = bmb.Model(f'{component}_t1 ~ 0 + group', data=pca_df.dropna())
    print(ttest)
    ttest_results = ttest.fit()
    t1_models[component] = ttest_results
```

2.3 Defining and fitting the mixed effects models.

For more detail on priors and deviations please see supplementary material one that is included with the paper

[7]:
```
models = {
    'null':{},
    'alternative':{}
}

pca_df = pca_df.rename(columns={'G_Number':'participants'})
for model_component in comp:
    null = bmb.Model(f'{model_component}_t2 ~ 0 + (0 +␣
 ↪{model_component}_t1_demean|participants)', data=pca_df, noncentered=False)
    alternative = bmb.Model(f'{model_component}_t2 ~ 0 +␣
 ↪{model_component}_t1_demean + group + (0 +␣
 ↪{model_component}_t1_demean|group)', data=pca_df, noncentered=False)

    models['null'][f'{model_component}'] = null
    models['alternative'][f'{model_component}'] = alternative
```

[ ]:
```
for alternative_model in models['alternative'].keys():
    print(models['alternative'][alternative_model], '\n')
```

[ ]:
```
for null_models in models['null'].keys():
    print(models['null'][null_models], '\n')
```

[10]:
```
draw_numb = 2000
tune_numb = 3500
target_accept_numb = 0.95
```

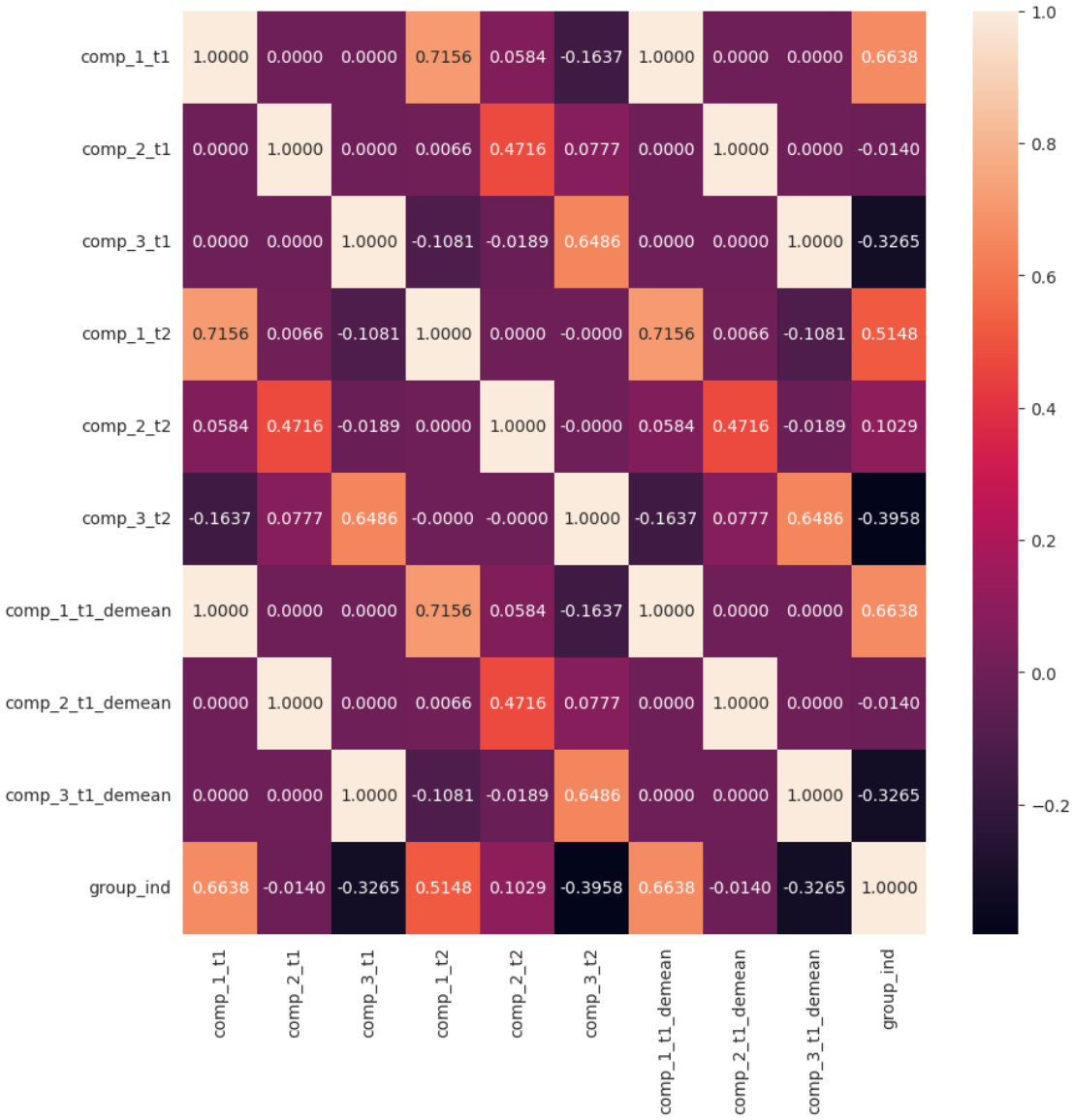
[ ]:
```
fitted_models ={
    'null':{},
    'alternative':{}
}

for alternative_model in models['alternative'].keys():
    alternative_fitted = models['alternative'][alternative_model].
 ↪fit(draws=draw_numb, tune=tune_numb, target_accept=target_accept_numb)
    print('\n')
    fitted_models['alternative'][alternative_model] = alternative_fitted

for null_model in models['null'].keys():
    null_fitted = models['null'][null_model].fit(draws=draw_numb,␣
 ↪tune=tune_numb, target_accept=target_accept_numb)
    print('\n')
    fitted_models['null'][null_model] = null_fitted
```

3 Heatmap

This is a heatmap of all the variables in the used in the models to check for multicollinearity

[ ]:
```
plt.figure(figsize=(10, 10))
sns.heatmap(pca_df[['comp_1_t1','comp_2_t1', 'comp_3_t1', 'comp_1_t2',␣
 ↪'comp_2_t2', 'comp_3_t2', 'comp_1_t1_demean', 'comp_2_t1_demean',␣
 ↪'comp_3_t1_demean','group_ind']].corr(),  annot=True,  fmt=".4f")
```

```
<AxesSubplot: >
```

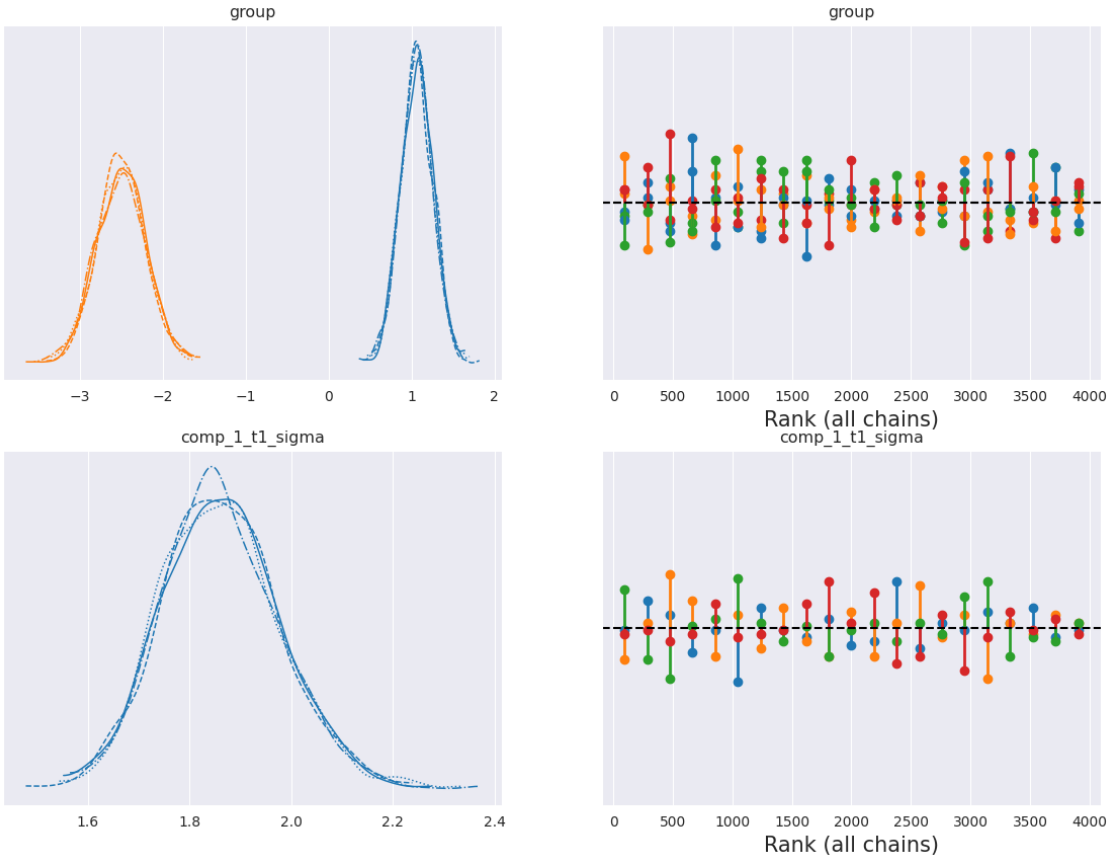


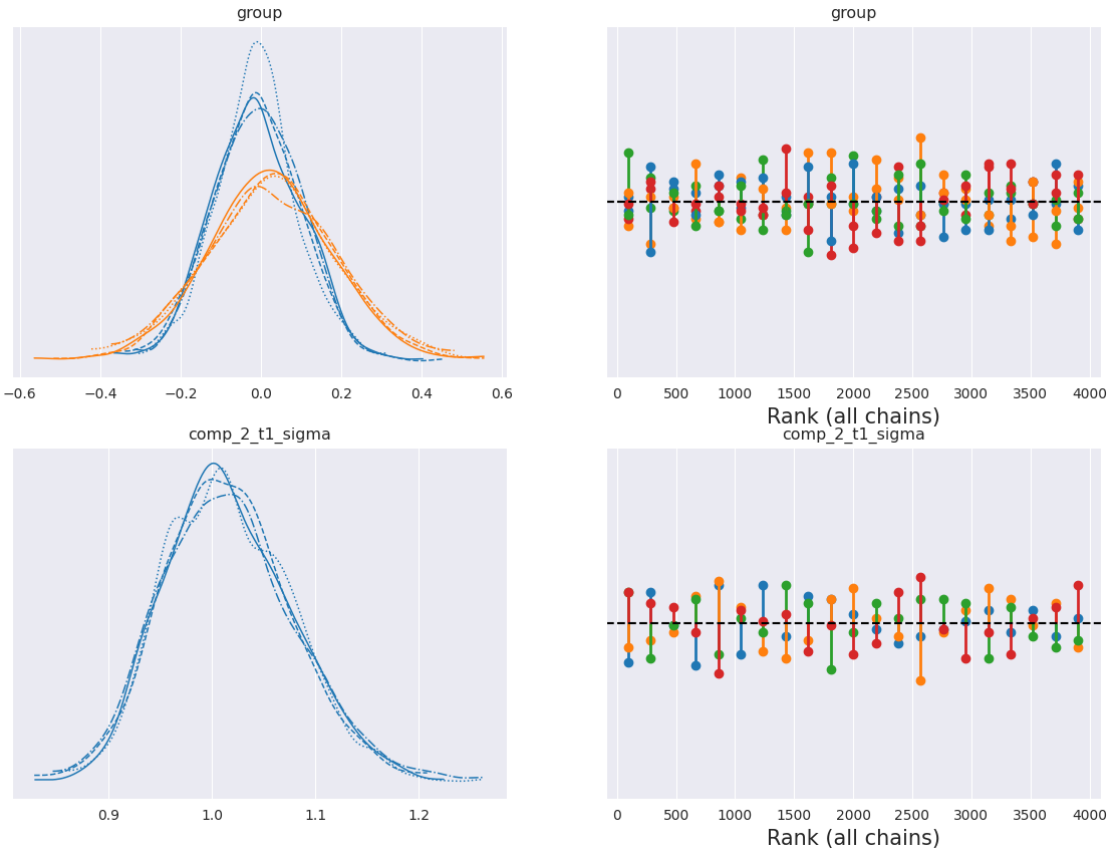
4 The KDE and the trace plots for linear regressions at time point one

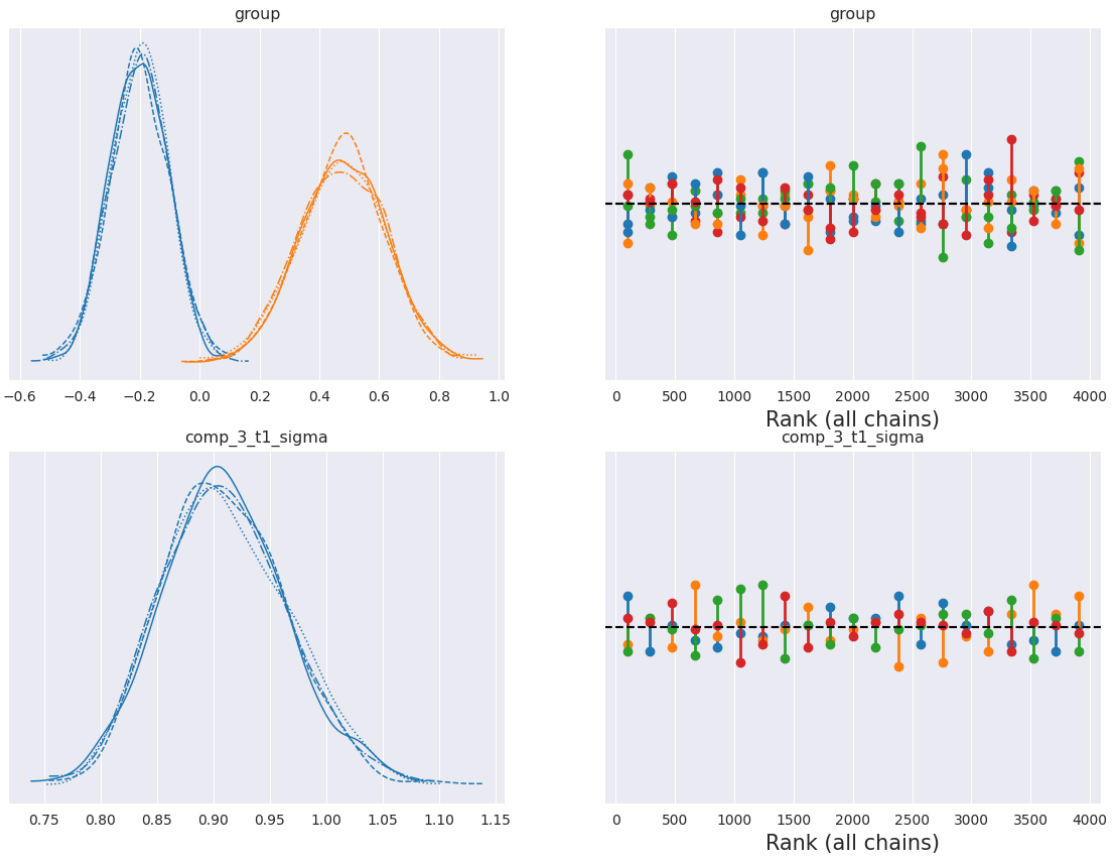
[22]:
```
for model in t1_models.keys():
    print(model, '\n')
    az.plot_trace(t1_models[model], kind="rank_vlines", figsize=(14,10))
```

```
comp_1

comp_2
```

comp_3


group
group
−3
−2
−1
0
1
2
0
500
1000
1500
2000
2500
3000
3500
4000
Rank (all chains)
comp_1_t1_sigma
comp_1_t1_sigma
1.6
1.8
2.0
2.2
2.4
0
500
1000
1500
2000
2500
3000
3500
4000
Rank (all chains)

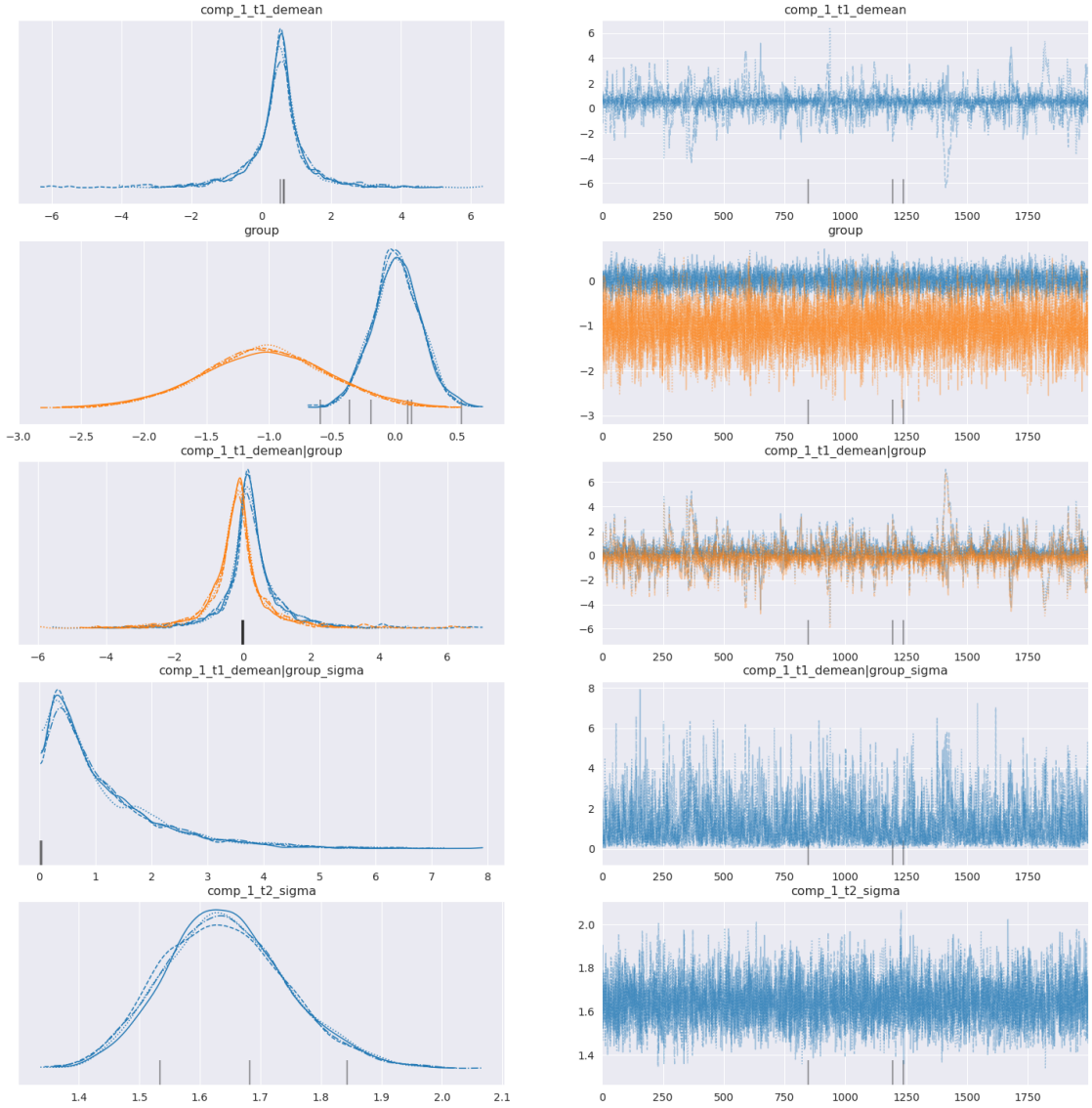

group
−0.6
−0.4
−0.2
0.0
0.2
0.4
0.6
group
0
500
1000
1500
2000
2500
3000
3500
4000
Rank (all chains)
comp_2_t1_sigma
0.9
1.0
1.1
1.2
comp_2_t1_sigma
0
500
1000
1500
2000
2500
3000
3500
4000
Rank (all chains)

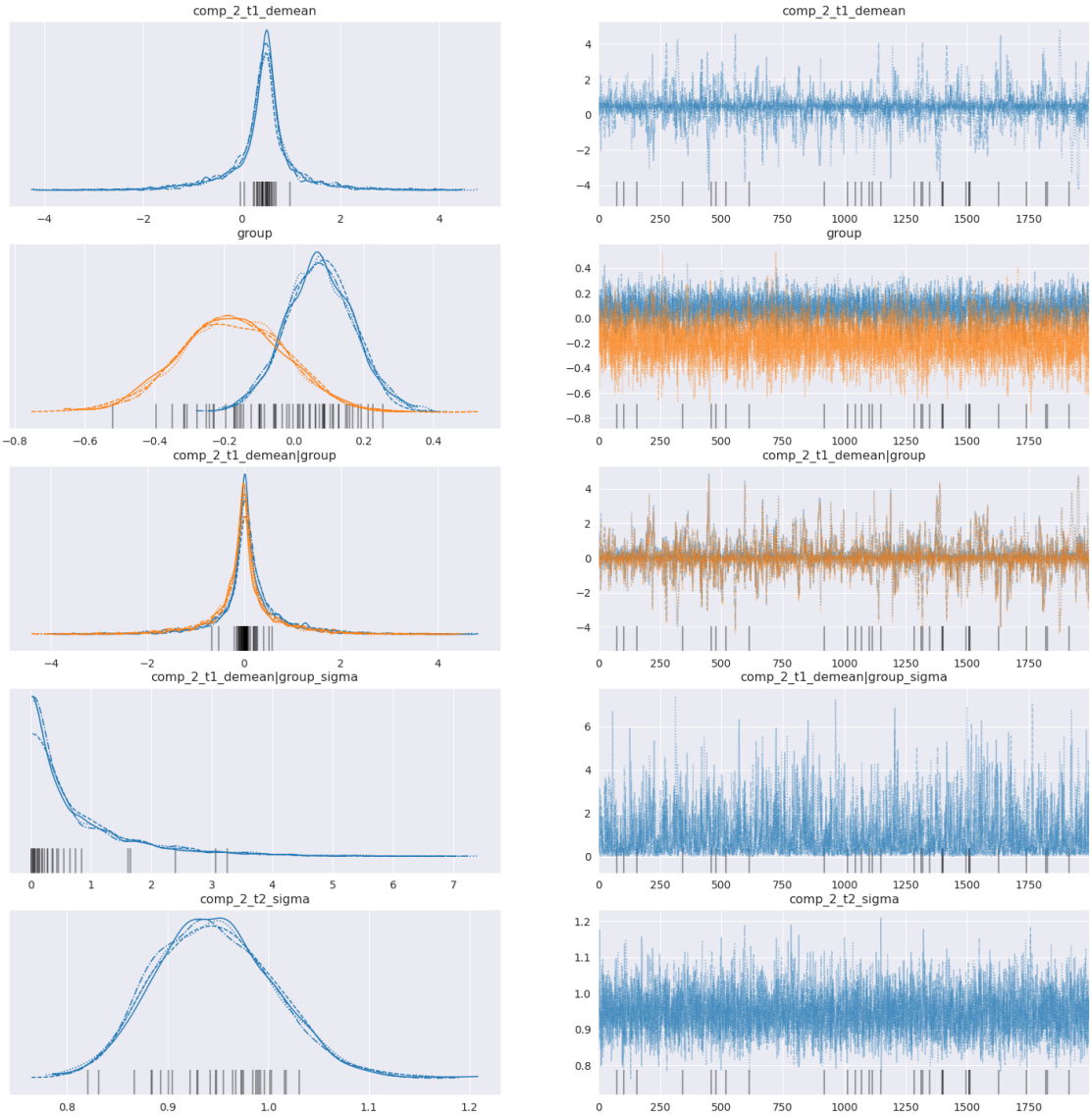


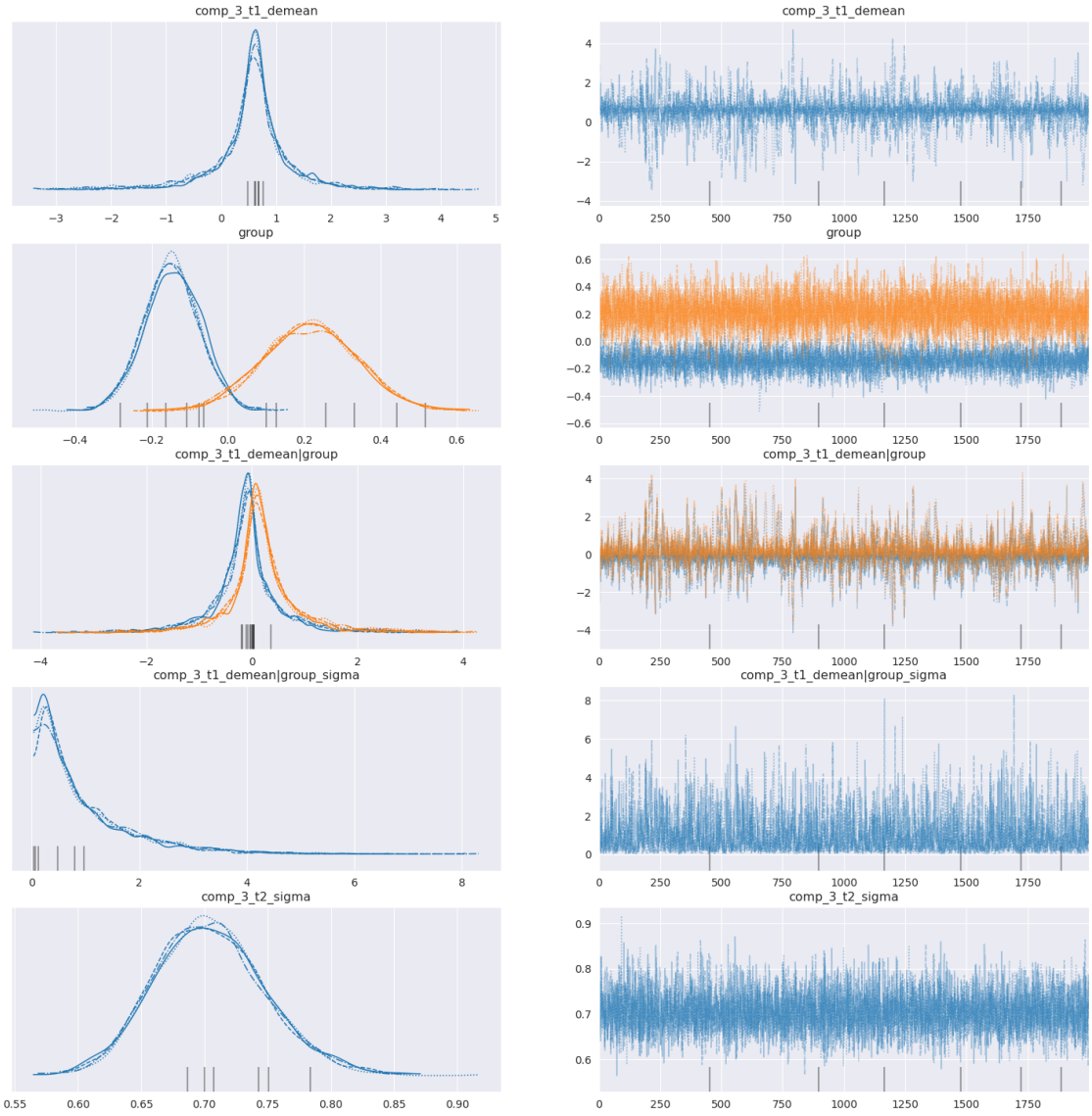
5 KDE and trace plots for mixed effects models

5.1 Plotting the KDE and the trace plots for the alternative model.

[14]:
```
for model in comp:
    az.plot_trace(fitted_models['alternative'][model], figsize=(18,18))
```

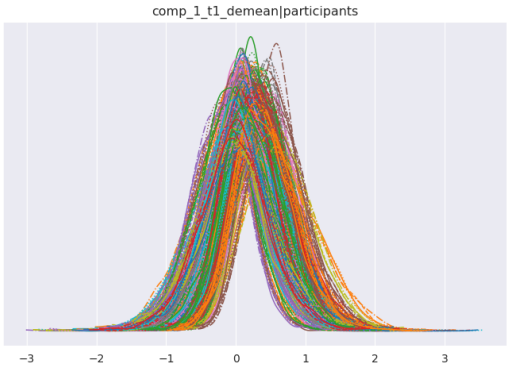

comp_1_t1_demean
comp_1_t1_demean
group
group
comp_1_t1_demean|group
comp_1_t1_demean|group
comp_1_t1_demean|group_sigma
comp_1_t1_demean|group_sigma
comp_1_t2_sigma
comp_1_t2_sigma

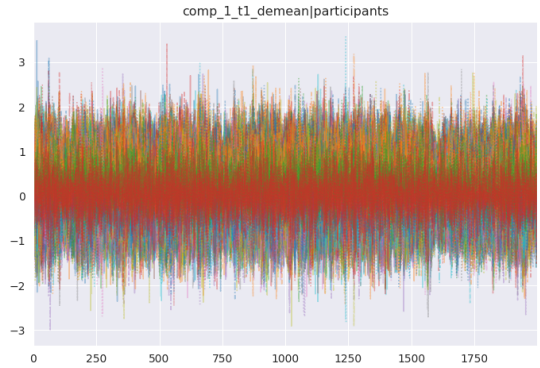

comp_2_t1_demean
comp_2_t1_demean
group
group
comp_2_t1_demean|group
comp_2_t1_demean|group
comp_2_t1_demean|group_sigma
comp_2_t1_demean|group_sigma
comp_2_t2_sigma
comp_2_t2_sigma

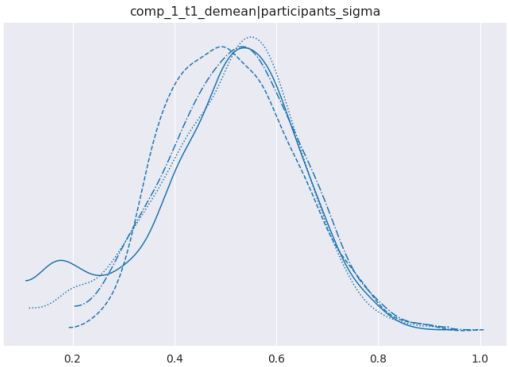


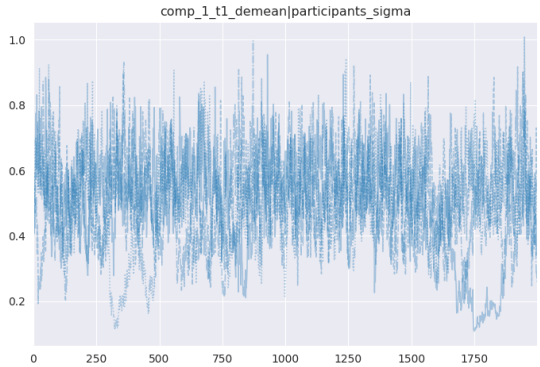
5.2 Plotting the KDE and trace plots for the null hypothesis models

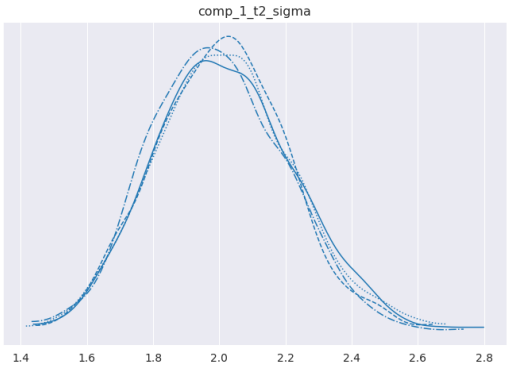
[15]:
```
for model in comp:
    az.plot_trace(fitted_models['null'][model], figsize=(18,18))
```

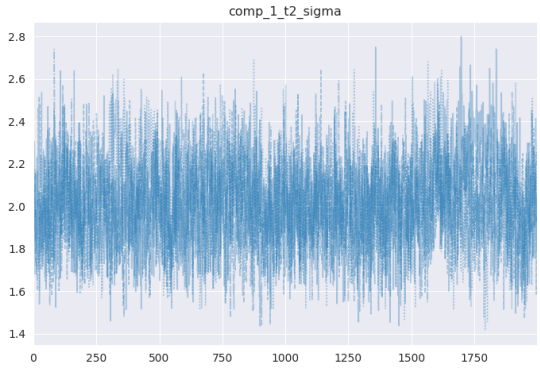

comp_1_t1_demean|participants
−3
−2
−1
0
1
2
3

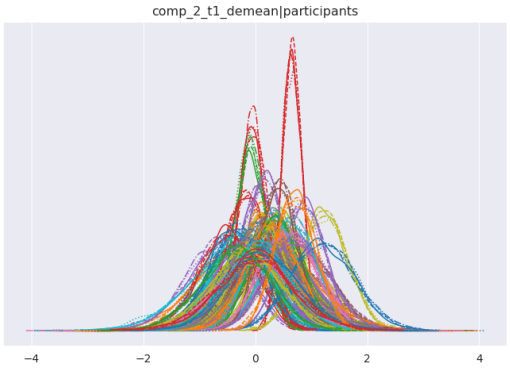

comp_1_t1_demean|participants
3
2
1
0
−1
−2
−3
0
250
500
750
1000
1250
1500
1750

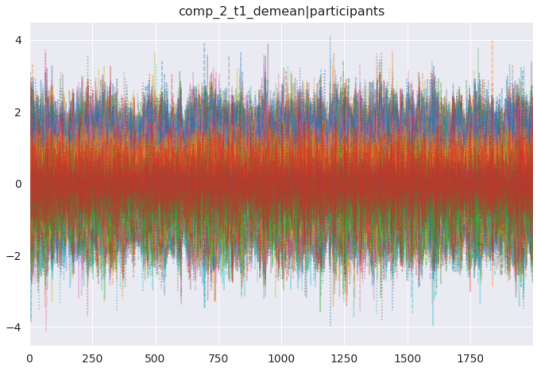

comp_1_t1_demean|participants_sigma
0.2
0.4
0.6
0.8
1.0

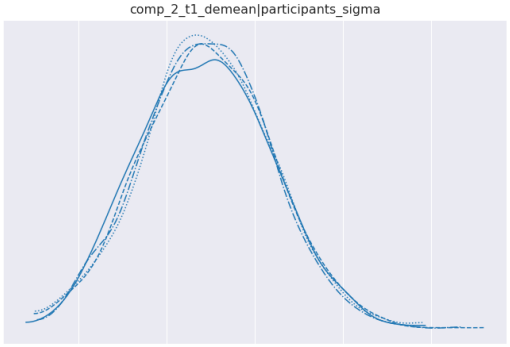

comp_1_t1_demean|participants_sigma
1.0
0.8
0.6
0.4
0.2
0
250
500
750
1000
1250
1500
1750

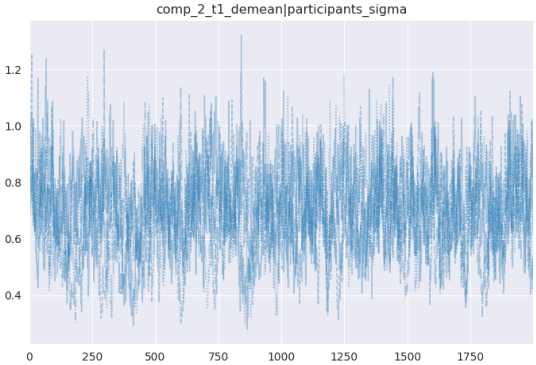

comp_1_t2_sigma
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8

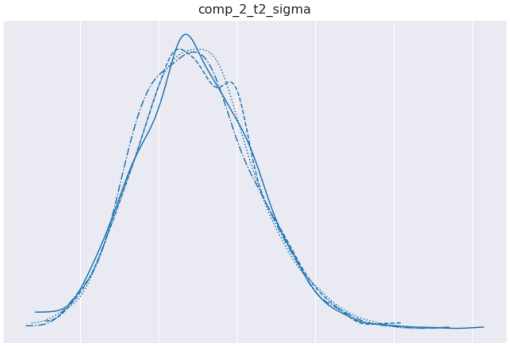

comp_1_t2_sigma
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
0
250
500
750
1000
1250
1500
1750

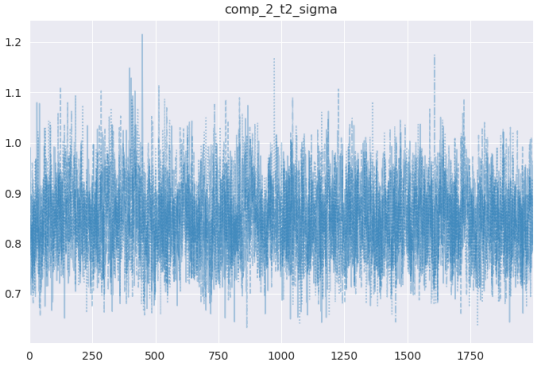

comp_2_t1_demean|participants
−4
−2
0
2
4

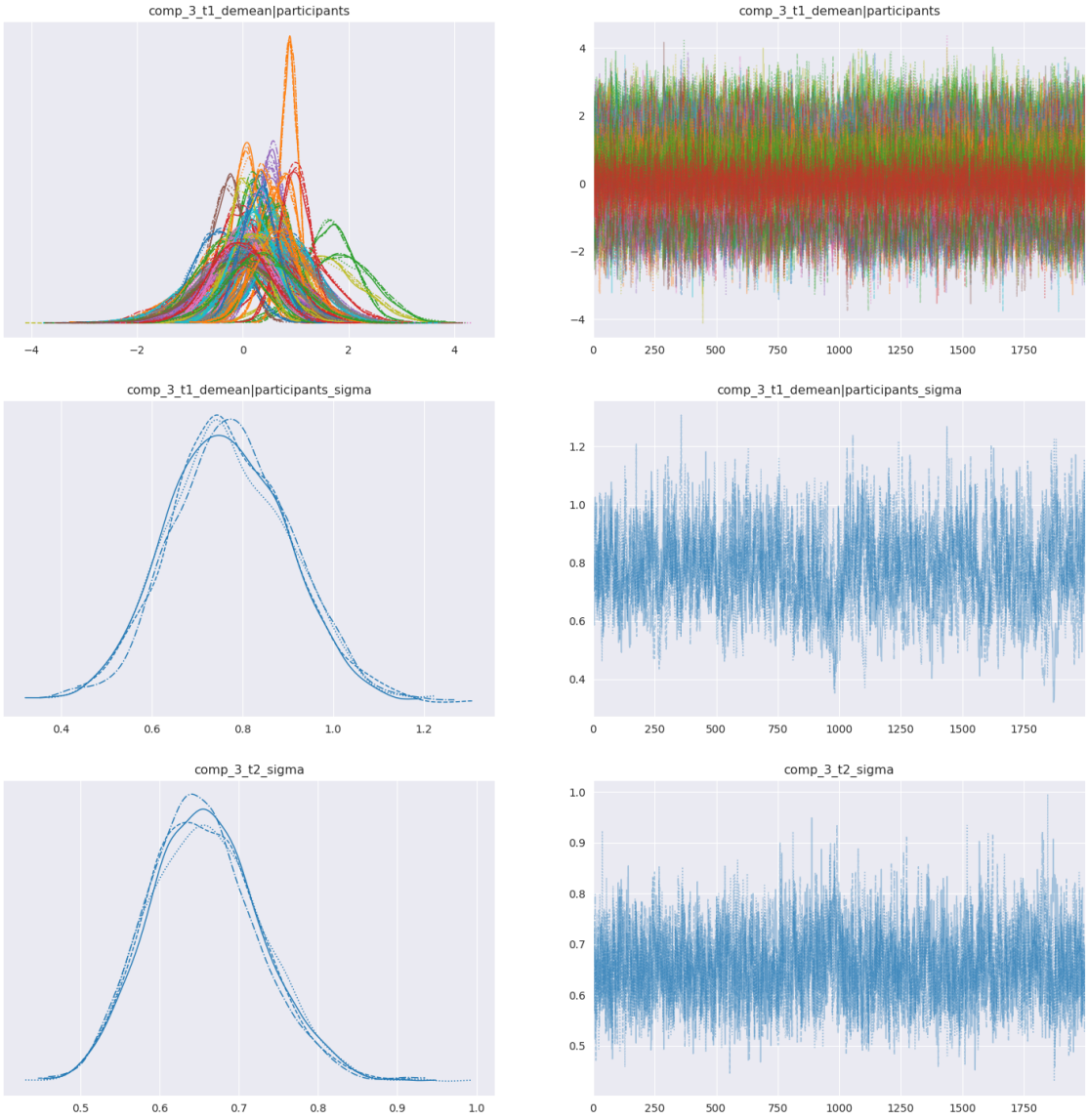

comp_2_t1_demean|participants
4
2
0
−2
−4
0
250
500
750
1000
1250
1500
1750


comp_2_t1_demean|participants_sigma
0.4
0.6
0.8
1.0
1.2


comp_2_t1_demean|participants_sigma
1.2
1.0
0.8
0.6
0.4
0
250
500
750
1000
1250
1500
1750


comp_2_t2_sigma
0.7
0.8
0.9
1.0
1.1
1.2

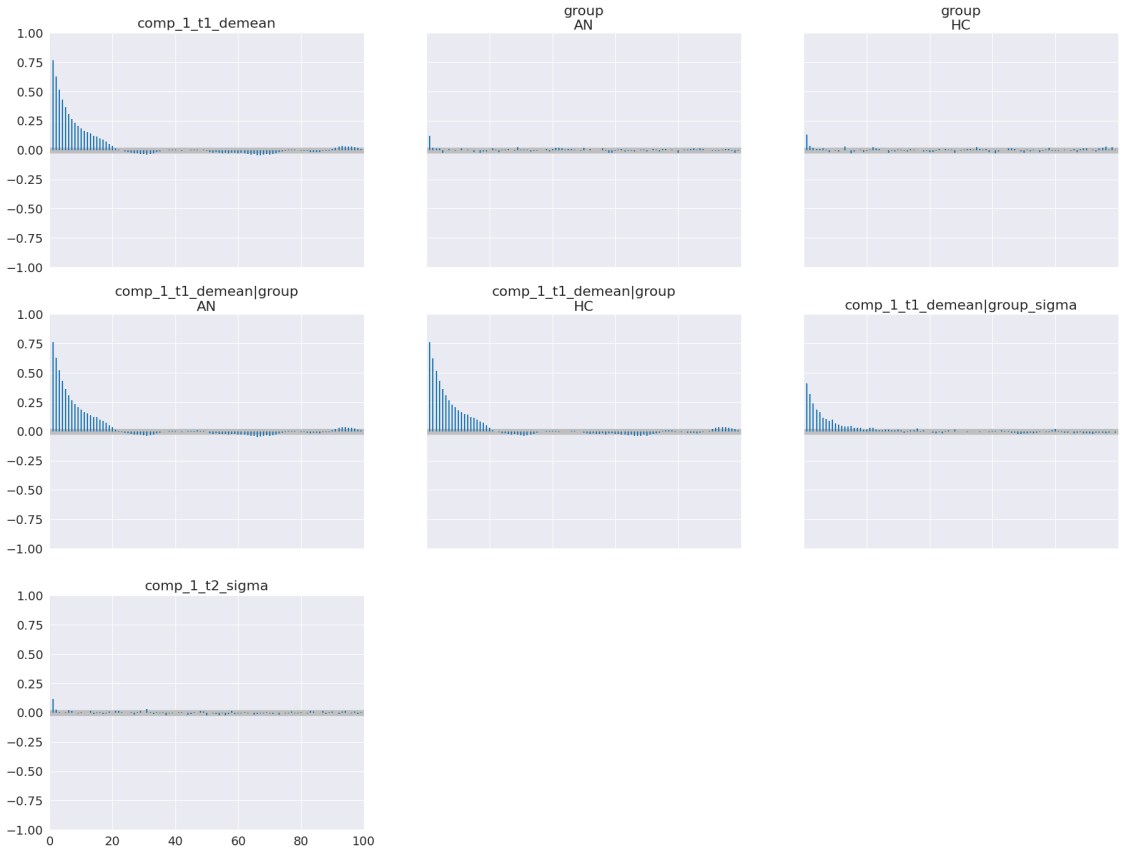

comp_2_t2_sigma
1.2
1.1
1.0
0.9
0.8
0.7
0
250
500
750
1000
1250
1500
1750

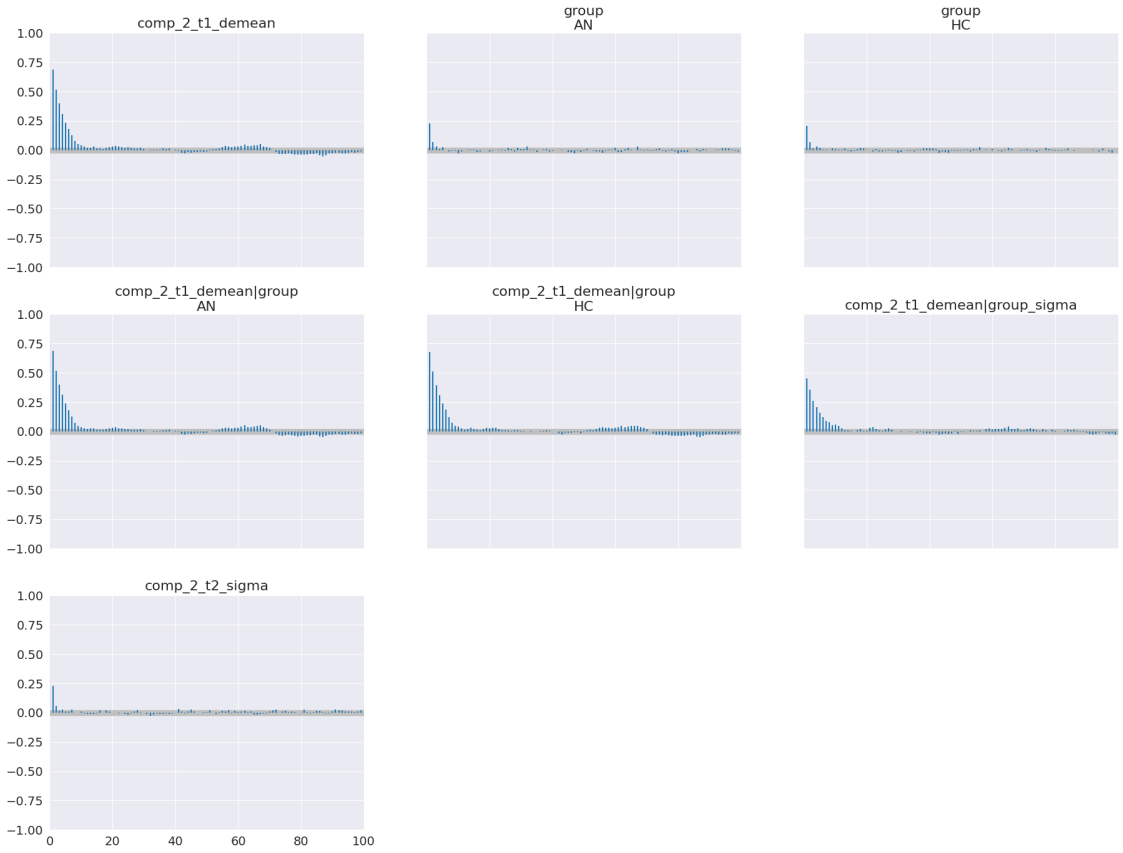


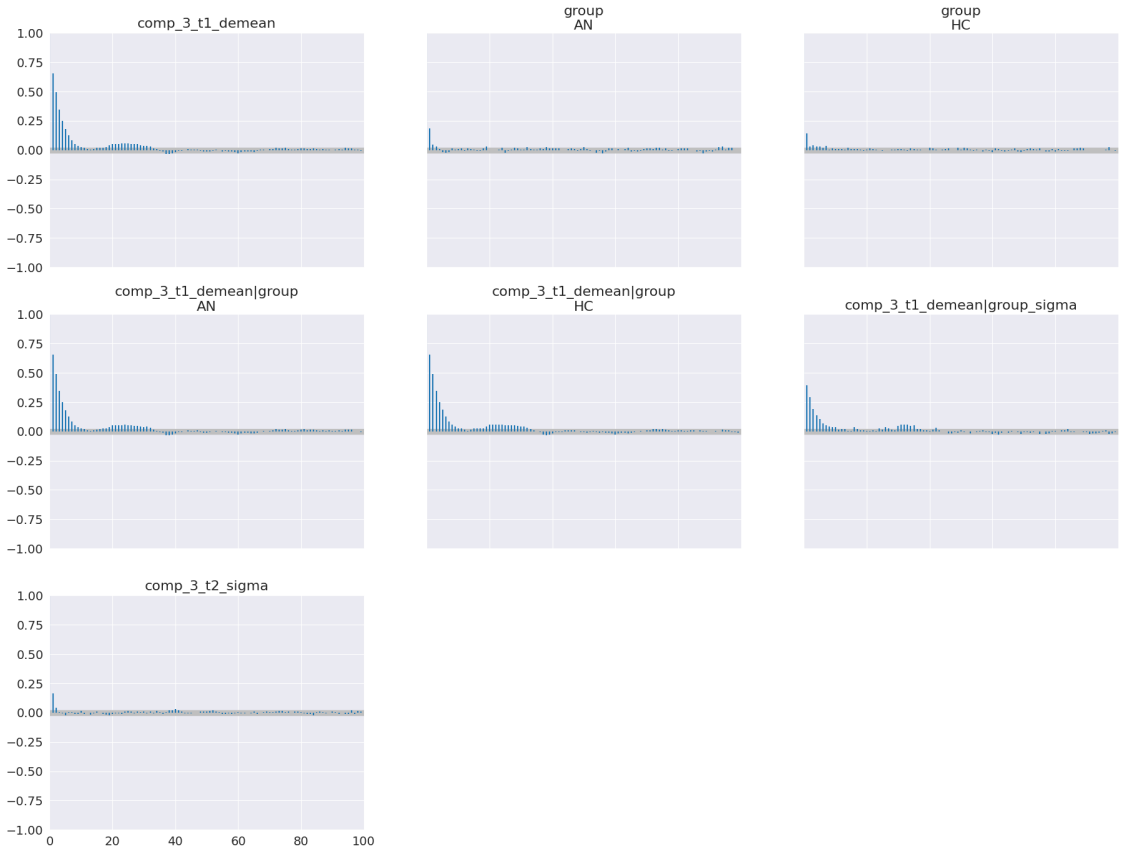
6 Autocorrelation plots

6.1 Autocorrelation plots for the alternative model

[12]:
```
for model in comp:
    az.plot_autocorr(fitted_models['alternative'][model], combined=True)
```

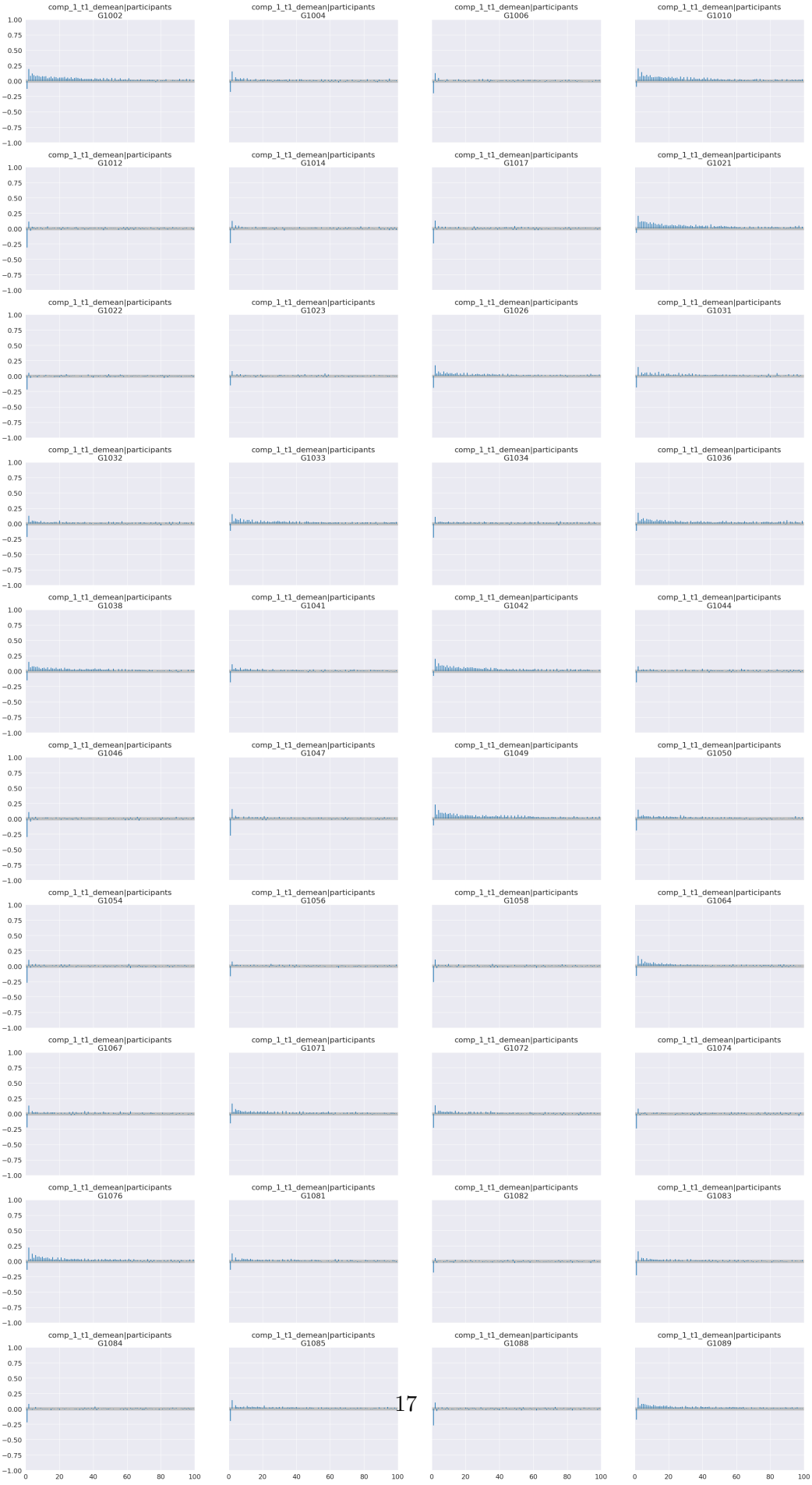

comp_1_t1_demean
group
AN
group
HC
comp_1_t1_demean|group
AN
comp_1_t1_demean|group
HC
comp_1_t1_demean|group_sigma
comp_1_t2_sigma
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
20
40
60
80
100

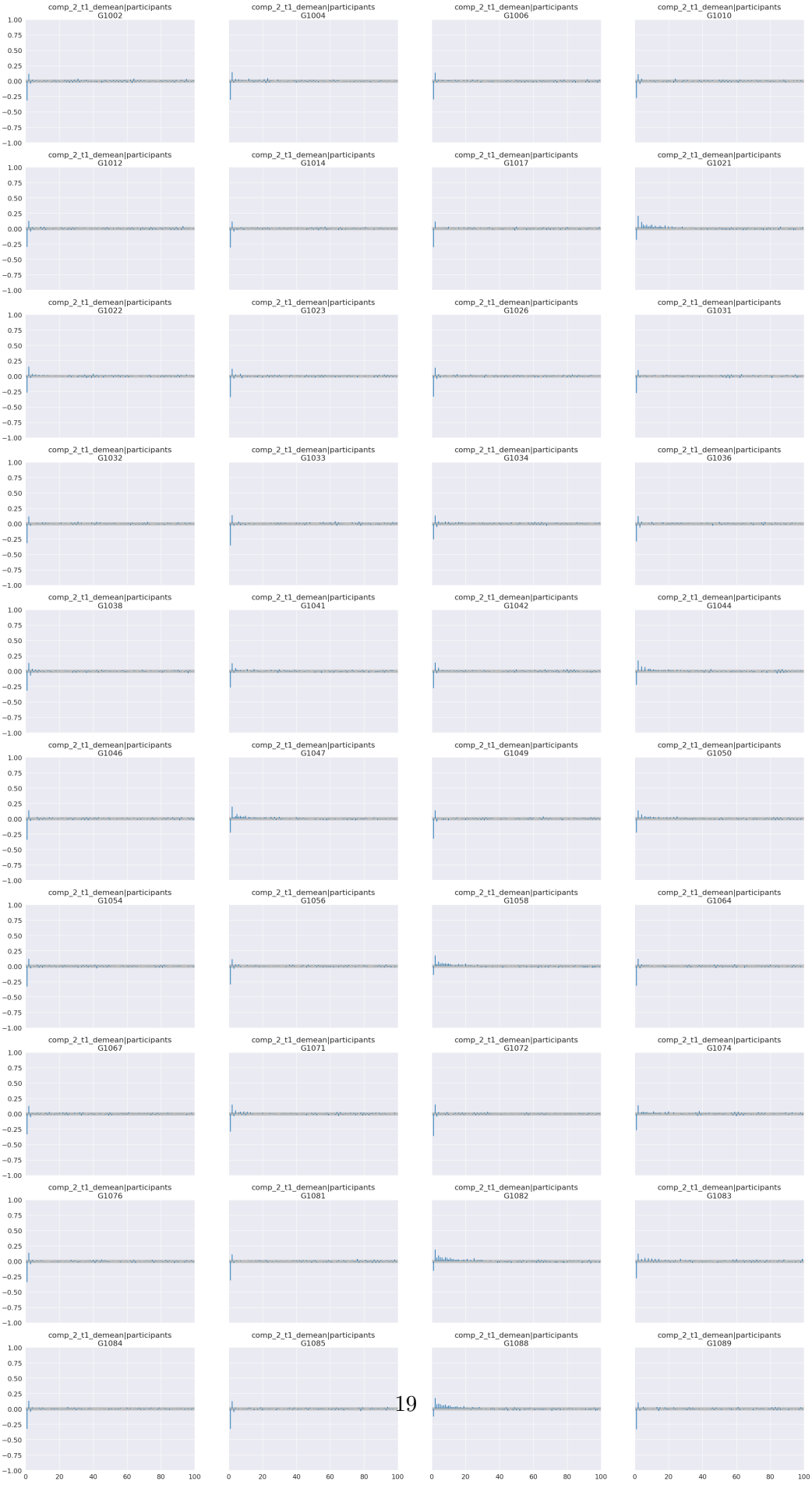

comp_2_t1_demean
group
AN
group
HC
comp_2_t1_demean|group
AN
comp_2_t1_demean|group
HC
comp_2_t1_demean|group_sigma
comp_2_t2_sigma
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
20
40
60
80
100

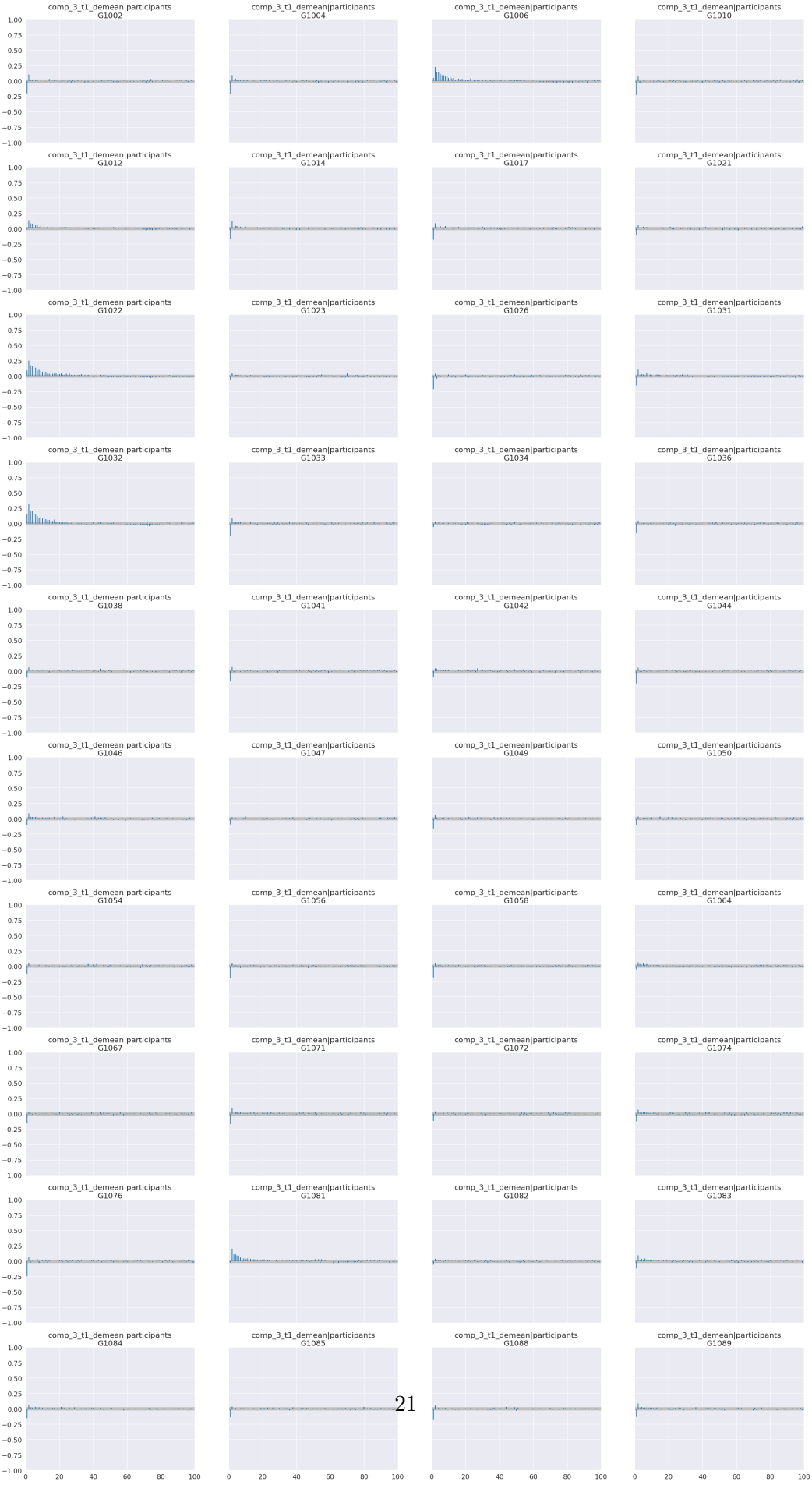


6.2 Autocorrelation plots for null model

[13]:
```
for model in comp:
    az.plot_autocorr(fitted_models['null'][model], combined=True)
```


comp_1_t1_demean|participants
G1002
comp_1_t1_demean|participants
G1004
comp_1_t1_demean|participants
G1006
comp_1_t1_demean|participants
G1010
comp_1_t1_demean|participants
G1012
comp_1_t1_demean|participants
G1014
comp_1_t1_demean|participants
G1017
comp_1_t1_demean|participants
G1021
comp_1_t1_demean|participants
G1022
comp_1_t1_demean|participants
G1023
comp_1_t1_demean|participants
G1026
comp_1_t1_demean|participants
G1031
comp_1_t1_demean|participants
G1032
comp_1_t1_demean|participants
G1033
comp_1_t1_demean|participants
G1034
comp_1_t1_demean|participants
G1036
comp_1_t1_demean|participants
G1038
comp_1_t1_demean|participants
G1041
comp_1_t1_demean|participants
G1042
comp_1_t1_demean|participants
G1044
comp_1_t1_demean|participants
G1046
comp_1_t1_demean|participants
G1047
comp_1_t1_demean|participants
G1049
comp_1_t1_demean|participants
G1050
comp_1_t1_demean|participants
G1054
comp_1_t1_demean|participants
G1056
comp_1_t1_demean|participants
G1058
comp_1_t1_demean|participants
G1064
comp_1_t1_demean|participants
G1067
comp_1_t1_demean|participants
G1071
comp_1_t1_demean|participants
G1072
comp_1_t1_demean|participants
G1074
comp_1_t1_demean|participants
G1076
comp_1_t1_demean|participants
G1081
comp_1_t1_demean|participants
G1082
comp_1_t1_demean|participants
G1083
comp_1_t1_demean|participants
G1084
comp_1_t1_demean|participants
G1085
comp_1_t1_demean|participants
G1088
comp_1_t1_demean|participants
G1089
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
20
40
60
80
100


comp_2_t1_demean|participants
G1002
comp_2_t1_demean|participants
G1004
comp_2_t1_demean|participants
G1006
comp_2_t1_demean|participants
G1010
comp_2_t1_demean|participants
G1012
comp_2_t1_demean|participants
G1014
comp_2_t1_demean|participants
G1017
comp_2_t1_demean|participants
G1021
comp_2_t1_demean|participants
G1022
comp_2_t1_demean|participants
G1023
comp_2_t1_demean|participants
G1026
comp_2_t1_demean|participants
G1031
comp_2_t1_demean|participants
G1032
comp_2_t1_demean|participants
G1033
comp_2_t1_demean|participants
G1034
comp_2_t1_demean|participants
G1036
comp_2_t1_demean|participants
G1038
comp_2_t1_demean|participants
G1041
comp_2_t1_demean|participants
G1042
comp_2_t1_demean|participants
G1044
comp_2_t1_demean|participants
G1046
comp_2_t1_demean|participants
G1047
comp_2_t1_demean|participants
G1049
comp_2_t1_demean|participants
G1050
comp_2_t1_demean|participants
G1054
comp_2_t1_demean|participants
G1056
comp_2_t1_demean|participants
G1058
comp_2_t1_demean|participants
G1064
comp_2_t1_demean|participants
G1067
comp_2_t1_demean|participants
G1071
comp_2_t1_demean|participants
G1072
comp_2_t1_demean|participants
G1074
comp_2_t1_demean|participants
G1076
comp_2_t1_demean|participants
G1081
comp_2_t1_demean|participants
G1082
comp_2_t1_demean|participants
G1083
comp_2_t1_demean|participants
G1084
comp_2_t1_demean|participants
G1085
comp_2_t1_demean|participants
G1088
comp_2_t1_demean|participants
G1089
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
20
40
60
80
100


comp_3_t1_demean|participants
G1002
comp_3_t1_demean|participants
G1004
comp_3_t1_demean|participants
G1006
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G1010
comp_3_t1_demean|participants
G1012
comp_3_t1_demean|participants
G1014
comp_3_t1_demean|participants
G1017
comp_3_t1_demean|participants
G1021
comp_3_t1_demean|participants
G1022
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G1023
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G1026
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G1031
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G1032
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G1033
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G1034
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G1036
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G1038
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G1041
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G1085
comp_3_t1_demean|participants
G1088
comp_3_t1_demean|participants
G1089
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0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
20
40
60
80
100