Assuming you've already ran 'Lineup_Merge.py' and have your progression data in a folder called 'output'

In [1]:
```
import pandas as pd
import os
from pathlib import Path
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
```

Load Data Function

In [8]:
```
teams_list = ['Akron', 'Ball St.', 'Bowling Green', 'Buffalo', 'Central Mich.',
            'Eastern Mich.', 'Kent St.', 'Miami (OH)', 'NIU', 'Ohio',
            'Toledo', 'Western Mich.','Brown', 'Columbia', 'Cornell', 'Dartmouth',
            'Harvard', 'Penn', 'Princeton', 'Yale','Gonzaga', 'LMU (CA)', 'Oregon St.', 'Pacific',
            'Pepperdine', 'Portland', "Saint Mary's (CA)", 'San Diego',
            'San Francisco', 'Santa Clara', 'Washington St.']

CONFERENCE_MAPPING = {
    'MAC': ['Akron', 'Ball St.', 'Bowling Green', 'Buffalo', 'Central Mich.',
            'Eastern Mich.', 'Kent St.', 'Miami (OH)', 'NIU', 'Ohio',
            'Toledo', 'Western Mich.'],
    'IVY': ['Brown', 'Columbia', 'Cornell', 'Dartmouth',
            'Harvard', 'Penn', 'Princeton', 'Yale'],
    'WCC': ['Gonzaga', 'LMU (CA)', 'Oregon St.', 'Pacific',
            'Pepperdine', 'Portland', "Saint Mary's (CA)", 'San Diego',
            'San Francisco', 'Santa Clara', 'Washington St.']
}

def load_all_team_data(teams_list):
    """Load and merge all team progression and top lineup data"""
    # Initialize containers
    all_progression = []
    all_top_lineups = []
    TEAM_TO_CONFERENCE = {}
    for conf, teams in CONFERENCE_MAPPING.items():
        for t in teams:
            TEAM_TO_CONFERENCE[t] = conf
    for team in teams_list:
        # Load progression data
        prog_file = f"output/{team.replace('/', '_')}_progression.csv"  # Handle special chars
        if Path(prog_file).exists():
            prog_df = pd.read_csv(prog_file)
            prog_df['team'] = team
            # Add conference column using mapping
            prog_df['conference'] = TEAM_TO_CONFERENCE.get(team, 'Unknown')
            all_progression.append(prog_df)

        # Load top lineups data
        top_file = f"output/{team.replace('/', '_')}_top_lineups.csv"
        if Path(top_file).exists():
            top_df = pd.read_csv(top_file)
            top_df['team'] = team
            # Add conference column using mapping
            top_df['conference'] = TEAM_TO_CONFERENCE.get(team, 'Unknown')
            all_top_lineups.append(top_df)

    # Combine all data
    combined_progression = pd.concat(all_progression, ignore_index=True)
    #drop 'interval' column if it exists
    if 'interval' in combined_progression.columns:
        combined_progression.drop(columns=['interval'], inplace=True)
    combined_top_lineups = pd.concat(all_top_lineups, ignore_index=True)

    combined_progression.fillna(0, inplace=True)
    combined_top_lineups.fillna(0, inplace=True)

    return combined_progression, combined_top_lineups
```

Load all data

In [9]:
```
combined_progression, combined_top_lineups = load_all_team_data(teams_list)
```

Lineups with more than delta = 50 minutes in any given interval

In [ ]:
```
delta = 50

lineups_over_50_per_interval = combined_progression[combined_progression['minutes'] > delta][['lineup','conf
    by='plusminus_per40', ascending=False
)
```

	lineup	conference	team	interval_num	minutes	plusminus_per40
4605	HTUR-GAND-LCHA-SGLE-EROD	IVY	Harvard	3	68	44.4
6855	MMEE-AMAR-ESHE-MBUR-THUL	WCC	Portland	2	68	36.5
3823	MAVL-KHEN-RWEI-CCOL-SRAF	IVY	Columbia	3	54	24.6
6947	MMEE-AMAR-ESHE-MBUR-THUL	WCC	Portland	3	114	23.8
4991	ACHE-SBEL-OHUT-FTAL-PHIL	IVY	Princeton	1	56	23.6
6750	MMEE-AMAR-ESHE-MBUR-THUL	WCC	Portland	1	88	23.3
6315	AJAM-LSMI-SWAR-EELL-MRAD	WCC	Pacific	2	63	21.7
624	LFLE-AVEL-PKOH-EPOR-KMCG	MAC	Bowling Green	2	67	19.1
8490	EVIL-ATUH-JVIL-DMEN-TWAL	WCC	Washington St.	3	60	18.7
7006	MMEE-AMAR-ESHE-MBUR-THUL	WCC	Portland	4	147	17.7
5163	ACHE-SBEL-OHUT-FTAL-PHIL	IVY	Princeton	3	56	17.2
433	LAUS-ABEC-MBIS-ARIC-MKIE	MAC	Ball St.	3	112	16.4
3621	IMAU-GARN-OYOU-ENEL-GAIE	IVY	Brown	4	78	15.4
7839	LLEI-CFUL-EPOR-DSAN-FWER	WCC	San Francisco	2	68	14.7
6068	KSHU-TBOL-CFER-AMAR-KREE	WCC	Oregon St.	1	56	13.5
951	LCOR-CWAT-KLEW-SGIN-ASEA	MAC	Buffalo	4	62	12.9
1737	DGRA-MBAB-JTYL-JBAT-BDUN	MAC	Kent St.	3	108	12.6
6195	KSHU-TBOL-CFER-AMAR-KREE	WCC	Oregon St.	4	80	11.6
8567	EVIL-ATUH-JVIL-DMEN-TWAL	WCC	Washington St.	4	56	11.4
5248	ACHE-SBEL-OHUT-FTAL-PHIL	IVY	Princeton	4	111	11.2
2134	TSIN-MCHA-EGON-ATRE-KRIC	MAC	Miami (OH)	4	58	10.4
764	LFLE-AVEL-JDON-PKOH-EPOR	MAC	Bowling Green	4	123	10.4
1788	DGRA-MBAB-JTYL-JBAT-BDUN	MAC	Kent St.	4	93	10.3
5593	ATUR-IBET-CO'C-YEJI-MHUI	WCC	Gonzaga	1	74	10.3
1390	JLAW-LTES-MMOR-TAND-ADAR	MAC	Central Mich.	4	57	9.2
807	LCOR-CWAT-THAR-KLEW-ADAV	MAC	Buffalo	1	72	8.9
6461	AJAM-LSMI-SWAR-EELL-MRAD	WCC	Pacific	4	56	8.5
7987	LLEI-CFUL-AKÉI-EPOR-FWER	WCC	San Francisco	4	56	7.9
478	LAUS-ABEC-MBIS-ARIC-MKIE	MAC	Ball St.	4	149	6.4
425	LAUS-ABEC-MBIS-ARIC-MJOH	MAC	Ball St.	3	53	6.1
2049	TSIN-MCHA-EGON-ATRE-IVRI	MAC	Miami (OH)	3	55	5.8
3905	KHEN-RWEI-PPAG-CCOL-SRAF	IVY	Columbia	4	85	5.6
865	LCOR-CWAT-THAR-KLEW-ADAV	MAC	Buffalo	2	78	5.6
1682	DGRA-MBAB-JTYL-JBAT-BDUN	MAC	Kent St.	2	78	5.1
6595	MMAS-MMAS-CSOT-EBRU-MVIC	WCC	Pepperdine	2	55	4.4
1967	TSIN-MCHA-EGON-ATRE-KRIC	MAC	Miami (OH)	3	56	4.3
4029	AKIL-KLAN-CJAC-SPAR-EPAP	IVY	Cornell	1	72	3.9
6526	OMUC-MMAS-MMAS-EBRU-MHAR	WCC	Pepperdine	1	55	3.7
972	LCOR-CWAT-KLEW-SGIN-JBEA	MAC	Buffalo	4	87	3.2
4422	HTUR-GAND-LCHA-SGLE-EROD	IVY	Harvard	1	112	2.9
4749	HTUR-GAND-LCHA-SGLE-EROD	IVY	Harvard	4	68	2.4
690	LFLE-AVEL-JDON-PKOH-EPOR	MAC	Bowling Green	3	69	1.7
5990	BWIL-NEVA-ZOGO-MHER-CHEI	WCC	LMU (CA)	2	60	0.7

	lineup	conference	team	interval_num	minutes	plusminus_per40
1285	JLAW-LTES-MMOR-TAND-ADAR	MAC	Central Mich.	3	73	0.0
3559	IMAU-GARN-AMOR-OYOU-ENEL	IVY	Brown	3	55	0.0
4950	MGAY-SCAL-SSAW-SALM-KCOL	IVY	Penn	4	68	-0.6
1520	OSMI-OWES-BTHR-ECAB-SELE	MAC	Eastern Mich.	3	68	-0.6
3979	AKIL-KLAN-CJAC-RKAU-EPAP	IVY	Cornell	1	56	-0.7
3444	ACAR-MASE-MSTU-HSPI-LAUD	MAC	Western Mich.	4	62	-1.3
4282	VPAG-ZOZE-AELD-OAUS-CMEY	IVY	Dartmouth	3	62	-1.9
6040	BWIL-NEVA-ACLA-MHER-CHEI	WCC	LMU (CA)	4	129	-2.5
3364	ACAR-MASE-MSTU-HSPI-LAUD	MAC	Western Mich.	3	66	-3.0
2371	CKOK-ADOY-LCAR-LNIC-BSTO	MAC	NIU	3	89	-4.5
1429	MAMA-OSMI-OWES-BTHR-SELE	MAC	Eastern Mich.	1	52	-4.6
8150	MNAR-KING-MLAT-HRAP-OPOL	WCC	Santa Clara	3	52	-4.6
5991	BWIL-NEVA-ACLA-MHER-CHEI	WCC	LMU (CA)	3	155	-4.7
3648	KHEN-RWEI-PPAG-CCOL-SRAF	IVY	Columbia	1	101	-4.8
6159	KSHU-TBOL-CFER-AMAR-KREE	WCC	Oregon St.	3	125	-5.4
1616	DGRA-MBAB-JBAT-BDUN-RRIS	MAC	Kent St.	1	53	-6.8
6139	KSHU-TBOL-CFER-AMAR-KREE	WCC	Oregon St.	2	88	-8.2
6029	BWIL-NEVA-ZOGO-MHER-CHEI	WCC	LMU (CA)	3	61	-8.5
2306	CKOK-ADOY-LCAR-BBLU-BSTO	MAC	NIU	2	78	-9.3
289	LAUS-ABEC-MBIS-ESTU-MKIE	MAC	Ball St.	1	69	-9.3
8233	EVIL-ATUH-JVIL-TWAL-ACOV	WCC	Washington St.	1	86	-10.3
6294	AJAM-LSMI-SWAR-EELL-MRAD	WCC	Pacific	1	71	-11.2
5286	ALEE-MCHA-KCAP-MEGG-GTHY	IVY	Yale	1	70	-11.4
7685	ARAN-HRHO-DMOO-KHOR-TREI	WCC	San Diego	3	73	-12.6
7721	ARAN-HRHO-DMOO-KHOR-TREI	WCC	San Diego	4	84	-13.7
4166	VPAG-ZOZE-AELD-OAUS-CMEY	IVY	Dartmouth	1	73	-17.1
1468	MAMA-OSMI-OWES-BTHR-SELE	MAC	Eastern Mich.	2	60	-17.2
6693	MMAS-MMAS-CSOT-EMAS-MVIC	WCC	Pepperdine	3	110	-21.1
2561	GBOW-BTAB-KWAT-ABAX-KDEN	MAC	Ohio	2	54	-22.3
1470	MAMA-OWES-BTHR-ECAB-SELE	MAC	Eastern Mich.	2	68	-24.7
5529	ALEE-MCHA-KCAP-MEGG-GTHY	IVY	Yale	3	61	-24.8
7709	LMCC-ARAN-DMOO-KHOR-TREI	WCC	San Diego	3	58	-26.9

```
Number of distinct teams :  31
```

```
Number of Lineups with over 50 minutes in an interval :  75
```

Lineups with more than delta = 50 minutes in any given interval (sorted by interval)

In [16]:
```
delta = 50

lineups_over_50_per_interval = combined_progression[combined_progression['minutes'] > delta][['lineup', 'tea
    by='interval_num', ascending=True
)


styled = lineups_over_50_per_interval.style.background_gradient(
```

```
    cmap = 'RdYlGn',
    subset = ['plusminus_per40']
).format(
    {
    'plusminus_per40': '{:.1f}',
    'minutes': '{:.0f}'
    }
)
display(styled)

print(lineups_over_50_per_interval.aggregate(
    {
        'minutes': ['mean','std','max']
    }
))
print('Number of distinct teams : ',len(combined_progression['team'].unique()))
print('\n'*2)
print('Number of Lineups with over 50 minutes in an interval : ', len(lineups_over_50_per_interval))
```

	lineup	team	interval_num	minutes	plusminus_per40
289	LAUS-ABEC-MBIS-ESTU-MKIE	Ball St.	1	69	-9.3
4166	VPAG-ZOZE-AELD-OAUS-CMEY	Dartmouth	1	73	-17.1
4029	AKIL-KLAN-CJAC-SPAR-EPAP	Cornell	1	72	3.9
3979	AKIL-KLAN-CJAC-RKAU-EPAP	Cornell	1	56	-0.7
5286	ALEE-MCHA-KCAP-MEGG-GTHY	Yale	1	70	-11.4
3648	KHEN-RWEI-PPAG-CCOL-SRAF	Columbia	1	101	-4.8
5593	ATUR-IBET-CO'C-YEJI-MHUI	Gonzaga	1	74	10.3
6068	KSHU-TBOL-CFER-AMAR-KREE	Oregon St.	1	56	13.5
6294	AJAM-LSMI-SWAR-EELL-MRAD	Pacific	1	71	-11.2
4422	HTUR-GAND-LCHA-SGLE-EROD	Harvard	1	112	2.9
1616	DGRA-MBAB-JBAT-BDUN-RRIS	Kent St.	1	53	-6.8
1429	MAMA-OSMI-OWES-BTHR-SELE	Eastern Mich.	1	52	-4.6
6526	OMUC-MMAS-MMAS-EBRU-MHAR	Pepperdine	1	55	3.7
6750	MMEE-AMAR-ESHE-MBUR-THUL	Portland	1	88	23.3
8233	EVIL-ATUH-JVIL-TWAL-ACOV	Washington St.	1	86	-10.3
807	LCOR-CWAT-THAR-KLEW-ADAV	Buffalo	1	72	8.9
4991	ACHE-SBEL-OHUT-FTAL-PHIL	Princeton	1	56	23.6
6855	MMEE-AMAR-ESHE-MBUR-THUL	Portland	2	68	36.5
1468	MAMA-OSMI-OWES-BTHR-SELE	Eastern Mich.	2	60	-17.2
7839	LLEI-CFUL-EPOR-DSAN-FWER	San Francisco	2	68	14.7
624	LFLE-AVEL-PKOH-EPOR-KMCG	Bowling Green	2	67	19.1
5990	BWIL-NEVA-ZOGO-MHER-CHEI	LMU (CA)	2	60	0.7
6595	MMAS-MMAS-CSOT-EBRU-MVIC	Pepperdine	2	55	4.4
1470	MAMA-OWES-BTHR-ECAB-SELE	Eastern Mich.	2	68	-24.7
2561	GBOW-BTAB-KWAT-ABAX-KDEN	Ohio	2	54	-22.3
6139	KSHU-TBOL-CFER-AMAR-KREE	Oregon St.	2	88	-8.2
865	LCOR-CWAT-THAR-KLEW-ADAV	Buffalo	2	78	5.6
6315	AJAM-LSMI-SWAR-EELL-MRAD	Pacific	2	63	21.7
1682	DGRA-MBAB-JTYL-JBAT-BDUN	Kent St.	2	78	5.1
2306	CKOK-ADOY-LCAR-BBLU-BSTO	NIU	2	78	-9.3
6693	MMAS-MMAS-CSOT-EMAS-MVIC	Pepperdine	3	110	-21.1
6029	BWIL-NEVA-ZOGO-MHER-CHEI	LMU (CA)	3	61	-8.5
6159	KSHU-TBOL-CFER-AMAR-KREE	Oregon St.	3	125	-5.4
7685	ARAN-HRHO-DMOO-KHOR-TREI	San Diego	3	73	-12.6
7709	LMCC-ARAN-DMOO-KHOR-TREI	San Diego	3	58	-26.9
5529	ALEE-MCHA-KCAP-MEGG-GTHY	Yale	3	61	-24.8
6947	MMEE-AMAR-ESHE-MBUR-THUL	Portland	3	114	23.8
8150	MNAR-KING-MLAT-HRAP-OPOL	Santa Clara	3	52	-4.6
5163	ACHE-SBEL-OHUT-FTAL-PHIL	Princeton	3	56	17.2
5991	BWIL-NEVA-ACLA-MHER-CHEI	LMU (CA)	3	155	-4.7
4282	VPAG-ZOZE-AELD-OAUS-CMEY	Dartmouth	3	62	-1.9
1285	JLAW-LTES-MMOR-TAND-ADAR	Central Mich.	3	73	0.0
4605	HTUR-GAND-LCHA-SGLE-EROD	Harvard	3	68	44.4

	lineup	team	interval_num	minutes	plusminus_per40
8490	EVIL-ATUH-JVIL-DMEN-TWAL	Washington St.	3	60	18.7
425	LAUS-ABEC-MBIS-ARIC-MJOH	Ball St.	3	53	6.1
433	LAUS-ABEC-MBIS-ARIC-MKIE	Ball St.	3	112	16.4
3823	MAVL-KHEN-RWEI-CCOL-SRAF	Columbia	3	54	24.6
1520	OSMI-OWES-BTHR-ECAB-SELE	Eastern Mich.	3	68	-0.6
3559	IMAU-GARN-AMOR-OYOU-ENEL	Brown	3	55	0.0
1737	DGRA-MBAB-JTYL-JBAT-BDUN	Kent St.	3	108	12.6
3364	ACAR-MASE-MSTU-HSPI-LAUD	Western Mich.	3	66	-3.0
2371	CKOK-ADOY-LCAR-LNIC-BSTO	NIU	3	89	-4.5
690	LFLE-AVEL-JDON-PKOH-EPOR	Bowling Green	3	69	1.7
2049	TSIN-MCHA-EGON-ATRE-IVRI	Miami (OH)	3	55	5.8
1967	TSIN-MCHA-EGON-ATRE-KRIC	Miami (OH)	3	56	4.3
951	LCOR-CWAT-KLEW-SGIN-ASEA	Buffalo	4	62	12.9
7006	MMEE-AMAR-ESHE-MBUR-THUL	Portland	4	147	17.7
4950	MGAY-SCAL-SSAW-SALM-KCOL	Penn	4	68	-0.6
972	LCOR-CWAT-KLEW-SGIN-JBEA	Buffalo	4	87	3.2
478	LAUS-ABEC-MBIS-ARIC-MKIE	Ball St.	4	149	6.4
7987	LLEI-CFUL-AKÉI-EPOR-FWER	San Francisco	4	56	7.9
764	LFLE-AVEL-JDON-PKOH-EPOR	Bowling Green	4	123	10.4
7721	ARAN-HRHO-DMOO-KHOR-TREI	San Diego	4	84	-13.7
1788	DGRA-MBAB-JTYL-JBAT-BDUN	Kent St.	4	93	10.3
6461	AJAM-LSMI-SWAR-EELL-MRAD	Pacific	4	56	8.5
4749	HTUR-GAND-LCHA-SGLE-EROD	Harvard	4	68	2.4
6195	KSHU-TBOL-CFER-AMAR-KREE	Oregon St.	4	80	11.6
2134	TSIN-MCHA-EGON-ATRE-KRIC	Miami (OH)	4	58	10.4
6040	BWIL-NEVA-ACLA-MHER-CHEI	LMU (CA)	4	129	-2.5
3444	ACAR-MASE-MSTU-HSPI-LAUD	Western Mich.	4	62	-1.3
3621	IMAU-GARN-OYOU-ENEL-GAIE	Brown	4	78	15.4
3905	KHEN-RWEI-PPAG-CCOL-SRAF	Columbia	4	85	5.6
5248	ACHE-SBEL-OHUT-FTAL-PHIL	Princeton	4	111	11.2
1390	JLAW-LTES-MMOR-TAND-ADAR	Central Mich.	4	57	9.2
8567	EVIL-ATUH-JVIL-DMEN-TWAL	Washington St.	4	56	11.4

```
          minutes
mean    76.311200
std     24.733915
max    154.890000
Number of distinct teams :  31


Number of Lineups with over 50 minutes in an interval :  75
```

Team and Lineups with more than 50 minutes played full season

In [18]:
```
# First, compute total minutes per lineup
lineup_total_minutes = (
    combined_progression.groupby(['team', 'lineup'])['minutes']
    .sum()
    .reset_index()
    .rename(columns={'minutes': 'total_minutes'})
```

```
)

# Filter to only lineups that played more than 50 minutes total
full_season_lineups = lineup_total_minutes[lineup_total_minutes['total_minutes'] > delta]

# Count lineups per team
team_full_season_counts = (
    full_season_lineups.groupby('team')
    .size()
    .reset_index(name='num_lineups_over_50')
    .sort_values(by= 'num_lineups_over_50', ascending = True)
)

display(team_full_season_counts)
print('Average number of lineups with more than 50 minutes: ',team_full_season_counts['num_lineups_over_50']
print(team_full_season_counts.aggregate(
    {
        'num_lineups_over_50': ['mean','std','max']
    }
))
```

	team	num_lineups_over_50
29	Western Mich.	1
11	Harvard	1
30	Yale	2
14	Miami (OH)	2
5	Central Mich.	2
16	Ohio	3
13	LMU (CA)	3
12	Kent St.	3
22	Princeton	3
9	Eastern Mich.	3
8	Dartmouth	3
23	Saint Mary's (CA)	3
3	Brown	3
2	Bowling Green	3
24	San Diego	4
25	San Francisco	4
27	Toledo	4
20	Pepperdine	4
19	Penn	4
0	Akron	4
18	Pacific	4
17	Oregon St.	5
21	Portland	5
10	Gonzaga	5
6	Columbia	5
1	Ball St.	5
28	Washington St.	5
15	NIU	6
7	Cornell	7
4	Buffalo	7
26	Santa Clara	8

```
Average number of lineups with more than 50 minutes:  3.9
       num_lineups_over_50
mean              3.903226
std               1.660418
max               8.000000
```

Each Team's Top 2 Lineups (By Plusminus-Per40)

In [19]:
```
# Get top 2 lineups per team by plusminus_per40_mean
top2_per_team = (
    combined_top_lineups
    .sort_values(['team', 'plusminus_per40'], ascending=[True, False])
    .groupby('team')
    .head(2)
    [['team', 'lineup', 'minutes', 'plusminus_per40']]

)

# Style the table
styled_top2 = top2_per_team.style.background_gradient(
    cmap='RdYlGn',
    subset=['plusminus_per40']
).format({
    'plusminus_per40': '{:.1f}',
    'minutes': '{:.0f}',
})

display(styled_top2)
```

	team	lineup	minutes	plusminus_per40
9	Akron	EHAL-AMOB-SBRO-MVEJ-LTAP	33	14.6
5	Akron	EHAL-AMOB-SBRO-MVEJ-NCLA	42	11.4
20	Ball St.	LAUS-ABEC-GKIN-ARIC-MKIE	35	32.3
13	Ball St.	LAUS-ABEC-ARIC-ESTU-MKIE	90	23.2
31	Bowling Green	AVEL-JDON-PKOH-JFEA-EPOR	31	18.1
34	Bowling Green	AVEL-JDON-PKOH-EPOR-KMCG	24	13.5
154	Brown	IMAU-GARN-GPOW-AMOR-GAIE	19	19.3
149	Brown	IMAU-GARN-GPOW-OYOU-GAIE	47	13.7
43	Buffalo	CWAT-PLOP-THAR-KLEW-ADAV	44	41.8
47	Buffalo	LCOR-CWAT-THAR-SGIN-ADAV	31	28.5
55	Central Mich.	JLAW-LTES-MMOR-TAND-TJOH	26	23.3
54	Central Mich.	JMOS-LTES-MMOR-DPRE-ADAR	22	12.6
165	Columbia	KHEN-RWEI-PPAG-CCOL-MARR	23	38.6
166	Columbia	KHEN-RWEI-CCOL-MARR-SRAF	22	31.6
174	Cornell	AKIL-PENG-CJAC-SPAR-RKAU	54	8.9
172	Cornell	AKIL-KLAN-CJAC-SPAR-EPAP	80	-1.0
185	Dartmouth	NMIN-TMUH-VPAG-OAUS-CMEY	37	19.7
191	Dartmouth	NMIN-SCAR-VPAG-CMAC-DARI	16	5.1
65	Eastern Mich.	MAMA-OSMI-KLEW-OWES-SELE	36	6.7
62	Eastern Mich.	OSMI-OWES-BTHR-ECAB-SELE	87	-0.5
242	Gonzaga	ATUR-TDAL-CO'C-YEJI-ELIT	87	30.4
250	Gonzaga	ATUR-IBET-YEJI-BSAL-ELIT	27	28.1
194	Harvard	AROC-HTUR-GAND-LCHA-EROD	43	49.9
195	Harvard	KWHI-HTUR-GAND-SGLE-EROD	44	42.2
77	Kent St.	MMUR-MBAB-JTYL-JBAT-BDUN	28	26.7
83	Kent St.	DGRA-JHIL-JBAT-BDUN-RRIS	27	17.6
261	LMU (CA)	BWIL-NEVA-ACLA-AMAT-MHER	25	45.5
262	LMU (CA)	BWIL-NEVA-MWAT-MHER-CHEI	17	16.7
94	Miami (OH)	TSIN-MCHA-EGON-CJAC-ATRE	19	42.2
89	Miami (OH)	TSIN-MCHA-CLAR-EGON-ATRE	33	29.3
106	NIU	ADOY-LCAR-SMCC-BBLU-LNIC	23	59.9
98	NIU	CKOK-ADOY-LCAR-SMCC-BSTO	81	19.4
114	Ohio	AJON-BTAB-KWAT-ABAX-AMCW	21	11.5
112	Ohio	AJON-BTAB-ABAX-AMCW-KDEN	38	1.1
273	Oregon St.	ASCH-KSHU-TBOL-CFER-KREE	33	16.8
275	Oregon St.	ASCH-KSHU-TBOL-CFER-SHEI	33	13.2
278	Pacific	AJAM-LSMI-NLOW-EELL-LGLA	60	6.0
276	Pacific	AJAM-LSMI-SWAR-EELL-MRAD	231	5.4
214	Penn	ATAM-MGAY-SCAL-SALM-KCOL	19	17.2
213	Penn	SCAL-LGRO-SSAW-SALM-KCOL	15	13.1
297	Pepperdine	MMAS-MMAS-CSOT-HFRI-MVIC	28	25.3
299	Pepperdine	OMUC-MMAS-CSOT-EBRU-MVIC	25	17.8
307	Portland	RMOG-AMAR-ESHE-MBUR-LSPE	40	48.6

	team	lineup	minutes	plusminus_per40
300	Portland	MMEE-AMAR-ESHE-MBUR-THUL	417	23.6
225	Princeton	ANWO-AOSG-KTHI-PMOR-PHIL	18	49.9
222	Princeton	ACHE-SBEL-TNWE-FTAL-KTHI	26	20.4
318	Saint Mary's (CA)	JHUN-MJON-KJOH-ASHO-EFOY	25	29.9
316	Saint Mary's (CA)	MJON-ZAOK-KJOH-EFOY-MAFE	28	20.1
335	San Diego	LMCC-ARAN-KHOR-MTHA-CWRI	16	41.0
328	San Diego	ARAN-HRHO-JRHO-KHOR-TREI	48	15.7
341	San Francisco	EPAP-EPOR-AZIA-DSAN-FWER	37	30.1
342	San Francisco	LLEI-EPOR-AZIA-DSAN-FWER	29	25.2
357	Santa Clara	MNAR-MLAT-MCUR-AGOO-OPOL	39	22.9
359	Santa Clara	KING-MLAT-MCUR-AGOO-OPOL	29	17.9
130	Toledo	KCAR-KGOS-SMIK-FFED-JCOO	19	37.0
125	Toledo	DROB-KGOS-SMIK-FFED-NGAR	38	24.3
365	Washington St.	EVIL-ATUH-CABR-JVIL-TWAL	37	30.1
367	Washington St.	EVIL-ATUH-MALS-DMEN-TWAL	26	21.4
142	Western Mich.	ACAR-MASE-MSTU-HSPI-DBOL	22	30.6
133	Western Mich.	ACAR-MASE-AKOU-HSPI-LAUD	47	8.5
237	Yale	MCHA-CMOO-KCAP-MEGG-MSCH	15	30.3
231	Yale	ALEE-MCHA-KODU-MEGG-AGUI	23	24.3

Get top 2 lineups per team by plusminus_per40, but only for lineups with at least 50 minutes played

In [21]:
```
# Get top 2 lineups per team by plusminus_per40, but only for lineups with at least 50 minutes played

min_minutes = 50

top2_per_team_50min = (
    combined_top_lineups[combined_top_lineups['minutes'] >= min_minutes]
    .sort_values(['team', 'plusminus_per40'], ascending=[True, False])
    .groupby('team')
    .head(2)
    [['team', 'lineup', 'minutes', 'plusminus_per40']]
)

# Style the table for better visualization
styled_top2_50min = top2_per_team_50min.style.background_gradient(
    cmap='RdYlGn',
    subset=['plusminus_per40']
).format({
    'plusminus_per40': '{:.1f}',
    'minutes': '{:.0f}',
})

display(styled_top2_50min)
```

	team	lineup	minutes	plusminus_per40
0	Akron	EHAL-AMOB-ZRAS-SBRO-NCLA	80	0.0
1	Akron	EHAL-ZRAS-SBRO-MVEJ-NCLA	80	-3.5
13	Ball St.	LAUS-ABEC-ARIC-ESTU-MKIE	90	23.2
12	Ball St.	LAUS-ABEC-MBIS-ARIC-MKIE	279	10.0
25	Bowling Green	LFLE-AVEL-PKOH-EPOR-KMCG	134	11.7
24	Bowling Green	LFLE-AVEL-JDON-PKOH-EPOR	197	6.9
144	Brown	IMAU-GARN-OYOU-ENEL-GAIE	103	8.9
146	Brown	IMAU-GARN-AMOR-OYOU-ENEL	57	1.4
38	Buffalo	LCOR-CWAT-THAR-KLEW-JBEA	104	18.0
40	Buffalo	LCOR-CWAT-THAR-KLEW-ASEA	97	16.9
48	Central Mich.	JLAW-LTES-MMOR-TAND-ADAR	163	2.2
49	Central Mich.	JLAW-LTES-MMOR-DPRE-ADAR	66	-3.0
160	Columbia	MBRO-KHEN-RWEI-CCOL-SRAF	52	20.9
157	Columbia	MAVL-KHEN-RWEI-CCOL-SRAF	136	17.7
174	Cornell	AKIL-PENG-CJAC-SPAR-RKAU	54	8.9
172	Cornell	AKIL-KLAN-CJAC-SPAR-EPAP	80	-1.0
180	Dartmouth	VPAG-ZOZE-AELD-OAUS-CMEY	181	-9.7
181	Dartmouth	VPAG-ZOZE-AELD-CMAC-OAUS	73	-15.3
62	Eastern Mich.	OSMI-OWES-BTHR-ECAB-SELE	87	-0.5
60	Eastern Mich.	MAMA-OSMI-OWES-BTHR-SELE	184	-11.1
242	Gonzaga	ATUR-TDAL-CO'C-YEJI-ELIT	87	30.4
244	Gonzaga	ATUR-IBET-YEJI-ELIT-MHUI	54	20.0
192	Harvard	HTUR-GAND-LCHA-SGLE-EROD	269	14.8
74	Kent St.	DGRA-MBAB-TTHO-JBAT-BDUN	89	15.2
72	Kent St.	DGRA-MBAB-JTYL-JBAT-BDUN	286	10.1
253	LMU (CA)	BWIL-NEVA-ZOGO-MHER-CHEI	189	-1.9
252	LMU (CA)	BWIL-NEVA-ACLA-MHER-CHEI	318	-4.9
85	Miami (OH)	TSIN-MCHA-EGON-ATRE-KRIC	171	11.5
84	Miami (OH)	TSIN-MCHA-EGON-ATRE-IVRI	171	2.6
98	NIU	CKOK-ADOY-LCAR-SMCC-BSTO	81	19.4
102	NIU	CKOK-ADOY-SMCC-LNIC-BSTO	51	-4.7
108	Ohio	AJON-BTAB-KWAT-ABAX-KDEN	87	-22.6
110	Ohio	AJON-BTAB-KWAT-AMCW-KDEN	53	-22.6
266	Oregon St.	ASCH-KSHU-AMAR-KREE-SHEI	124	5.8
264	Oregon St.	KSHU-TBOL-CFER-AMAR-KREE	349	0.8
278	Pacific	AJAM-LSMI-NLOW-EELL-LGLA	60	6.0
276	Pacific	AJAM-LSMI-SWAR-EELL-MRAD	231	5.4
204	Penn	MGAY-SCAL-SSAW-SALM-KCOL	198	9.1
206	Penn	MGAY-SCAL-SMIL-SALM-KCOL	90	-4.9
291	Pepperdine	OMUC-MMAS-MMAS-EBRU-MHAR	74	0.0
290	Pepperdine	MMAS-MMAS-CSOT-EBRU-MHAR	72	-0.6
300	Portland	MMEE-AMAR-ESHE-MBUR-THUL	417	23.6
304	Portland	RMOG-AMAR-ESHE-MBUR-THUL	51	20.2

	team	lineup	minutes	plusminus_per40
218	Princeton	ACHE-SBEL-TNWE-FTAL-PHIL	81	19.4
216	Princeton	ACHE-SBEL-OHUT-FTAL-PHIL	263	17.6
313	Saint Mary's (CA)	JHUN-MJON-ZAOK-KJOH-ASHO	57	17.5
314	Saint Mary's (CA)	MJON-KJOH-ASHO-EFOY-MAFE	51	10.2
327	San Diego	ARAN-HRHO-KHOR-MTHA-TREI	67	-1.8
325	San Diego	LMCC-ARAN-KHOR-CWRI-TREI	75	-9.6
338	San Francisco	LLEI-CFUL-EPOR-DSAN-FWER	74	15.1
337	San Francisco	LLEI-CFUL-AKÉI-EPOR-FWER	106	12.1
354	Santa Clara	MNAR-KING-HRAP-AGOO-OPOL	51	17.2
352	Santa Clara	MNAR-KING-HRAP-OPOL-GGRI	62	8.4
123	Toledo	DROB-KCAR-KGOS-SMIK-JCOO	70	24.1
121	Toledo	KCAR-CDYK-KGOS-SMIK-NGAR	88	18.6
361	Washington St.	EVIL-ATUH-JVIL-DMEN-TWAL	157	15.0
364	Washington St.	EVIL-ATUH-CABR-DMEN-TWAL	55	10.2
132	Western Mich.	ACAR-MASE-MSTU-HSPI-LAUD	173	0.5
228	Yale	ALEE-MCHA-KCAP-MEGG-GTHY	165	-12.6
229	Yale	ALEE-MCHA-CMOO-KCAP-MEGG	54	-17.2

Conference-Wide Analysis Pipeline

In [50]:
```
import numpy as np
def analyze_conference(progression_df, top_lineups_df):
    """Complete analysis pipeline for WCC"""
    # 1. Filter to only include top lineups from each team
    top_lineup_names = top_lineups_df.groupby('team')['lineup'].unique()
    progression_top = progression_df[
        progression_df.apply(lambda x: x['lineup'] in top_lineup_names[x['team']], axis=1)
    ]

    # 2. Calculate stability metrics with weighted stats
    def weighted_mean(df):
        return np.average(df['plusminus_per40'],weights = df['minutes'])
    def weighted_std(df):
        avg = weighted_mean(df)
        variance = np.average((df['plusminus_per40'] - avg) ** 2, weights=df['minutes'])
        return np.sqrt(variance)

    stability_stats = progression_top.groupby(['team', 'lineup'],group_keys = False).apply(
        lambda x : pd.Series({
            'minutes_sum': x['minutes'].sum(),
            'minutes_count': len(x),
            'minutes_std': x['minutes'].std(),
            'plusminus_per40_mean': weighted_mean(x),
            'plusminus_per40_std': weighted_std(x),
            'netrating_mean': np.average(x['netrating'], weights=x['minutes']),
            'netrating_std': np.sqrt(np.average((x['netrating']-np.average(x['netrating'], weights=x['minute
                                                weights=x['minutes']))
        })
    ).reset_index()

    # Flatten multi-index columns
   # stability_stats.columns = ['_'.join(col).strip('_') if isinstance(col, tuple) else col for col in stabi

    # 3. Calculate coefficient of variation
    stability_stats['plusminus_per40_cv'] = (stability_stats['plusminus_per40_std'] /
                                        stability_stats['plusminus_per40_mean']).abs().fillna(0)
    stability_stats['netrating_cv'] = (stability_stats['netrating_std'] /
                                       stability_stats['netrating_mean']).abs().fillna(0)
```

```
    # 4. Determine minimum sample sizes
    min_samples = []
    for (team, lineup), group in progression_top.groupby(['team', 'lineup']):
        # Calculate PROPER cumulative plusminus_per40
        cum_minutes = group['minutes'].cumsum()
        cum_plusminus = group['plusminus'].cumsum()
        cum_p40 = (cum_plusminus/cum_minutes)*40

        # Check for stabilization
        stabilized = False
        # Iterate through cumulative minutes and p40
        for i in range(1, len(cum_minutes)):
            if abs(cum_p40.iloc[i] - cum_p40.iloc[i-1]) < 5 and abs(cum_minutes.iloc[i]-cum_minutes.iloc[i-1
                min_samples.append({
                    'team': team,
                    'lineup': lineup,
                    'stabilized_at': cum_minutes.iloc[i],
                    'stabilized_p40': cum_p40.iloc[i],
                    'final_plusminus_per40': (group['plusminus'].sum() / group['minutes'].sum()) * 40,
                    'total_minutes': cum_minutes.iloc[-1]
                })
                stabilized = True
                #print(f"Stabilized: {team} - {lineup} at {cum_minutes.iloc[i]} minutes with net rating {cum
                break



        min_samples_df = pd.DataFrame(min_samples)
    # Calculate % of lineups that stabilized
    num_stabilized = len(min_samples)
    num_total = stability_stats.shape[0]
    percent_stabilized = round(100 * num_stabilized / num_total, 2)
    print(f"Percentage of lineups that stabilized: {percent_stabilized}%")

    return stability_stats, min_samples_df
```

Run analysis pipeline - Min_Samples Table

In [51]:
```
stability_stats, min_samples = analyze_conference(combined_progression, combined_top_lineups)
numerical_cols = stability_stats.select_dtypes(include=['float64']).columns
stability_stats[numerical_cols] = stability_stats[numerical_cols].round(2)

numerical_cols = min_samples.select_dtypes(include=['float64']).columns
min_samples[numerical_cols] = min_samples[numerical_cols].round(2)
display(min_samples)
#print('\n',min_samples.iloc[149])
```

```
Percentage of lineups that stabilized: 56.45%
/Library/Frameworks/Python.framework/Versions/3.12/lib/python3.12/site-packages/numpy/lib/_function_base_imp
l.py:578: RuntimeWarning: invalid value encountered in multiply
  avg = avg_as_array = np.multiply(a, wgt,
/var/folders/qh/zhr4gq8s5px2ff46zwfdk90hy3y30j/T/ipykernel_59306/2539824208.py:18: DeprecationWarning: DataFr
ameGroupBy.apply operated on the grouping columns. This behavior is deprecated, and in a future version of pa
ndas the grouping columns will be excluded from the operation. Either pass `include_groups=False` to exclude
the groupings or explicitly select the grouping columns after groupby to silence this warning.
  stability_stats = progression_top.groupby(['team', 'lineup'],group_keys = False).apply(
```

	team	lineup	stabilized_at	stabilized_p40	final_plusminus_per40	total_minutes
0	Akron	EHAL-AMOB-SBRO-MVEJ-NCLA	42.13	11.39	11.39	42.13
1	Akron	EHAL-AMOB-ZRAS-MVEJ-NCLA	47.51	-25.26	-25.26	47.51
2	Akron	EHAL-AMOB-ZRAS-SBRO-LTAP	50.36	-6.35	-8.22	72.95
3	Akron	EHAL-AMOB-ZRAS-SBRO-NCLA	49.15	-4.07	0.00	79.56
4	Akron	EHAL-ZRAS-SBRO-MVEJ-LTAP	36.08	9.98	9.98	36.08
...	...	...	...	...	...	...
205	Western Mich.	MWAG-MASE-AKOU-HSPI-ECAR	22.97	-24.38	-24.38	22.97
206	Yale	ALEE-CMOO-KODU-MEGG-AGUI	17.82	-13.47	-13.47	17.82
207	Yale	ALEE-KCAP-KODU-MEGG-GTHY	24.21	-19.83	-18.79	29.81
208	Yale	ALEE-MCHA-CMOO-KCAP-MEGG	53.54	-17.18	-17.18	53.54
209	Yale	ALEE-MCHA-KCAP-MEGG-AGUI	21.06	11.40	11.40	21.06

210 rows × 6 columns

In case you want to reference the progression stats

In [35]:
```
display(combined_progression)

#print('\n',combined_progression.iloc[5075])
#print('\n',combined_progression.iloc[5093])
#print('\n',combined_progression.iloc[5222])
#print('\n',combined_progression.iloc[5249])
```

	lineup	interval_num	possessions	minutes	plusminus_per40	netrating	plusminus	team	conference
0	EHAL-AMOB-SBRO-MVEJ-NCLA	1	1.56	0.82	0.00	0.00	0	Akron	MAC
1	KRHO-ZRAS-TCLA-SBRO-LTAP	1	7.40	3.83	-20.89	-27.03	-2	Akron	MAC
2	KRHO-ZRAS-TCLA-MVEJ-LTAP	1	10.20	5.97	-53.60	-78.47	-8	Akron	MAC
3	EHAL-ZRAS-TCLA-SBRO-NCLA	1	0.40	0.00	inf	500.00	2	Akron	MAC
4	EHAL-ZRAS-SBRO-MVEJ-LTAP	1	0.40	0.27	296.30	500.00	2	Akron	MAC
...	...	...	...	...	...	...	...	...	...
8565	EVIL-MALS-CABR-JVIL-DMEN	4	6.50	3.82	41.88	61.54	4	Washington St.	WCC
8566	EVIL-ATUH-CABR-JVIL-TWAL	4	17.73	10.16	66.93	95.87	17	Washington St.	WCC
8567	EVIL-ATUH-JVIL-DMEN-TWAL	4	97.80	56.27	11.37	16.36	16	Washington St.	WCC
8568	ATUH-KGAR-CABR-JVIL-TWAL	4	9.29	5.65	0.00	0.00	0	Washington St.	WCC
8569	EVIL-ATUH-MALS-TWAL-ACOV	4	9.43	6.14	32.57	53.02	5	Washington St.	WCC

8570 rows × 9 columns

In case you want to reference top_lineup stats

In [36]:
```
display(combined_top_lineups)
```

	lineup	possessions	minutes	plusminus	plusminus_per40	netrating	offrating	defrating	team	conference
0	EHAL-AMOB-ZRAS-SBRO-NCLA	134.63	79.56	0	0.00	0.00	89.14	89.14	Akron	MAC
1	EHAL-ZRAS-SBRO-MVEJ-NCLA	131.04	80.24	-7	-3.49	-5.34	84.71	90.05	Akron	MAC
2	EHAL-AMOB-ZRAS-SBRO-LTAP	124.94	72.95	-15	-8.22	-12.01	87.25	99.25	Akron	MAC
3	EHAL-AMOB-ZRAS-MVEJ-LTAP	94.88	54.97	-32	-23.29	-33.73	95.91	129.64	Akron	MAC
4	EHAL-AMOB-ZRAS-MVEJ-NCLA	82.41	47.51	-30	-25.26	-36.41	61.89	98.29	Akron	MAC
...	...	...	...	...	...	...	...	...	...	...
367	EVIL-ATUH-MALS-DMEN-TWAL	43.34	26.22	14	21.36	32.30	129.20	96.90	Washington St.	WCC
368	EVIL-ATUH-MALS-TWAL-ACOV	40.52	24.84	-1	-1.61	-2.47	96.24	98.71	Washington St.	WCC
369	EVIL-KGAR-CABR-DMEN-TWAL	31.01	18.33	5	10.91	16.12	99.97	83.85	Washington St.	WCC
370	ATUH-CABR-JVIL-TWAL-ACOV	29.90	16.34	-4	-9.79	-13.38	70.23	83.61	Washington St.	WCC
371	EVIL-ATUH-KGAR-TWAL-ACOV	28.80	18.53	6	12.95	20.84	100.71	79.87	Washington St.	WCC

372 rows × 10 columns

Let's Look at lineups stabilized with at least 35 minutes and the DIFF between stabilized p40 and final_p40

In [38]:
```
min_samples35 = min_samples[min_samples['stabilized_at']>35]
min_samples35['p40_diff'] = min_samples35['final_plusminus_per40'] - min_samples35['stabilized_p40']
min_samples35['p40_diff'] = min_samples35['p40_diff'].round(2)
display(min_samples35.sort_values(by='total_minutes',ascending = False))
print(min_samples35.aggregate(
    {'p40_diff':['mean','std','max']
    }
))
```

```
/var/folders/qh/zhr4gq8s5px2ff46zwfdk90hy3y30j/T/ipykernel_59306/2806793756.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  min_samples35['p40_diff'] = min_samples35['final_plusminus_per40'] - min_samples35['stabilized_p40']
/var/folders/qh/zhr4gq8s5px2ff46zwfdk90hy3y30j/T/ipykernel_59306/2806793756.py:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  min_samples35['p40_diff'] = min_samples35['p40_diff'].round(2)
```

	team	lineup	stabilized_at	stabilized_p40	final_plusminus_per40	total_minutes	p40_diff
141	Portland	MMEE-AMAR-ESHE-MBUR-THUL	269.88	26.83	23.62	416.59	-3.21
113	Oregon St.	KSHU-TBOL-CFER-AMAR-KREE	269.14	-2.38	0.80	348.67	3.18
76	LMU (CA)	BWIL-NEVA-ACLA-MHER-CHEI	317.64	-4.91	-4.91	317.64	0.00
70	Kent St.	DGRA-MBAB-JTYL-JBAT-BDUN	192.89	9.95	10.07	285.89	0.12
64	Harvard	HTUR-GAND-LCHA-SGLE-EROD	132.86	6.02	14.85	269.28	8.83
...	...	...	...	...	...	...	...
4	Akron	EHAL-ZRAS-SBRO-MVEJ-LTAP	36.08	9.98	9.98	36.08	0.00
54	Eastern Mich.	MAMA-OSMI-KLEW-OWES-SELE	35.97	6.67	6.67	35.97	0.00
42	Cornell	AKIL-KLAN-PENG-SPAR-RKAU	35.44	-15.80	-15.80	35.44	0.00
164	San Diego	ARAN-HRHO-JRHO-DMOO-KHOR	35.40	-24.86	-24.86	35.40	0.00
125	Penn	MGAY-SCAL-ASHA-SALM-KCOL	35.23	9.08	9.08	35.23	0.00

108 rows × 7 columns

```
       p40_diff
mean  -0.502500
std    4.480154
max   13.950000
```

Stability Stats

In [39]:
```
display(stability_stats)
```

	team	lineup	minutes_sum	minutes_count	minutes_std	plusminus_per40_mean	plusminus_per40_std	netrating_m
0	Akron	EHAL-AMOB-SBRO-MVEJ-LTAP	32.87	3.0	10.39	14.60	37.92	25
1	Akron	EHAL-AMOB-SBRO-MVEJ-NCLA	42.13	4.0	9.23	11.39	13.26	16
2	Akron	EHAL-AMOB-ZRAS-MVEJ-LTAP	54.97	4.0	10.28	-23.28	44.17	-3
3	Akron	EHAL-AMOB-ZRAS-MVEJ-NCLA	47.51	4.0	7.45	-25.26	29.25	-38
4	Akron	EHAL-AMOB-ZRAS-NCLA-LTAP	28.46	3.0	13.36	2.81	1.06	4
...	...	...	...	...	...	...	...	
367	Yale	ALEE-MCHA-KODU-MEGG-AGUI	23.01	3.0	11.56	24.34	28.37	3
368	Yale	ALON-MCHA-KCAP-MEGG-GTHY	15.10	2.0	7.24	-21.19	19.55	-36
369	Yale	MCHA-CMOO-KCAP-KODU-MEGG	15.75	1.0	NaN	-33.02	0.00	-4
370	Yale	MCHA-CMOO-KCAP-MEGG-MSCH	14.53	2.0	3.44	30.28	13.69	38
371	Yale	MCHA-KCAP-KODU-MEGG-GTHY	23.40	3.0	8.23	-30.77	10.68	-45

372 rows × 11 columns

In case you want to reference progression stats

In [40]:
```
display(combined_progression)
```

	lineup	interval_num	possessions	minutes	plusminus_per40	netrating	plusminus	team	conference
0	EHAL-AMOB-SBRO-MVEJ-NCLA	1	1.56	0.82	0.00	0.00	0	Akron	MAC
1	KRHO-ZRAS-TCLA-SBRO-LTAP	1	7.40	3.83	-20.89	-27.03	-2	Akron	MAC
2	KRHO-ZRAS-TCLA-MVEJ-LTAP	1	10.20	5.97	-53.60	-78.47	-8	Akron	MAC
3	EHAL-ZRAS-TCLA-SBRO-NCLA	1	0.40	0.00	inf	500.00	2	Akron	MAC
4	EHAL-ZRAS-SBRO-MVEJ-LTAP	1	0.40	0.27	296.30	500.00	2	Akron	MAC
...	...	...	...	...	...	...	...	...	...
8565	EVIL-MALS-CABR-JVIL-DMEN	4	6.50	3.82	41.88	61.54	4	Washington St.	WCC
8566	EVIL-ATUH-CABR-JVIL-TWAL	4	17.73	10.16	66.93	95.87	17	Washington St.	WCC
8567	EVIL-ATUH-JVIL-DMEN-TWAL	4	97.80	56.27	11.37	16.36	16	Washington St.	WCC
8568	ATUH-KGAR-CABR-JVIL-TWAL	4	9.29	5.65	0.00	0.00	0	Washington St.	WCC
8569	EVIL-ATUH-MALS-TWAL-ACOV	4	9.43	6.14	32.57	53.02	5	Washington St.	WCC

8570 rows × 9 columns

Generate Key Insights

In [52]:
```
def generate_wcc_insights(stats_df, min_samples_df):
    """Print actionable conference insights"""
    # Conference averages
    # Calculate without extreme values
    q1 = stats_df['plusminus_per40_cv'].quantile(0.25)
    q3 = stats_df['plusminus_per40_cv'].quantile(0.75)
    iqr = q3 - q1
    filtered = stats_df[stats_df['plusminus_per40_cv'] <= (q3 + 1.5*iqr)]
    #print(filtered['plusminus_per40_cv'].median())


    avg_stabilization = min_samples_df['stabilized_at'].median()
    avg_cv = filtered['plusminus_per40_cv'].median()

    print(f"=== WCC Conference Insights ===\n")
    print(f"1. Lineups typically stabilize after {avg_stabilization:.0f} minutes")
    print(f"   - Median coefficient of variation: {avg_cv:.2f}")
```

```
    # Team rankings
    team_stability = filtered.groupby('team')['plusminus_per40_cv'].mean().sort_values()
    print("\n2. Teams by lineup stability (lower CV is better):")
    print(team_stability.round(2))

    # Sample size recommendations
    print("\n3. Evaluation guidelines:")
    print(f"   - <{avg_stabilization:.0f} minutes: Insufficient sample")
    print(f"   - {avg_stabilization:.0f}-100 minutes: Preliminary assessment")
    print("   - 100+ minutes: Reliable evaluation")
```

In [53]:
```
generate_wcc_insights(stability_stats, min_samples)
```

```
=== WCC Conference Insights ===

1. Lineups typically stabilize after 35 minutes
   - Median coefficient of variation: 1.17

2. Teams by lineup stability (lower CV is better):
team
Princeton            0.80
San Francisco        1.01
Buffalo              1.07
Harvard              1.10
San Diego            1.15
Bowling Green        1.19
NIU                  1.22
Miami (OH)           1.26
Ohio                 1.28
Cornell              1.31
Dartmouth            1.36
Akron                1.38
Yale                 1.53
Eastern Mich.        1.54
Saint Mary's (CA)    1.57
Gonzaga              1.60
Santa Clara          1.71
Columbia             1.73
Western Mich.        1.75
Pepperdine           1.81
Ball St.             1.85
Toledo               2.01
Washington St.       2.03
Portland             2.04
Pacific              2.23
Oregon St.           2.27
Brown                2.30
LMU (CA)             2.32
Central Mich.        2.34
Penn                 2.41
Kent St.             2.57
Name: plusminus_per40_cv, dtype: float64

3. Evaluation guidelines:
   - <35 minutes: Insufficient sample
   - 35-100 minutes: Preliminary assessment
   - 100+ minutes: Reliable evaluation
```

"Use" Actionable Insights

Note that there are 372 distinct lineups in this dataset

In [59]:
```
#lineups with more than avg_stabilization minutes played full season sorted by plusminus_per40 and with a cv
avg_stabilization = 35

lineups_over_50_full_season = stability_stats[(stability_stats['minutes_sum'] > avg_stabilization) & (stabil
lineups_over_50_full_season_sorted = lineups_over_50_full_season.sort_values(by='plusminus_per40_mean', asce
styled_full_season_sorted = lineups_over_50_full_season_sorted.style.background_gradient(
    cmap='RdYlGn',
    subset=['plusminus_per40_mean']
). format({
    'plusminus_per40_mean': '{:.1f}',
    'minutes_sum': '{:.0f}',
```

```
    'plusminus_per40_cv': '{:.1f}'
})
display(styled_full_season_sorted)

print("\n Number of lineups in this criteria: ", len(lineups_over_50_full_season))
print("'%' of lineups that meet this criteria", round(len(lineups_over_50_full_season)/372*100,2),'%')
```

	lineup	team	minutes_sum	plusminus_per40_mean	plusminus_per40_cv
132	AROC-HTUR-GAND-LCHA-EROD	Harvard	43	49.9	0.8
262	RMOG-AMAR-ESHE-MBUR-LSPE	Portland	40	48.6	0.8
140	KWHI-HTUR-GAND-SGLE-EROD	Harvard	44	42.2	0.4
50	CWAT-PLOP-THAR-KLEW-ADAV	Buffalo	44	41.8	0.6
127	ATUR-TDAL-CO'C-YEJI-ELIT	Gonzaga	87	30.4	0.1
338	EVIL-ATUH-CABR-JVIL-TWAL	Washington St.	37	30.1	1.0
301	EPAP-EPOR-AZIA-DSAN-FWER	San Francisco	37	30.1	0.8
142	KWHI-HTUR-SGLE-AWRI-EROD	Harvard	47	29.2	0.2
328	DROB-KGOS-SMIK-FFED-NGAR	Toledo	38	24.3	0.4
325	DROB-KCAR-KGOS-SMIK-JCOO	Toledo	70	24.1	1.0
254	MMEE-AMAR-ESHE-MBUR-THUL	Portland	417	23.6	0.3
170	MCHA-CLAR-EGON-ATRE-IVRI	Miami (OH)	45	23.3	0.8
13	LAUS-ABEC-ARIC-ESTU-MKIE	Ball St.	90	23.2	0.7
323	MNAR-MLAT-MCUR-AGOO-OPOL	Santa Clara	39	22.9	0.8
80	MBRO-KHEN-RWEI-CCOL-SRAF	Columbia	52	20.9	1.1
263	RMOG-AMAR-ESHE-MBUR-THUL	Portland	51	20.2	1.2
125	ATUR-IBET-YEJI-ELIT-MHUI	Gonzaga	54	20.0	0.5
99	NMIN-TMUH-VPAG-OAUS-CMEY	Dartmouth	37	19.7	0.9
188	CKOK-ADOY-LCAR-SMCC-BSTO	NIU	81	19.4	0.3
272	ACHE-SBEL-TNWE-FTAL-PHIL	Princeton	81	19.4	0.7
331	KCAR-CDYK-KGOS-SMIK-NGAR	Toledo	88	18.6	0.8
58	LCOR-CWAT-THAR-KLEW-JBEA	Buffalo	104	18.0	0.7
249	OMUC-MMAS-MMAS-EBRU-MVIC	Pepperdine	36	17.8	1.1
76	MAVL-KHEN-RWEI-CCOL-SRAF	Columbia	136	17.7	0.9
269	ACHE-SBEL-OHUT-FTAL-PHIL	Princeton	263	17.6	0.4
277	JHUN-MJON-ZAOK-KJOH-ASHO	Saint Mary's (CA)	57	17.5	0.1
314	MNAR-KING-HRAP-AGOO-OPOL	Santa Clara	51	17.2	1.5
57	LCOR-CWAT-THAR-KLEW-ASEA	Buffalo	97	16.9	0.5
17	LAUS-ABEC-GKIN-MKIE-MJOH	Ball St.	44	16.5	1.9
77	MAVL-KHEN-RWEI-PPAG-CCOL	Columbia	66	16.4	1.2
290	ARAN-HRHO-JRHO-KHOR-TREI	San Diego	48	15.7	1.4
151	DGRA-MBAB-TTHO-JBAT-BDUN	Kent St.	89	15.2	2.0
308	LLEI-CFUL-EPOR-DSAN-FWER	San Francisco	74	15.1	0.1
341	EVIL-ATUH-JVIL-DMEN-TWAL	Washington St.	157	15.0	0.8
133	HTUR-GAND-LCHA-SGLE-EROD	Harvard	269	14.8	1.2
120	ATUR-CO'C-YEJI-ELIT-MHUI	Gonzaga	94	14.4	1.7
253	MMEE-AMAR-ESHE-MBUR-LSPE	Portland	70	13.8	2.3
163	BWIL-NEVA-ZOGO-ASIT-CHEI	LMU (CA)	38	13.8	1.1
44	IMAU-GARN-GPOW-OYOU-GAIE	Brown	47	13.7	0.1
52	LCOR-CWAT-KLEW-SGIN-ASEA	Buffalo	104	13.4	0.2
129	ATUR-TDAL-YEJI-BSAL-ELIT	Gonzaga	42	12.4	0.7
304	LLEI-CFUL-AKÉI-EPOR-FWER	San Francisco	106	12.1	0.9
32	LFLE-AVEL-PKOH-EPOR-KMCG	Bowling Green	134	11.7	1.3

	lineup	team	minutes_sum	plusminus_per40_mean	plusminus_per40_cv
260	MMEE-RMOG-AMAR-MBUR-THUL	Portland	65	11.7	1.9
176	TSIN-MCHA-EGON-ATRE-KRIC	Miami (OH)	171	11.5	0.6
1	EHAL-AMOB-SBRO-MVEJ-NCLA	Akron	42	11.4	1.2
55	LCOR-CWAT-PLOP-KLEW-JBEA	Buffalo	70	10.3	1.8
53	LCOR-CWAT-KLEW-SGIN-JBEA	Buffalo	124	10.3	1.1
326	DROB-KCAR-KGOS-SMIK-NGAR	Toledo	66	10.3	1.6
337	EVIL-ATUH-CABR-DMEN-TWAL	Washington St.	55	10.2	1.9
282	MJON-KJOH-ASHO-EFOY-MAFE	Saint Mary's (CA)	51	10.2	1.8
150	DGRA-MBAB-JTYL-JBAT-BDUN	Kent St.	286	10.1	0.4
20	LAUS-ABEC-MBIS-ARIC-MKIE	Ball St.	279	10.0	0.5
8	EHAL-ZRAS-SBRO-MVEJ-LTAP	Akron	36	10.0	2.8
285	MJON-ZAOK-KJOH-ASHO-EFOY	Saint Mary's (CA)	77	9.3	1.8
122	ATUR-IBET-CO'C-YEJI-MHUI	Gonzaga	101	9.1	0.2
232	MGAY-SCAL-ASHA-SALM-KCOL	Penn	35	9.1	1.2
235	MGAY-SCAL-SSAW-SALM-KCOL	Penn	198	9.1	1.5
19	LAUS-ABEC-MBIS-ARIC-MJOH	Ball St.	76	9.0	0.7
47	IMAU-GARN-OYOU-ENEL-GAIE	Brown	103	8.9	1.4
348	ACAR-MASE-AKOU-HSPI-LAUD	Western Mich.	47	8.5	0.8
14	LAUS-ABEC-ESTU-MKIE-MJOH	Ball St.	47	8.5	2.9
316	MNAR-KING-HRAP-OPOL-GGRI	Santa Clara	62	8.4	2.3
81	MBRO-KHEN-RWEI-PPAG-CCOL	Columbia	58	8.3	2.2
43	IMAU-GARN-GPOW-OYOU-AOFU	Brown	49	8.1	2.6
353	ACAR-MASE-VMOR-HSPI-LAUD	Western Mich.	42	7.6	1.6
22	LAUS-ABEC-MBIS-MKIE-MJOH	Ball St.	74	7.1	1.9
30	LFLE-AVEL-JDON-PKOH-EPOR	Bowling Green	197	6.9	0.7
191	CKOK-LCAR-SMCC-LNIC-BSTO	NIU	47	6.8	0.9
206	ASCH-KSHU-CFER-AMAR-SHEI	Oregon St.	44	6.4	2.4
56	LCOR-CWAT-THAR-KLEW-ADAV	Buffalo	167	6.2	0.6
204	ASCH-KSHU-AMAR-KREE-SHEI	Oregon St.	124	5.8	2.2
256	MMEE-RMOG-AMAR-ESHE-LSPE	Portland	42	5.8	2.8
286	MJON-ZAOK-KJOH-ASHO-MAFE	Saint Mary's (CA)	36	5.5	2.2
33	LFLE-AVEL-PKOH-JFEA-EPOR	Bowling Green	37	5.4	1.2
222	AJAM-LSMI-SWAR-EELL-MRAD	Pacific	231	5.4	2.4
356	ACAR-MWAG-MASE-HSPI-LAUD	Western Mich.	41	3.9	2.6
217	AJAM-LSMI-JKEN-SWAR-MRAD	Pacific	42	3.8	1.2
234	MGAY-SCAL-SMIL-SALM-KCOL	Penn	90	-4.9	2.2
159	BWIL-NEVA-ACLA-MHER-CHEI	LMU (CA)	318	-4.9	1.1
321	MNAR-MLAT-HRAP-AGOO-OPOL	Santa Clara	64	-5.0	2.9
212	KSHU-CFER-AMAR-KREE-SHEI	Oregon St.	42	-5.7	2.4
186	CKOK-ADOY-LCAR-LNIC-BSTO	NIU	144	-6.7	2.4
330	KCAR-CDYK-KGOS-SMIK-JCOO	Toledo	129	-6.8	1.9
205	ASCH-KSHU-CFER-AMAR-KREE	Oregon St.	132	-7.3	1.9
84	AKIL-KLAN-CJAC-RKAU-EPAP	Cornell	82	-7.3	1.9

	lineup	team	minutes_sum	plusminus_per40_mean	plusminus_per40_cv
224	DNES-AJAM-LSMI-SWAR-EELL	Pacific	43	-7.5	1.4
5	EHAL-AMOB-ZRAS-SBRO-LTAP	Akron	73	-8.2	0.7
12	ABEC-MBIS-GKIN-ARIC-MKIE	Ball St.	44	-8.2	2.0
90	AKIL-PENG-CJAC-SPAR-EPAP	Cornell	94	-8.5	0.4
92	KLAN-PENG-CJAC-RKAU-EPAP	Cornell	108	-8.5	1.8
335	KCAR-KGOS-SMIK-FFED-NGAR	Toledo	46	-8.7	2.0
295	LMCC-ARAN-KHOR-CWRI-TREI	San Diego	75	-9.6	1.0
107	VPAG-ZOZE-AELD-OAUS-CMEY	Dartmouth	181	-9.7	0.7
307	LLEI-CFUL-EPOR-AZIA-FWER	San Francisco	110	-10.5	1.3
258	MMEE-RMOG-AMAR-ESHE-THUL	Portland	57	-10.5	2.1
148	DGRA-MBAB-JHIL-JBAT-BDUN	Kent St.	41	-10.6	2.9
288	ARAN-HRHO-DMOO-KHOR-TREI	San Diego	173	-10.8	0.7
139	KWHI-HTUR-GAND-LCHA-EROD	Harvard	36	-11.0	1.1
112	MAMA-OSMI-OWES-BTHR-SELE	Eastern Mich.	184	-11.1	0.6
312	KING-MLAT-HRAP-MCUR-OPOL	Santa Clara	41	-11.6	2.3
215	KSHU-TBOL-CFER-AMAR-SHEI	Oregon St.	76	-12.1	1.6
236	MGAY-SMIL-SSAW-SALM-KCOL	Penn	105	-12.6	0.7
319	MNAR-KING-MLAT-HRAP-OPOL	Santa Clara	134	-12.6	0.5
366	ALEE-MCHA-KCAP-MEGG-GTHY	Yale	165	-12.6	0.9
31	LFLE-AVEL-JDON-PKOH-TELL	Bowling Green	71	-12.9	0.2
116	MAMA-OWES-BTHR-ECAB-SELE	Eastern Mich.	116	-13.1	1.2
243	MMAS-MMAS-CSOT-EMAS-MVIC	Pepperdine	154	-13.2	1.0
185	CKOK-ADOY-LCAR-BBLU-LNIC	NIU	50	-13.5	0.6
231	MGAY-LGRO-SSAW-SALM-KCOL	Penn	86	-13.5	2.5
184	CKOK-ADOY-LCAR-BBLU-BSTO	NIU	102	-14.9	2.3
103	NMIN-VPAG-ZOZE-CMAC-OAUS	Dartmouth	43	-14.9	2.4
157	BWIL-NEVA-ACLA-ASIT-CHEI	LMU (CA)	70	-15.0	1.5
106	VPAG-ZOZE-AELD-CMAC-OAUS	Dartmouth	73	-15.3	1.5
181	ADOY-LCAR-SMCC-LNIC-BSTO	NIU	60	-15.4	0.6
88	AKIL-KLAN-PENG-SPAR-RKAU	Cornell	35	-15.8	0.6
42	IMAU-GARN-GPOW-AMOR-OYOU	Brown	64	-16.2	0.8
93	KLAN-PENG-CJAC-SPAR-EPAP	Cornell	101	-16.2	0.9
339	EVIL-ATUH-CABR-TWAL-ACOV	Washington St.	41	-16.8	1.2
220	AJAM-LSMI-NLOW-SWAR-LGLA	Pacific	52	-17.0	0.9
364	ALEE-MCHA-CMOO-KCAP-MEGG	Yale	54	-17.2	1.8
242	MMAS-MMAS-CSOT-EMAS-MHAR	Pepperdine	47	-17.7	1.0
197	BTAB-KWAT-ABAX-AMCW-KDEN	Ohio	47	-17.8	1.1
294	LMCC-ARAN-DMOO-KHOR-TREI	San Diego	75	-18.2	0.9
270	ACHE-SBEL-OHUT-FTAL-TAMA	Princeton	36	-18.9	2.0
178	TSIN-MCHA-EGON-KRIC-IVRI	Miami (OH)	36	-19.1	1.7
318	MNAR-KING-MLAT-AGOO-OPOL	Santa Clara	96	-20.0	0.6
118	OSMI-KLEW-OWES-BTHR-SELE	Eastern Mich.	42	-20.0	0.7
104	NMIN-VPAG-ZOZE-OAUS-CMEY	Dartmouth	61	-20.2	1.4

	lineup	team	minutes_sum	plusminus_per40_mean	plusminus_per40_cv
187	CKOK-ADOY-LCAR-SMCC-BBLU	NIU	35	-20.5	0.6
195	AJON-BTAB-KWAT-ABAX-KDEN	Ohio	87	-22.6	1.2
196	AJON-BTAB-KWAT-AMCW-KDEN	Ohio	53	-22.6	0.4
2	EHAL-AMOB-ZRAS-MVEJ-LTAP	Akron	55	-23.3	1.9
201	GBOW-BTAB-KWAT-ABAX-KDEN	Ohio	78	-24.0	0.4
289	ARAN-HRHO-JRHO-DMOO-KHOR	San Diego	35	-24.9	0.2
3	EHAL-AMOB-ZRAS-MVEJ-NCLA	Akron	48	-25.3	1.2
317	MNAR-KING-MCUR-AGOO-OPOL	Santa Clara	52	-26.0	1.0
182	ADOY-SMCC-BBLU-LNIC-BSTO	NIU	44	-31.9	0.2
89	AKIL-PENG-CJAC-RKAU-EPAP	Cornell	66	-38.3	0.5
94	KLAN-PENG-CJAC-SPAR-RKAU	Cornell	46	nan	0.0
218	AJAM-LSMI-NLOW-EELL-LGLA	Pacific	60	nan	0.0

```
 Number of lineups in this criteria:  141
'%' of lineups that meet this criteria 37.9 %
```

Lastly, just for fun, let's look at team combo pairs

In [62]:
```
all_team_pairs = []

for team, group in stability_stats.groupby('team'):
    # Step 1: Get top 2 lineups by minutes for this team
    top_2_lineups = (
        group.sort_values('minutes_sum', ascending=False)
        .head(2)['lineup'].tolist()
    )
    top_2_data = group[group['lineup'].isin(top_2_lineups)]

    # Step 2: Get players in top 2 lineups (ordered, deduped)
    top_players_ordered = []
    for lu in top_2_lineups:
        top_players_ordered += lu.split('-')
    top_players_ordered = list(dict.fromkeys(top_players_ordered))

    # Step 3: Build player pair combos for all top 2 lineups
    player_combos = []
    for _, row in top_2_data.iterrows():
        players = row['lineup'].split('-')
        for i in range(len(players)):
            for j in range(i+1, len(players)):
                player_combos.append({
                    'team': team,
                    'player1': players[i],
                    'player2': players[j],
                    'plusminus_per40': row['plusminus_per40_mean'],
                    'minutes': row['minutes_sum']
                })
    combo_df = pd.DataFrame(player_combos)
    if combo_df.empty:
        continue
    combo_df = combo_df[combo_df['minutes']>150]
    # Step 4: Aggregate across all appearances (mean plusminus, sum minutes)
    top_pairs = (
        combo_df.groupby(['team', 'player1', 'player2'])
        .agg({'plusminus_per40': 'mean', 'minutes': 'sum'})
        .reset_index()
    )

    # Step 5: Filter to pairs where both players are in top 2 lineups
    filtered_pairs = top_pairs[
        top_pairs['player1'].isin(top_players_ordered) &
        top_pairs['player2'].isin(top_players_ordered)
    ].copy()

    # Step 6: Sort by player1's appearance order
```

```
    filtered_pairs['player1'] = pd.Categorical(filtered_pairs['player1'],
                                               categories=top_players_ordered,
                                               ordered=True)
    filtered_pairs = filtered_pairs.sort_values(['player1', 'minutes'], ascending=[True, False])

    all_team_pairs.append(filtered_pairs)

# Combine all teams
final_pairs = pd.concat(all_team_pairs, ignore_index=True)

# Style and display
styled_pairs = final_pairs.style.background_gradient(
    cmap='RdYlGn',
    subset=['plusminus_per40']
).format({
    'plusminus_per40': '{:.1f}',
    'minutes': '{:.0f}',
})

display(styled_pairs)
```

	team	player1	player2	plusminus_per40	minutes
0	Ball St.	LAUS	ABEC	10.0	279
1	Ball St.	LAUS	ARIC	10.0	279
2	Ball St.	LAUS	MBIS	10.0	279
3	Ball St.	LAUS	MKIE	10.0	279
4	Ball St.	ABEC	ARIC	10.0	279
5	Ball St.	ABEC	MBIS	10.0	279
6	Ball St.	ABEC	MKIE	10.0	279
7	Ball St.	MBIS	ARIC	10.0	279
8	Ball St.	MBIS	MKIE	10.0	279
9	Ball St.	ARIC	MKIE	10.0	279
10	Bowling Green	LFLE	AVEL	6.9	197
11	Bowling Green	LFLE	EPOR	6.9	197
12	Bowling Green	LFLE	JDON	6.9	197
13	Bowling Green	LFLE	PKOH	6.9	197
14	Bowling Green	AVEL	EPOR	6.9	197
15	Bowling Green	AVEL	JDON	6.9	197
16	Bowling Green	AVEL	PKOH	6.9	197
17	Bowling Green	JDON	EPOR	6.9	197
18	Bowling Green	JDON	PKOH	6.9	197
19	Bowling Green	PKOH	EPOR	6.9	197
20	Buffalo	LCOR	ADAV	6.2	167
21	Buffalo	LCOR	CWAT	6.2	167
22	Buffalo	LCOR	KLEW	6.2	167
23	Buffalo	LCOR	THAR	6.2	167
24	Buffalo	CWAT	ADAV	6.2	167
25	Buffalo	CWAT	KLEW	6.2	167
26	Buffalo	CWAT	THAR	6.2	167
27	Buffalo	THAR	ADAV	6.2	167
28	Buffalo	THAR	KLEW	6.2	167
29	Buffalo	KLEW	ADAV	6.2	167
30	Central Mich.	JLAW	ADAR	2.2	163
31	Central Mich.	JLAW	LTES	2.2	163
32	Central Mich.	JLAW	MMOR	2.2	163
33	Central Mich.	JLAW	TAND	2.2	163
34	Central Mich.	LTES	ADAR	2.2	163
35	Central Mich.	LTES	MMOR	2.2	163
36	Central Mich.	LTES	TAND	2.2	163
37	Central Mich.	MMOR	ADAR	2.2	163
38	Central Mich.	MMOR	TAND	2.2	163
39	Central Mich.	TAND	ADAR	2.2	163
40	Columbia	KHEN	CCOL	1.8	205
41	Columbia	KHEN	PPAG	1.8	205
42	Columbia	KHEN	RWEI	1.8	205

	team	player1	player2	plusminus_per40	minutes
43	Columbia	KHEN	SRAF	1.8	205
44	Columbia	RWEI	CCOL	1.8	205
45	Columbia	RWEI	PPAG	1.8	205
46	Columbia	RWEI	SRAF	1.8	205
47	Columbia	PPAG	CCOL	1.8	205
48	Columbia	PPAG	SRAF	1.8	205
49	Columbia	CCOL	SRAF	1.8	205
50	Dartmouth	VPAG	AELD	-9.7	181
51	Dartmouth	VPAG	CMEY	-9.7	181
52	Dartmouth	VPAG	OAUS	-9.7	181
53	Dartmouth	VPAG	ZOZE	-9.7	181
54	Dartmouth	ZOZE	AELD	-9.7	181
55	Dartmouth	ZOZE	CMEY	-9.7	181
56	Dartmouth	ZOZE	OAUS	-9.7	181
57	Dartmouth	AELD	CMEY	-9.7	181
58	Dartmouth	AELD	OAUS	-9.7	181
59	Dartmouth	OAUS	CMEY	-9.7	181
60	Eastern Mich.	MAMA	BTHR	-11.1	184
61	Eastern Mich.	MAMA	OSMI	-11.1	184
62	Eastern Mich.	MAMA	OWES	-11.1	184
63	Eastern Mich.	MAMA	SELE	-11.1	184
64	Eastern Mich.	OSMI	BTHR	-11.1	184
65	Eastern Mich.	OSMI	OWES	-11.1	184
66	Eastern Mich.	OSMI	SELE	-11.1	184
67	Eastern Mich.	OWES	BTHR	-11.1	184
68	Eastern Mich.	OWES	SELE	-11.1	184
69	Eastern Mich.	BTHR	SELE	-11.1	184
70	Harvard	HTUR	EROD	14.8	269
71	Harvard	HTUR	GAND	14.8	269
72	Harvard	HTUR	LCHA	14.8	269
73	Harvard	HTUR	SGLE	14.8	269
74	Harvard	GAND	EROD	14.8	269
75	Harvard	GAND	LCHA	14.8	269
76	Harvard	GAND	SGLE	14.8	269
77	Harvard	LCHA	EROD	14.8	269
78	Harvard	LCHA	SGLE	14.8	269
79	Harvard	SGLE	EROD	14.8	269
80	Kent St.	DGRA	BDUN	10.1	286
81	Kent St.	DGRA	JBAT	10.1	286
82	Kent St.	DGRA	JTYL	10.1	286
83	Kent St.	DGRA	MBAB	10.1	286
84	Kent St.	MBAB	BDUN	10.1	286
85	Kent St.	MBAB	JBAT	10.1	286

	team	player1	player2	plusminus_per40	minutes
86	Kent St.	MBAB	JTYL	10.1	286
87	Kent St.	JTYL	BDUN	10.1	286
88	Kent St.	JTYL	JBAT	10.1	286
89	Kent St.	JBAT	BDUN	10.1	286
90	LMU (CA)	BWIL	CHEI	-3.4	507
91	LMU (CA)	BWIL	MHER	-3.4	507
92	LMU (CA)	BWIL	NEVA	-3.4	507
93	LMU (CA)	BWIL	ACLA	-4.9	318
94	LMU (CA)	BWIL	ZOGO	-1.9	189
95	LMU (CA)	NEVA	CHEI	-3.4	507
96	LMU (CA)	NEVA	MHER	-3.4	507
97	LMU (CA)	NEVA	ACLA	-4.9	318
98	LMU (CA)	NEVA	ZOGO	-1.9	189
99	LMU (CA)	ACLA	CHEI	-4.9	318
100	LMU (CA)	ACLA	MHER	-4.9	318
101	LMU (CA)	MHER	CHEI	-3.4	507
102	LMU (CA)	ZOGO	CHEI	-1.9	189
103	LMU (CA)	ZOGO	MHER	-1.9	189
104	Miami (OH)	TSIN	ATRE	7.0	341
105	Miami (OH)	TSIN	EGON	7.0	341
106	Miami (OH)	TSIN	MCHA	7.0	341
107	Miami (OH)	TSIN	KRIC	11.5	171
108	Miami (OH)	TSIN	IVRI	2.6	171
109	Miami (OH)	MCHA	ATRE	7.0	341
110	Miami (OH)	MCHA	EGON	7.0	341
111	Miami (OH)	MCHA	KRIC	11.5	171
112	Miami (OH)	MCHA	IVRI	2.6	171
113	Miami (OH)	EGON	ATRE	7.0	341
114	Miami (OH)	EGON	KRIC	11.5	171
115	Miami (OH)	EGON	IVRI	2.6	171
116	Miami (OH)	ATRE	KRIC	11.5	171
117	Miami (OH)	ATRE	IVRI	2.6	171
118	Oregon St.	KSHU	AMAR	0.8	349
119	Oregon St.	KSHU	CFER	0.8	349
120	Oregon St.	KSHU	KREE	0.8	349
121	Oregon St.	KSHU	TBOL	0.8	349
122	Oregon St.	TBOL	AMAR	0.8	349
123	Oregon St.	TBOL	CFER	0.8	349
124	Oregon St.	TBOL	KREE	0.8	349
125	Oregon St.	CFER	AMAR	0.8	349
126	Oregon St.	CFER	KREE	0.8	349
127	Oregon St.	AMAR	KREE	0.8	349
128	Pacific	AJAM	EELL	5.4	231

	team	player1	player2	plusminus_per40	minutes
129	Pacific	AJAM	LSMI	5.4	231
130	Pacific	AJAM	MRAD	5.4	231
131	Pacific	AJAM	SWAR	5.4	231
132	Pacific	LSMI	EELL	5.4	231
133	Pacific	LSMI	MRAD	5.4	231
134	Pacific	LSMI	SWAR	5.4	231
135	Pacific	SWAR	EELL	5.4	231
136	Pacific	SWAR	MRAD	5.4	231
137	Pacific	EELL	MRAD	5.4	231
138	Penn	MGAY	KCOL	9.1	198
139	Penn	MGAY	SALM	9.1	198
140	Penn	MGAY	SCAL	9.1	198
141	Penn	MGAY	SSAW	9.1	198
142	Penn	SCAL	KCOL	9.1	198
143	Penn	SCAL	SALM	9.1	198
144	Penn	SCAL	SSAW	9.1	198
145	Penn	SSAW	KCOL	9.1	198
146	Penn	SSAW	SALM	9.1	198
147	Penn	SALM	KCOL	9.1	198
148	Pepperdine	MMAS	CSOT	-13.2	308
149	Pepperdine	MMAS	EMAS	-13.2	308
150	Pepperdine	MMAS	MVIC	-13.2	308
151	Pepperdine	MMAS	MMAS	-13.2	154
152	Pepperdine	CSOT	EMAS	-13.2	154
153	Pepperdine	CSOT	MVIC	-13.2	154
154	Pepperdine	EMAS	MVIC	-13.2	154
155	Portland	MMEE	AMAR	23.6	417
156	Portland	MMEE	ESHE	23.6	417
157	Portland	MMEE	MBUR	23.6	417
158	Portland	MMEE	THUL	23.6	417
159	Portland	AMAR	ESHE	23.6	417
160	Portland	AMAR	MBUR	23.6	417
161	Portland	AMAR	THUL	23.6	417
162	Portland	ESHE	MBUR	23.6	417
163	Portland	ESHE	THUL	23.6	417
164	Portland	MBUR	THUL	23.6	417
165	Princeton	ACHE	FTAL	17.6	263
166	Princeton	ACHE	OHUT	17.6	263
167	Princeton	ACHE	PHIL	17.6	263
168	Princeton	ACHE	SBEL	17.6	263
169	Princeton	SBEL	FTAL	17.6	263
170	Princeton	SBEL	OHUT	17.6	263
171	Princeton	SBEL	PHIL	17.6	263

	team	player1	player2	plusminus_per40	minutes
172	Princeton	OHUT	FTAL	17.6	263
173	Princeton	OHUT	PHIL	17.6	263
174	Princeton	FTAL	PHIL	17.6	263
175	San Diego	ARAN	DMOO	-10.8	173
176	San Diego	ARAN	HRHO	-10.8	173
177	San Diego	ARAN	KHOR	-10.8	173
178	San Diego	ARAN	TREI	-10.8	173
179	San Diego	HRHO	DMOO	-10.8	173
180	San Diego	HRHO	KHOR	-10.8	173
181	San Diego	HRHO	TREI	-10.8	173
182	San Diego	DMOO	KHOR	-10.8	173
183	San Diego	DMOO	TREI	-10.8	173
184	San Diego	KHOR	TREI	-10.8	173
185	Washington St.	EVIL	ATUH	7.8	343
186	Washington St.	EVIL	JVIL	7.8	343
187	Washington St.	EVIL	TWAL	7.8	343
188	Washington St.	EVIL	ACOV	0.7	186
189	Washington St.	EVIL	DMEN	15.0	157
190	Washington St.	ATUH	JVIL	7.8	343
191	Washington St.	ATUH	TWAL	7.8	343
192	Washington St.	ATUH	ACOV	0.7	186
193	Washington St.	ATUH	DMEN	15.0	157
194	Washington St.	JVIL	TWAL	7.8	343
195	Washington St.	JVIL	ACOV	0.7	186
196	Washington St.	JVIL	DMEN	15.0	157
197	Washington St.	TWAL	ACOV	0.7	186
198	Washington St.	DMEN	TWAL	15.0	157
199	Western Mich.	ACAR	HSPI	0.5	173
200	Western Mich.	ACAR	LAUD	0.5	173
201	Western Mich.	ACAR	MASE	0.5	173
202	Western Mich.	ACAR	MSTU	0.5	173
203	Western Mich.	MASE	HSPI	0.5	173
204	Western Mich.	MASE	LAUD	0.5	173
205	Western Mich.	MASE	MSTU	0.5	173
206	Western Mich.	MSTU	HSPI	0.5	173
207	Western Mich.	MSTU	LAUD	0.5	173
208	Western Mich.	HSPI	LAUD	0.5	173
209	Yale	ALEE	GTHY	-12.6	165
210	Yale	ALEE	KCAP	-12.6	165
211	Yale	ALEE	MCHA	-12.6	165
212	Yale	ALEE	MEGG	-12.6	165
213	Yale	MCHA	GTHY	-12.6	165
214	Yale	MCHA	KCAP	-12.6	165

	team	player1	player2	plusminus_per40	minutes
215	Yale	MCHA	MEGG	-12.6	165
216	Yale	KCAP	GTHY	-12.6	165
217	Yale	KCAP	MEGG	-12.6	165
218	Yale	MEGG	GTHY	-12.6	165

Save Results

In [30]:
```
stability_stats.to_csv('output/wcc_stability_stats.csv', index=False)
min_samples.to_csv('output/wcc_min_samples.csv', index=False)
```