DEI Dataset

In [74]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [5]:
```
df=pd.read_excel('/Users/linyuanjing/Desktop/Denominator_230519_Berryl_S&P500.xlsx')
df.head()
```

Out[5]:

DEI ID number	ISIN - 1000 values	Legal Entity Identifier	Location Country	Primary Sector	Primary Industry	Advanced Total (2023)	Board Total (2023)	Executive Total (2023)	...
1345634	US88579EAD76, US88579EAS46, US88579EAU91, US88...	LUZQVYP4VS22CLWDAR65	United States	BUSINESS/CONSUMER SERVICES	BUSINESS/CONSUMER SERVICES - Business/Manageme...	56.19	60.94	43.32	...
648856	US8318652091, US8318654071	549300XG4US7UJNECY36	United States	REAL ESTATE/CONSTRUCTION	REAL ESTATE/CONSTRUCTION - Building Materials/...	50.97	53.59	40.61	...
1539971	US00763MAF59, US00763MAG33, US00763MAH16, US00...	HQD377W2YR662HK5JX27	United States	HEALTH CARE/LIFE SCIENCES	HEALTH CARE/LIFE SCIENCES - Pharmaceuticals	60.22	67.11	50.74	...
1547048	US00287YAL39, US00287YAM12, US00287YAN94, US00...	FR5LCKFTG8054YNNRU85	United States	HEALTH CARE/LIFE SCIENCES	HEALTH CARE/LIFE SCIENCES - Biotechnology	62.75	55.24	67.52	...
1741869	IE00B4BNMY34	549300JY6CF6DO4YFQ03	Gibraltar	BUSINESS/CONSUMER SERVICES	BUSINESS/CONSUMER SERVICES - Business/Manageme...	53.67	55.31	49.94	...

ıs

In [58]:
```
df.shape
```

Out[58]:
```
(501, 424)
```

In [6]:
```
df.columns
```

Out[6]:
```
Index(['Name', 'DEI ID number', 'ISIN - 1000 values',
       'Legal Entity Identifier', 'Location Country', 'Primary Sector',
       'Primary Industry', 'Advanced Total (2023)', 'Board Total (2023)',
       'Executive Total (2023)',
       ...
       '% hispanic executives - calculated - Country - Median (2021)',
       '% hispanic executives - calculated - Country - Average (2021)',
       '% caucasian executives - calculated - Country - First Quartile (2021)',
       '% caucasian executives - calculated - Country - Fourth Quartile (2021)',
       '% caucasian executives - calculated - Country - Median (2021)',
       '% caucasian executives - calculated - Country - Average (2021)',
       '% indigenous executives - calculated - Country - First Quartile (2021)',
       '% indigenous executives - calculated - Country - Fourth Quartile (2021)',
       '% indigenous executives - calculated - Country - Median (2021)',
       '% indigenous executives - calculated - Country - Average (2021)'],
      dtype='object', length=424)
```

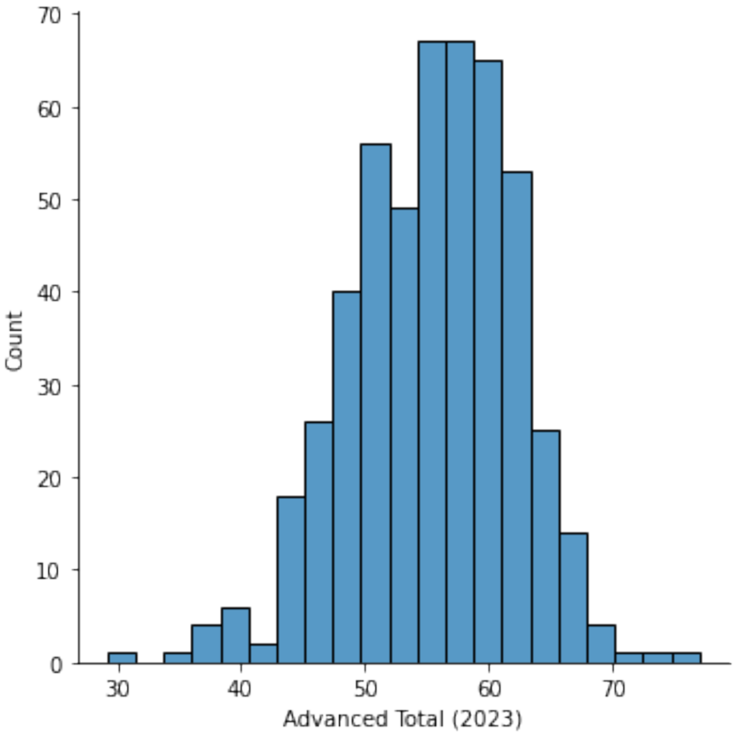
1. Analyze Data in 2023

In [17]:

```
#Visualize total DEI score based on all DEI dimensions
#across executive, board, and company level performance in 2023
sns.displot(df['Advanced Total (2023)'])
```

Out[17]:

```
<seaborn.axisgrid.FacetGrid at 0x7ff0599d26d0>
```



In [159]:

```
df['Advanced Total (2023)'].mean()
```

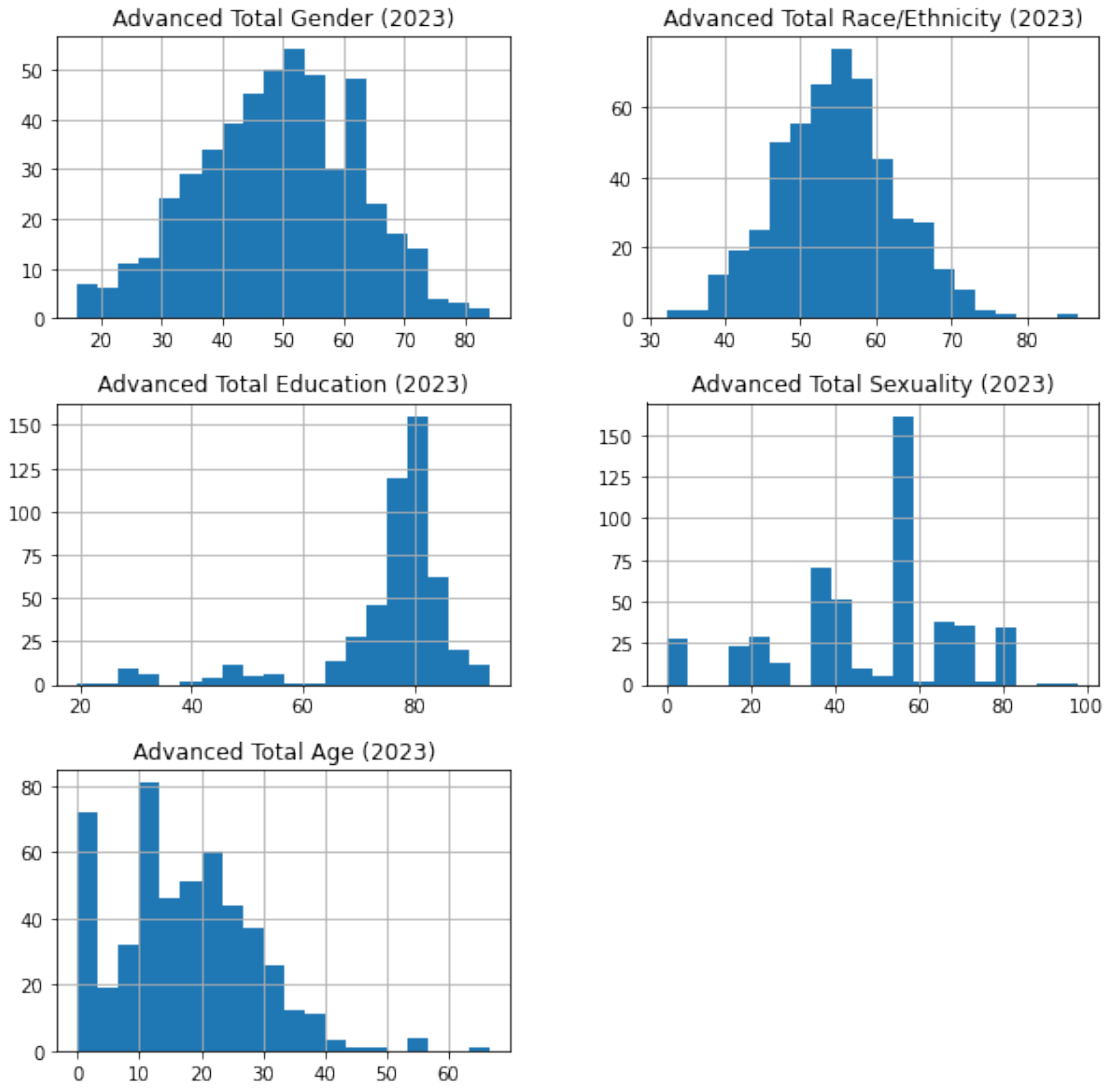
Out[159]:

```
55.34804391217563
```

THe total DEI score based on all DEI dimensions across executive, board, and company level performance in 2023 is **slightly skewed to the left**. The mean is about 55.

```
In [45]: #Visualize total Gender, Race/Ethnicity, Education, Sexuality, Age score
         #across the board, executive, and company-levels in 2023
         DEI_dimensions = ['Advanced Total Gender (2023)','Advanced Total Race/Ethnicity (2023)',
                           'Advanced Total Education (2023)','Advanced Total Sexuality (2023)','Advanced Total Age
         df[DEI_dimensions].hist(bins=20, figsize=(10, 10))
```

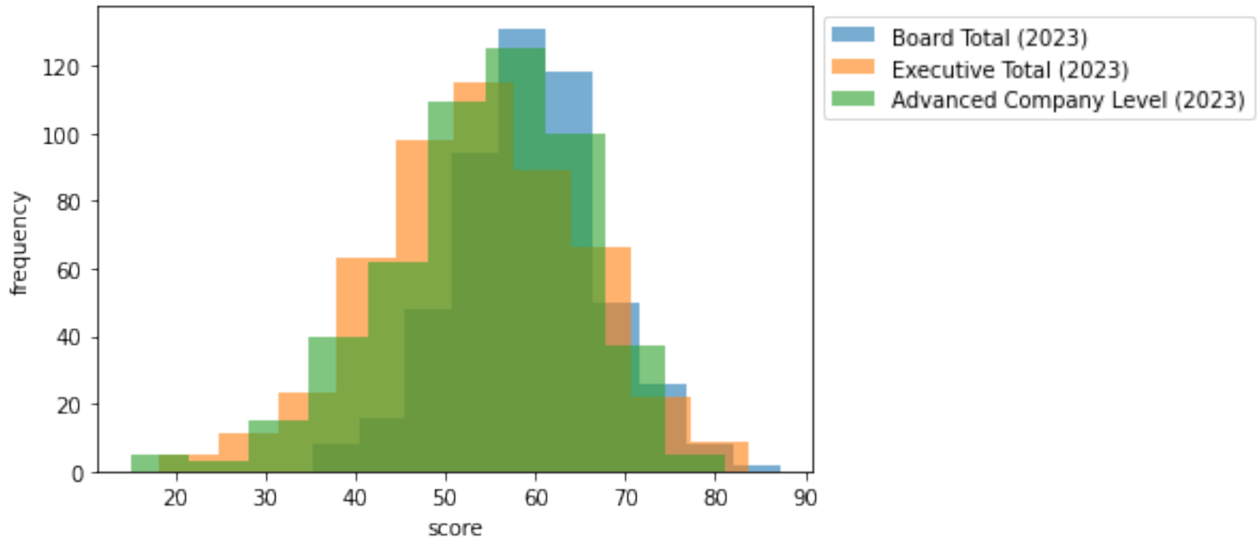
```
Out[45]: array([[<AxesSubplot:title={'center':'Advanced Total Gender (2023)'}>,
                 <AxesSubplot:title={'center':'Advanced Total Race/Ethnicity (2023)'}>],
                [<AxesSubplot:title={'center':'Advanced Total Education (2023)'}>,
                 <AxesSubplot:title={'center':'Advanced Total Sexuality (2023)'}>],
                [<AxesSubplot:title={'center':'Advanced Total Age (2023)'}>,
                 <AxesSubplot:>]], dtype=object)
```



The graphs above show the distributions of total score of different dimensions in 2023. The distribution of total gender and total race/ethnicity is **almost normal**. The distribution of total education and total sexuality is skewed to the left. The distribution of total age is skewed to the right.

In [93]:
```
#Compare DEI score based on all DEI dimensions among board, executive, and company-levels in 2023
plt.xlabel('score')
plt.ylabel('frequency')
plt.hist(df['Board Total (2023)'],alpha = 0.6, label = "Board Total (2023)")
plt.hist(df['Executive Total (2023)'],alpha = 0.6, label = "Executive Total (2023)")
plt.hist(df['Advanced Company Level (2023)'],alpha = 0.6, label = "Advanced Company Level (2023)")
plt.legend(bbox_to_anchor=(1, 1))
```

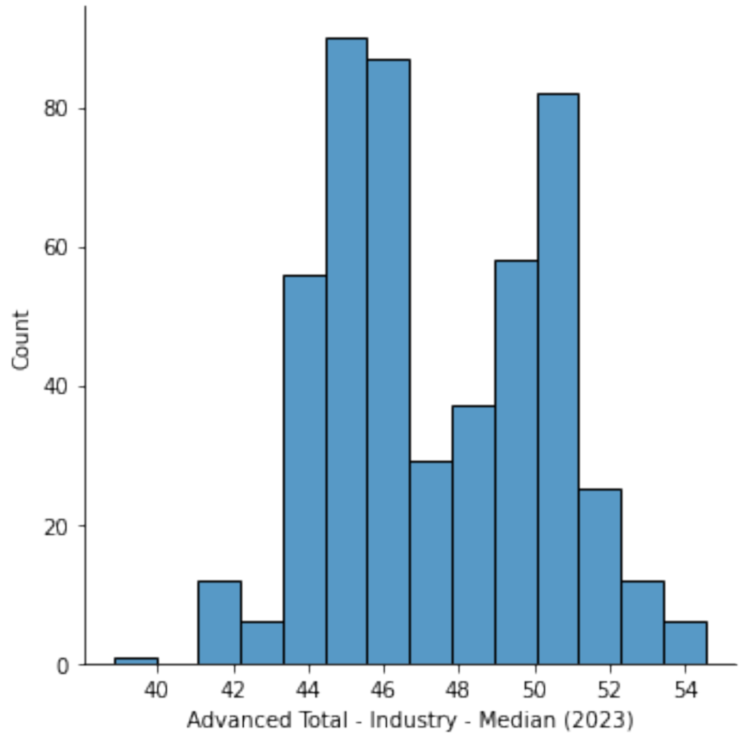
Out[93]:
```
<matplotlib.legend.Legend at 0x7ff0522ad0d0>
```



The distributions of DEI scores of board, executive, and company-levels are **overlapping in most parts**.

In [41]:
```
sns.displot(df['Advanced Total - Industry - Median (2023)'])
```

Out[41]:
```
<seaborn.axisgrid.FacetGrid at 0x7ff04ec64490>
```



In [51]:

```
#Compare DEI score based on all DEI dimensions among all primary sectors
total_score = ['Advanced Total (2023)','Board Total (2023)','Executive Total (2023)','Advanced Company Le
sector_score = df.groupby(['Primary Sector'])[total_score].median()
sector_score
```

Out[51]:

	Advanced Total (2023)	Board Total (2023)	Executive Total (2023)	Advanced Company Level (2023)
Primary Sector				
AUTOMOTIVE	53.950	56.840	48.390	55.280
BASIC MATERIALS/RESOURCES	56.305	59.365	57.040	55.675
BUSINESS/CONSUMER SERVICES	54.755	56.690	52.140	54.865
CONSUMER GOODS	58.830	59.850	57.650	60.530
ENERGY	51.800	56.320	51.100	50.800
FINANCIAL SERVICES	57.470	59.610	54.920	58.260
HEALTH CARE/LIFE SCIENCES	55.920	59.480	55.640	54.380
INDUSTRIAL GOODS	54.175	59.585	51.345	54.130
LEISURE/HOSPITALITY	54.135	64.130	44.905	53.865
MEDIA/ENTERTAINMENT	57.410	57.590	63.950	55.180
REAL ESTATE/CONSTRUCTION	53.495	57.740	49.350	49.585
RETAIL/WHOLESALE	57.005	63.025	59.680	53.965
TECHNOLOGY	54.660	57.960	49.610	57.300
TELECOMMUNICATION SERVICES	56.630	53.830	56.770	59.830
TRANSPORTATION/LOGISTICS	55.725	54.805	50.645	55.275
UTILITIES	56.870	61.650	62.190	55.250

In [52]:

```
sector_score.describe()
```

Out[52]:

	Advanced Total (2023)	Board Total (2023)	Executive Total (2023)	Advanced Company Level (2023)
count	16.000000	16.000000	16.000000	16.000000
mean	55.570937	58.654375	54.082813	55.260625
std	1.822512	2.776058	5.274243	2.827559
min	51.800000	53.830000	44.905000	49.585000
25%	54.165000	56.802500	50.386250	54.088750
50%	55.822500	58.662500	53.530000	55.215000
75%	56.903750	59.670000	57.192500	56.081250
max	58.830000	64.130000	63.950000	60.530000

The companies in the **Consumer Goods** sector has average highest DEI advanced total score. The companies in the **Energy** sector has average lowest DEI advanced total score. The **spread (5.27) of executive** total score among different sectors is comparatively large.

In [55]:

```python
country_score = df.groupby(['Location Country'])[total_score].median()
country_score
```

Out[55]:

Location Country	Advanced Total (2023)	Board Total (2023)	Executive Total (2023)	Advanced Company Level (2023)
Bermuda	45.830	48.915	54.775	41.590
Gibraltar	53.670	55.310	49.940	62.910
Ireland	57.295	59.930	53.915	55.090
Israel	37.440	45.360	40.750	26.800
Netherlands	49.010	67.360	49.520	33.480
Switzerland	49.050	59.860	55.200	36.350
United Kingdom	66.620	74.300	69.205	61.735
United States	55.900	59.130	54.090	55.580

In [56]:

```python
country_score.describe()
```

Out[56]:

	Advanced Total (2023)	Board Total (2023)	Executive Total (2023)	Advanced Company Level (2023)
count	8.000000	8.000000	8.000000	8.000000
mean	51.851875	58.770625	53.424375	46.691875
std	8.679285	9.308621	7.952661	13.846476
min	37.440000	45.360000	40.750000	26.800000
25%	48.215000	53.711250	49.835000	35.632500
50%	51.360000	59.495000	54.002500	48.340000
75%	56.248750	61.787500	54.881250	57.118750
max	66.620000	74.300000	69.205000	62.910000

In [164]:

```python
df['Location Country'].describe()
```

Out[164]:

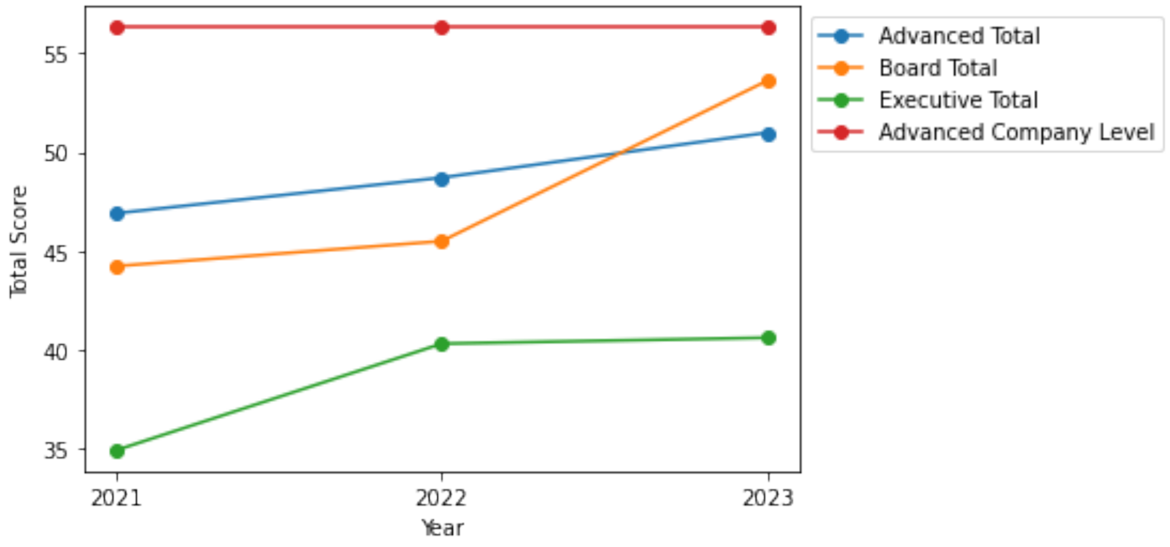
```
count               501
unique                8
top       United States
freq                481
Name: Location Country, dtype: object
```

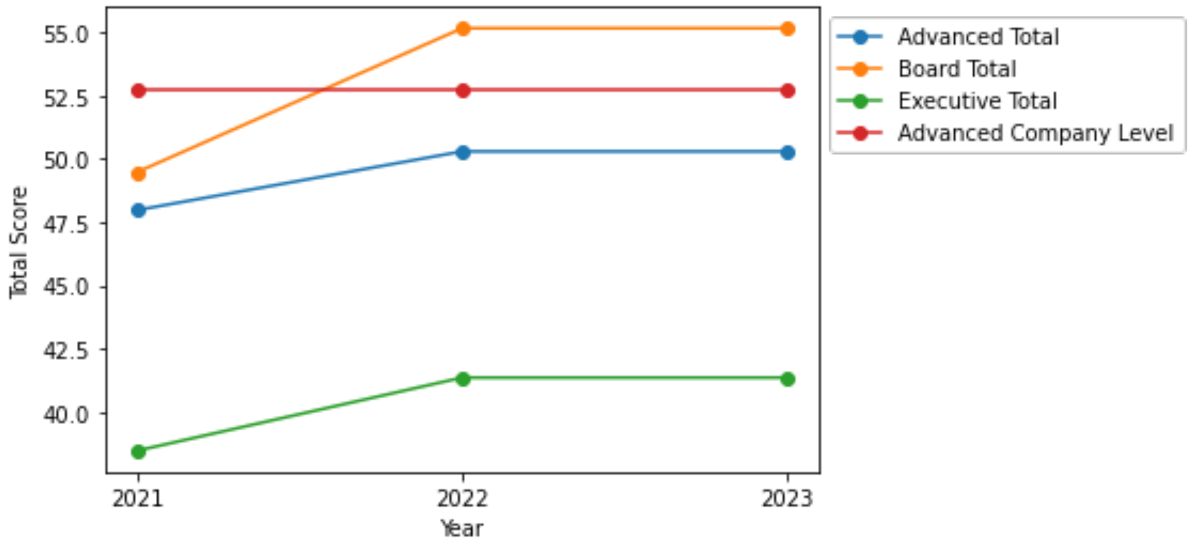
The companies in **United Kingdom** has average highest DEI advanced total score, board total score, and executive total score. The companies in **Israel** has average lowest DEI score in all four dimensions. However, these statistics may not be well descriptive because the majority of companies in this dataset are in the United States, so the data in other countries are not representative.

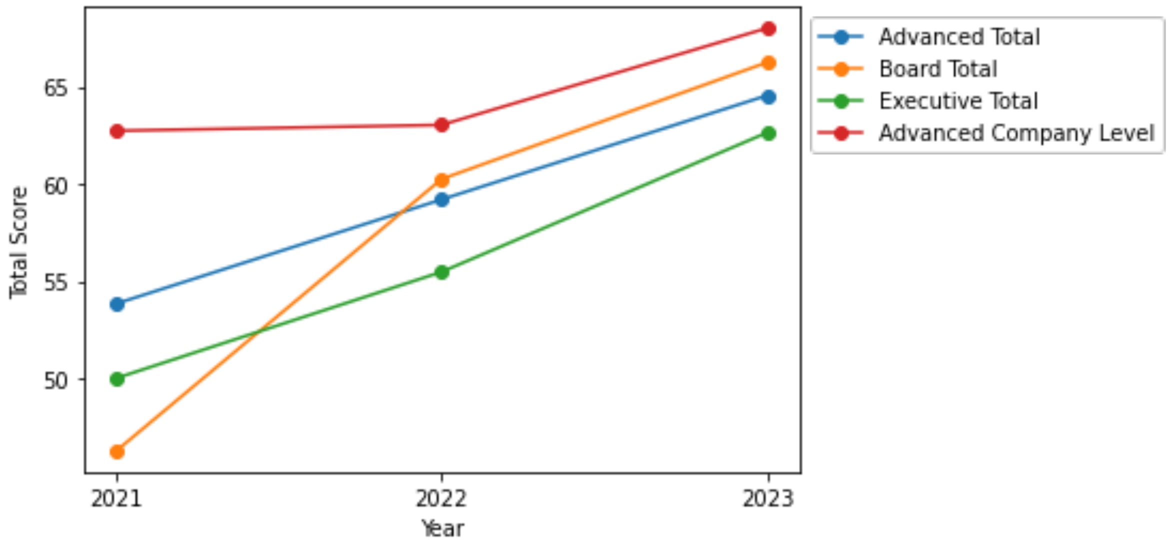
2. Analyze Data from 2021-2023

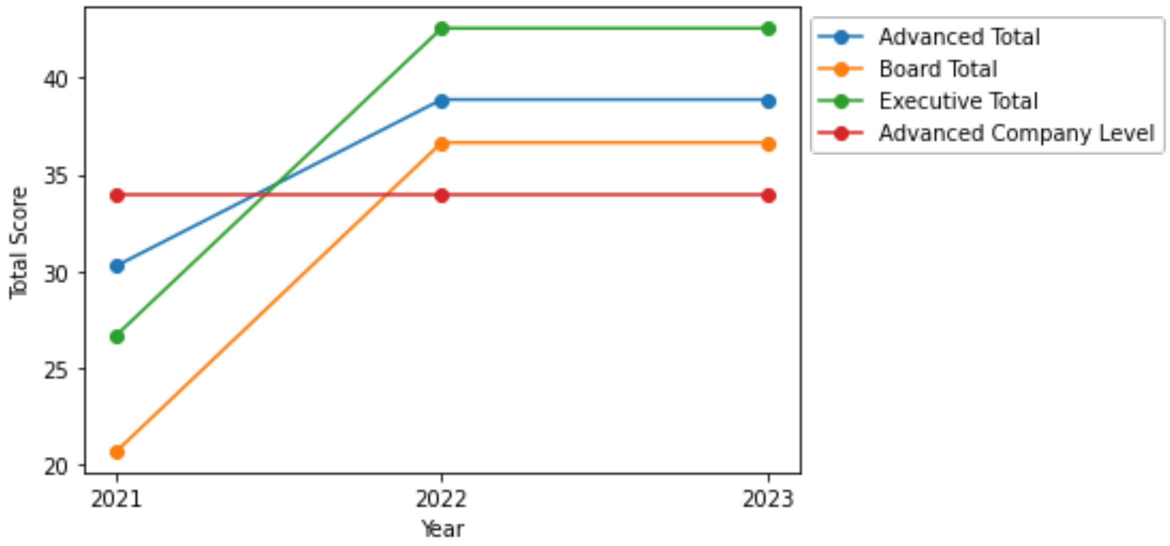
In [105]:

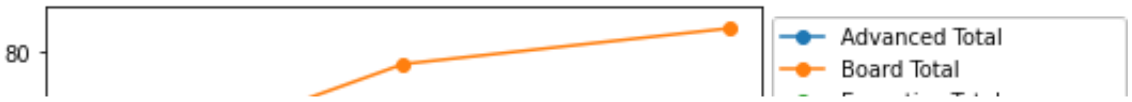
```python
#Visualize the trends of DEI score from 2021-2023 of randomly chosen companies
for i in np.arange(1, 501, 100):
    x1 = np.array(['2021','2022','2023'])
    y1 = df.loc[i, ['Advanced Total (2021)','Advanced Total (2022)','Advanced Total (2023)']]
    y2 = df.loc[i, ['Board Total (2021)','Board Total (2022)','Board Total (2023)']]
    y3 = df.loc[i, ['Executive Total (2021)','Executive Total (2022)','Executive Total (2023)']]
    y4 = df.loc[i, ['Advanced Company Level (2021)','Advanced Company Level (2022)','Advanced Company Lev
    plt.plot(x1, y1, marker = 'o', label = 'Advanced Total')
    plt.plot(x1, y2, marker = 'o', label = 'Board Total')
    plt.plot(x1, y3, marker = 'o', label = 'Executive Total')
    plt.plot(x1, y4, marker = 'o', label = 'Advanced Company Level')
    plt.xlabel('Year')
    plt.ylabel('Total Score')
    plt.legend(bbox_to_anchor=(1, 1))
    plt.show()
```

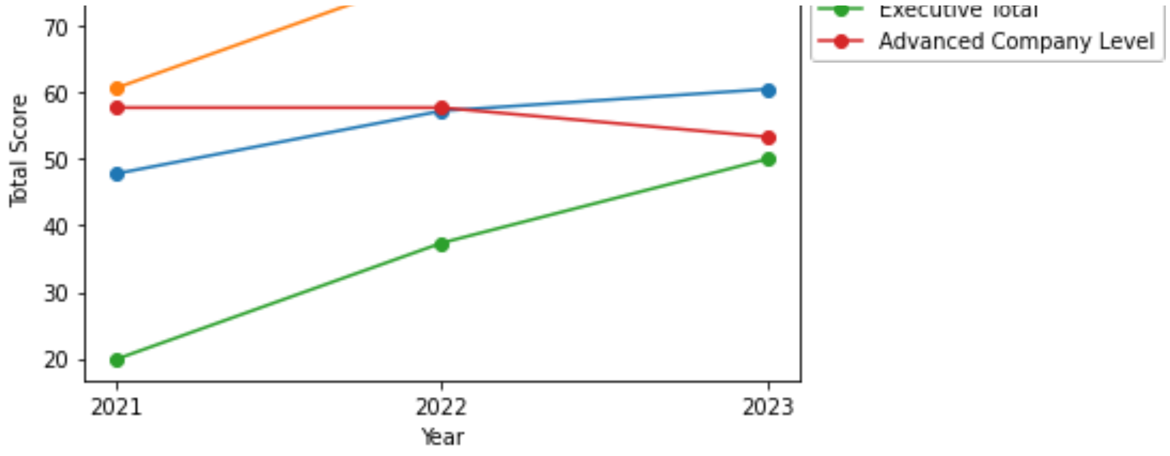






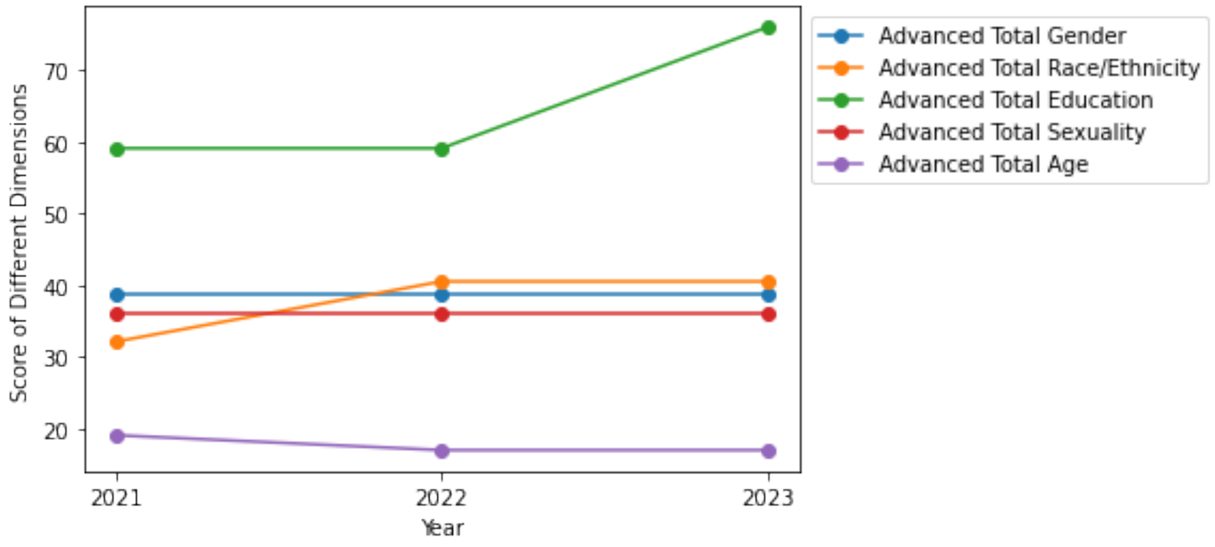


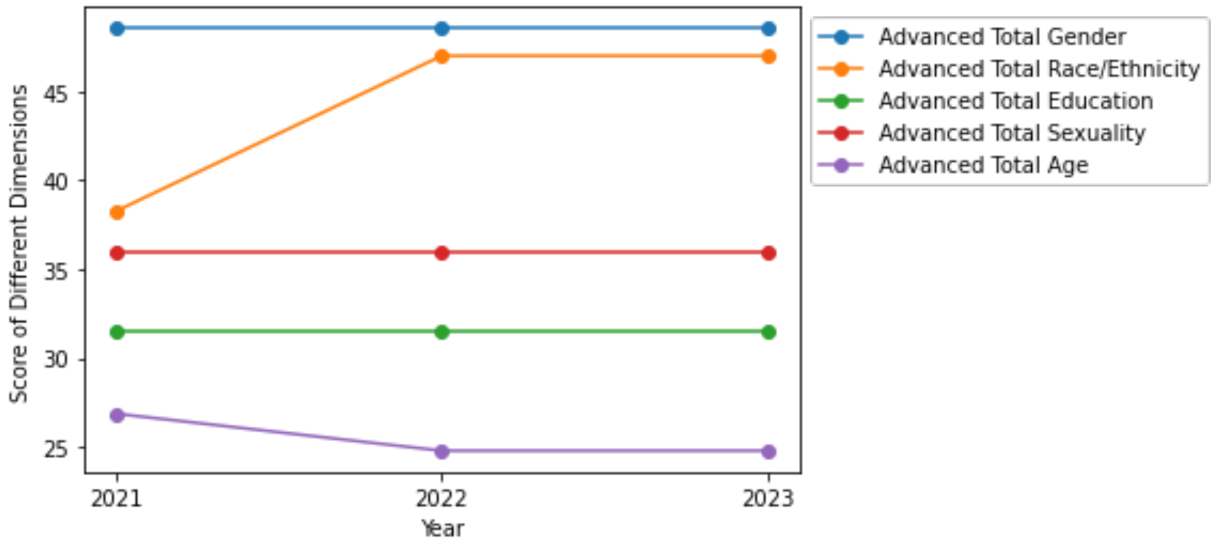


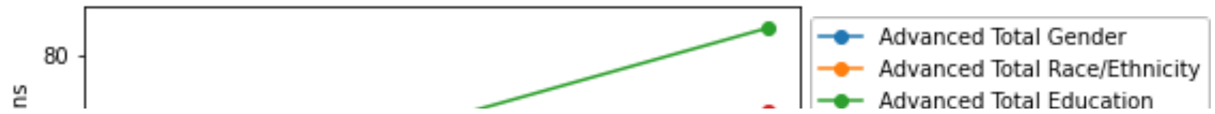


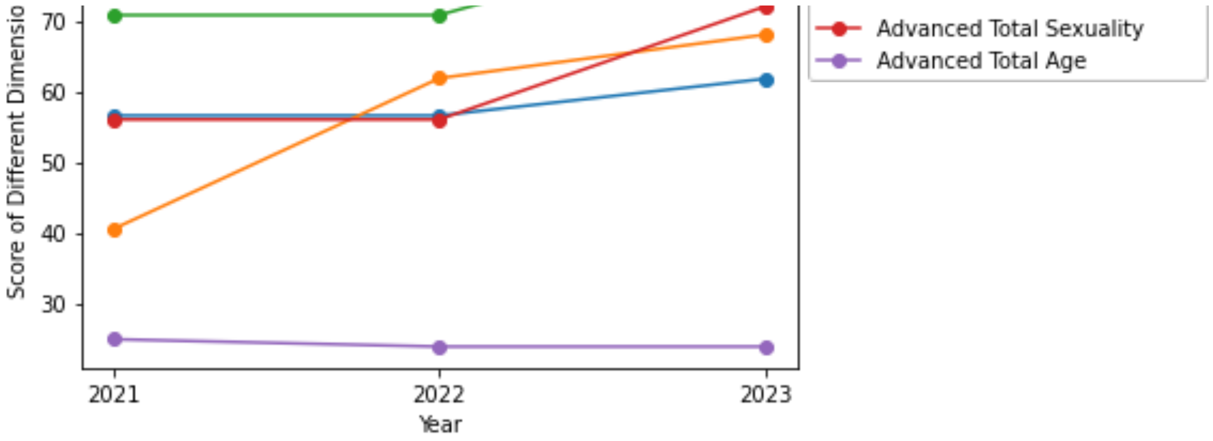
Based on the five randomly chosen companies results, it shows that their DEI scores are **increasing** from 2021 to 2023 in most parts.

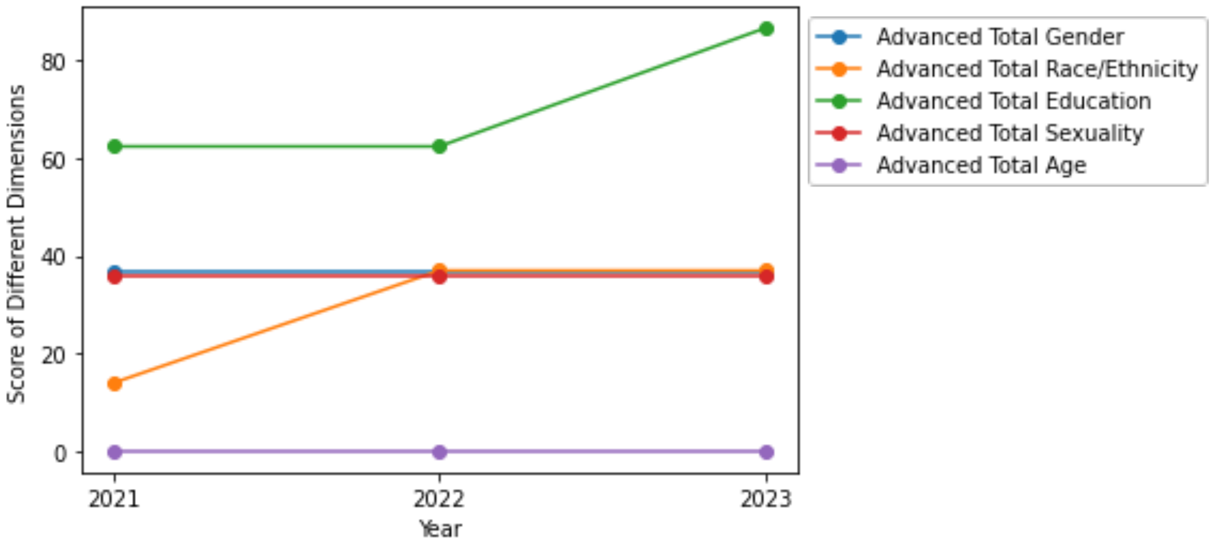
In [116]:
```
#Visualize the trends of DEI score in different dimensions from 2021-2023 of randomly chosen companies
for i in np.arange(1, 501, 100):
    x1 = np.array(['2021','2022','2023'])
    y1 = df.loc[i, ['Advanced Total Gender (2021)','Advanced Total Gender (2022)','Advanced Total Gender
    y2 = df.loc[i, ['Advanced Total Race/Ethnicity (2021)','Advanced Total Race/Ethnicity (2022)','Advanc
    y3 = df.loc[i, ['Advanced Total Education (2021)','Advanced Total Education (2022)','Advanced Total E
    y4 = df.loc[i, ['Advanced Total Sexuality (2021)','Advanced Total Sexuality (2022)','Advanced Total S
    y5 = df.loc[i, ['Advanced Total Age (2021)','Advanced Total Age (2022)','Advanced Total Age (2023)']]
    plt.plot(x1, y1, marker = 'o', label = 'Advanced Total Gender')
    plt.plot(x1, y2, marker = 'o', label = 'Advanced Total Race/Ethnicity')
    plt.plot(x1, y3, marker = 'o', label = 'Advanced Total Education')
    plt.plot(x1, y4, marker = 'o', label = 'Advanced Total Sexuality')
    plt.plot(x1, y5, marker = 'o', label = 'Advanced Total Age')
    plt.xlabel('Year')
    plt.ylabel('Score of Different Dimensions')
    plt.legend(bbox_to_anchor=(1, 1))
    plt.show()
```

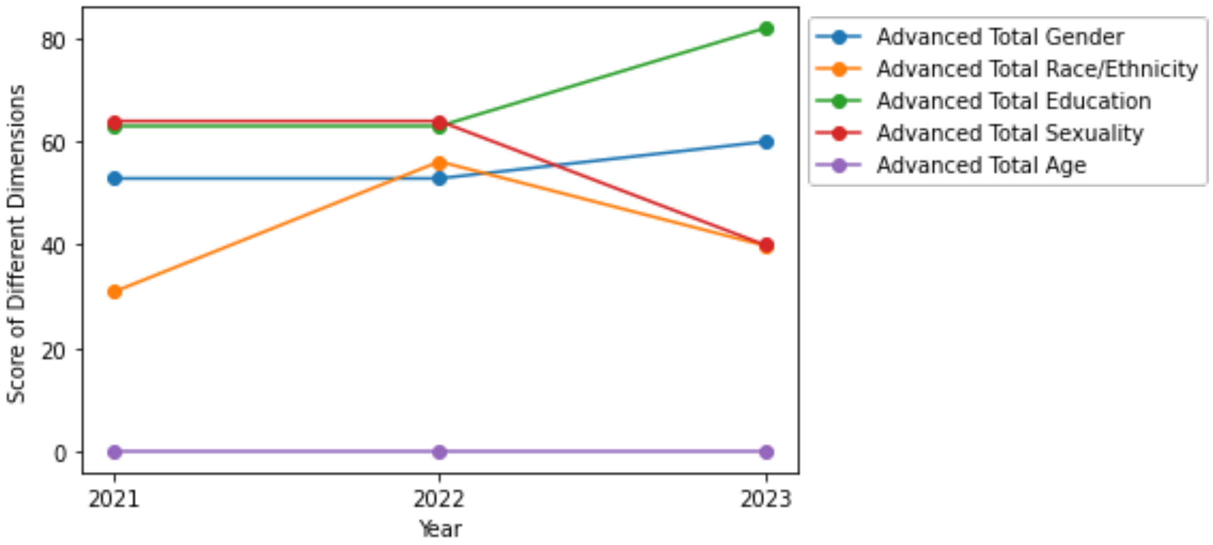






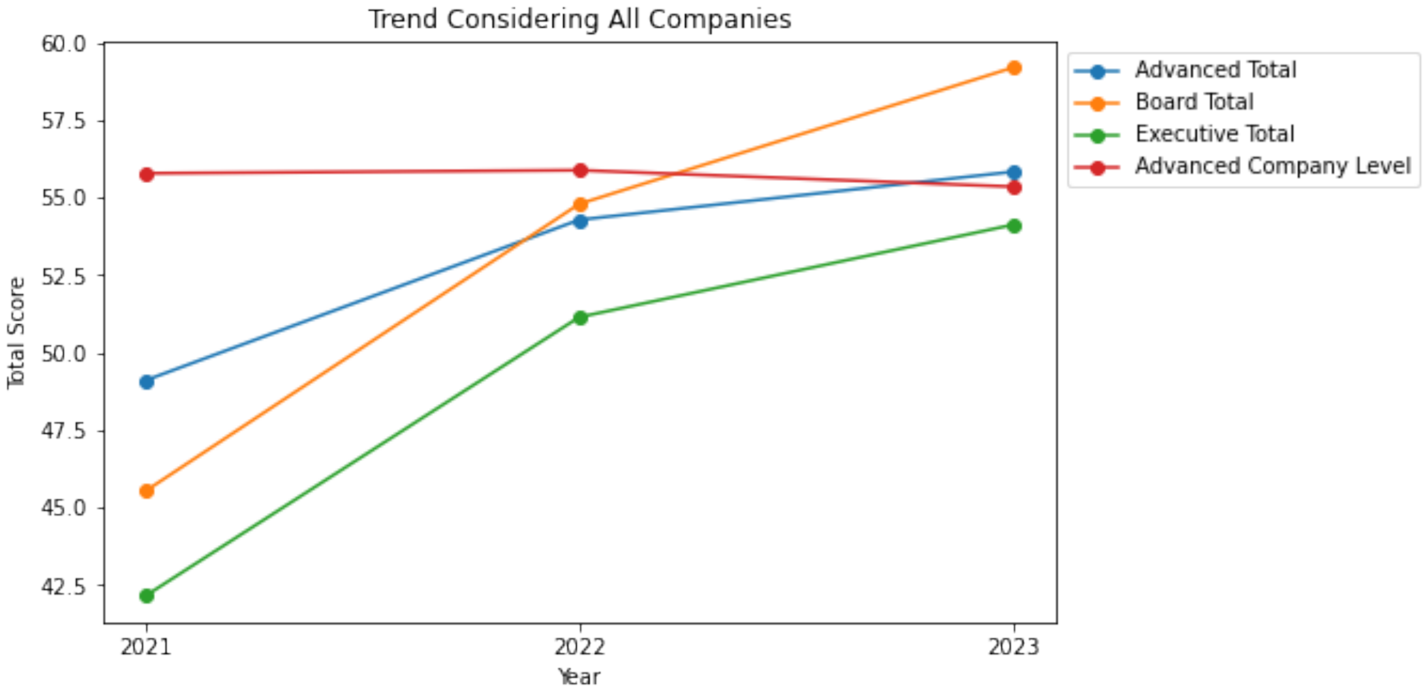

Score of Different Dimensio
70
60
50
40
30
2021
2022
2023
Year
Advanced Total Sexuality
Advanced Total Age


Score of Different Dimensions
80
60
40
20
0
2021
2022
2023
Year
Advanced Total Gender
Advanced Total Race/Ethnicity
Advanced Total Education
Advanced Total Sexuality
Advanced Total Age


Score of Different Dimensions
80
60
40
20
0
2021
2022
2023
Year
Advanced Total Gender
Advanced Total Race/Ethnicity
Advanced Total Education
Advanced Total Sexuality
Advanced Total Age

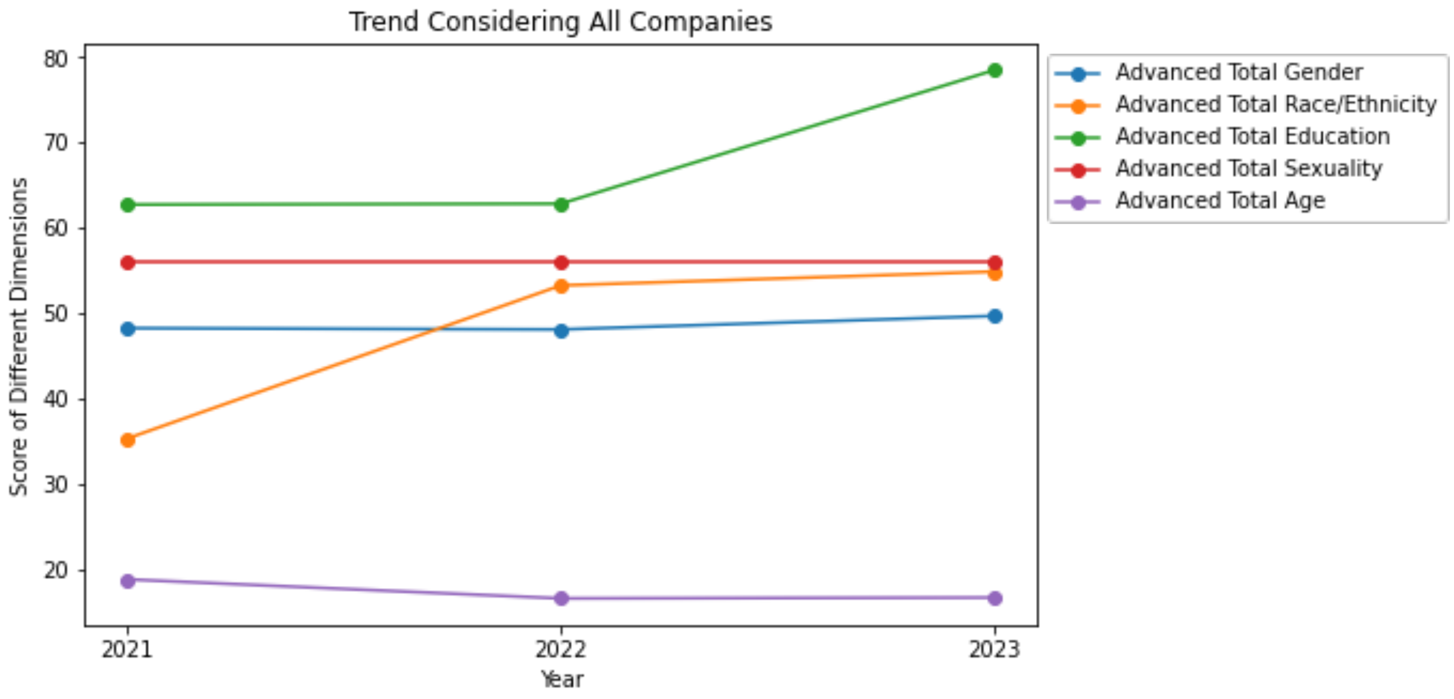
In [115]:

```
#Visualize the trends of average DEI score level from 2021-2023 of all companies
x1 = np.array(['2021','2022','2023'])
advanced_total = ['Advanced Total (2021)', 'Advanced Total (2022)', 'Advanced Total (2023)']
y1 = np.array([df[i].median() for i in advanced_total])
board_total = ['Board Total (2021)', 'Board Total (2022)', 'Board Total (2023)']
y2 = np.array([df[i].median() for i in board_total])
executive_total = ['Executive Total (2021)', 'Executive Total (2022)', 'Executive Total (2023)']
y3 = np.array([df[i].median() for i in executive_total])
company_level = ['Advanced Company Level (2021)', 'Advanced Company Level (2022)', 'Advanced Company Leve
y4 = np.array([df[i].median() for i in company_level])
plt.figure(figsize=(8, 5))
plt.plot(x1, y1, marker = 'o', label = 'Advanced Total')
plt.plot(x1, y2, marker = 'o', label = 'Board Total')
plt.plot(x1, y3, marker = 'o', label = 'Executive Total')
plt.plot(x1, y4, marker = 'o', label = 'Advanced Company Level')
plt.xlabel('Year')
plt.ylabel('Total Score')
plt.title('Trend Considering All Companies')
plt.legend(bbox_to_anchor=(1, 1))
plt.show()
```



The average DEI score levels in aspects of advnaced total, board total, and executive total are **increasing** from 2021-2023. The average DEI score level in the company level is slightly **decreasing**.

```
In [117]: #Visualize the trends of average DEI score level among different dimensions from 2021-2023 of all compani
          x1 = np.array(['2021','2022','2023'])
          gender = ['Advanced Total Gender (2021)','Advanced Total Gender (2022)','Advanced Total Gender (2023)']
          y1 = np.array([df[i].median() for i in gender])
          race = ['Advanced Total Race/Ethnicity (2021)','Advanced Total Race/Ethnicity (2022)','Advanced Total Rac
          y2 = np.array([df[i].median() for i in race])
          education = ['Advanced Total Education (2021)','Advanced Total Education (2022)','Advanced Total Educatio
          y3 = np.array([df[i].median() for i in education])
          sexuality = ['Advanced Total Sexuality (2021)','Advanced Total Sexuality (2022)','Advanced Total Sexualit
          y4 = np.array([df[i].median() for i in sexuality])
          age = ['Advanced Total Age (2021)','Advanced Total Age (2022)','Advanced Total Age (2023)']
          y5 = np.array([df[i].median() for i in age])
          plt.figure(figsize=(8, 5))
          plt.plot(x1, y1, marker = 'o', label = 'Advanced Total Gender')
          plt.plot(x1, y2, marker = 'o', label = 'Advanced Total Race/Ethnicity')
          plt.plot(x1, y3, marker = 'o', label = 'Advanced Total Education')
          plt.plot(x1, y4, marker = 'o', label = 'Advanced Total Sexuality')
          plt.plot(x1, y5, marker = 'o', label = 'Advanced Total Age')
          plt.xlabel('Year')
          plt.ylabel('Score of Different Dimensions')
          plt.title('Trend Considering All Companies')
          plt.legend(bbox_to_anchor=(1, 1))
          plt.show()
```



The average DEI score levels in the dimensions of **race/ethnicity and education are increasing** from 2021-2023. The other three dimentions are almost keeping the same.

3. Correlation Analysis

In [157]:

```
#Find the correlation between the DEI gender score and different measures
df_gender = df[['Advanced Total Gender (2023)','Board Gender Score (2023)','Executive Gender Score (2023)
                'CEO a Woman (2023)','Chair a Woman (2023)','Board Woman Ratio - calculated (2023)',
                'Executives Woman Ratio - calculated (2023)','% woman employees (2023)']]
df_gender['% woman employees (2023)']=df['% woman employees (2023)'].replace(to_replace='U/A',value=np.na
df_gender = df_gender.replace({'CEO a Woman (2023)':{'Yes':1,'No':0}}|{'Chair a Woman (2023)':{'Yes':1,'N
df_gender = df_gender.dropna()
corr_matrix = df_gender.corr()
corr_matrix[(abs(corr_matrix) > 0.5)&(abs(corr_matrix) < 1)]
```

```
/var/folders/3k/j10ggy9x48lfnss8qw330t6c0000gn/T/ipykernel_38583/4084358358.py:4: 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.h
tml#returning-a-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.htm
l#returning-a-view-versus-a-copy)
  df_gender['% woman employees (2023)']=df['% woman employees (2023)'].replace(to_replace='U/A',value=np
.nan)
```

Out[157]:

	Advanced Total Gender (2023)	Board Gender Score (2023)	Executive Gender Score (2023)	CEO a Woman (2023)	Chair a Woman (2023)	Board Woman Ratio - calculated (2023)	Executives Woman Ratio - calculated (2023)	% woman employees (2023)
Advanced Total Gender (2023)	NaN	0.631416	0.835543	NaN	NaN	0.619457	0.826008	NaN
Board Gender Score (2023)	0.631416	NaN	NaN	NaN	NaN	0.960571	NaN	NaN
Executive Gender Score (2023)	0.835543	NaN	NaN	NaN	NaN	NaN	0.980172	NaN
CEO a Woman (2023)	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Chair a Woman (2023)	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Board Woman Ratio - calculated (2023)	0.619457	0.960571	NaN	NaN	NaN	NaN	NaN	NaN
Executives Woman Ratio - calculated (2023)	0.826008	NaN	0.980172	NaN	NaN	NaN	NaN	NaN
% woman employees (2023)	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

The Board Gender Score and Executive Gender Score are **highly correlated** with Board Woman Ratio - calculated and Executives Woman Ratio - calculated, respectively.

In [151]:

```
df.columns.get_loc('Board Race/Ethnicity Score (2023)')
```

Out[151]: 18

In [148]:

```
df.columns.get_loc('CEO a Racial Minority (2023)')
```

Out[148]: 22

In [142]:

```
df.columns.get_loc('% black board - calculated (2023)')
```

Out[142]: 28

In [143]:

```
df.columns.get_loc('% indigenous executives - calculated (2023)')
```

Out[143]: 37

In [158]:

```
#Find the correlation between the DEI race/ethnicity score and different measures
df_race = df.iloc[:, np.r_[18, 20, 22, 23, 28:37]]
df_race = df_race.replace({'CEO a Racial Minority (2023)':{'Yes':1,'No':0}}|{'Chair a Racial Minority (20
corr_matrix = df_race.corr()
corr_matrix[(abs(corr_matrix) > 0.5)&(abs(corr_matrix) < 1)]
```

Out[158]:

	Board Race/Ethnicity Score (2023)	Executive Race/Ethnicity Score (2023)	CEO a Racial Minority (2023)	Chair a Racial Minority (2023)	% black board - calculated (2023)	% asian board - calculated (2023)	% hispanic board - calculated (2023)	% caucasian board - calculated (2023)	% indigenous board - calculated (2023)	% black executives - calculated (2023)	% as executi calcula (20
Board Race/Ethnicity Score (2023)	NaN	NaN	NaN	NaN	NaN	-0.539470	NaN	NaN	NaN	NaN	N
Executive Race/Ethnicity Score (2023)	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
CEO a Racial Minority (2023)	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
Chair a Racial Minority (2023)	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
% black board - calculated (2023)	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
% asian board - calculated (2023)	-0.53947	NaN	NaN	NaN	NaN	NaN	NaN	-0.573902	NaN	NaN	N
% hispanic board - calculated (2023)	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
% caucasian board - calculated (2023)	NaN	NaN	NaN	NaN	NaN	-0.573902	NaN	NaN	NaN	NaN	N
% indigenous board - calculated (2023)	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
% black executives - calculated (2023)	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
% asian executives - calculated (2023)	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
% hispanic executives - calculated (2023)	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	N
% caucasian executives - calculated (2023)	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	-0.766

There are not highly correlation between the DEI race/ethnicity score and any specific measure. The potential reason may be that these measures are considered together when calculating the score. However, there are two interesting findings. The % asian board - calculated is **negatively correlated** with Board Race/Ethnicity Score. Also, the % asian board and the % asian executives are **negatively correlated** with % caucasian board and % caucasian executives, respectively.