In [1]:
```
import pandas as pd
```

In [2]:
```
draft_df = pd.read_csv(r"C:\Users\Omie\Desktop\DSC 530 Project\nfl_draft_prospects.csv")
```

In [3]:
```
print("Draft Data:")
print(draft_df.head())
```

```
Draft Data:
   draft_year  player_id                   player_name position pos_abbr \
0        1967      23590      Bubba Smith Defensive End       DE
1        1967      23591    Clinton Jones   Running Back       RB
2        1967      23592   Steve Spurrier    Quarterback       QB
3        1967      23593      Bob Griese     Quarterback       QB
4        1967      23594   George Webster     Linebacker       LB

           school   school_name school_abbr  \
 0 Michigan State      Spartans         MSU
 1 Michigan State      Spartans         MSU
2         Florida        Gators         FLA
3          Purdue  Boilermakers         PUR
 4 Michigan State      Spartans         MSU

                                                link pick ... \
0  http://insider.espn.com/nfl/draft/player/_id/... (http://insider.espn.com/nfl/draft/player/_id/...)   1.0  ...
1  http://insider.espn.com/nfl/draft/player/_id/... (http://insider.espn.com/nfl/draft/player/_id/...)   2.0  ...
2  http://insider.espn.com/nfl/draft/player/_id/... (http://insider.espn.com/nfl/draft/player/_id/...)   3.0  ...
3  http://insider.espn.com/nfl/draft/player/_id/... (http://insider.espn.com/nfl/draft/player/_id/...)   4.0  ...
4  http://insider.espn.com/nfl/draft/player/_id/... (http://insider.espn.com/nfl/draft/player/_id/...)   5.0  ...

                   team team_abbr  \
0      Baltimore Colts        IND
1    Minnesota Vikings        MIN
2 San Francisco 49ers          SF
3Miami Dolphins               MIA
4Houston Oilers               TEN

                                     team_logo_espn guid weight height \
0  https://a.espncdn.com/i/teamlogos/nfl/500/scor... (https://a.espncdn.com/i/teamlogos/nfl/500/scor...) NaN     NaN    NaN
1  https://a.espncdn.com/i/teamlogos/nfl/500/scor... (https://a.espncdn.com/i/teamlogos/nfl/500/scor...) NaN     NaN    NaN
2  https://a.espncdn.com/i/teamlogos/nfl/500/scor... (https://a.espncdn.com/i/teamlogos/nfl/500/scor...) NaN     NaN    NaN
3  https://a.espncdn.com/i/teamlogos/nfl/500/scor... (https://a.espncdn.com/i/teamlogos/nfl/500/scor...) NaN     NaN    NaN
4  https://a.espncdn.com/i/teamlogos/nfl/500/scor... (https://a.espncdn.com/i/teamlogos/nfl/500/scor...) NaN     NaN    NaN

  pos_rk ovr_rk   grade player_image
0    NaN    NaN   NaN            NaN
1    NaN    NaN   NaN            NaN
2    NaN    NaN   NaN            NaN
3    NaN    NaN   NaN            NaN
4    NaN    NaN   NaN            NaN

[5 rows x 24 columns]
```

In [4]:
```
performance_df = pd.read_csv(r"C:\Users\Omie\Desktop\DSC 530 Project\yearly_player_data.csv")
```

In [5]:
```
print("Performance Data:")
print(performance_df.head())
```

```
Performance Data:
  team   player_id player_name position season depth pass_attempts \
 0 TEN  00-0035676  A.J. Brown       WR    2019    2.0           0.0
 1 TEN  00-0035676  A.J. Brown       WR    2020    1.0           0.0
 2 TEN  00-0035676  A.J. Brown       WR    2021    1.0           2.0
 3 PHI  00-0035676  A.J. Brown       WR    2022    1.0           0.0
 4 PHI  00-0035676  A.J. Brown       WR    2023    1.0           0.0

   complete_pass      incomplete_pass passing_yards ... vacated_receptions \
0            0.0              0.0           0.0 ...               147.0
1            0.0              0.0           0.0 ...                62.0
2            0.0              2.0           0.0 ...                74.0
3            0.0              0.0           0.0 ...               135.0
4            0.0              0.0           0.0 ...                47.0

   vacated_receiving_yards vacated_receiving_air_yards \
0                   1632.0                      1886.0
1                    730.0                      1015.0
2                    741.0                       804.0
3                   1769.0                      2911.0
4                    471.0                       753.0

   vacated_yards_after_catch   vacated_reception_td vacated_rush_attempts \
0                      646.0                    6.0                 185.0
1                      284.0                    4.0                   8.0
2                      331.0                    7.0                  88.0
3                      463.0                   10.0                  83.0
4                      217.0                    6.0                  96.0

      vacated_rushing_yards vacated_run_td vacated_touches vacated_total_yards
0                    656.0            6.0           383.0              2420.0
1                     19.0            0.0           176.0              1338.0
2                    365.0            0.0           345.0              2147.0
3                    397.0            6.0           724.0              4486.0
4                    438.0            3.0           145.0               911.0

[5 rows x 195 columns]
```

In [6]:
```
# Display column names
print("Draft Dataset Columns:", draft_df.columns)
print("Performance Dataset Columns:", performance_df.columns)
```

```
Draft Dataset Columns: Index(['draft_year', 'player_id', 'player_name', 'position', 'pos_abbr',
       'school', 'school_name', 'school_abbr', 'link', 'pick', 'overall',
       'round', 'traded', 'trade_note', 'team', 'team_abbr', 'team_logo_espn',
       'guid', 'weight', 'height', 'pos_rk', 'ovr_rk', 'grade',
       'player_image'],
      dtype='object')
Performance Dataset Columns: Index(['team', 'player_id', 'player_name', 'position', 'season', 'depth',
       'pass_attempts', 'complete_pass', 'incomplete_pass', 'passing_yards',
       ...
       'vacated_receptions', 'vacated_receiving_yards',
       'vacated_receiving_air_yards', 'vacated_yards_after_catch',
       'vacated_reception_td', 'vacated_rush_attempts',
       'vacated_rushing_yards', 'vacated_run_td', 'vacated_touches',
       'vacated_total_yards'],
      dtype='object', length=195)
```

In [7]:
```
# Convert names to lowercase and strip spaces
draft_df["player_name"] = draft_df["player_name"].str.lower().str.strip()
performance_df["player_name"] = performance_df["player_name"].str.lower().str.strip()
```

In [8]:
```
# Merge datasets on player_name
merged_df = pd.merge(draft_df, performance_df, on="player_name", how="inner")

# Display merged dataset
print(merged_df.head())
```

```
   draft_year_x player_id_x    player_name       position_x pos_abbr  \
0          1967       23681      tim jones      Quarterback       QB
1          1967       23681      tim jones      Quarterback       QB
2          2021      105442      tim jones    Wide Receiver       WR
3          2021      105442      tim jones    Wide Receiver       WR
4          1967       12413 william powell       Linebacker       LB

                school    school_name school_abbr  \
0          Weber State       Wildcats         WEB
1          Weber State       Wildcats         WEB
2 Southern Mississippi Golden Eagles         USM
3 Southern Mississippi Golden Eagles         USM
4             Missouri         Tigers         MIZ

                                                link  pick  ...  \
0  http://insider.espn.com/nfl/draft/player/_/id/... (http://insider.espn.com/nfl/draft/player/_/id/...)   8.0  ...
1  http://insider.espn.com/nfl/draft/player/_/id/... (http://insider.espn.com/nfl/draft/player/_/id/...)   8.0  ...
2  http://insider.espn.com/nfl/draft/player/_/id/... (http://insider.espn.com/nfl/draft/player/_/id/...)   NaN  ...
3  http://insider.espn.com/nfl/draft/player/_/id/... (http://insider.espn.com/nfl/draft/player/_/id/...)   NaN  ...
4  http://insider.espn.com/nfl/draft/player/_/id/... (http://insider.espn.com/nfl/draft/player/_/id/...) 25.0  ...

  vacated_receptions vacated_receiving_yards vacated_receiving_air_yards  \
0              187.0                  1988.0                      2705.0
1              223.0                  2164.0                      2396.0
2              187.0                  1988.0                      2705.0
3              223.0                  2164.0                      2396.0
4                NaN                     NaN                         NaN

  vacated_yards_after_catch vacated_reception_td vacated_rush_attempts  \
0                     688.0                 12.0                  44.0
1                    1189.0                  7.0                 310.0
2                     688.0                 12.0                  44.0
3                    1189.0                  7.0                 310.0
4                       NaN                  NaN                   NaN

   vacated_rushing_yards vacated_run_td vacated_touches vacated_total_yards
0                  213.0            2.0           895.0              5908.0
1                 1302.0           10.0           533.0              3466.0
2                  213.0            2.0           895.0              5908.0
3                 1302.0           10.0           533.0              3466.0
4                    NaN            NaN             NaN                 NaN

[5 rows x 218 columns]
```

In [9]:
```
print(merged_df.isnull().sum())
```

```
draft_year_x               0
player_id_x                0
player_name                0
position_x                 0
pos_abbr                   0
                        ...
vacated_rush_attempts    345
vacated_rushing_yards    345
vacated_run_td           345
vacated_touches          345
vacated_total_yards      345
Length: 218, dtype: int64
```

In [10]:
```
# Fill missing performance metrics with 0
merged_df.fillna(0, inplace=True)
```

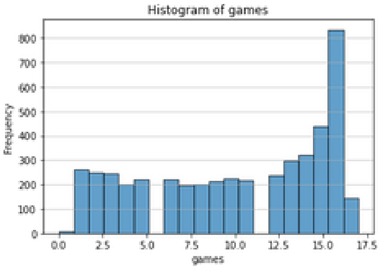
In [11]:
```
merged_df.to_csv("merged_nfl_draft_data.csv", index=False)
```

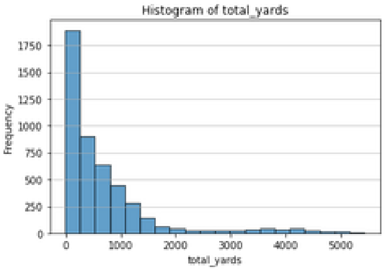
In [12]:
```
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
from scipy.stats import ttest_ind
import statsmodels.api as sm
```

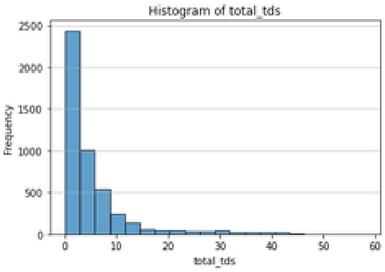
In [13]:
```
df = pd.read_csv(r"C:\Users\Omie\Desktop\DSC 530 Project\merged_nfl_draft_data.csv", low_memory=False)
```

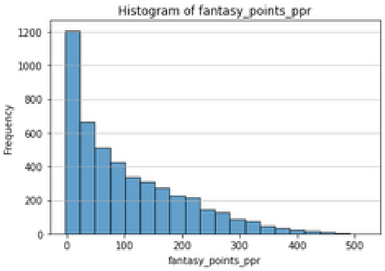
In [14]:
```
# Select key variables
variables = ['games', 'total_yards', 'total_tds', 'fantasy_points_ppr', 'round']
```

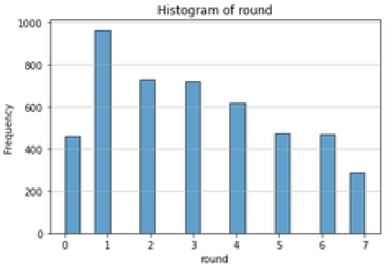
```
In [15]: # Histograms
         variables = ['games', 'total_yards', 'total_tds', 'fantasy_points_ppr', 'round']

         for var in variables:
             plt.figure(figsize=(6, 4))
             plt.hist(df[var], bins=20, edgecolor='black', alpha=0.7)
             plt.title(f'Histogram of {var}')
             plt.xlabel(var)
             plt.ylabel('Frequency')
             plt.grid(axis='y', alpha=0.75)
             plt.show()
```



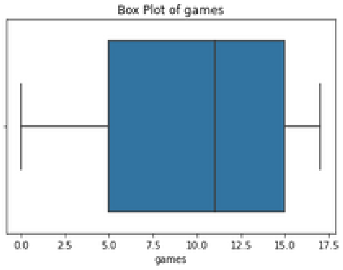


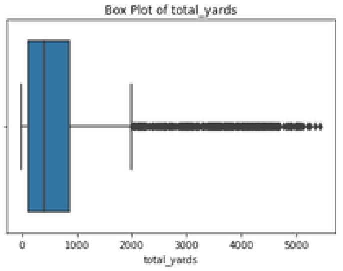


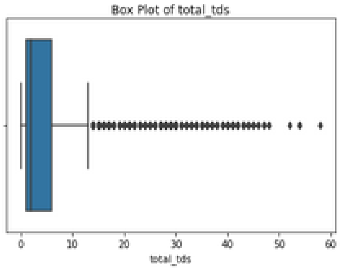


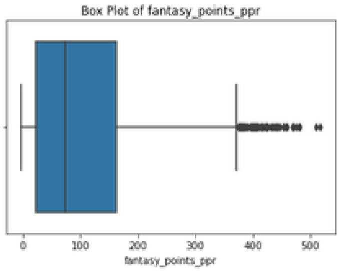


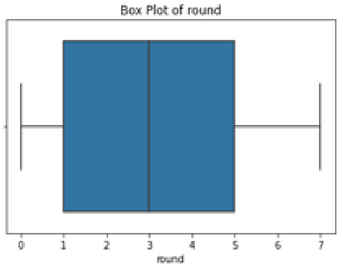
```
In [16]: # Boxplots for outliers
         for var in variables:
             plt.figure(figsize=(6, 4))
             sns.boxplot(x=df[var])
             plt.title(f'Box Plot of {var}')
             plt.show()
```











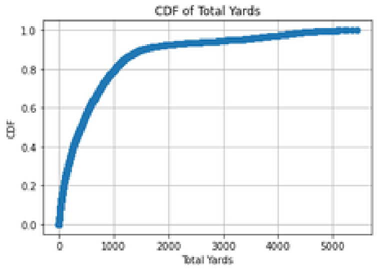
```
In [17]: # Summary statistics
         summary_stats = df[variables].describe().T
         summary_stats['mode'] = df[variables].mode().iloc[0]
         summary_stats['spread'] = summary_stats['max'] - summary_stats['min']

         print(summary_stats)

         summary_stats.to_csv("summary_statistics.csv")
```

```
                            coeant         std    min     25%    50% \
games                    10.473166    5.165192   0.00    5.00   11.0
total_yards         4731.0 705.918622  949.508775 -14.00  118.50  399.0
total_tds          4731.0   4.945043    7.499538   0.00    1.00    2.0
fantasy_points_ppr  4731.0 103.849622   97.980116 -3.32   22.05   73.9
round              4731.0   3.015853    2.059671   0.00    1.00    3.0

                     75%      max mode  spread
games               15.0    17.00 16.0    17.0
total_yards        872.0  5440.00   0.0 5454.0
total_tds            6.0    58.00  0.0    58.0
fantasy_points_ppr 162.5   517.38  0.0   520.7
round                5.0     7.00  1.0     7.0
```

In [18]:
```
# Probability Mass Function
def compute_pmf(data):
    counts = data.value_counts(normalize=True)
    return counts.sort_index()

#   Compute   PMF   for   first-round   vs.   later   rounds
first_round_pmf = compute_pmf(df[df['round'] == 1]['games'])
later_round_pmf = compute_pmf(df[df['round'] > 1]['games'])

#   Display   PMF   results   print("First   Round   PMF:\n",
first_round_pmf.head())    print("Later    Round    PMF:\n",
later_round_pmf.head())
```

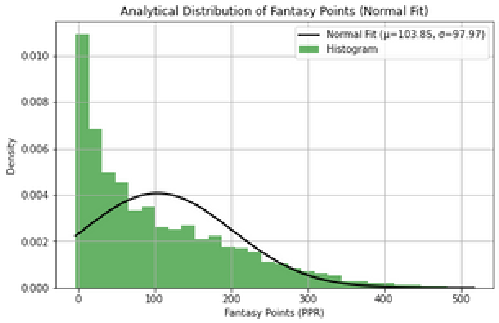
```
First Round PMF:

 1    0.021739
2    0.025880
3    0.034161
4    0.021739
5    0.027950
Name: games, dtype: float64
Later Round PMF:
 0    0.001816
1    0.055387
2    0.052361
3    0.056598
4    0.046005
Name: games, dtype: float64
```

In [19]:
```
# Cumulative Distribution Function
def compute_cdf(data):
    sorted_data = np.sort(data)
    cdf = np.arange(1, len(sorted_data) + 1) / len(sorted_data)
    return sorted_data, cdf

x, y = compute_cdf(df['total_yards'])

plt.figure(figsize=(6,  4))  plt.plot(x,  y,
marker='o',                linestyle='none')
plt.xlabel('Total  Yards')  plt.ylabel('CDF')
plt.title('CDF  of  Total  Yards')  plt.grid()
plt.show()
```



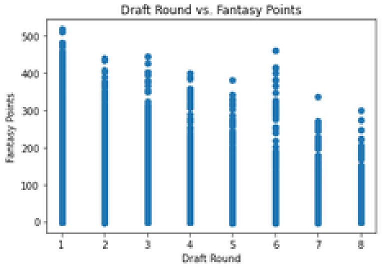
In [20]:
```
import scipy.stats as stats
```

In [21]:
```
data = df['fantasy_points_ppr'].dropna()

# Fit a normal distribution to the data mu, std = stats.norm.fit(data)

# Generate values for plotting the fitted distribution xmin, xmax = data.min(), data.max() x = np.linspace(xmin, xmax, 100) pdf =
stats.norm.pdf(x, mu, std)

# Plot histogram and fitted normal distribution plt.figure(figsize=(8, 5)) plt.hist(data, bins=30, density=True, alpha=0.6,
color='g', label="Histogram") plt.plot(x, pdf, 'k', linewidth=2, label=f"Normal Fit (μ={mu:.2f}, σ={std:.2f})")

plt.title("Analytical Distribution of Fantasy Points (Normal Fit)") plt.xlabel("Fantasy Points (PPR)") plt.ylabel("Density")
plt.legend() plt.grid() plt.show()

# Perform normality test (Shapiro-Wilk Test) shapiro_test_stat, shapiro_p_value = stats.shapiro(data.sample(500, random_state=42))
if len(data) > 500 else stats.shapiro(data)

# Store results in a DataFrame distribution_results = {

    "Mean (μ)": mu,
    "Standard Deviation (σ)": std,
    "Shapiro-Wilk Test Statistic": shapiro_test_stat,
    "Shapiro-Wilk P-Value": shapiro_p_value
}

# Convert to DataFrame for display
distribution_df = pd.DataFrame([distribution_results])

print(distribution_df.to_string(index=False))
```

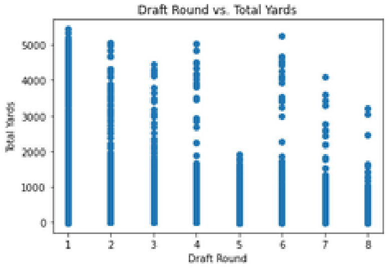


```
      Mean (μ) Standard Deviation (σ) Shapiro-Wilk Test StatisticShapiro-Wilk P-Value
103.849622               97.96976                       0.871248         6.602537e-20
```

In [22]:
```
# Scatter Plot: Draft Round vs. Fantasy Points
plt.figure(figsize=(6, 4))
plt.scatter(df['draft_round'], df['fantasy_points_ppr'])
plt.xlabel('Draft Round')
plt.ylabel('Fantasy Points')
plt.title('Draft Round vs. Fantasy Points')
plt.show()
```



In [23]:
```
# Scatter Plot: Draft Round vs. Total Yards
plt.figure(figsize=(6,                    4))
plt.scatter(df['draft_round'],  df['total_yards'])
plt.xlabel('Draft     Round')     plt.ylabel('Total
Yards') plt.title('Draft Round vs. Total Yards')
plt.show()
```



In [24]:
```
# Pearson correlation
corr, _ = stats.pearsonr(df['draft_round'], df['fantasy_points_ppr'])
print(f"Pearson Correlation: {corr}")
```

```
Pearson Correlation: -0.4086080725726298
```

In [25]:
```
# Hypothesis Testing
first_round = df[df['round'] == 1]['fantasy_points_ppr']
later_round = df[df['round'] > 1]['fantasy_points_ppr']

t_stat, p_val = ttest_ind(first_round, later_round, equal_var=False)
print(f"T-Statistic: {t_stat}, P-Value: {p_val}")
```

```
T-Statistic: 18.39448593274092, P-Value: 1.7122973538443794e-67
```

In [26]:
```
# Regression Analysis
X = df[['round']]
y = df['fantasy_points_ppr']

X = sm.add_constant(X)  # Add intercept
model = sm.OLS(y, X).fit()
print(model.summary())
```

```
                            OLS Regression Results                            
==============================================================================
Dep. Variable:     fantasy_points_ppr   R-squared:                       0.047
Model:                            OLS   Adj. R-squared:                  0.046
Method:                 Least Squares   F-statistic:                     231.1
Date:                Mon, 24 Feb 2025   Prob (F-statistic):           5.46e-51
Time:                        20:08:59   Log-Likelihood:                -28290.
No. Observations:                4731   AIC:                         5.658e+04
Df Residuals:                    4729   BIC:                         5.660e+04
Df Model:                           1                                         
Covariance Type:            nonrobust                                         
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const        134.8159      2.467     54.654      0.000     129.980     139.652
round        -10.2678      0.675    -15.201      0.000     -11.592      -8.944
==============================================================================
Omnibus:                      626.853   Durbin-Watson:                   0.793
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              900.745
Skew:                           1.018   Prob(JB):                    2.54e-196
Kurtosis:                       3.654   Cond. No.                         6.81
==============================================================================
```