```python
import pandas as pd

# Load the dataset
data = pd.read_csv('RR GEM TEST DATA.csv')

data
```

```
              hjd     mag  mag_err
0    2.457317e+06  11.130     0.02
1    2.457077e+06  11.411     0.02
2    2.457745e+06  10.766     0.02
3    2.456657e+06  11.097     0.02
4    2.457451e+06  10.747     0.02
..            ...     ...      ...
243  2.457018e+06  11.078     0.02
244  2.456960e+06  11.224     0.02
245  2.457446e+06  11.477     0.02
246  2.457265e+06  11.414     0.02
247  2.457789e+06  11.317     0.02

[248 rows x 3 columns]
```

```python
data.tail()
```

```
              hjd     mag  mag_err
243  2.457018e+06  11.078     0.02
244  2.456960e+06  11.224     0.02
245  2.457446e+06  11.477     0.02
246  2.457265e+06  11.414     0.02
247  2.457789e+06  11.317     0.02
```

```python
data.duplicated().sum()
```

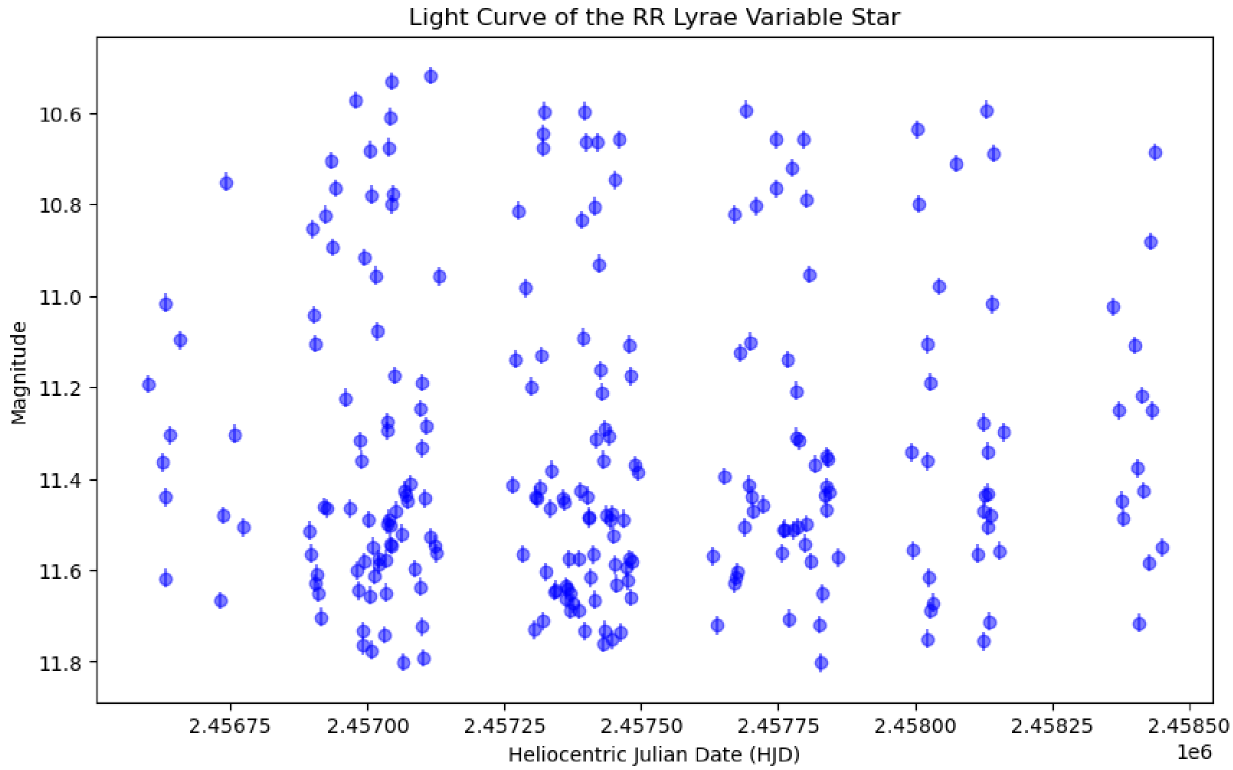
```
0
```

```python
# Check for missing values
print(data.isnull().sum())
```

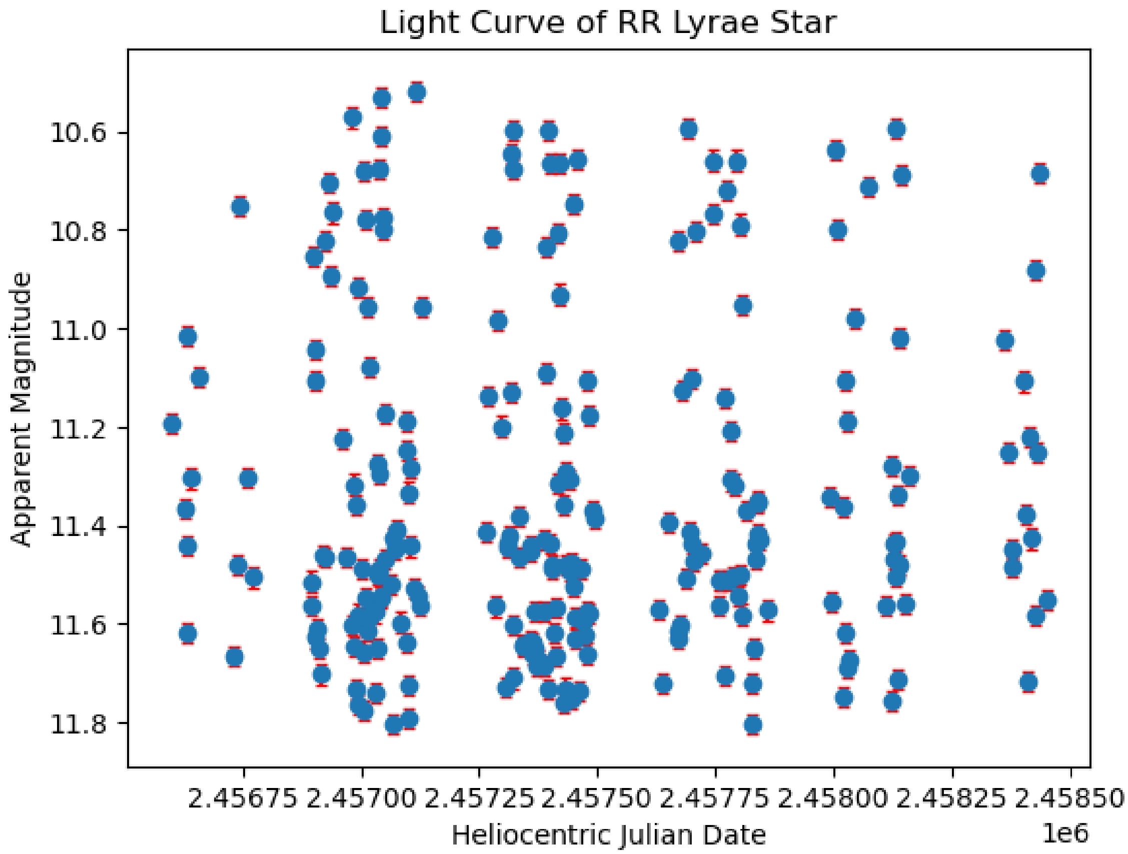
```
hjd        0
mag        0
mag_err    0
dtype: int64
```

```python
import matplotlib.pyplot as plt

# Plot the Light Curve
plt.figure(figsize=(10, 6))
plt.errorbar(data['hjd'], data['mag'], yerr=data['mag_err'], fmt='o',
color='blue', alpha=0.5)
plt.xlabel('Heliocentric Julian Date (HJD)')
plt.ylabel('Magnitude')
plt.title('Light Curve of the RR Lyrae Variable Star')
```

```
plt.gca().invert_yaxis()
plt.show()
```



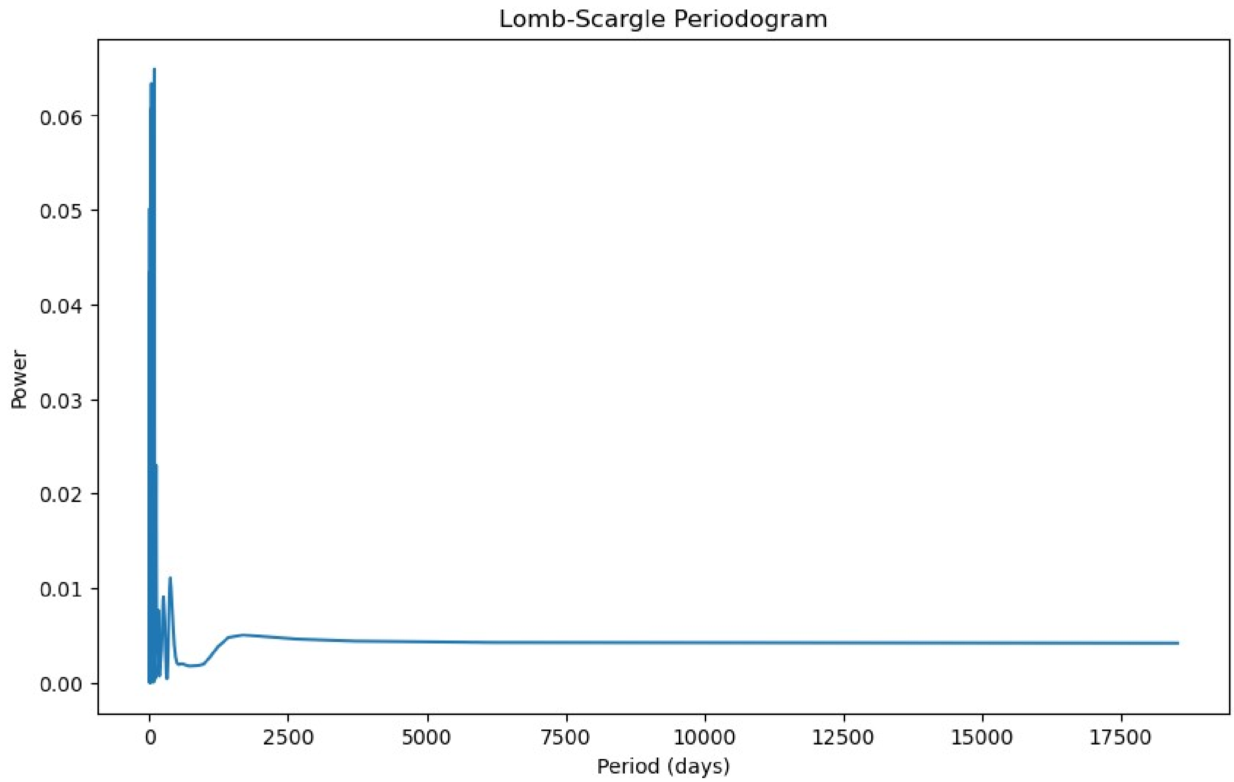

```
# Plot the light curve
plt.errorbar(data['hjd'], data['mag'], yerr=data['mag_err'], fmt='o',
ecolor='r', capsize=2)
plt.gca().invert_yaxis()  # Invert y-axis to have brighter magnitudes
on top
plt.xlabel('Heliocentric Julian Date')
plt.ylabel('Apparent Magnitude')
plt.title('Light Curve of RR Lyrae Star')
plt.show()
```




```python
from astropy.timeseries import LombScargle
import numpy as np
# Calculate the Lomb-Scargle periodogram
frequency, power = LombScargle(data['hjd'], data['mag']).autopower()

# Find the best frequency
best_frequency = frequency[np.argmax(power)]
best_period = 1 / best_frequency

print(f"Best period: {best_period} days")
```

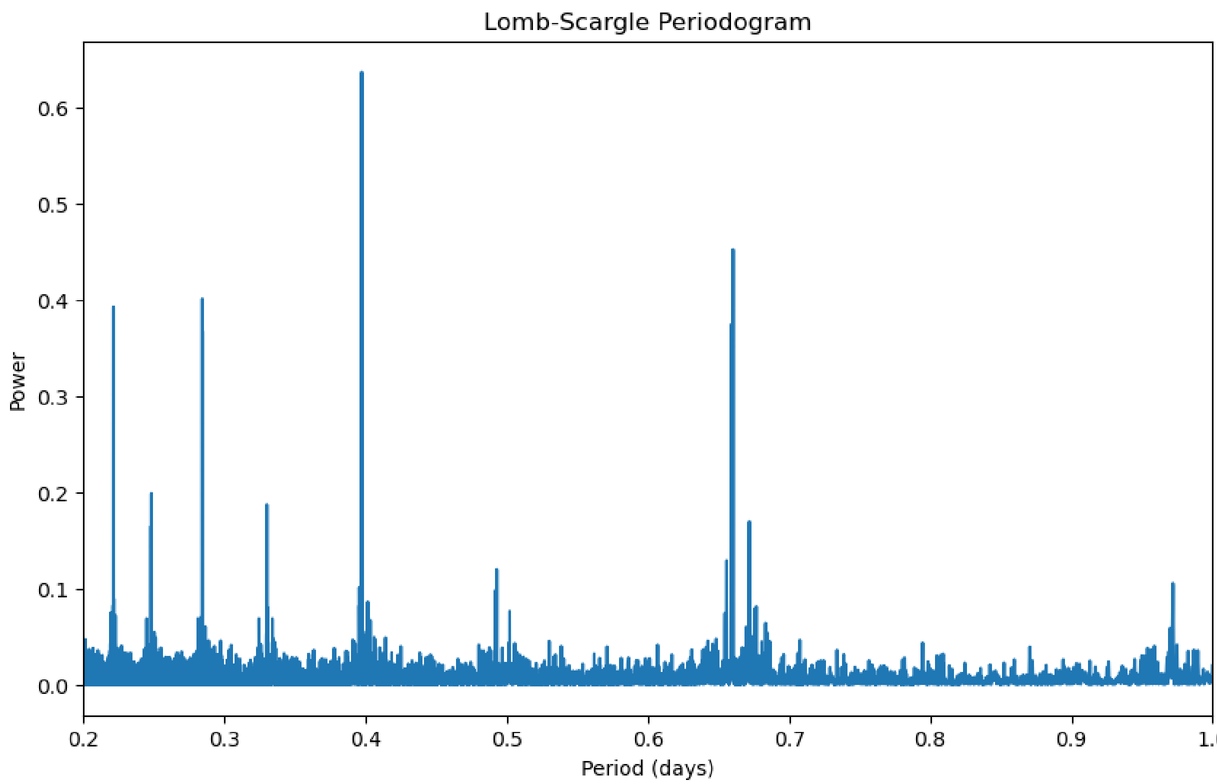
```
Best period: 94.06435228428013 days
```

```python
# Calculate the Lomb-Scargle periodogram
frequency, power = LombScargle(data['hjd'], data['mag']).autopower()

# Plot the periodogram
plt.figure(figsize=(10, 6))
plt.plot(1/frequency, power)
plt.xlabel('Period (days)')
plt.ylabel('Power')
plt.title('Lomb-Scargle Periodogram')
plt.show()
```



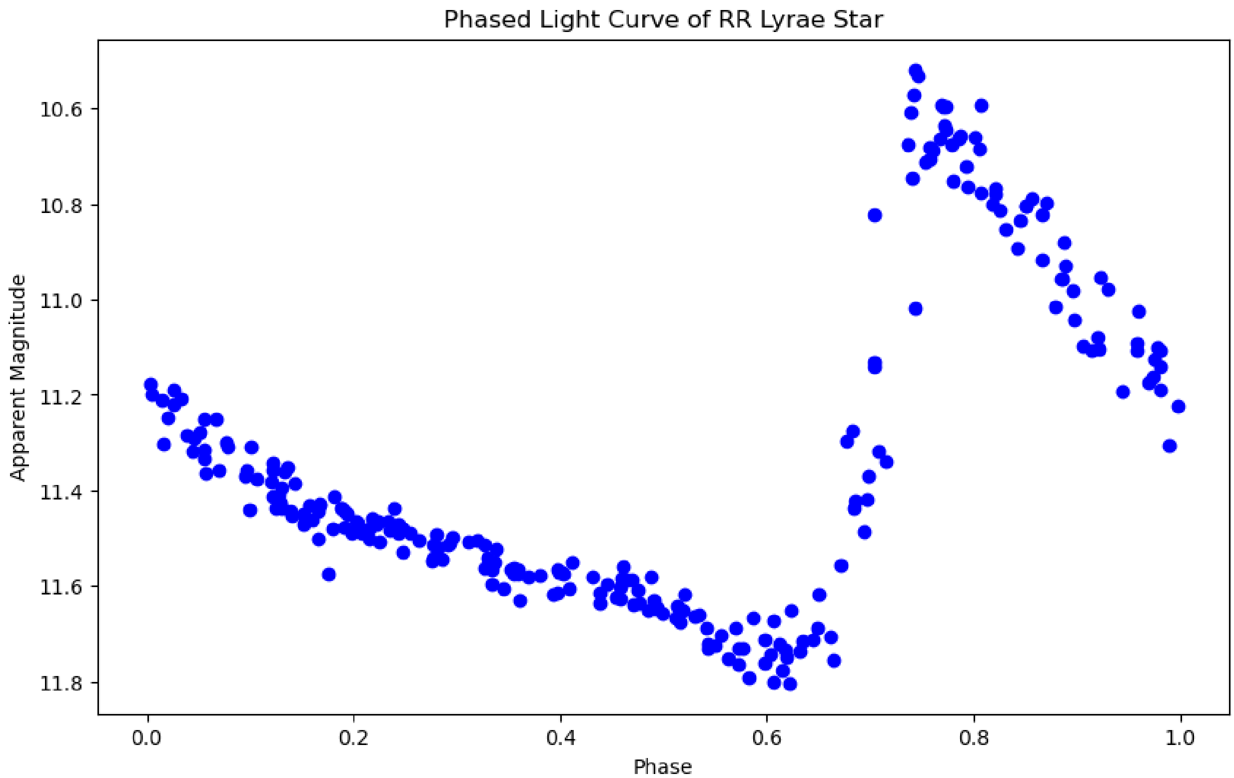

```
from astropy.timeseries import LombScargle
import numpy as np

# Define the period range for RR Lyrae stars
min_period = 0.2  # days
max_period = 1.0  # days
min_frequency = 1 / max_period
max_frequency = 1 / min_period

# Calculate the Lomb-Scargle periodogram within the restricted
frequency range
frequency, power = LombScargle(data['hjd'],
data['mag']).autopower(minimum_frequency=min_frequency,
maximum_frequency=max_frequency)
frequency, power

(array([1.        , 1.00010793, 1.00021586, ..., 4.99974585,
4.99985378,
        4.99996171]),
 array([0.01971643, 0.01060333, 0.00524978, ..., 0.02298379,
0.02124143,
        0.0178524 ]))

# Plot the periodogram
plt.figure(figsize=(10, 6))
plt.plot(1/frequency, power)
```

```
plt.xlabel('Period (days)')
plt.ylabel('Power')
plt.title('Lomb-Scargle Periodogram')
plt.xlim(min_period, max_period)  # Restrict x-axis to the period
range of interest
plt.show()

# Find the best frequency
best_frequency = frequency[np.argmax(power)]
best_period = 1 / best_frequency

print(f"Best period: {best_period} days")
```




```
Best period: 0.397273138821235 days

# Convert HJD to phase using the best period
data['phase'] = (data['hjd'] % best_period) / best_period

# Sort by phase for a cleaner plot
data = data.sort_values('phase')

# Plot the phased light curve
plt.figure(figsize=(10, 6))
plt.scatter(data['phase'], data['mag'], color='blue')
plt.xlabel('Phase')
```

```
plt.ylabel('Apparent Magnitude')
plt.gca().invert_yaxis()  # Invert y-axis to match the astronomical
convention
plt.title('Phased Light Curve of RR Lyrae Star')
plt.show()
```

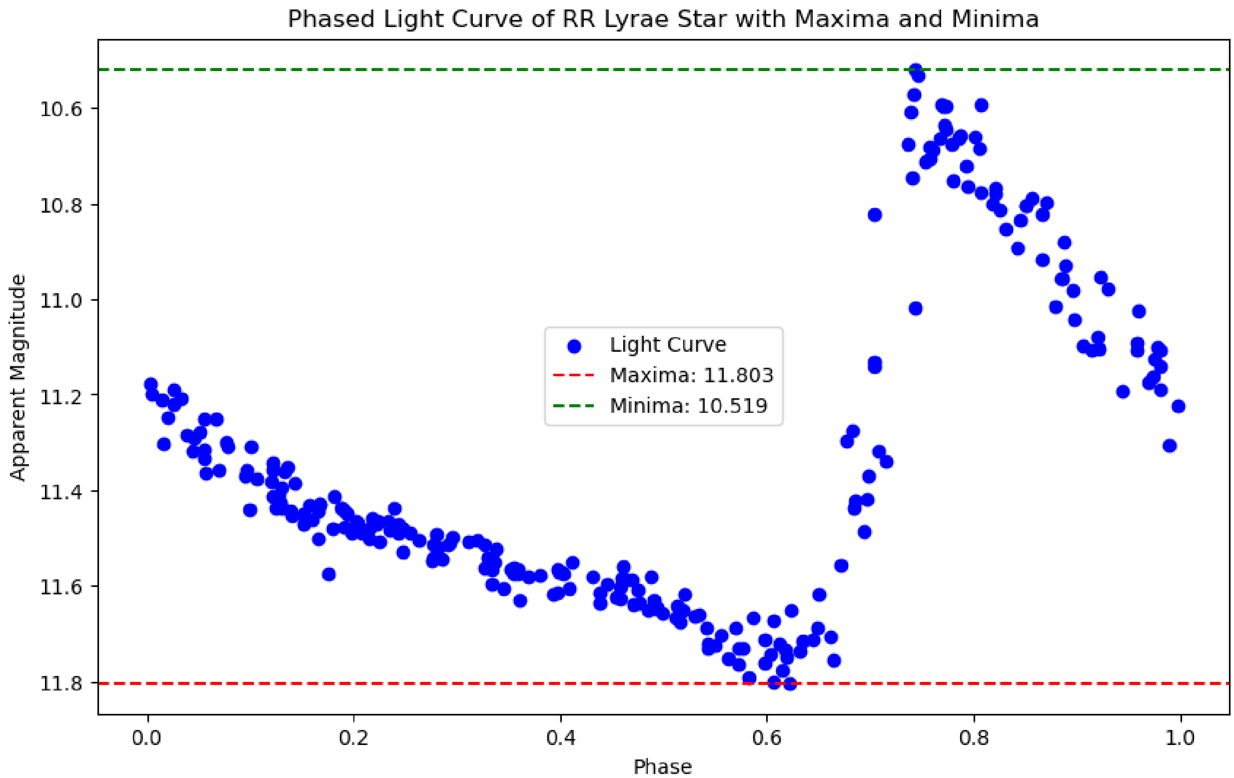



```
# Find maxima and minima
max_magnitude = data['mag'].max()
min_magnitude = data['mag'].min()

# Calculate amplitude
amplitude = max_magnitude - min_magnitude

print(f"Maxima (Magnitude): {max_magnitude}")
print(f"Minima (Magnitude): {min_magnitude}")
print(f"Amplitude: {amplitude}")
```

```
Maxima (Magnitude): 11.803
Minima (Magnitude): 10.519
Amplitude: 1.2840000000000007
```

```
# Plot the phased light curve with maxima and minima
plt.figure(figsize=(10, 6))
plt.scatter(data['phase'], data['mag'], color='blue', label='Light
Curve')
```

```
plt.axhline(y=max_magnitude, color='red', linestyle='--',
label=f'Maxima: {max_magnitude}')
plt.axhline(y=min_magnitude, color='green', linestyle='--',
label=f'Minima: {min_magnitude}')
plt.xlabel('Phase')
plt.ylabel('Apparent Magnitude')
plt.gca().invert_yaxis()  # Invert y-axis to match the astronomical
convention
plt.title('Phased Light Curve of RR Lyrae Star with Maxima and
Minima')
plt.legend()
plt.show()
```




```
# Summary of Analysis for RR Lyrae Variable Star Dataset

# 1. Load and Explore the Dataset
# - Loaded the RR Lyrae Variable Star dataset
# - Checked for duplicate entries and missing values in the dataset

# 2. Plot the Light Curve
# - Plotted the light curve showing the variation in magnitude over
time
# - Inverted the y-axis to display brighter magnitudes at the top

# 3. Calculate the Lomb-Scargle Periodogram
```

```
# - Used the Lomb-Scargle method to analyze periodicity in the star's
brightness variations
# - Determined the best period of the star's brightness variations

# 4. Plot the Lomb-Scargle Periodogram
# - Visualized the Lomb-Scargle periodogram to show the power spectrum
of the star's brightness variations

# 5. Phased Light Curve Analysis
# - Converted the Heliocentric Julian Date (HJD) to phase using the
best period
# - Sorted the data by phase for a clearer plot
# - Plotted the phased light curve to show the periodic behavior of
the star

# 6. Identify Maxima, Minima, and Amplitude
# - Found the maximum and minimum magnitudes in the dataset
# - Calculated the amplitude of the star's brightness variations

# 7. Plot Phased Light Curve with Maxima and Minima
# - Visualized the phased light curve with markers for maxima and
minima
# - Highlighted the maximum and minimum magnitudes on the plot

# This code provides a comprehensive analysis of the RR Lyrae Variable
Star dataset, including period determination, phased light curve
visualization, and identification of key features in the star's
brightness variations.
```