In [1]:
```
#Name-Pawar ved balsaheb(T512037)
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import seaborn as sns
%matplotlib inline
from sklearn.metrics import mean_squared_error,mean_absolute_error,r2_score
```

In [3]:
```
temp_dataset = pd.read_csv('temperatures.csv')
temp_dataset
```

Out[3]:

	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	
0	1901	22.40	24.14	29.07	31.91	33.41	33.18	31.21	30.39	30.47	29.97	27.31	2
1	1902	24.93	26.58	29.77	31.78	33.73	32.91	30.92	30.73	29.80	29.12	26.31	2
2	1903	23.44	25.03	27.83	31.39	32.91	33.00	31.34	29.98	29.85	29.04	26.08	2
3	1904	22.50	24.73	28.21	32.02	32.64	32.07	30.36	30.09	30.04	29.20	26.36	2
4	1905	22.00	22.83	26.68	30.01	33.32	33.25	31.44	30.68	30.12	30.67	27.52	2
...	...	...	...	...	...	...	...	...	...	...	...	...	
112	2013	24.56	26.59	30.62	32.66	34.46	32.44	31.07	30.76	31.04	30.27	27.83	2
113	2014	23.83	25.97	28.95	32.74	33.77	34.15	31.85	31.32	30.68	30.29	28.05	2
114	2015	24.58	26.89	29.07	31.87	34.09	32.48	31.88	31.52	31.55	31.04	28.10	2
115	2016	26.94	29.72	32.62	35.38	35.72	34.03	31.64	31.79	31.66	31.98	30.11	2
116	2017	26.45	29.46	31.60	34.95	35.84	33.82	31.88	31.72	32.22	32.29	29.60	2

117 rows × 18 columns

In [5]:
```
temp_dataset.shape
```

Out[5]: (117, 18)

In [7]:
```
temp_dataset.describe().T
```

Out[7]:

	count	mean	std	min	25%	50%	75%	max
YEAR	117.0	1959.000000	33.919021	1901.00	1930.00	1959.00	1988.00	2017.00
JAN	117.0	23.687436	0.834588	22.00	23.10	23.68	24.18	26.94
FEB	117.0	25.597863	1.150757	22.83	24.78	25.48	26.31	29.72
MAR	117.0	29.085983	1.068451	26.68	28.37	29.04	29.61	32.62
APR	117.0	31.975812	0.889478	30.01	31.46	31.95	32.42	35.38
MAY	117.0	33.565299	0.724905	31.93	33.11	33.51	34.03	35.84
JUN	117.0	32.774274	0.633132	31.10	32.34	32.73	33.18	34.48
JUL	117.0	31.035897	0.468818	29.76	30.74	31.00	31.33	32.76
AUG	117.0	30.507692	0.476312	29.31	30.18	30.54	30.76	31.84
SEP	117.0	30.486752	0.544295	29.07	30.12	30.52	30.81	32.22
OCT	117.0	29.766581	0.705492	27.90	29.38	29.78	30.17	32.29
NOV	117.0	27.285470	0.714518	25.70	26.79	27.30	27.72	30.11
DEC	117.0	24.608291	0.782644	23.02	24.04	24.66	25.11	28.01
ANNUAL	117.0	29.181368	0.555555	28.11	28.76	29.09	29.47	31.63
JAN-FEB	117.0	24.629573	0.911239	22.25	24.11	24.53	25.15	28.33
MAR-MAY	117.0	31.517607	0.740585	29.92	31.04	31.47	31.89	34.57
JUN-SEP	117.0	31.198205	0.420508	30.24	30.92	31.19	31.40	32.41
OCT-DEC	117.0	27.208120	0.672003	25.74	26.70	27.21	27.61	30.03

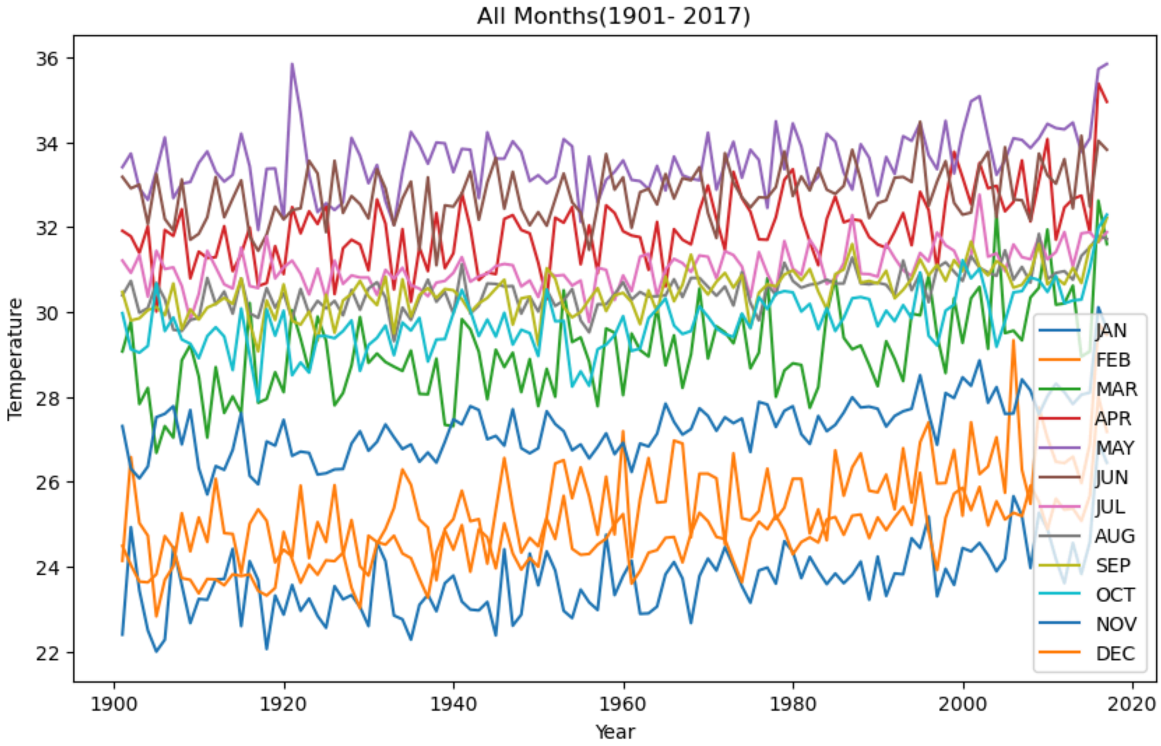
In [9]:

```
temp_dataset.isnull().sum()
```

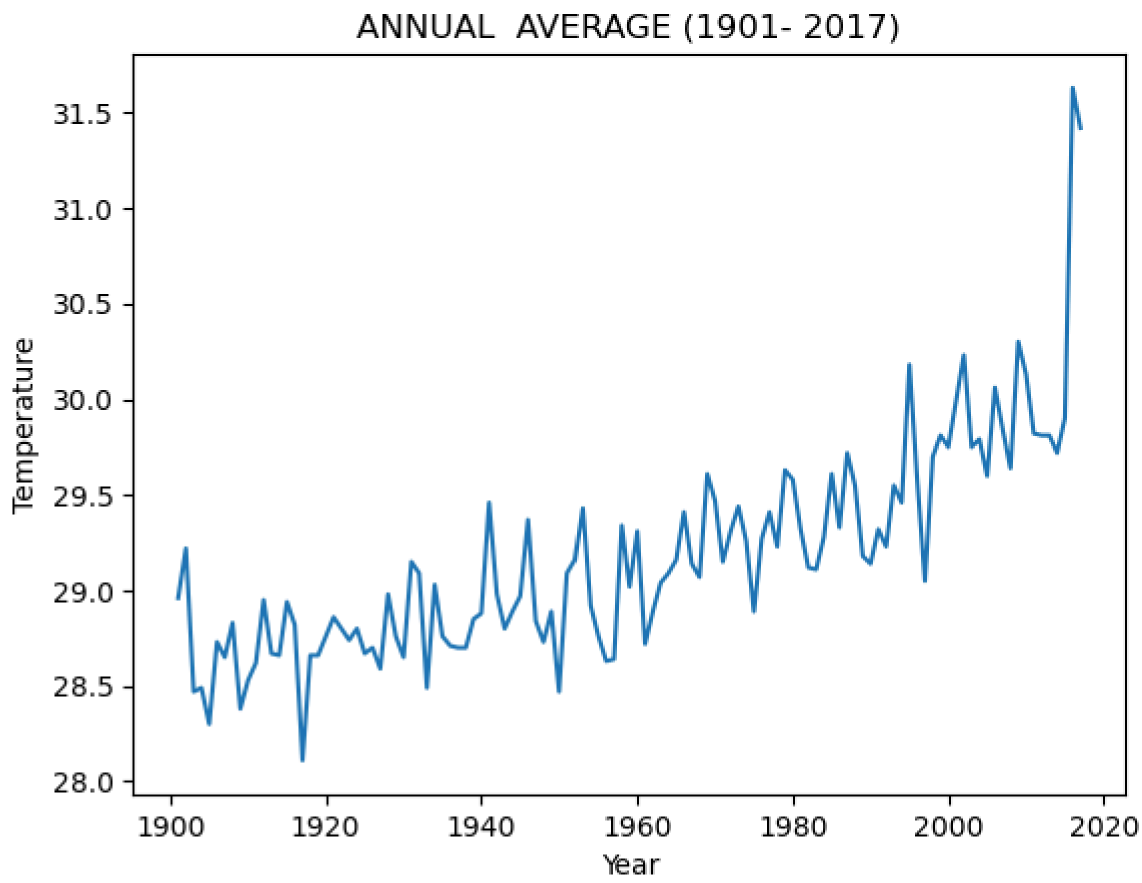
Out[9]:

```
YEAR        0
JAN         0
FEB         0
MAR         0
APR         0
MAY         0
JUN         0
JUL         0
AUG         0
SEP         0
OCT         0
NOV         0
DEC         0
ANNUAL      0
JAN-FEB     0
MAR-MAY     0
JUN-SEP     0
OCT-DEC     0
dtype: int64
```

In [11]:
```
plt.figure(figsize=(10,6))
plt.plot(temp_dataset["YEAR"],temp_dataset.iloc[:,1:13])
plt.xlabel("Year")
plt.ylabel("Temperature")
plt.title("All Months(1901- 2017)")
plt.legend(["JAN","FEB","MAR","APR","MAY","JUN","JUL","AUG","SEP","OCT","NOV","D
plt.show()
```



In [13]:
```
plt.plot(temp_dataset["YEAR"],temp_dataset["ANNUAL"])
plt.xlabel("Year")
plt.ylabel("Temperature")
plt.title("ANNUAL  AVERAGE (1901- 2017)")
plt.show()
```



In [15]:
```
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression

X=temp_dataset[["YEAR"]]
y=temp_dataset["JAN"]

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, rando
print(X_train.shape, X_test.shape)

# instantiate the model
lr = LinearRegression()

# fit the model
lr.fit(X_train, y_train)

#predicting the target value from the model for the samples
y_test_lr = lr.predict(X_test)
y_train_lr = lr.predict(X_train)
```

```
(93, 1) (24, 1)
```

In [17]:
```
print("Intercept",lr.intercept_)
print("Slope",lr.coef_)
```

```
Intercept 0.04088196282960865
Slope [0.01206848]
```

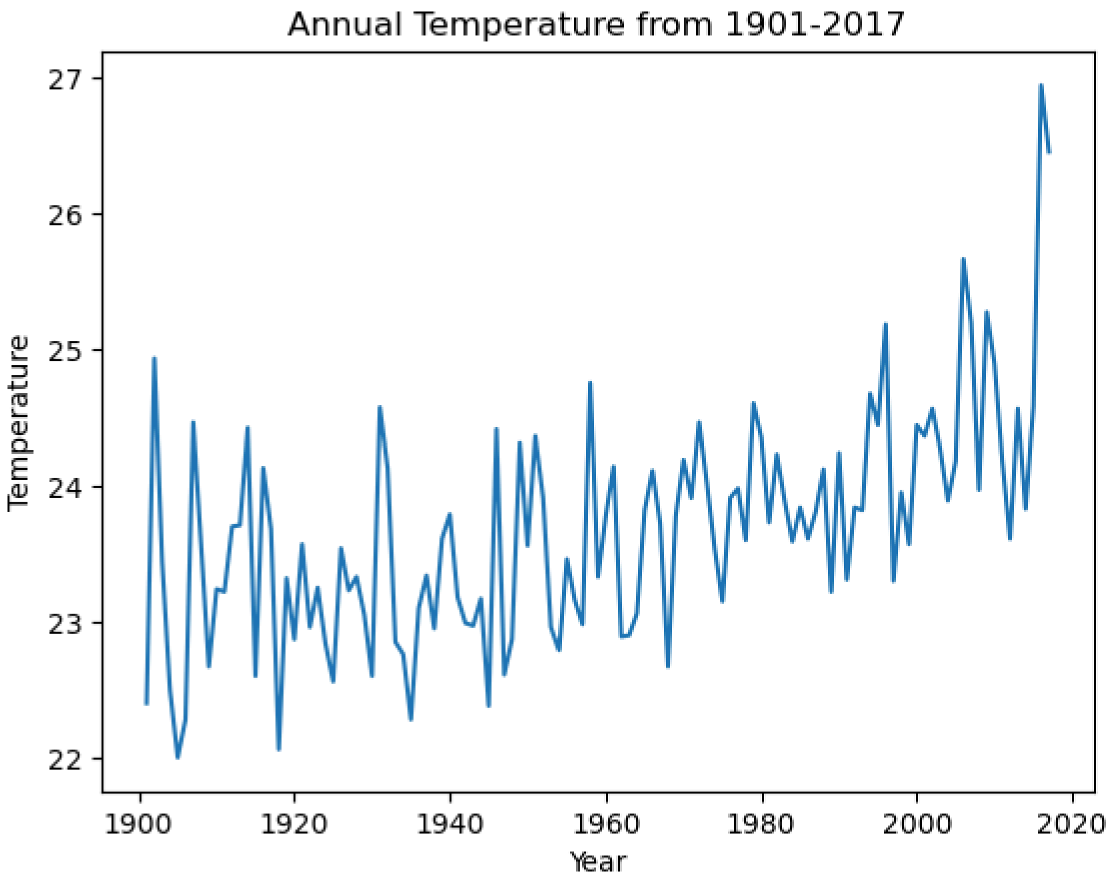
In [19]:
```
#computing the accuracy of the model performance
acc_train_lr = lr.score(X_train, y_train)
acc_test_lr = lr.score(X_test, y_test)

#computing root mean squared error (RMSE)
rmse_train_lr = np.sqrt(mean_squared_error(y_train, y_train_lr))
```

```python
rmse_test_lr = np.sqrt(mean_squared_error(y_test, y_test_lr))

print("Linear Regression: Accuracy on training Data: {:.3f}".format(acc_train_lr
print("Linear Regression: Accuracy on test Data: {:.3f}".format(acc_test_lr))
print('\nLinear Regression: The RMSE of the training set is:', rmse_train_lr)
print('Linear Regression: The RMSE of the testing set is:', rmse_test_lr)
```

```
Linear Regression: Accuracy on training Data: 0.264
Linear Regression: Accuracy on test Data: 0.460

Linear Regression: The RMSE of the training set is: 0.6660910902332355
Linear Regression: The RMSE of the testing set is: 0.7461610613861772
```

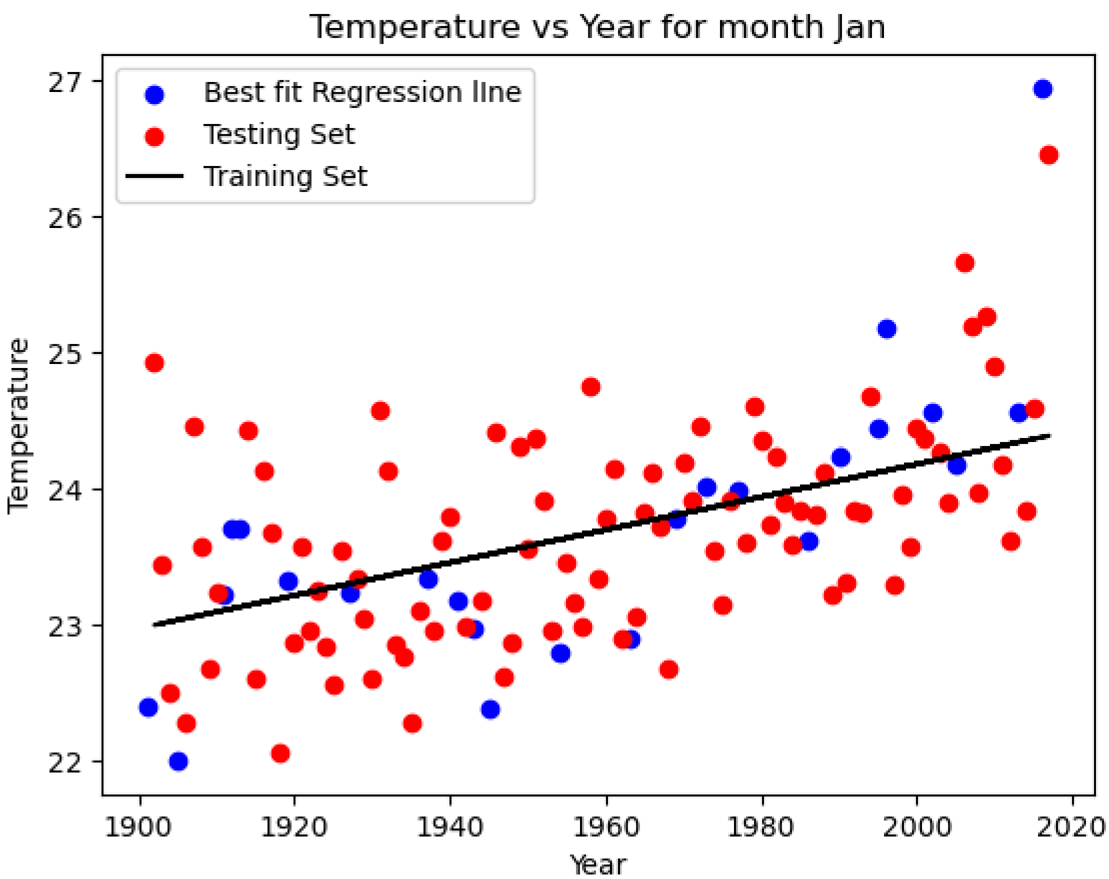
In [21]:

```python
#visulaize annaul temperature
plt.plot(X,y)
plt.xlabel("Year")
plt.ylabel("Temperature")
plt.title("Annual Temperature from 1901-2017")
plt.show()
```



In [23]:

```python
# Visualization
#plt.figure(figsize=(8, 6))
plt.scatter(X_test,y_test,color = 'blue');
plt.scatter(X_train,y_train,color = 'red');
plt.plot(X_train,lr.predict(X_train), color = 'black');
plt.legend(['Best fit Regression lIne','Testing Set','Training Set'])
plt.title('Temperature vs Year for month Jan')
plt.xlabel('Year')
plt.ylabel('Temperature')
plt.show();
```



In [25]:
```
#Errors for month Jan
print('R-Squared Error :',r2_score(y_test,y_test_lr))
print('Mean Absolute Error :',mean_absolute_error(y_test,y_test_lr))
print('Mean Squared Error :',mean_squared_error(y_test,y_test_lr))
print('Root Mean Squared Error :',np.sqrt(mean_squared_error(y_test,y_test_lr)))
```

```
R-Squared Error : 0.4601171648515957
Mean Absolute Error : 0.5083956669577453
Mean Squared Error : 0.5567563295289465
Root Mean Squared Error : 0.7461610613861772
```

In [27]:
```
# Split the dataset into training and testing

from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression

X=temp_dataset[["YEAR"]]
y=temp_dataset["FEB"]
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, randc
print(X_train.shape, X_test.shape)

# instantiate the model
lr = LinearRegression()
# fit the model
lr.fit(X_train, y_train)

#predicting the target value from the model for the samples
y_test_lr = lr.predict(X_test)
y_train_lr = lr.predict(X_train)
```

```
(93, 1) (24, 1)
```

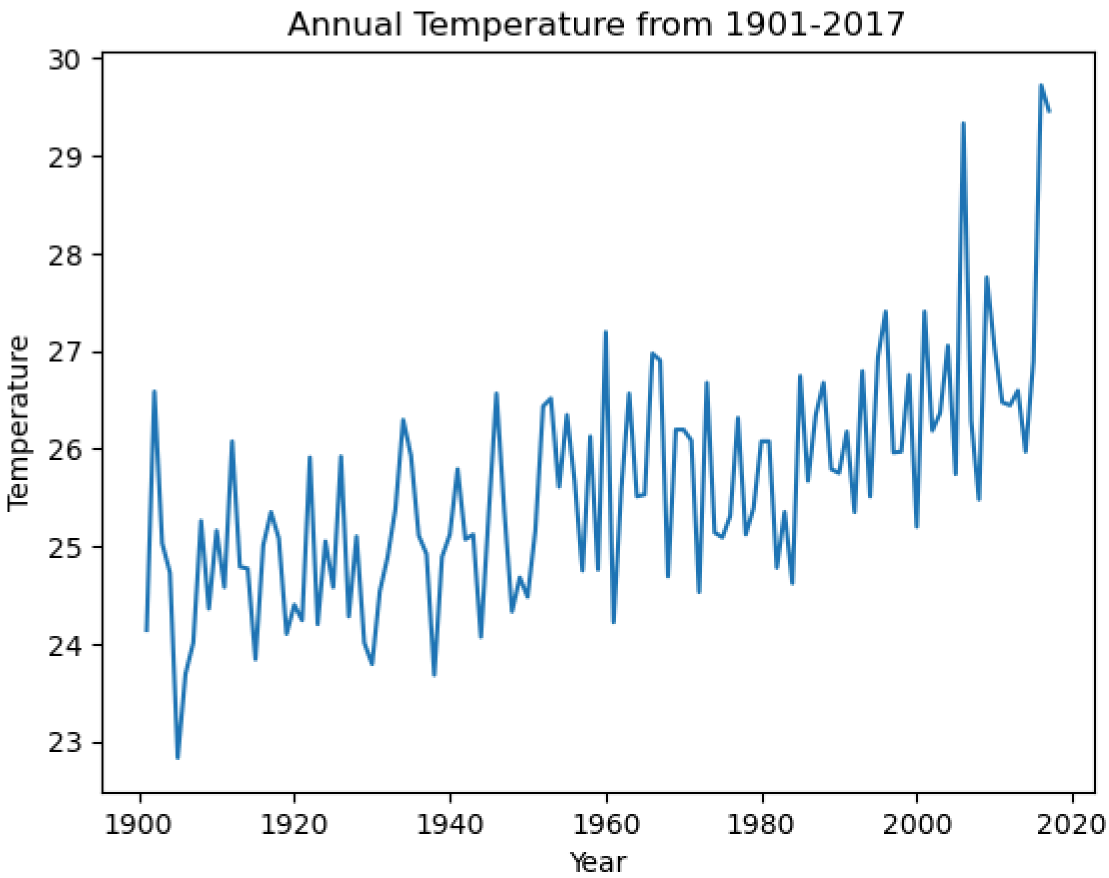
In [29]:
```
print("Intercept",lr.intercept_)
print("Slope",lr.coef_)
```

```
Intercept -13.589454788386252
Slope [0.01998518]
```

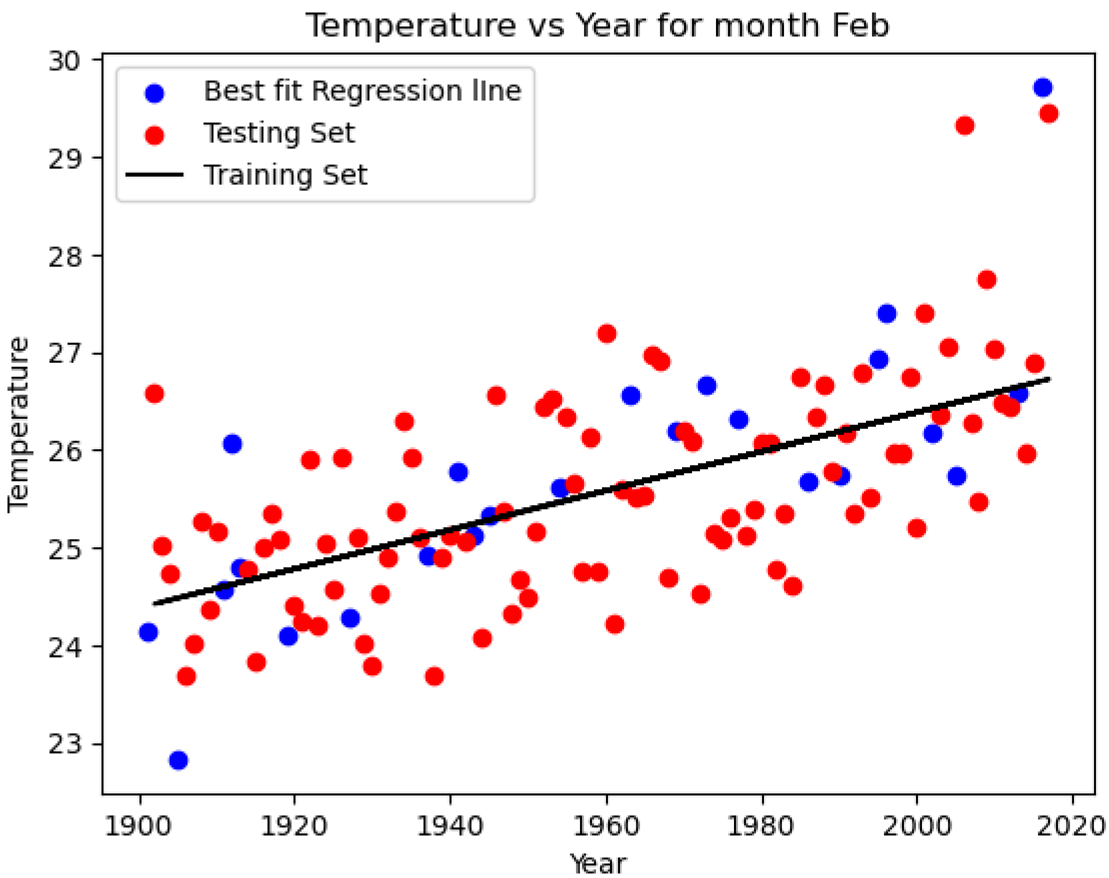
In [31]:
```
#computing the accuracy of the model performance
acc_train_lr = lr.score(X_train, y_train)
acc_test_lr = lr.score(X_test, y_test)

#computing root mean squared error (RMSE)
rmse_train_lr = np.sqrt(mean_squared_error(y_train, y_train_lr))
rmse_test_lr = np.sqrt(mean_squared_error(y_test, y_test_lr))

print("Linear Regression: Accuracy on training Data: {:.3f}".format(acc_train_lr
print("Linear Regression: Accuracy on test Data: {:.3f}".format(acc_test_lr))
print('\nLinear Regression: The RMSE of the training set is:', rmse_train_lr)
print('Linear Regression: The RMSE of the testing set is:', rmse_test_lr)
```

```
Linear Regression: Accuracy on training Data: 0.366
Linear Regression: Accuracy on test Data: 0.534

Linear Regression: The RMSE of the training set is: 0.8686967555951215
Linear Regression: The RMSE of the testing set is: 0.9079689831221699
```

In [33]:
```
#visulaize annaul temperature
plt.plot( X,y )
plt.xlabel("Year")
plt.ylabel("Temperature")
plt.title("Annual Temperature from 1901-2017")
plt.show()
```



In [35]:
```
# Visualization
#plt.figure(figsize=(12, 9))
plt.scatter(X_test,y_test,color = 'blue');
plt.scatter(X_train,y_train,color = 'red');
plt.plot(X_train,lr.predict(X_train), color = 'black');
plt.legend(['Best fit Regression lIne','Testing Set','Training Set'])
plt.title('Temperature vs Year for month Feb')
plt.ylabel('Temperature')
plt.xlabel('Year')
plt.show();
```



In [37]:
```
#Errors for month Feb
print('R-Squared Error :',r2_score(y_test,y_test_lr))
print('Mean Absolute Error :',mean_absolute_error(y_test,y_test_lr))
print('Mean Squared Error :',mean_squared_error(y_test,y_test_lr))
print('Root Mean Squared Error :',np.sqrt(mean_squared_error(y_test,y_test_lr)))
```

```
R-Squared Error : 0.5337774396814265
Mean Absolute Error : 0.6321543551026766
Mean Squared Error : 0.8244076743119072
Root Mean Squared Error : 0.9079689831221699
```

In [39]:
```
# Split the dataset into training and testing

from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression

X=temp_dataset[["YEAR"]]
y=temp_dataset["MAR"]
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, randc
print(X_train.shape, X_test.shape)
```

```
# instantiate the model
lr = LinearRegression()
# fit the model
lr.fit(X_train, y_train)

#predicting the target value from the model for the samples
y_test_lr = lr.predict(X_test)
y_train_lr = lr.predict(X_train)
```

```
(93, 1) (24, 1)
```

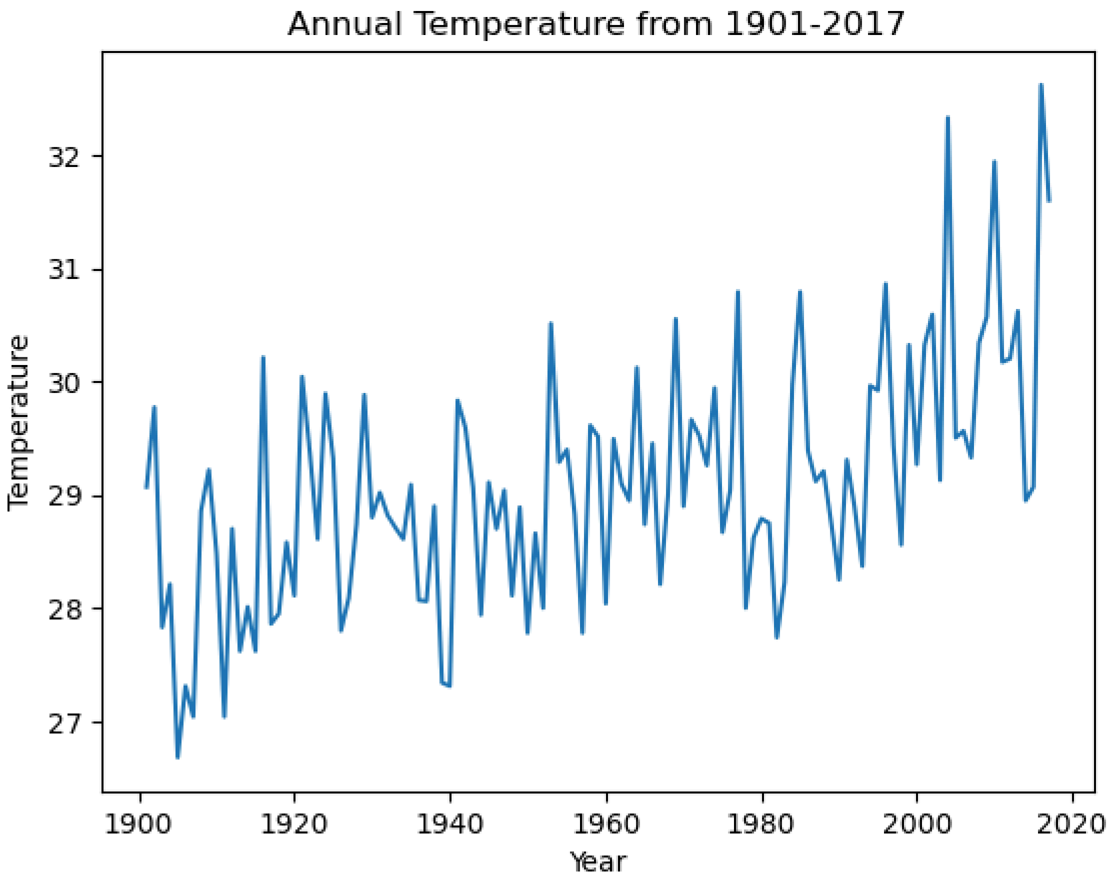
In [41]:
```
print("Intercept",lr.intercept_)
print("Slope",lr.coef_)
```

```
Intercept 0.8326151493664895
Slope [0.01439656]
```

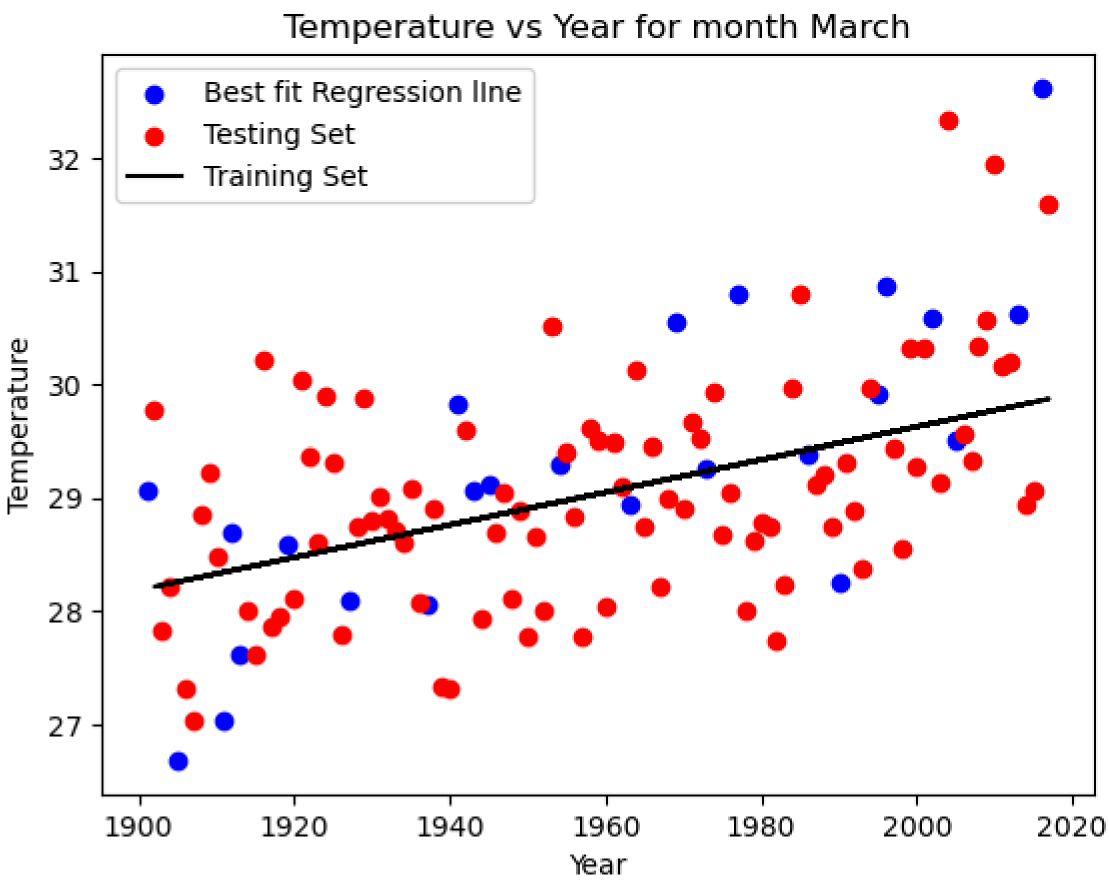
In [43]:
```
#computing the accuracy of the model performance
acc_train_lr = lr.score(X_train, y_train)
acc_test_lr = lr.score(X_test, y_test)

#computing root mean squared error (RMSE)
rmse_train_lr = np.sqrt(mean_squared_error(y_train, y_train_lr))
rmse_test_lr = np.sqrt(mean_squared_error(y_test, y_test_lr))

print("Linear Regression: Accuracy on training Data: {:.3f}".format(acc_train_lr
print("Linear Regression: Accuracy on test Data: {:.3f}".format(acc_test_lr))
print('\nLinear Regression: The RMSE of the training set is:', rmse_train_lr)
print('Linear Regression: The RMSE of the testing set is:', rmse_test_lr)
```

```
Linear Regression: Accuracy on training Data: 0.234
Linear Regression: Accuracy on test Data: 0.412

Linear Regression: The RMSE of the training set is: 0.8613784589579908
Linear Regression: The RMSE of the testing set is: 1.0069570422964147
```

In [45]:
```
#visulaize annaul temperature
plt.plot( X,y )
plt.xlabel("Year")
plt.ylabel("Temperature")
plt.title("Annual Temperature from 1901-2017")
plt.show()
```



In [47]:
```
# Visualization
#plt.figure(figsize=(12, 9))
plt.scatter(X_test,y_test,color = 'blue');
plt.scatter(X_train,y_train,color = 'red');
plt.plot(X_train,lr.predict(X_train), color = 'black');
plt.legend(['Best fit Regression lIne','Testing Set','Training Set'])
plt.title('Temperature vs Year for month March')
plt.ylabel('Temperature')
plt.xlabel('Year')
plt.show();
```



In [49]:
```
#Errors for month March
print('R-Squared Error :',r2_score(y_test,y_test_lr))
print('Mean Absolute Error :',mean_absolute_error(y_test,y_test_lr))
print('Mean Squared Error :',mean_squared_error(y_test,y_test_lr))
print('Root Mean Squared Error :',np.sqrt(mean_squared_error(y_test,y_test_lr)))
```

```
R-Squared Error : 0.41193423910621496
Mean Absolute Error : 0.7784057105758042
Mean Squared Error : 1.0139624850303435
Root Mean Squared Error : 1.0069570422964147
```

In [51]:
```
# Split the dataset into training and testing

from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression

X=temp_dataset[["YEAR"]]
y=temp_dataset["MAR-MAY"]
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, randc
print(X_train.shape, X_test.shape)

# instantiate the model
lr = LinearRegression()
# fit the model
lr.fit(X_train, y_train)

#predicting the target value from the model for the samples
y_test_lr = lr.predict(X_test)
y_train_lr = lr.predict(X_train)
```

```
(93, 1) (24, 1)
```

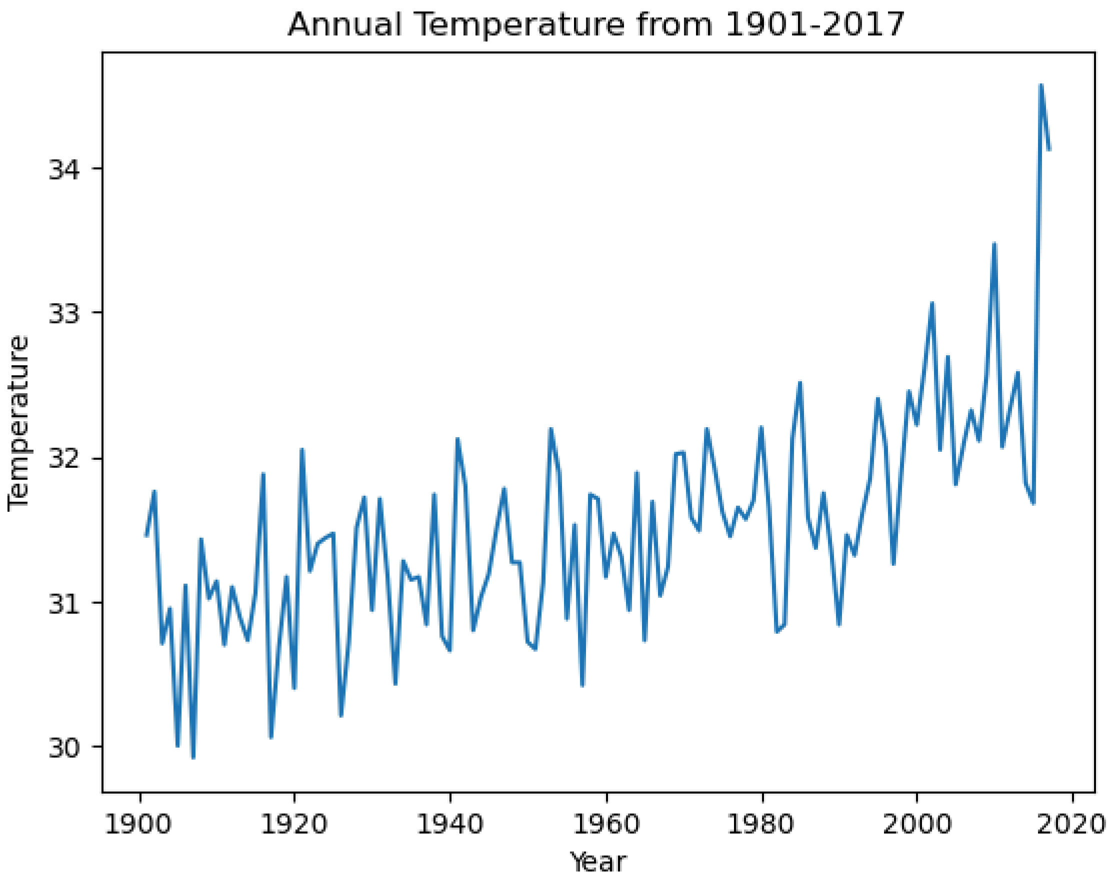
In [53]:
```
print("Intercept",lr.intercept_)
print("Slope",lr.coef_)
```

```
Intercept 6.838794003180691
Slope [0.01258417]
```

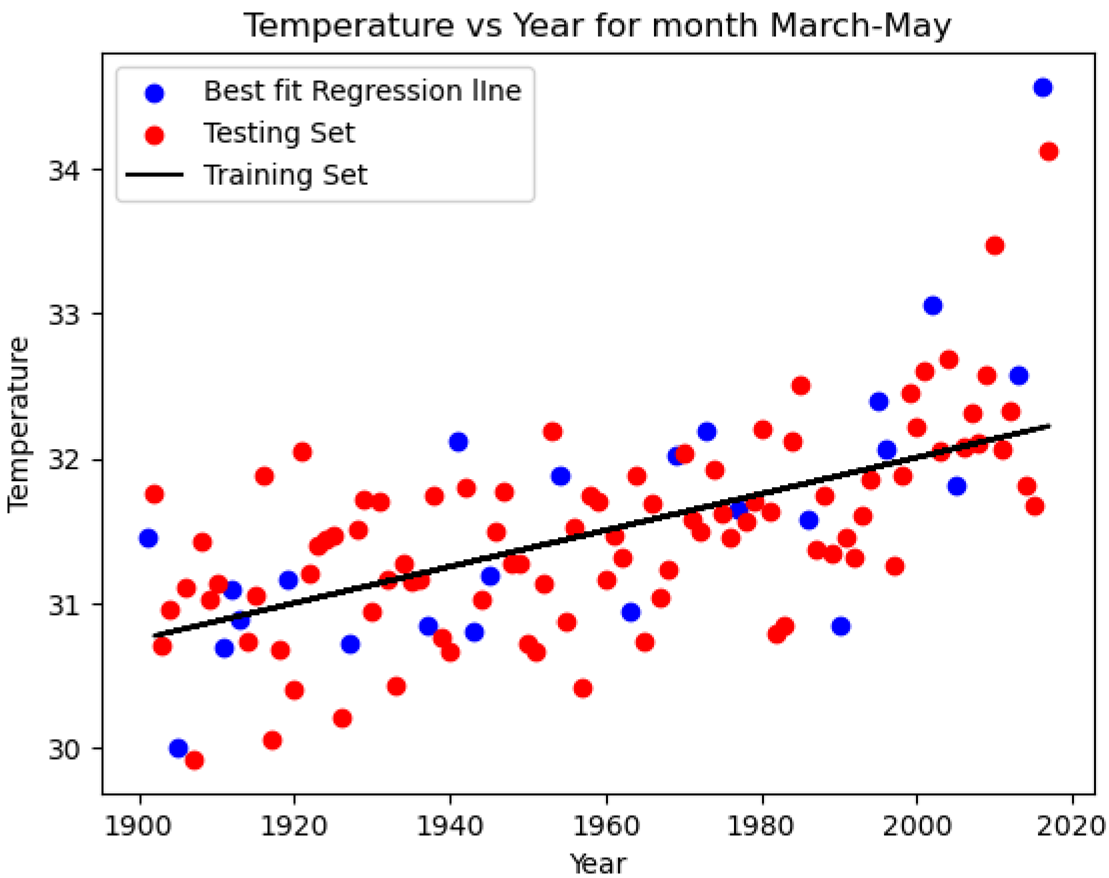
In [55]:
```
#computing the accuracy of the model performance
acc_train_lr = lr.score(X_train, y_train)
acc_test_lr = lr.score(X_test, y_test)

#computing root mean squared error (RMSE)
rmse_train_lr = np.sqrt(mean_squared_error(y_train, y_train_lr))
rmse_test_lr = np.sqrt(mean_squared_error(y_test, y_test_lr))

print("Linear Regression: Accuracy on training Data: {:.3f}".format(acc_train_lr
print("Linear Regression: Accuracy on test Data: {:.3f}".format(acc_test_lr))
print('\nLinear Regression: The RMSE of the training set is:', rmse_train_lr)
print('Linear Regression: The RMSE of the testing set is:', rmse_test_lr)
```

```
Linear Regression: Accuracy on training Data: 0.381
Linear Regression: Accuracy on test Data: 0.445

Linear Regression: The RMSE of the training set is: 0.5297583992887077
Linear Regression: The RMSE of the testing set is: 0.7002924995190984
```

In [57]:
```
#visulaize annaul temperature
plt.plot(X,y)
plt.xlabel("Year")
plt.ylabel("Temperature")
plt.title("Annual Temperature from 1901-2017")
plt.show()
```



In [59]:
```
# Visualization
#plt.figure(figsize=(12, 9))
plt.scatter(X_test,y_test,color = 'blue');
plt.scatter(X_train,y_train,color = 'red');
plt.plot(X_train,lr.predict(X_train), color = 'black');
plt.legend(['Best fit Regression lIne','Testing Set','Training Set'])
plt.title('Temperature vs Year for month March-May')
plt.ylabel('Temperature')
plt.xlabel('Year')
plt.show();
```



In [61]:
```
#Errors for month Mar-May
print('R-Squared Error :',r2_score(y_test,y_test_lr))
print('Mean Absolute Error :',mean_absolute_error(y_test,y_test_lr))
print('Mean Squared Error :',mean_squared_error(y_test,y_test_lr))
print('Root Mean Squared Error :',np.sqrt(mean_squared_error(y_test,y_test_lr)))
```

```
R-Squared Error : 0.4448244662589811
Mean Absolute Error : 0.5121496378249248
Mean Squared Error : 0.49040958488270653
Root Mean Squared Error : 0.7002924995190984
```

In [ ]: