A Computational Model of Okun's Law

Liam Resnick - 9th Grade
Lower Moreland High School

Definitions

Okun's law - An empirically observed relationship between unemployment and losses in a country's production.

Okun’s Coefficient - Represented as C in Okun’s law, it is the factor relating changes in unemployment to changes in output; Okun believed it to be 2.

Cyclical unemployment - Overall unemployment resulting from cycles of economic upturn and downturn.

Gross Domestic Product - Often referred to as GDP, it is the total value of goods produced and services provided.

Research

- Okun's law was postulated by Yale professor and economist Arthur Okun in the early 1960s. Okun's law looks at the statistical relationship between a country's unemployment and economic growth rates.
- The relationship states: $\bar{Y}-Y / \bar{Y} = C\ (U-\bar{U})$

  -$\bar{Y}$ = potential GDP

  -Y = actual output

  -C = factor relating changes in unemployment to changes in output

  -U = actual unemployment rate

  -$\bar{U}$ = natural rate of unemployment

- To isolate Okun's coefficient, the law must be rewritten as: $\bar{Y}-Y / \bar{Y} / (U-\bar{U}) = C$

Background & Expected Outcome

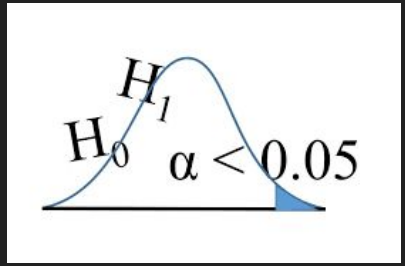
- Okun's law is based on the principle that output depends on the amount of labor used in the production process, so there is a positive relationship between output and employment.
- The data I collected shows that the American economy has been steadily increasing since the 1940s, with the 50s being a key point of economic recovery, and 2008 as well as 2020, being two points of critical economic recession.

Okun predicted a 2% increase GDP ⇨1% decline in the rate of cyclical unemployment. However, smaller external factors would likely increase the percentage of GDP growth to around 3% (correlating to a 1% decrease in unemployment).

Hypothesis & Null

- Hypothesis: Once all real values for Okun's coefficient are averaged, the final outcome will be slightly over the predetermined expectation of 2, as factors such as capacity utilization and hours worked would reduce the effect that unemployment has on GDP.

- Null: Once the real values of Okun's coefficient are averaged, there will be a significant negative disparity between Okun's expected (2), and the final result.



Variables

Independent:

- The inputted data from the last 71 years of documented quarterly reports relating to the American economy

Dependent:

- The subsequent real world values of Okun's coefficient for all quarters, which once averaged, would more accurately model C.

Control:

- The timing of each reporting which has has been fitted to be from the first quarter of 1949 to the last quarter of 2020
- The data came from one reputable source (Federal reserve bank of St. Louis)

Material list

Materials needed for the experiment:

- Computer running windows with a core I7 7th generation processor
- Python 3
- Text Editor - Idle
- Anaconda
- matplotlib

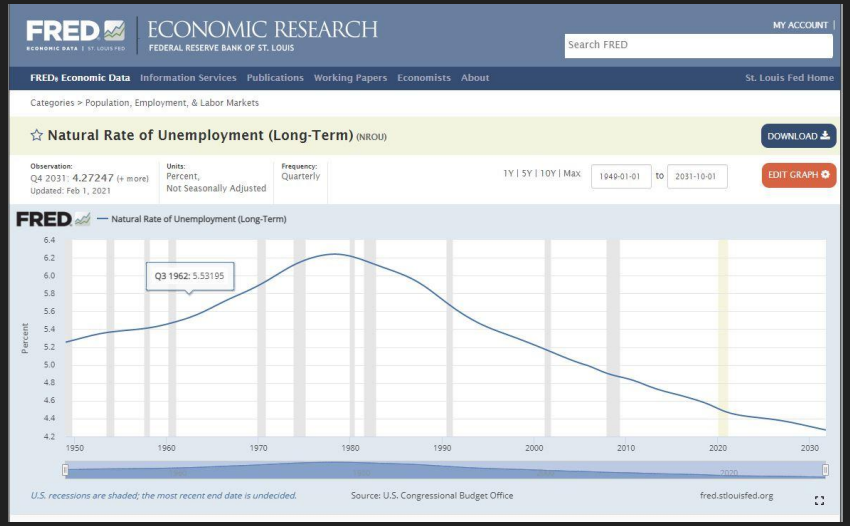
Procedure

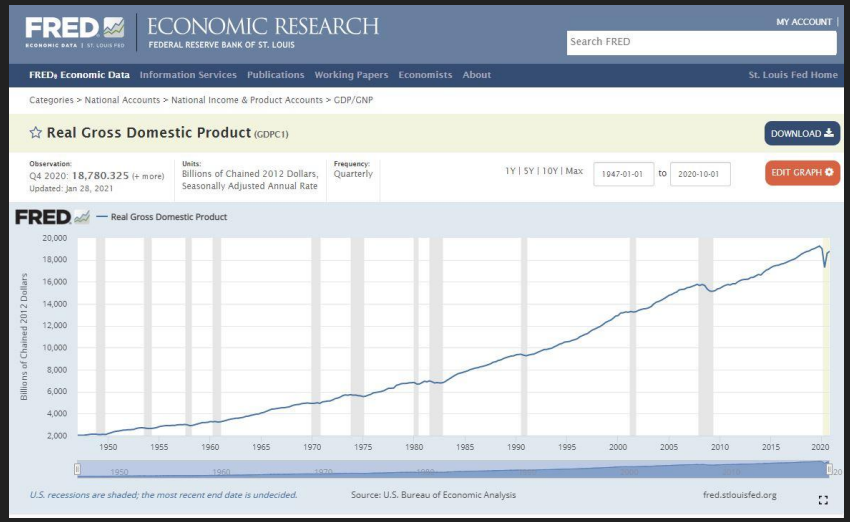
1) The first step in my procedure was researching Okun's law as well as Okun's coefficient to determine if it was possible to create a more accurate value.
2) I had to find the right sources for all my data, download all the information as CSVs, and finally edit the CSVs to make sure dates and values aligned.
3) Applying all of the previously gathered information, I wrote a program in Python 3 which inputs the data sets from the CSVs, organizes them, and reworks the data to output real world C values for every quarter.
4) I ran all the values through matplotlib which outputted a graph, where-in-which I noticed certain outliers which I cut from my final data set as these outliers would greatly affect the average, rendering my result inaccurate.
5) Finally, I averaged the uncut C values to determine the most accurate and true version of Okun's coefficient.

Afterwards I drew my conclusions as to the reasoning of the result

Source for Data

- Federal reserve bank of St. Louis
- Used to ascertain the real/potential GDP as well as real/natural rate of unemployment
- Quarterly reports from quarter 1 1949, to quarter 4 of 2020





Code

```
import csv
from matplotlib import pyplot as plt

dataDict = {}
computedCoeffs = []
computedCoeffsRefined = []
quarters = []
outlierMin = 50

GDPC1_CSV = "Revised_GDPC1.csv"
UNRATE_CSV = "Revised_UNRATE.csv"
NROU_CSV = "Revised_NROU.csv"
GDPPOT_CSV = "Revised_GDPPOT.csv"

csvList = [GDPC1_CSV, UNRATE_CSV, NROU_CSV, GDPPOT_CSV]
```

```
for i in range(0, 288):
    shift = i * 0.25
    date = 1949 + shift
    quarters.append(date)
    dataDict.update({date : []})
```

```
for file in csvList:
    values = []
    with open(file, 'r') as csvFile:
        # iterate through each line
        csvReader = csv.reader(csvFile)

        # skip the first row
        firstRow = next(csvReader)

        for row in csvReader:
            values.append(row[1])

    for i in range(0, 288):
        shift = i * 0.25
        date = 1949 + shift

        # add to current list of values
        currentList = dataDict[date]
        currentList.append(float(values[i]))
        dataDict.update({date : currentList})
```

Code

```
for i in range(0, 288):
    shift = i * 0.25
    date = 1949 + shift

    a = dataDict[date][0]
    b = dataDict[date][1]
    c = dataDict[date][2]
    d = dataDict[date][3]

    # computes accurate okun's constant
    computedCoeffs.append(((d - a) / d) * 100 / (b - c))
```

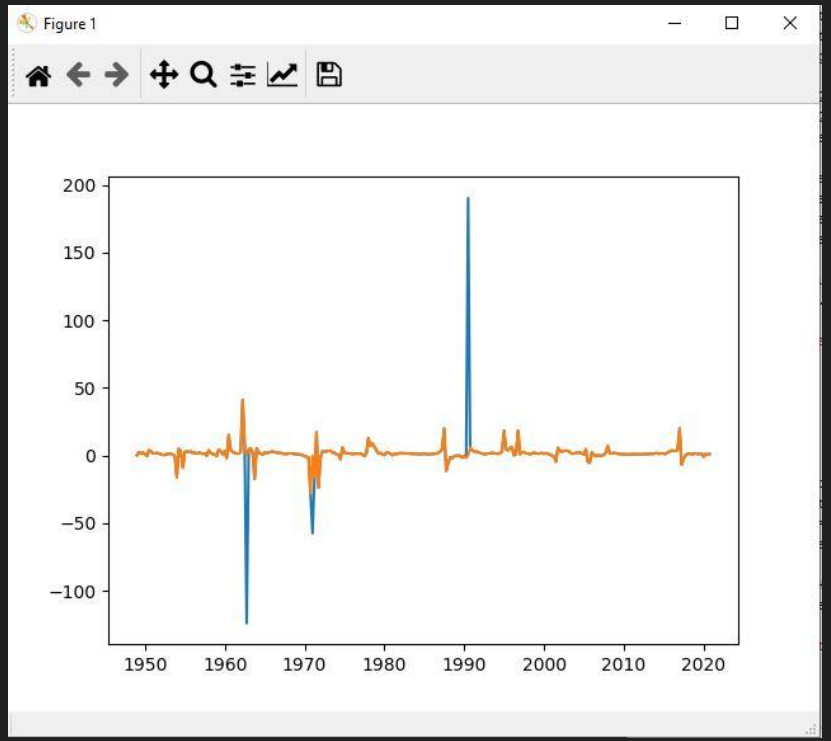
```
# graph with outliers
plt.plot(quarters, computedCoeffs)
#plt.show()

sumNoOuts = 0.0
outliers = 0.0

for x in computedCoeffs:
    if abs(x) > outlierMin:
        outliers += 1.0
        computedCoeffsRefined.append(0.0)
    else:
        sumNoOuts += x
        computedCoeffsRefined.append(x)

# graph without outliers
plt.plot(quarters, computedCoeffsRefined)
plt.show()
print(outliers)
print(sumNoOuts / (len(quarters) - outliers))
```

Data




```
(base) C:\Users\liamr\Desktop\Coding\PJAS 2021>python main.py
3.0
1.685621959284021
```

Summary

- The code I wrote successfully inputted the economic data sets, organized and aligned them, ran individual values through a formula which isolated Okun’s coefficient, graphed the results excluding outliers, and averaged all values to create a more accurate version of Okun's coefficient.
- The most accurate value relating output to the rate of cyclical unemployment would be 1.69.
- Some variants of C greatly differed from the expected range which would be close to 2 (the outliers).

Conclusion

- Based on my data, we can conclude a 1.69% increase in output corresponds to a 1% decline in the rate of cyclical unemployment.
- I chose to exclude outliers over the coefficient value of 50 as they increase the variability of my results, thus decreasing statistical power and significance. Many major outliers can be explained by economic occurrences such as an economic recession.
- While my hypothesis was incorrect, I believe my fundamental thought process behind it wasn't entirely wrong. I understood that there were extraneous factors which affected the 2 to 1 relationship outlined by Okun. I believed that such factors increased the output rate as it corresponded to a decline in unemployment, however, my results show that these factors did the opposite.

Real World Application

Economics, and subsequent branches like macroeconomics and microeconomics, play a role in every individual's lives. A more accurate version of Okun's coefficient can be used to predict market patterns, and assist economists in understanding and explaining economic fluctuations which deviate from an expected steady uptrend.

Errors & Further Study

Errors:

- The large outliers can be accounted for by unexpected economic disturbances and sudden fluctuations (upwards and downwards)

Further study:

- With more time, I would try to apply my result to the current economic condition as a continuation of my work
- While I consider quarterly records sufficient for creating a large enough sample size, I think that an even smaller time gap will provide me with an even more accurate real world representation of Okun’s coefficient

Citations

https://www.investopedia.com/terms/o/okunslaw.asp

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Thank You For Listening