textMiningEV

May 31, 2022

0.1 Data/Text Mining Project

Course: CISD 43 Professor: Sohair Zaki Student: Fiona Xu and Jack Chen Overview: 1. Parsing - alpha_vantage, beautifulsoup; ML - sklearn, keras, tensorflow 2. Data cleaning, EDA, Preprocessing, Model featuring 3. Time Series: Machine Learning, Deep Learning (ANN, LSTM, Bidrectional LSTM) 4. Save transformer to pickle, Model checkpoint 5. Conclusion 6. References

0.2 Libraries, Functions, Load/Cleaning Data

0.2.1 Load Libraries

[ ]:
```
# Parsing Part
import requests
from bs4 import BeautifulSoup
# Alpha Vantage API - stock data
from alpha_vantage.timeseries import TimeSeries
from alpha_vantage.fundamentaldata import FundamentalData
from alpha_vantage.cryptocurrencies import CryptoCurrencies
from alpha_vantage.techindicators import TechIndicators

# Data
import numpy as np
import pandas as pd

# Visualization
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
sns.set_style("whitegrid")

# Deep Learning
import tensorflow
import keras.layers

# Data Preprocessing
from sklearn.preprocessing import StandardScaler, MinMaxScaler
from sklearn.model_selection import train_test_split

# Model Featuring
```

```
from keras.layers import Input, Flatten, Dense, Activation, LeakyReLU,␣
 ↪Bidirectional, LSTM
from tensorflow.keras.optimizers import SGD
from sklearn.model_selection import GridSearchCV
from scikeras.wrappers import KerasClassifier, KerasRegressor

# Models
from xgboost import XGBRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.linear_model import Ridge, LinearRegression
from keras import Sequential, Model

# Analyze Results
from sklearn.metrics import roc_curve, plot_roc_curve, r2_score,␣
 ↪mean_absolute_error, mean_squared_error, accuracy_score
from sklearn import metrics

# Misc
# filter warnings
from keras.callbacks import ModelCheckpoint, LearningRateScheduler, History
import pickle

import datetime as dt
from datetime import datetime

import warnings
warnings.filterwarnings("ignore")
```

0.2.2 Functions

[ ]:
```
# Function to clean balance sheet df
def convMonth(x):
    if x == 'MAR':
        x = 3
    elif x == 'DEC':
        x = 12
    elif x =='JUN':
        x = 6
    elif x == 'SEP':
        x = 9
    return x
```

[ ]:
```
# Function - ML - run machine learning model and print out MSE
def runML(model,feature,target,ftest,ttest):
    model.fit(feature, target)
    t_predict = model.predict(ftest)
    print(model)
```

```
    print('MAE score:', mean_absolute_error(ttest,t_predict))
    print('MSE score:', mean_squared_error(ttest,t_predict))
    print('')
```

[ ]:
```
# Convert to sequence
# function for TimeSeries to seq models
def convSeq(feature, target, seq):
    Xs, ys = [],[]

    # from 0 to (len - seq)
    for i in range(len(feature) - seq):

        # from i to (i + seq)
        v = feature.iloc[i:(i+seq)]
        Xs.append(v)

        # target of (i+seq)
        ys.append(target.iloc[i+seq])
    return np.array(Xs), np.array(ys)
```

[ ]:
```
# Convert sequence dimenstions
def convDim(feature, target):
    targetArray = np.array(target)
    targetNew = targetArray.reshape(-1,1)
    featureArray = np.array(feature)
    featureNew = featureArray.reshape(featureArray.shape[0], featureArray.
 ↪shape[1], 1)
    return featureNew, targetNew
```

[ ]:
```
# didnt work...

def hyperLSTM(units=32,activation='relu',optimizer='adam'):
    x=Xt
    ls = Sequential()
    ls.
 ↪add(LSTM(units=32,activation=activation,return_sequences=True,input_shape=(x.
 ↪shape[1],x.shape[2]),input_dim=3))
    ls.add(LSTM(units=32/2, activation=activation, input_shape=(x[1],units)))
    ls.add(Dense(units=3, activation = activation))
    ls.add(Dense(units=1, activation = activation))
    ls.compile(optimizer=optimizer, loss='mse',metrics=['mse','mae'])
    return ls
```

0.2.3 AlphaVantage API

[ ]:
```
# Variable - store Alpha Vantage API key
# path =  r'C:\Users\Gumo\Desktop\Git\Notebook\keys\alphaVantage.txt'
# with open(path, mode='r') as w:
#     key = (w.readline())
```

[ ]:
```
# URL Method
# def alpha(function, symbol):
#     url = 'https://www.alphavantage.co/query?
 ↪function='+function+'&symbol='+symbol+'&apikey='+key
#     response = requests.get(url)

# Function AlphaVantage
def alpha(symbol, function, period=None, typ = None, tim=None):

    # Funciton - TimeSeries
    if function == 't':
        # Instance - TimeSeries Instance
        ts = TimeSeries(key = key, output_format='pandas')
        if period == 'd':
            data = ts.get_daily_adjusted(symbol, outputsize=outputsize)[0]
        elif period == 'w':
            data = ts.get_weekly_adjusted(symbol)[0]
        elif period == 'm':
            data = ts.get_monthly_adjusted(symbol)[0]

    # Funciton - FundamentalData
    elif function == 'f':
        # Instance - FundamentalData Instance
        fd = FundamentalData(key, output_format='pandas')
        if period == 'q':
            if typ == 'i':
                data = fd.get_income_statement_quarterly(symbol)[0]
                data.index = data.iloc[:,0]
                data=data.iloc[:,2:]
            elif typ == 'b':
                data = fd.get_balance_sheet_quarterly(symbol)[0]
                data.index = data.iloc[:,0]
                data=data.iloc[:,2:]
            elif typ=='c':
                data = fd.get_cash_flow_quarterly(symbol)[0]
                data.index = data.iloc[:,0]
                data=data.iloc[:,2:]
        elif period =='a':
            if typ == 'i':
                data = fd.get_income_statement_annual(symbol)[0]
```

```
                data.index = data.iloc[:,0]
                data=data.iloc[:,2:]
            elif typ == 'b':
                data = fd.get_balance_sheet_annual(symbol)[0]
                data.index = data.iloc[:,0]
                data=data.iloc[:,2:]
            elif typ=='c':
                data = fd.get_cash_flow_annual(symbol)[0]
                data.index = data.iloc[:,0]
                data=data.iloc[:,2:]

    # Funciton - TechnicalIndicator
    elif function =='ti':
        ti = TechIndicators(key,output_format='pandas')

        # reassign period into TI format
        if period == 'm':
            period = 'monthly'
        elif period =='w':
            period = 'weekly'
        elif period == 'd':
            period ='daily'

        if typ == 'rsi':
            data=ti.
 ↪get_rsi(symbol,interval=period,time_period=tim,series_type='close')[0]
        elif typ =='so':
            data = ti.get_stoch(symbol,interval=period)[0]

    # Funciton - CC
    elif function == 'c':
        # Instance - Crypto
        cc = CryptoCurrencies(key, output_format='pandas')
        pass
    return data
```

[ ]:
```
# Variable Size
outputsize = 'compact'

# Variable Stock
symbol = 'cvx'

# Variable Function - t, f, c, ti (timeseries, financialdata, crypto, technical␣
 ↪indicator)
function = 'ti'

# Variable Period
```

```
# TimeSeries: d,w,m,i (daily, weekly, monthly, interval(mins))
# Fundamental: q,a (quarterly,annually)
# Technical: d,w,m, (interval(mins))
period = 'm'

# Varible - Type
# Fundamental: i,b,c
# Technical: so,rsi
typ ='so'

# Varible - Time
tim = 60

info = alpha(symbol,function,period=period,typ = typ,tim=tim)
info.head()
```

[ ]:
```
# save to local stock data
# info.to_csv('data/'+symbol.upper()+'stockPrice.csv')
```

[ ]:
```

```

0.2.4 BeautifulSoup

Scrape Inflation

[ ]:
```
# Define a variable for the url of the site
site = "https://www.usinflationcalculator.com/inflation/current-inflation-rates/
 ↪#:~:text=The%20annual%20inflation%20rate%20for,at%208%3A30%20a.m.%20ET"
```

[ ]:
```
# Making a get request and assign the result to a variable response
response = requests.get(site)

#Check that the response was processed correctly
response.status_code
```

[ ]:
```
200
```

[ ]:
```
# Extracting the HTML
#assign a variable html to response content.
html = response.content

# Checking that the reply is indeed an HTML code by inspecting the first 200␣
 ↪symbols
html[:200]
```

[ ]:
```
b'<!DOCTYPE html>\n<!--[if IE 7]>\n<html class="ie ie7" dir="ltr" lang="en-
US"\n\tprefix="og: https://ogp.me/ns#" >\n<![endif]-->\n<!--[if IE 8]>\n<html
class="ie ie8" dir="ltr" lang="en-US"\n\tprefix="og: https'
```

[ ]:
```
#Convert HTML to a BeautifulSoup object, using the default parser of html
#Create a BeautifulSoup object and store it in a variable named soup.
soup = BeautifulSoup(html, "html.parser")
```

[ ]:
```
# The soup variable (BeautifulSoup object) we defined earlier can be seen as␣
 ↪representing the whole document
soup
```

[ ]:
```
<!DOCTYPE html>

<!--[if IE 7]>
<html class="ie ie7" dir="ltr" lang="en-US"
        prefix="og: https://ogp.me/ns#" >
<![endif]-->
<!--[if IE 8]>
<html class="ie ie8" dir="ltr" lang="en-US"
        prefix="og: https://ogp.me/ns#" >
<![endif]-->
<!--[if !(IE 7) | !(IE 8) ]><!-->
<html dir="ltr" lang="en-US" prefix="og: https://ogp.me/ns#">
<!--<![endif]-->
<head>
<!-- Global site tag (gtag.js) - Google Analytics -->
<script async=""
src="https://www.googletagmanager.com/gtag/js?id=UA-2181571-7"></script>
<script>
  window.dataLayer = window.dataLayer || [];
  function gtag(){dataLayer.push(arguments);}
  gtag('js', new Date());

  gtag('config', 'UA-2181571-7');
</script>
<meta charset="utf-8"/>
<meta content="width=device-width" name="viewport"/>
<link href="http://gmpg.org/xfn/11" rel="profile"/>
<link href="https://www.usinflationcalculator.com/xmlrpc.php" rel="pingback"/>
<!--[if lt IE 9]>
        <script src="https://www.usinflationcalculator.com/wp-
content/themes/twentyfourteen/js/html5.js"></script>
        <![endif]-->
<!-- All in One SEO 4.2.0 -->
<title>Current US Inflation Rates: 2000-2022 | US Inflation Calculator</title>
<meta content="The annual inflation rate for the United States is 8.3% for the
12 months ended April 2022 after rising 8.5% previously, according to U.S. Labor
Department data published May 11. The next inflation update is scheduled for
release on June 10 at 8:30 a.m. ET. It will offer the rate of inflation over the
12" name="description">
```

<meta content="max-image-preview:large" name="robots">
<link href="https://www.usinflationcalculator.com/inflation/current-inflation-rates/" rel="canonical">
<meta content="en_US" property="og:locale"/>
<meta content="US Inflation Calculator |" property="og:site_name"/>
<meta content="article" property="og:type"/>
<meta content="Current US Inflation Rates: 2000-2022 | US Inflation Calculator" property="og:title"/>
<meta content="The annual inflation rate for the United States is 8.3% for the 12 months ended April 2022 after rising 8.5% previously, according to U.S. Labor Department data published May 11. The next inflation update is scheduled for release on June 10 at 8:30 a.m. ET. It will offer the rate of inflation over the 12" property="og:description"/>
<meta content="https://www.usinflationcalculator.com/inflation/current-inflation-rates/" property="og:url"/>
<meta content="2008-07-23T03:07:58+00:00" property="article:published_time"/>
<meta content="2022-05-11T13:01:22+00:00" property="article:modified_time"/>
<meta content="summary" name="twitter:card"/>
<meta content="Current US Inflation Rates: 2000-2022 | US Inflation Calculator" name="twitter:title"/>
<meta content="The annual inflation rate for the United States is 8.3% for the 12 months ended April 2022 after rising 8.5% previously, according to U.S. Labor Department data published May 11. The next inflation update is scheduled for release on June 10 at 8:30 a.m. ET. It will offer the rate of inflation over the 12" name="twitter:description"/>
<meta content="nositelinkssearchbox" name="google"/>
<script class="aioseo-schema" type="application/ld+json">
{"@context":"https:\/\/schema.org","@graph":[{"@type":"WebSite","@id":"https:\/\/www.usinflationcalculator.com\/#website","url":"https:\/\/www.usinflationcalculator.com\/","name":"US Inflation Calculator","inLanguage":"en-US","publisher":{"@id":"https:\/\/www.usinflationcalculator.com\/#organization"}},{"@type":"Organization","@id":"https:\/\/www.usinflationcalculator.com\/#organization","name":"US Inflation Calculator","url":"https:\/\/www.usinflationcalculator.com\/"},{"@type":"BreadcrumbList","@id":"https:\/\/www.usinflationcalculator.com\/inflation\/current-inflation-rates\/#breadcrumblist","itemListElement":[{"@type":"ListItem","@id":"https:\/\/www.usinflationcalculator.com\/#listItem","position":1,"item":{"@type":"WebPage","@id":"https:\/\/www.usinflationcalculator.com\/","name":"Home","description":"Easily calculate how the buying power of the US dollar has changed from 1913 to 2022. Get inflation rates and US inflation news.","url":"https:\/\/www.usinflationcalculator.com\/"},"nextItem":"https:\/\/www.usinflationcalculator.com\/inflation\/#listItem"},{"@type":"ListItem","@id":"https:\/\/www.usinflationcalculator.com\/inflation\/#listItem","position":2,"item":{"@type":"WebPage","@id":"https:\/\/www.usinflationcalculator.com\/inflation\/","name":"Inflation and Prices","description":"A bevy of inflation and consumer price related resources are available on US Inflation Calculator, to include rates, charts and tables of data. Just follow: Current US Inflation Rates Historical US Inflation Rates CPI

Data from 1913 to Current CPI Release Schedule Annual Averages for Rates of Inflation A brief overview of each page follows.","url":"https:\/\/www.usinflationcalculator.com\/inflation\/"},"nextItem":"https:\/\/www.usinflationcalculator.com\/inflation\/current-inflation-rates\/#listItem","previousItem":"https:\/\/www.usinflationcalculator.com\/#listItem"},{"@type":"ListItem","@id":"https:\/\/www.usinflationcalculator.com\/inflation\/current-inflation-rates\/#listItem","position":3,"item":{"@type":"WebPage","@id":"https:\/\/www.usinflationcalculator.com\/inflation\/current-inflation-rates\/","name":"Current US Inflation Rates: 2000-2022","description":"The annual inflation rate for the United States is 8.3% for the 12 months ended April 2022 after rising 8.5% previously, according to U.S. Labor Department data published May 11. The next inflation update is scheduled for release on June 10 at 8:30 a.m. ET. It will offer the rate of inflation over the
12","url":"https:\/\/www.usinflationcalculator.com\/inflation\/current-inflation-rates\/"},"previousItem":"https:\/\/www.usinflationcalculator.com\/inflation\/#listItem"}]},{"@type":"WebPage","@id":"https:\/\/www.usinflationcalculator.com\/inflation\/current-inflation-rates\/#webpage","url":"https:\/\/www.usinflationcalculator.com\/inflation\/current-inflation-rates\/","name":"Current US Inflation Rates: 2000-2022 | US Inflation Calculator","description":"The annual inflation rate for the United States is 8.3% for the 12 months ended April 2022 after rising 8.5% previously, according to U.S. Labor Department data published May 11. The next inflation update is scheduled for release on June 10 at 8:30 a.m. ET. It will offer the rate of inflation over the 12","inLanguage":"en-US","isPartOf":{"@id":"https:\/\/www.usinflationcalculator.com\/#website"},"breadcrumb":{"@id":"https:\/\/www.usinflationcalculator.com\/inflation\/current-inflation-rates\/#breadcrumblist"},"datePublished":"2008-07-23T03:07:58-04:00","dateModified":"2022-05-11T13:01:22-04:00"}]}
</script>
<!-- All in One SEO -->
<link href="//secure.gravatar.com" rel="dns-prefetch">
<link href="//www.usinflationcalculator.com" rel="dns-prefetch"/>
<link href="//fonts.googleapis.com" rel="dns-prefetch"/>
<link href="//s.w.org" rel="dns-prefetch"/>
<link href="//v0.wordpress.com" rel="dns-prefetch"/>
<link href="//jetpack.wordpress.com" rel="dns-prefetch"/>
<link href="//s0.wp.com" rel="dns-prefetch"/>
<link href="//public-api.wordpress.com" rel="dns-prefetch"/>
<link href="//0.gravatar.com" rel="dns-prefetch"/>
<link href="//1.gravatar.com" rel="dns-prefetch"/>
<link href="//2.gravatar.com" rel="dns-prefetch"/>
<link crossorigin="" href="https://fonts.gstatic.com" rel="preconnect"/>
<link href="https://www.usinflationcalculator.com/feed/" rel="alternate" title="US Inflation Calculator » Feed" type="application/rss+xml"/>
<link href="https://www.usinflationcalculator.com/comments/feed/" rel="alternate" title="US Inflation Calculator » Comments Feed" type="application/rss+xml"/>
<script>

```
window._wpemojiSettings = {"baseUrl":"https:\/\/s.w.org\/images\/core\/emoji\/13
.1.0\/72x72\/","ext":".png","svgUrl":"https:\/\/s.w.org\/images\/core\/emoji\/13
.1.0\/svg\/","svgExt":".svg","source":{"concatemoji":"https:\/\/www.usinflationc
alculator.com\/wp-includes\/js\/wp-emoji-release.min.js?ver=5.9.3"}};
/*! This file is auto-generated */
!function(e,a,t){var
n,r,o,i=a.createElement("canvas"),p=i.getContext&&i.getContext("2d");function
s(e,t){var a=String.fromCharCode;p.clearRect(0,0,i.width,i.height),p.fillText(a.
apply(this,e),0,0);e=i.toDataURL();return p.clearRect(0,0,i.width,i.height),p.fi
llText(a.apply(this,t),0,0),e===i.toDataURL()}function c(e){var t=a.createElemen
t("script");t.src=e,t.defer=t.type="text/javascript",a.getElementsByTagName("hea
d")[0].appendChild(t)}for(o=Array("flag","emoji"),t.supports={everything:!0,ever
ythingExceptFlag:!0},r=0;r<o.length;r++)t.supports[o[r]]=function(e){if(!p||!p.f
illText)return!1;switch(p.textBaseline="top",p.font="600 32px
Arial",e){case"flag":return s([127987,65039,8205,9895,65039],[127987,65039,8203,
9895,65039])?!1:!s([55356,56826,55356,56819],[55356,56826,8203,55356,56819])&&!s
([55356,57332,56128,56423,56128,56418,56128,56421,56128,56430,56128,56423,56128,
56447],[55356,57332,8203,56128,56423,8203,56128,56418,8203,56128,56421,8203,5612
8,56430,8203,56128,56423,8203,56128,56447]);case"emoji":return!s([10084,65039,82
05,55357,56613],[10084,65039,8203,55357,56613])}return!1}(o[r]),t.supports.every
thing=t.supports.everything&&t.supports[o[r]],"flag"!==o[r]&&(t.supports.everyth
ingExceptFlag=t.supports.everythingExceptFlag&&t.supports[o[r]]);t.supports.ever
ythingExceptFlag=t.supports.everythingExceptFlag&&!t.supports.flag,t.DOMReady=!1
,t.readyCallback=function(){t.DOMReady=!0},t.supports.everything||(n=function(){
t.readyCallback()},a.addEventListener?(a.addEventListener("DOMContentLoaded",n,!
1),e.addEventListener("load",n,!1)):(e.attachEvent("onload",n),a.attachEvent("on
readystatechange",function(){"complete"===a.readyState&&t.readyCallback()})),(n=
t.source||{}).concatemoji?c(n.concatemoji):n.wpemoji&&n.twemoji&&(c(n.twemoji),c
(n.wpemoji)))}(window,document,window._wpemojiSettings);
</script>
<style>
img.wp-smiley,
img.emoji {
        display: inline !important;
        border: none !important;
        box-shadow: none !important;
        height: 1em !important;
        width: 1em !important;
        margin: 0 0.07em !important;
        vertical-align: -0.1em !important;
        background: none !important;
        padding: 0 !important;
}
</style>
<link href="https://www.usinflationcalculator.com/wp-
content/plugins/jetpack/modules/theme-tools/compat/twentyfourteen.css?ver=10.9"
id="twentyfourteen-jetpack-css" media="all" rel="stylesheet"/>
```

<link href="https://www.usinflationcalculator.com/wp-includes/css/dist/block-library/style.min.css?ver=5.9.3" id="wp-block-library-css" media="all" rel="stylesheet"/>
<style id="wp-block-library-inline-css">
.has-text-align-justify{text-align:justify;}
</style>
<style id="wp-block-library-theme-inline-css">
.wp-block-audio figcaption{color:#555;font-size:13px;text-align:center}.is-dark-theme .wp-block-audio figcaption{color:hsla(0,0%,100%,.65)}.wp-block-code>code{font-family:Menlo,Consolas,monaco,monospace;color:#1e1e1e;padding:.8em 1em;border:1px solid #ddd;border-radius:4px}.wp-block-embed figcaption{color:#555;font-size:13px;text-align:center}.is-dark-theme .wp-block-embed figcaption{color:hsla(0,0%,100%,.65)}.blocks-gallery-caption{color:#555;font-size:13px;text-align:center}.is-dark-theme .blocks-gallery-caption{color:hsla(0,0%,100%,.65)}.wp-block-image figcaption{color:#555;font-size:13px;text-align:center}.is-dark-theme .wp-block-image figcaption{color:hsla(0,0%,100%,.65)}.wp-block-pullquote{border-top:4px solid;border-bottom:4px solid;margin-bottom:1.75em;color:currentColor}.wp-block-pullquote__citation,.wp-block-pullquote cite,.wp-block-pullquote footer{color:currentColor;text-transform:uppercase;font-size:.8125em;font-style:normal}.wp-block-quote{border-left:.25em solid;margin:0 0 1.75em;padding-left:1em}.wp-block-quote cite,.wp-block-quote footer{color:currentColor;font-size:.8125em;position:relative;font-style:normal}.wp-block-quote.has-text-align-right{border-left:none;border-right:.25em solid;padding-left:0;padding-right:1em}.wp-block-quote.has-text-align-center{border:none;padding-left:0}.wp-block-quote.is-large,.wp-block-quote.is-style-large,.wp-block-quote.is-style-plain{border:none}.wp-block-search .wp-block-search__label{font-weight:700}.wp-block-group:where(.has-background){padding:1.25em 2.375em}.wp-block-separator{border:none;border-bottom:2px solid;margin-left:auto;margin-right:auto;opacity:.4}.wp-block-separator:not(.is-style-wide):not(.is-style-dots){width:100px}.wp-block-separator.has-background:not(.is-style-dots){border-bottom:none;height:1px}.wp-block-separator.has-background:not(.is-style-wide):not(.is-style-dots){height:2px}.wp-block-table thead{border-bottom:3px solid}.wp-block-table tfoot{border-top:3px solid}.wp-block-table td,.wp-block-table th{padding:.5em;border:1px solid;word-break:normal}.wp-block-table figcaption{color:#555;font-size:13px;text-align:center}.is-dark-theme .wp-block-table figcaption{color:hsla(0,0%,100%,.65)}.wp-block-video figcaption{color:#555;font-size:13px;text-align:center}.is-dark-theme .wp-block-video figcaption{color:hsla(0,0%,100%,.65)}.wp-block-template-part.has-background{padding:1.25em 2.375em;margin-top:0;margin-bottom:0}
</style>
<link href="https://www.usinflationcalculator.com/wp-includes/js/mediaelement/mediaelementplayer-legacy.min.css?ver=4.2.16" id="mediaelement-css" media="all" rel="stylesheet"/>
<link href="https://www.usinflationcalculator.com/wp-includes/js/mediaelement/wp-mediaelement.min.css?ver=5.9.3" id="wp-mediaelement-css" media="all" rel="stylesheet"/>

```
<style id="global-styles-inline-css">
body{--wp--preset--color--black: #1a4e88;--wp--preset--color--cyan-bluish-gray:
#abb8c3;--wp--preset--color--white: #fff;--wp--preset--color--pale-pink:
#f78da7;--wp--preset--color--vivid-red: #cf2e2e;--wp--preset--color--luminous-
vivid-orange: #ff6900;--wp--preset--color--luminous-vivid-amber: #fcb900;--wp--
preset--color--light-green-cyan: #7bdcb5;--wp--preset--color--vivid-green-cyan:
#00d084;--wp--preset--color--pale-cyan-blue: #8ed1fc;--wp--preset--color--vivid-
cyan-blue: #0693e3;--wp--preset--color--vivid-purple: #9b51e0;--wp--preset--
color--green: #2c6db7;--wp--preset--color--dark-gray: #2b2b2b;--wp--preset--
color--medium-gray: #767676;--wp--preset--color--light-gray: #f5f5f5;--wp--
preset--gradient--vivid-cyan-blue-to-vivid-purple: linear-
gradient(135deg,rgba(6,147,227,1) 0%,rgb(155,81,224) 100%);--wp--preset--
gradient--light-green-cyan-to-vivid-green-cyan: linear-
gradient(135deg,rgb(122,220,180) 0%,rgb(0,208,130) 100%);--wp--preset--gradient
--luminous-vivid-amber-to-luminous-vivid-orange: linear-
gradient(135deg,rgba(252,185,0,1) 0%,rgba(255,105,0,1) 100%);--wp--preset--
gradient--luminous-vivid-orange-to-vivid-red: linear-
gradient(135deg,rgba(255,105,0,1) 0%,rgb(207,46,46) 100%);--wp--preset--gradient
--very-light-gray-to-cyan-bluish-gray: linear-gradient(135deg,rgb(238,238,238)
0%,rgb(169,184,195) 100%);--wp--preset--gradient--cool-to-warm-spectrum: linear-
gradient(135deg,rgb(74,234,220) 0%,rgb(151,120,209) 20%,rgb(207,42,186)
40%,rgb(238,44,130) 60%,rgb(251,105,98) 80%,rgb(254,248,76) 100%);--wp--preset--
gradient--blush-light-purple: linear-gradient(135deg,rgb(255,206,236)
0%,rgb(152,150,240) 100%);--wp--preset--gradient--blush-bordeaux: linear-
gradient(135deg,rgb(254,205,165) 0%,rgb(254,45,45) 50%,rgb(107,0,62) 100%);--wp
--preset--gradient--luminous-dusk: linear-gradient(135deg,rgb(255,203,112)
0%,rgb(199,81,192) 50%,rgb(65,88,208) 100%);--wp--preset--gradient--pale-ocean:
linear-gradient(135deg,rgb(255,245,203) 0%,rgb(182,227,212) 50%,rgb(51,167,181)
100%);--wp--preset--gradient--electric-grass: linear-
gradient(135deg,rgb(202,248,128) 0%,rgb(113,206,126) 100%);--wp--preset--
gradient--midnight: linear-gradient(135deg,rgb(2,3,129) 0%,rgb(40,116,252)
100%);--wp--preset--duotone--dark-grayscale: url('#wp-duotone-dark-
grayscale');--wp--preset--duotone--grayscale: url('#wp-duotone-grayscale');--wp
--preset--duotone--purple-yellow: url('#wp-duotone-purple-yellow');--wp--preset
--duotone--blue-red: url('#wp-duotone-blue-red');--wp--preset--duotone--
midnight: url('#wp-duotone-midnight');--wp--preset--duotone--magenta-yellow:
url('#wp-duotone-magenta-yellow');--wp--preset--duotone--purple-green: url('#wp-
duotone-purple-green');--wp--preset--duotone--blue-orange: url('#wp-duotone-
blue-orange');--wp--preset--font-size--small: 13px;--wp--preset--font-size--
medium: 20px;--wp--preset--font-size--large: 36px;--wp--preset--font-size--
x-large: 42px;}.has-black-color{color: var(--wp--preset--color--black)
!important;}.has-cyan-bluish-gray-color{color: var(--wp--preset--color--cyan-
bluish-gray) !important;}.has-white-color{color: var(--wp--preset--color--white)
!important;}.has-pale-pink-color{color: var(--wp--preset--color--pale-pink)
!important;}.has-vivid-red-color{color: var(--wp--preset--color--vivid-red)
!important;}.has-luminous-vivid-orange-color{color: var(--wp--preset--color--
luminous-vivid-orange) !important;}.has-luminous-vivid-amber-color{color:
```

var(--wp--preset--color--luminous-vivid-amber) !important;}.has-light-green-cyan-color{color: var(--wp--preset--color--light-green-cyan) !important;}.has-vivid-green-cyan-color{color: var(--wp--preset--color--vivid-green-cyan) !important;}.has-pale-cyan-blue-color{color: var(--wp--preset--color--pale-cyan-blue) !important;}.has-vivid-cyan-blue-color{color: var(--wp--preset--color--vivid-cyan-blue) !important;}.has-vivid-purple-color{color: var(--wp--preset--color--vivid-purple) !important;}.has-black-background-color{background-color: var(--wp--preset--color--black) !important;}.has-cyan-bluish-gray-background-color{background-color: var(--wp--preset--color--cyan-bluish-gray) !important;}.has-white-background-color{background-color: var(--wp--preset--color--white) !important;}.has-pale-pink-background-color{background-color: var(--wp--preset--color--pale-pink) !important;}.has-vivid-red-background-color{background-color: var(--wp--preset--color--vivid-red) !important;}.has-luminous-vivid-orange-background-color{background-color: var(--wp--preset--color--luminous-vivid-orange) !important;}.has-luminous-vivid-amber-background-color{background-color: var(--wp--preset--color--luminous-vivid-amber) !important;}.has-light-green-cyan-background-color{background-color: var(--wp--preset--color--light-green-cyan) !important;}.has-vivid-green-cyan-background-color{background-color: var(--wp--preset--color--vivid-green-cyan) !important;}.has-pale-cyan-blue-background-color{background-color: var(--wp--preset--color--pale-cyan-blue) !important;}.has-vivid-cyan-blue-background-color{background-color: var(--wp--preset--color--vivid-cyan-blue) !important;}.has-vivid-purple-background-color{background-color: var(--wp--preset--color--vivid-purple) !important;}.has-black-border-color{border-color: var(--wp--preset--color--black) !important;}.has-cyan-bluish-gray-border-color{border-color: var(--wp--preset--color--cyan-bluish-gray) !important;}.has-white-border-color{border-color: var(--wp--preset--color--white) !important;}.has-pale-pink-border-color{border-color: var(--wp--preset--color--pale-pink) !important;}.has-vivid-red-border-color{border-color: var(--wp--preset--color--vivid-red) !important;}.has-luminous-vivid-orange-border-color{border-color: var(--wp--preset--color--luminous-vivid-orange) !important;}.has-luminous-vivid-amber-border-color{border-color: var(--wp--preset--color--luminous-vivid-amber) !important;}.has-light-green-cyan-border-color{border-color: var(--wp--preset--color--light-green-cyan) !important;}.has-vivid-green-cyan-border-color{border-color: var(--wp--preset--color--vivid-green-cyan) !important;}.has-pale-cyan-blue-border-color{border-color: var(--wp--preset--color--pale-cyan-blue) !important;}.has-vivid-cyan-blue-border-color{border-color: var(--wp--preset--color--vivid-cyan-blue) !important;}.has-vivid-purple-border-color{border-color: var(--wp--preset--color--vivid-purple) !important;}.has-vivid-cyan-blue-to-vivid-purple-gradient-background{background: var(--wp--preset--gradient--vivid-cyan-blue-to-vivid-purple) !important;}.has-light-green-cyan-to-vivid-green-cyan-gradient-background{background: var(--wp--preset--gradient--light-green-cyan-to-vivid-green-cyan) !important;}.has-luminous-vivid-amber-to-luminous-vivid-orange-gradient-background{background: var(--wp--preset--gradient--luminous-vivid-amber-to-luminous-vivid-orange) !important;}.has-luminous-vivid-orange-to-vivid-red-gradient-background{background: var(--wp--preset--gradient--luminous-vivid-orange-to-

vivid-red) !important;}.has-very-light-gray-to-cyan-bluish-gray-gradient-background{background: var(--wp--preset--gradient--very-light-gray-to-cyan-bluish-gray) !important;}.has-cool-to-warm-spectrum-gradient-background{background: var(--wp--preset--gradient--cool-to-warm-spectrum) !important;}.has-blush-light-purple-gradient-background{background: var(--wp--preset--gradient--blush-light-purple) !important;}.has-blush-bordeaux-gradient-background{background: var(--wp--preset--gradient--blush-bordeaux) !important;}.has-luminous-dusk-gradient-background{background: var(--wp--preset--gradient--luminous-dusk) !important;}.has-pale-ocean-gradient-background{background: var(--wp--preset--gradient--pale-ocean) !important;}.has-electric-grass-gradient-background{background: var(--wp--preset--gradient--electric-grass) !important;}.has-midnight-gradient-background{background: var(--wp--preset--gradient--midnight) !important;}.has-small-font-size{font-size: var(--wp--preset--font-size--small) !important;}.has-medium-font-size{font-size: var(--wp--preset--font-size--medium) !important;}.has-large-font-size{font-size: var(--wp--preset--font-size--large) !important;}.has-x-large-font-size{font-size: var(--wp--preset--font-size--x-large) !important;}
</style>
<link href="https://fonts.googleapis.com/css?family=Lato%3A300%2C400%2C700%2C900%2C300italic%2C400italic%2C700italic&subset=latin%2Clatin-ext&display=fallback" id="twentyfourteen-lato-css" media="all" rel="stylesheet"/>
<link href="https://www.usinflationcalculator.com/wp-content/plugins/jetpack/_inc/genericons/genericons/genericons.css?ver=3.1" id="genericons-css" media="all" rel="stylesheet"/>
<link href="https://www.usinflationcalculator.com/wp-content/themes/twentyfourteen-child/style.css?ver=20190507" id="twentyfourteen-style-css" media="all" rel="stylesheet"/>
<link href="https://www.usinflationcalculator.com/wp-content/themes/twentyfourteen/css/blocks.css?ver=20190102" id="twentyfourteen-block-style-css" media="all" rel="stylesheet"/>
<!--[if lt IE 9]>
<link rel='stylesheet' id='twentyfourteen-ie-css' href='https://www.usinflationcalculator.com/wp-content/themes/twentyfourteen/css/ie.css?ver=20140701' media='all' />
<![endif]-->
<link href="https://www.usinflationcalculator.com/wp-content/plugins/jetpack/_inc/social-logos/social-logos.min.css?ver=10.9" id="social-logos-css" media="all" rel="stylesheet"/>
<link href="https://www.usinflationcalculator.com/wp-content/plugins/jetpack/css/jetpack.css?ver=10.9" id="jetpack_css-css" media="all" rel="stylesheet"/>
<script id="jquery-core-js" src="https://www.usinflationcalculator.com/wp-includes/js/jquery/jquery.min.js?ver=3.6.0"></script>
<script id="jquery-migrate-js" src="https://www.usinflationcalculator.com/wp-includes/js/jquery/jquery-migrate.min.js?ver=3.3.2"></script>
<link href="https://www.usinflationcalculator.com/wp-json/"

```
rel="https://api.w.org/"/><link href="https://www.usinflationcalculator.com/wp-
json/wp/v2/pages/75" rel="alternate" type="application/json"/><link
href="https://www.usinflationcalculator.com/xmlrpc.php?rsd" rel="EditURI"
title="RSD" type="application/rsd+xml"/>
<link href="https://www.usinflationcalculator.com/wp-includes/wlwmanifest.xml"
rel="wlwmanifest" type="application/wlwmanifest+xml"/>
<link href="https://wp.me/PoZpd-1d" rel="shortlink"/>
<link href="https://www.usinflationcalculator.com/wp-json/oembed/1.0/embed?url=h
ttps%3A%2F%2Fwww.usinflationcalculator.com%2Finflation%2Fcurrent-inflation-
rates%2F" rel="alternate" type="application/json+oembed"/>
<link href="https://www.usinflationcalculator.com/wp-json/oembed/1.0/embed?url=h
ttps%3A%2F%2Fwww.usinflationcalculator.com%2Finflation%2Fcurrent-inflation-
rates%2F&amp;format=xml" rel="alternate" type="text/xml+oembed"/>
<style id="fourteen-colors" type="text/css">/* Custom Contrast Color */
                .site:before,
                #secondary,
                .site-header,
                .site-footer,
                .menu-toggle,
                .featured-content,
                .featured-content .entry-header,
                .slider-direction-nav a,
                .ie8 .featured-content,
                .ie8 .site:before,
                .has-black-background-color {
                        background-color: #1a4e88;
                }

                .has-black-color {
                        color: #1a4e88;
                }

                .grid .featured-content .entry-header,
                .ie8 .grid .featured-content .entry-header {
                        border-color: #1a4e88;
                }

                .slider-control-paging a:before {
                        background-color: rgba(255,255,255,.33);
                }

                .hentry .mejs-mediaelement,
                .widget .mejs-mediaelement,
                .hentry .mejs-container .mejs-controls,
                .widget .mejs-container .mejs-controls {
                        background: #1a4e88;
                }
```

```
                /* Player controls need separation from the contrast background
*/
                .primary-sidebar .mejs-controls,
                .site-footer .mejs-controls {
                        border: 1px solid;
                }

                        .content-sidebar .widget_twentyfourteen_ephemera
.widget-title:before {
                                background: #1a4e88;
                        }

                        .paging-navigation,
                        .content-sidebar .widget .widget-title {
                                border-top-color: #1a4e88;
                        }

                        .content-sidebar .widget .widget-title,
                        .content-sidebar .widget .widget-title a,
                        .paging-navigation,
                        .paging-navigation a:hover,
                        .paging-navigation a {
                                color: #1a4e88;
                        }

                        /* Override the site title color option with an over-
qualified selector, as the option is hidden. */
                        h1.site-title a {
                                color: #fff;
                        }

                .menu-toggle:active,
                .menu-toggle:focus,
                .menu-toggle:hover {
                        background-color: #5e92cc;
                }
                /* Custom accent color. */
                button,
                .button,
                .contributor-posts-link,
                input[type="button"],
                input[type="reset"],
                input[type="submit"],
                .search-toggle,
                .hentry .mejs-controls .mejs-time-rail .mejs-time-current,
                .widget .mejs-controls .mejs-time-rail .mejs-time-current,
```

```
.hentry .mejs-overlay:hover .mejs-overlay-button,
.widget .mejs-overlay:hover .mejs-overlay-button,
.widget button,
.widget .button,
.widget input[type="button"],
.widget input[type="reset"],
.widget input[type="submit"],
.widget_calendar tbody a,
.content-sidebar .widget input[type="button"],
.content-sidebar .widget input[type="reset"],
.content-sidebar .widget input[type="submit"],
.slider-control-paging .slider-active:before,
.slider-control-paging .slider-active:hover:before,
.slider-direction-nav a:hover,
.ie8 .primary-navigation ul ul,
.ie8 .secondary-navigation ul ul,
.ie8 .primary-navigation li:hover > a,
.ie8 .primary-navigation li.focus > a,
.ie8 .secondary-navigation li:hover > a,
.ie8 .secondary-navigation li.focus > a,
.wp-block-file .wp-block-file__button,
.wp-block-button__link,
.has-green-background-color {
        background-color: #2c6db7;
}

.site-navigation a:hover,
.is-style-outline .wp-block-button__link:not(.has-text-color),
.has-green-color {
        color: #2c6db7;
}

::-moz-selection {
        background: #2c6db7;
}

::selection {
        background: #2c6db7;
}

.paging-navigation .page-numbers.current {
        border-color: #2c6db7;
}

@media screen and (min-width: 782px) {
        .primary-navigation li:hover > a,
        .primary-navigation li.focus > a,
```

```
        .primary-navigation ul ul {
                background-color: #2c6db7;
        }
}

@media screen and (min-width: 1008px) {
        .secondary-navigation li:hover > a,
        .secondary-navigation li.focus > a,
        .secondary-navigation ul ul {
                background-color: #2c6db7;
        }
}

        .contributor-posts-link,
        button,
        .button,
        input[type="button"],
        input[type="reset"],
        input[type="submit"],
        .search-toggle:before,
        .hentry .mejs-overlay:hover .mejs-overlay-button,
        .widget .mejs-overlay:hover .mejs-overlay-button,
        .widget button,
        .widget .button,
        .widget input[type="button"],
        .widget input[type="reset"],
        .widget input[type="submit"],
        .widget_calendar tbody a,
        .widget_calendar tbody a:hover,
        .site-footer .widget_calendar tbody a,
        .content-sidebar .widget input[type="button"],
        .content-sidebar .widget input[type="reset"],
        .content-sidebar .widget input[type="submit"],
        button:hover,
        button:focus,
        .button:hover,
        .button:focus,
        .widget a.button:hover,
        .widget a.button:focus,
        .widget a.button:active,
        .content-sidebar .widget a.button,
        .content-sidebar .widget a.button:hover,
        .content-sidebar .widget a.button:focus,
        .content-sidebar .widget a.button:active,
        .contributor-posts-link:hover,
        .contributor-posts-link:active,
        input[type="button"]:hover,
```

```
        input[type="button"]:focus,
        input[type="reset"]:hover,
        input[type="reset"]:focus,
        input[type="submit"]:hover,
        input[type="submit"]:focus,
        .slider-direction-nav a:hover:before {
                color: #fff;
        }

        @media screen and (min-width: 782px) {
                .primary-navigation ul ul a,
                .primary-navigation li:hover > a,
                .primary-navigation li.focus > a,
                .primary-navigation ul ul {
                        color: #fff;
                }
        }

        @media screen and (min-width: 1008px) {
                .secondary-navigation ul ul a,
                .secondary-navigation li:hover > a,
                .secondary-navigation li.focus > a,
                .secondary-navigation ul ul {
                        color: #fff;
                }
        }

/* Generated variants of custom accent color. */
a,
.content-sidebar .widget a {
        color: #2c6db7;
}

.contributor-posts-link:hover,
.button:hover,
.button:focus,
.slider-control-paging a:hover:before,
.search-toggle:hover,
.search-toggle.active,
.search-box,
.widget_calendar tbody a:hover,
button:hover,
button:focus,
input[type="button"]:hover,
input[type="button"]:focus,
input[type="reset"]:hover,
input[type="reset"]:focus,
```

```
                input[type="submit"]:hover,
                input[type="submit"]:focus,
                .widget button:hover,
                .widget .button:hover,
                .widget button:focus,
                .widget .button:focus,
                .widget input[type="button"]:hover,
                .widget input[type="button"]:focus,
                .widget input[type="reset"]:hover,
                .widget input[type="reset"]:focus,
                .widget input[type="submit"]:hover,
                .widget input[type="submit"]:focus,
                .content-sidebar .widget input[type="button"]:hover,
                .content-sidebar .widget input[type="button"]:focus,
                .content-sidebar .widget input[type="reset"]:hover,
                .content-sidebar .widget input[type="reset"]:focus,
                .content-sidebar .widget input[type="submit"]:hover,
                .content-sidebar .widget input[type="submit"]:focus,
                .ie8 .primary-navigation ul ul a:hover,
                .ie8 .primary-navigation ul ul li.focus > a,
                .ie8 .secondary-navigation ul ul a:hover,
                .ie8 .secondary-navigation ul ul li.focus > a,
                .wp-block-file .wp-block-file__button:hover,
                .wp-block-file .wp-block-file__button:focus,
                .wp-block-button__link:not(.has-text-color):hover,
                .wp-block-button__link:not(.has-text-color):focus,
                .is-style-outline .wp-block-button__link:not(.has-text-
color):hover,
                .is-style-outline .wp-block-button__link:not(.has-text-
color):focus {
                        background-color: #498ad4;
                }

                .featured-content a:hover,
                .featured-content .entry-title a:hover,
                .widget a:hover,
                .widget-title a:hover,
                .widget_twentyfourteen_ephemera .entry-meta a:hover,
                .hentry .mejs-controls .mejs-button button:hover,
                .widget .mejs-controls .mejs-button button:hover,
                .site-info a:hover,
                .featured-content a:hover,
                .wp-block-latest-comments_comment-meta a:hover,
                .wp-block-latest-comments_comment-meta a:focus {
                        color: #498ad4;
                }
```

```
                a:active,
                a:hover,
                .entry-title a:hover,
                .entry-meta a:hover,
                .cat-links a:hover,
                .entry-content .edit-link a:hover,
                .post-navigation a:hover,
                .image-navigation a:hover,
                .comment-author a:hover,
                .comment-list .pingback a:hover,
                .comment-list .trackback a:hover,
                .comment-metadata a:hover,
                .comment-reply-title small a:hover,
                .content-sidebar .widget a:hover,
                .content-sidebar .widget .widget-title a:hover,
                .content-sidebar .widget_twentyfourteen_ephemera .entry-meta
a:hover {
                        color: #498ad4;
                }

                .page-links a:hover,
                .paging-navigation a:hover {
                        border-color: #498ad4;
                }

                .entry-meta .tag-links a:hover:before {
                        border-right-color: #498ad4;
                }

                .page-links a:hover,
                .entry-meta .tag-links a:hover {
                        background-color: #498ad4;
                }

                @media screen and (min-width: 782px) {
                        .primary-navigation ul ul a:hover,
                        .primary-navigation ul ul li.focus > a {
                                background-color: #498ad4;
                        }
                }

                @media screen and (min-width: 1008px) {
                        .secondary-navigation ul ul a:hover,
                        .secondary-navigation ul ul li.focus > a {
                                background-color: #498ad4;
                        }
                }
```

```
button:active,
.button:active,
.contributor-posts-link:active,
input[type="button"]:active,
input[type="reset"]:active,
input[type="submit"]:active,
.widget input[type="button"]:active,
.widget input[type="reset"]:active,
.widget input[type="submit"]:active,
.content-sidebar .widget input[type="button"]:active,
.content-sidebar .widget input[type="reset"]:active,
.content-sidebar .widget input[type="submit"]:active,
.wp-block-file .wp-block-file__button:active,
.wp-block-button__link:active {
        background-color: #5d9ee8;
}

.site-navigation .current_page_item > a,
.site-navigation .current_page_ancestor > a,
.site-navigation .current-menu-item > a,
.site-navigation .current-menu-ancestor > a {
        color: #5d9ee8;
}

/* Higher contrast Accent Color against contrast color */
.site-navigation .current_page_item > a,
.site-navigation .current_page_ancestor > a,
.site-navigation .current-menu-item > a,
.site-navigation .current-menu-ancestor > a,
.site-navigation a:hover,
.featured-content a:hover,
.featured-content .entry-title a:hover,
.widget a:hover,
.widget-title a:hover,
.widget_twentyfourteen_ephemera .entry-meta a:hover,
.hentry .mejs-controls .mejs-button button:hover,
.widget .mejs-controls .mejs-button button:hover,
.site-info a:hover,
.featured-content a:hover {
        color: #64a5ef;
}

.hentry .mejs-controls .mejs-time-rail .mejs-time-current,
.widget .mejs-controls .mejs-time-rail .mejs-time-current,
.slider-control-paging a:hover:before,
.slider-control-paging .slider-active:before,
```

```
                .slider-control-paging .slider-active:hover:before {
                        background-color: #64a5ef;
                }
        </style> <style>@media screen and (min-width: 783px){.primary-
navigation{float: left;margin-left: 20px;}a { transition: all .5s ease;
}}</style>
<style>.site {margin: 0 auto;max-width: 1260px;width: 100%;}.site-header{max-
width: 1260px;}
                @media screen and (min-width: 1110px) {.archive-
header,.comments-area,.image-navigation,.page-header,.page-content,.post-
navigation,.site-content .entry-header,
            .site-content .entry-content,.site-content .entry-summary,.site-
content footer.entry-meta{padding-left: 55px;}}</style>
<style>
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content .entry-summary,.site-content .entry-meta,.page-content
                {max-width: 600px;}.comments-area{max-width: 600px;}.post-
navigation, .image-navigation{max-width: 600px;}</style>
<style>.content-area{padding-top: 30px;}.content-sidebar{padding-top: 30px;}
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sidebar{padding-top: 30px;}}</style>
<style>.hentry{max-width: 1260px;}
            img.size-full,img.size-large,.wp-post-image,.post-thumbnail
img,.site-content .post-thumbnail img{max-height: 572px;}
        </style>
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img{max-width: 1600px;width: 100%;}
                .slider .featured-content .post-
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<style>.featured-content{display:none; visibility: hidden;}</style>
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12 months ended April 2022 after rising 8.5% previously, according to U.S. Labor
Department data published May 11. …" name="description"/>
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                .site-description {
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                        clip: rect(1px, 1px, 1px, 1px);
                        position: absolute;
                }
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icon"/>
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content/uploads/2015/05/USInflationHeader6.jpg" width="1260"/>
</a>
</div>
<header class="site-header" id="masthead" role="banner">
<div class="header-main">
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rel="home">US Inflation Calculator</a></h1>
<div class="search-toggle">
<a class="screen-reader-text" href="#search-container">Search</a>
</div>
<nav class="site-navigation primary-navigation" id="primary-navigation"
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<h1 class="menu-toggle">Primary Menu</h1>
<a class="screen-reader-text skip-link" href="#content">Skip to content</a>
<div class="menu-mainmen-container"><ul class="nav-menu" id="menu-mainmen"><li
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menu-item-1343" id="menu-item-1343"><a
href="http://www.usinflationcalculator.com/">US Inflation Home</a></li>
<li class="menu-item menu-item-type-custom menu-item-object-custom current-menu-
ancestor current-menu-parent menu-item-has-children menu-item-1344" id="menu-
item-1344"><a href="http://www.usinflationcalculator.com/inflation/">Inflation
and Prices</a>
```

<ul class="sub-menu">
<li class="menu-item menu-item-type-post_type menu-item-object-page current-menu-item page_item page-item-75 current_page_item menu-item-1349" id="menu-item-1349"><a aria-current="page" href="https://www.usinflationcalculator.com/inflation/current-inflation-rates/">Current US Inflation Rates: 2000-2022
<li class="menu-item menu-item-type-post_type menu-item-object-page menu-item-1348" id="menu-item-1348">Historical Inflation Rates: 1914-2022
<li class="menu-item menu-item-type-post_type menu-item-object-page menu-item-1352" id="menu-item-1352">Consumer Price Index Data from 1913 to 2022
<li class="menu-item menu-item-type-post_type menu-item-object-page menu-item-1351" id="menu-item-1351">Consumer Price Index - Release Schedule (2018-2022)
<li class="menu-item menu-item-type-post_type menu-item-object-page menu-item-1353" id="menu-item-1353">Inflation vs. Consumer Price Index (CPI), How They Are Different
<li class="menu-item menu-item-type-post_type menu-item-object-page menu-item-15703" id="menu-item-15703">Core Inflation Rates (1957-2022)
<li class="menu-item menu-item-type-post_type menu-item-object-page menu-item-22750" id="menu-item-22750">Grocery Store Food Prices (2015-Present)
<li class="menu-item menu-item-type-post_type menu-item-object-page menu-item-22769" id="menu-item-22769">Energy Prices: Gasoline, Electricity and Fuel Oil (2015-Present)
<li class="menu-item menu-item-type-post_type menu-item-object-page menu-item-1350" id="menu-item-1350">Annual Averages for Rates of Inflation
<li class="menu-item menu-item-type-post_type menu-item-object-page menu-item-1739" id="menu-item-1739">Monthly US Inflation Rates: 1913-Present


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</li>
<li class="menu-item menu-item-type-custom menu-item-object-custom menu-item-
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&amp;amp; Health Care Inflation</a>
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href="https://www.usinflationcalculator.com/inflation/gasoline-inflation-in-the-
united-states/">Gasoline Inflation (1968-2022)</a></li>
<li class="menu-item menu-item-type-post_type menu-item-object-page menu-
item-15714" id="menu-item-15714"><a
href="https://www.usinflationcalculator.com/inflation/food-inflation-in-the-
united-states/">Food Inflation (1968-2022)</a></li>
<li class="menu-item menu-item-type-post_type menu-item-object-page menu-
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href="https://www.usinflationcalculator.com/inflation/health-care-inflation-in-
the-united-states/">Health Care Inflation in the United States
(1948-2022)</a></li>
</ul>
</li>
<li class="menu-item menu-item-type-custom menu-item-object-custom menu-item-
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for Inflation</a>
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href="https://www.usinflationcalculator.com/gasoline-prices-adjusted-for-
inflation/">Gasoline Prices Adjusted for Inflation</a></li>
<li class="menu-item menu-item-type-post_type menu-item-object-page menu-
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href="https://www.usinflationcalculator.com/inflation/electricity-prices-
adjusted-for-inflation/">Electricity Prices By Year And Adjusted For
Inflation</a></li>
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href="https://www.usinflationcalculator.com/inflation/milk-prices-adjusted-for-
inflation/">Milk Prices By Year And Adjusted For Inflation</a></li>
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href="https://www.usinflationcalculator.com/inflation/coffee-prices-by-year-and-
adjust-for-inflation/">Coffee Prices By Year And Adjusted For Inflation</a></li>
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href="https://www.usinflationcalculator.com/inflation/bacon-prices-by-year-and-
adjusted-for-inflation/">Bacon Prices By Year And Adjusted For
Inflation</a></li>
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href="https://www.usinflationcalculator.com/inflation/egg-prices-adjusted-for-
inflation/">Egg Prices By Year And Adjusted For Inflation

<li class="menu-item menu-item-type-post_type menu-item-object-page menu-
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href="https://www.usinflationcalculator.com/frequently-asked-questions-
faqs/">Inflation FAQ's
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href="https://www.usinflationcalculator.com/about/">About
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Search for:
<input class="search-field" name="s" placeholder="Search …" type="search"
value=""/>
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<input class="search-submit" type="submit" value="Search"/>
</form>

</header><!-- #masthead -->

<article class="post-75 page type-page status-publish hentry" id="post-75">
<header class="entry-header"><h1 class="entry-title">Current US Inflation Rates:
2000-2022</h1></header><!-- .entry-header -->

The annual inflation rate for the United States is 8.3% for the 12 months
ended April 2022 after rising 8.5% previously, according to U.S. Labor
Department data published May 11. The next inflation update is scheduled for
release on June 10 at 8:30 a.m. ET. It will offer the rate of inflation over the
12 months ended May 2022.
The chart and table below display annual US inflation rates
for calendar years from 2000 and 2012 to 2022. (For prior years, see <a
href="https://www.usinflationcalculator.com/inflation/historical-inflation-
rates/" title="Historical US Inflation Rates">historical inflation rates.)
If you would like to calculate accumulated rates between two different dates,
use the <a href="https://www.usinflationcalculator.com/" title="US Inflation
Calculator">US Inflation Calculator.

```
<div style="margin-left:-50px"><iframe frameborder="0" height="450"
scrolling="yes" seamless=""
src="https://www.usinflationcalculator.com/charts/inflation/inflation-
chart.html" width="580"></iframe></div>
<p>*The latest inflation data (12-month based) is always displayed in the
chart's final column.</p>
<p><strong>Table: Annual Inflation Rates by Month and Year</strong></p>
<p>Since figures below are 12-month periods, look to the December column to find
inflation rates by calendar year. For example, the rate of inflation in 2021 was
7.0%.</p>
<p>The last column, "Ave," shows the average inflation rate for each year <a
href="https://www.usinflationcalculator.com/inflation/consumer-price-index-and-
annual-percent-changes-from-1913-to-2008/" title="Consumer Price Index
Data">using CPI data</a>, which was 4.7% in 2021. They are published by the BLS
but are rarely discussed in news media, taking a back seat to a calendar year's
actual rate of inflation.</p>
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<td align="right"><strong>Apr</strong></td>
<td align="right"><strong>May</strong></td>
<td align="right"><strong>Jun</strong></td>
<td align="right"><strong>Jul</strong></td>
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<td align="right"><em>Avail.<br/>
     June<br/>
     10</em></td>
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<td align="right">2.3</td>
<td align="right">3.1</td>
<td align="right">3.3</td>
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<td align="right">2.7</td>
<td align="right">2.5</td>
<td align="right">3.2</td>
<td align="right">3.5</td>
<td align="right">3.3</td>
<td align="right">2.7</td>
</tr>
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<td align="right" height="17"><strong>2003</strong></td>
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<td align="right">3.0</td>
<td align="right">3.0</td>
<td align="right">2.2</td>
<td align="right">2.1</td>
<td align="right">2.1</td>
<td align="right">2.1</td>
<td align="right">2.2</td>
<td align="right">2.3</td>
<td align="right">2.0</td>
<td align="right">1.8</td>
<td align="right">1.9</td>
<td align="right">2.3</td>
</tr>
<tr height="17">
<td align="right" height="17"><strong>2002</strong></td>
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<td align="right">1.1</td>
<td align="right">1.5</td>
<td align="right">1.6</td>
<td align="right">1.2</td>
<td align="right">1.1</td>
<td align="right">1.5</td>
<td align="right">1.8</td>
<td align="right">1.5</td>
<td align="right">2.0</td>
<td align="right">2.2</td>
<td align="right">2.4</td>
<td align="right">1.6</td>
</tr>
<tr bgcolor="#dae9fc">
<td align="right" height="17"><strong>2001</strong></td>
<td align="right">3.7</td>
<td align="right">3.5</td>
```

<td align="right">2.9</td>
<td align="right">3.3</td>
<td align="right">3.6</td>
<td align="right">3.2</td>
<td align="right">2.7</td>
<td align="right">2.7</td>
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<td align="right">1.9</td>
<td align="right">1.6</td>
<td align="right">2.8</td>
</tr>
<tr height="17">
<td align="right" height="17">2000</td>
<td align="right">2.7</td>
<td align="right">3.2</td>
<td align="right">3.8</td>
<td align="right">3.1</td>
<td align="right">3.2</td>
<td align="right">3.7</td>
<td align="right">3.7</td>
<td align="right">3.4</td>
<td align="right">3.5</td>
<td align="right">3.4</td>
<td align="right">3.4</td>
<td align="right">3.4</td>
<td align="right">3.4</td>
</tr>
</table>

Calculating Annual Inflation Rates
Annual rates of inflation are calculated using 12-month selections of the <a
href="http://www.usinflationcalculator.com/inflation/consumer-price-index-and-
annual-percent-changes-from-1913-to-2008/" title="Consumer Price Index Data from
1913 to Present">Consumer Price Index which is <a
href="https://www.usinflationcalculator.com/inflation/consumer-price-index-
release-schedule/" title="Consumer Price Index Release Schedule">published
monthly by the Labor Department's Bureau of Labor Statistics (<a
href="http://www.bls.gov/cpi/" title="Bureau of Labor Statistics (BLS) -
Consumer Price Index">BLS).
For example, to calculate the inflation rate for January 2017, subtract the
January 2016 CPI of "236.916" from the January 2017 CPI of "242.839." The result
is "5.923." Divide this number by the January 2016 CPI and then multiply by 100
and add a % sign.
The result is January's annual inflation rate of 2.5%.
<div class="robots-nocontent sd-block

```
sd-social sd-social-icon-text sd-sharing"><h3 class="sd-title">Share
this:</h3><div class="sd-content"><ul><li class="share-facebook"><a
class="share-facebook sd-button share-icon" data-shared="sharing-facebook-75"
href="https://www.usinflationcalculator.com/inflation/current-inflation-
rates/?share=facebook" rel="nofollow noopener noreferrer" target="_blank"
title="Click to share on Facebook"><span>Facebook</span></a></li><li
class="share-twitter"><a class="share-twitter sd-button share-icon" data-
shared="sharing-twitter-75"
href="https://www.usinflationcalculator.com/inflation/current-inflation-
rates/?share=twitter" rel="nofollow noopener noreferrer" target="_blank"
title="Click to share on Twitter"><span>Twitter</span></a></li><li class="share-
reddit"><a class="share-reddit sd-button share-icon" data-shared=""
href="https://www.usinflationcalculator.com/inflation/current-inflation-
rates/?share=reddit" rel="nofollow noopener noreferrer" target="_blank"
title="Click to share on Reddit"><span>Reddit</span></a></li><li><a
class="sharing-anchor sd-button share-more"
href="#"><span>More</span></a></li><li class="share-end"></li></ul><div
class="sharing-hidden"><div class="inner" style="display: none;"><ul><li
class="share-print"><a class="share-print sd-button share-icon" data-shared=""
href="https://www.usinflationcalculator.com/inflation/current-inflation-
rates/#print" rel="nofollow noopener noreferrer" target="_blank" title="Click to
print"><span>Print</span></a></li><li class="share-email"><a class="share-email
sd-button share-icon" data-shared=""
href="https://www.usinflationcalculator.com/inflation/current-inflation-
rates/?share=email" rel="nofollow noopener noreferrer" target="_blank"
title="Click to email this to a friend"><span>Email</span></a></li><li
class="share-end"></li><li class="share-
end"></li></ul></div></div></div></div></div> </div><!-- .entry-content -->
</article><!-- #post-75 -->
</div><!-- #content -->
</div><!-- #primary -->
<div class="content-sidebar widget-area" id="content-sidebar"
role="complementary">
<aside class="widget widget_text" id="text-176465771"> <div
class="textwidget"><style type="text/css">
<!--
.smallBox5{
        border-right-width: 1px;
        border-top-width: 1px;
        border-bottom-width: 1px;
        border-left-width: 1px;
        border-top-style: solid;
        border-right-style: solid;
        border-bottom-style: solid;
        border-left-style: solid;
}
.style1 {font-size: xx-small}
```

```
-->
</style>
<div align="center">
<table ;="" class="smallBox5" width="180px"><tr><td valign="middle"><h3 ;=""
align="center" style="margin-bottom:2px; border-bottom:none"><a
href="https://www.usinflationcalculator.com/" title="US Inflation
Calculator">Try Inflation Calculator!</a></h3>
<p ;="" align="center" style="margin-bottom:2px; border-
bottom:none"> </p></td></tr></table>
</div></div>
</aside><aside class="widget widget_text" id="text-176031101"> <div
class="textwidget"><style type="text/css">
<!-- .smallBox5{ border-right-width: 1px; border-top-width: 1px; border-bottom-
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solid; border-bottom-style: solid; border-left-style: solid; } hr { border-
top:1px dotted #000; width:85%; align="center"; margin-bottom:7px; margin-
top:7px; /*Rest of stuff here*/ } .style1 {font-size: xx-small} --><br
/></style>
<div align="center">
<table class="smallBox5" width="230px">
<tbody>
<tr>
<td>
<h3 align="center" style="margin-bottom: 0px;"><a
href="http://www.usinflationcalculator.com/inflation/current-inflation-rates/"
title="Current US Inflation Rates">Inflation Rate</a> <u>8.3%</u></h3>
</td>
</tr>
<tr>
<td>
<hr/>
</td>
</tr>
<tr>
<td>
<h3 align="center" style="margin-bottom: 0px; margin-top: 0px; padding-top:
2px;">Consumer Price Index (CPI) 289.109</h3>
</td>
</tr>
<tr>
<td>
<hr/>
</td>
</tr>
<tr>
<td>
<p align="center" class="style1">Released on May 11 for  April 2022.<br/>
```

Next release on June 10 for May 2022.</p>
</td>
</tr>
</tbody>
</table>

</aside><aside class="widget widget_text" id="text-430430986"> <script async="" crossorigin="anonymous" src="https://pagead2.googlesyndication.com/pagead/js/adsbygoogle.js?client=ca-pub-0374335159561115"></script>
<!-- USInflationCalc300x600 -->
<ins class="adsbygoogle" data-ad-client="ca-pub-0374335159561115" data-ad-format="auto" data-ad-slot="9115547791" style="display:block"></ins>
<script>
     (adsbygoogle = window.adsbygoogle || []).push({});
</script>
</aside>
<aside class="widget widget_recent_entries" id="recent-posts-2">
<h1 class="widget-title">US Inflation Reports (Monthly CPI)</h1><nav aria-label="US Inflation Reports (Monthly CPI)">

U.S. Inflation Remains Near 40-Year Highs as April CPI Tops Expectations

U.S. Inflation Highest Since 1981 as CPI Hits 8.5% in March

U.S. Inflation at 7.9% Highest Since 1982 as Prices Surge for Gas, Food and Shelter

U.S. Inflation Rate at 7.5% Hits 40-Year High

<a href="https://www.usinflationcalculator.com/inflation/u-s-inflation-

rises-7-in-2021-marking-highest-rate-since-1982/100021708/">U.S. Inflation Rises 7% in 2021, Marking Highest Rate Since 1982

U.S. Rate of Inflation Soars to 39-Year High as Consumer Prices Jump in November

U.S. Rate of Inflation Highest Since 1990

U.S. Inflation Resumes Quicker Pace in September

Annual U.S. Inflation Cools Slightly; Consumer Price Gains Ease in August

U.S. Consumer Price Gains Slow in July; Annual Inflation Remains Near 13-Year High

Annual Inflation and Consumer Prices in June Rise Most Since 2008

U.S. Inflation Hottest Annually Since August 2008; Consumer Prices in May Rise Strongly

Inflation Marks Quickest Pace Since 2008; Consumer Prices Surge in April

</nav></aside><aside class="widget widget_search" id="search-3"><form action="https://www.usinflationcalculator.com/" class="search-form" method="get"

```
role="search">
<label>
<span class="screen-reader-text">Search for:</span>
<input class="search-field" name="s" placeholder="Search …" type="search"
value=""/>
</label>
<input class="search-submit" type="submit" value="Search"/>
</form></aside><aside class="widget widget_top-posts" id="top-posts-2"><h1
class="widget-title">Popular US Inflation Pages</h1><ul><li><a aria-
current="page" class="bump-view" data-bump-view="tp"
href="https://www.usinflationcalculator.com/inflation/current-inflation-
rates/">Current US Inflation Rates: 2000-2022</a></li><li><a class="bump-view"
data-bump-view="tp"
href="https://www.usinflationcalculator.com/inflation/historical-inflation-
rates/">Historical Inflation Rates: 1914-2022</a></li><li><a class="bump-view"
data-bump-view="tp" href="https://www.usinflationcalculator.com/gasoline-prices-
adjusted-for-inflation/">Gasoline Prices Adjusted for Inflation</a></li><li><a
class="bump-view" data-bump-view="tp"
href="https://www.usinflationcalculator.com/inflation/consumer-price-index-and-
annual-percent-changes-from-1913-to-2008/">Consumer Price Index Data from 1913
to 2022</a></li><li><a class="bump-view" data-bump-view="tp"
href="https://www.usinflationcalculator.com/inflation/consumer-price-index-
release-schedule/">Consumer Price Index - Release Schedule
(2021-2022)</a></li></ul></aside><aside class="widget widget_block"
id="block-7">
<hr class="wp-block-separator is-style-wide"/>
</aside><aside class="widget widget_block"
id="block-5"><p><strong>**NEW**</strong></p>
<ul>
<li><a href="https://www.usinflationcalculator.com/inflation/inflation-in-the-
los-angeles-long-beach-anaheim-metropolitan-area/" title="Inflation in the Los
Angeles-Long Beach-Anaheim Metropolitan Area">Los Angeles Area Inflation Data
and Calculator</a></li><br/>
<li><a href="https://www.usinflationcalculator.com/inflation/inflation-in-new-
york-newark-and-jersey-city-metropolitan-area/" title="Inflation in New York,
Newark and Jersey City Metropolitan Area">New York-Newark-Jersey City Area
Inflation Data and Calculator</a></li>
</ul></aside></div><!-- #content-sidebar -->
</div><!-- #main-content -->
<div id="secondary">
<div class="primary-sidebar widget-area" id="primary-sidebar"
role="complementary">
<aside class="widget widget_block" id="block-2"><script async=""
crossorigin="anonymous"
src="https://pagead2.googlesyndication.com/pagead/js/adsbygoogle.js?client=ca-
pub-0374335159561115"></script>
<!-- 160x600, created 7/16/08 -->
```

```
<ins class="adsbygoogle" data-ad-client="ca-pub-0374335159561115" data-ad-
slot="5338972341" style="display:inline-block;width:160px;height:600px"></ins>
<script>
     (adsbygoogle = window.adsbygoogle || []).push({});
</script></aside><aside class="widget widget_block"
id="block-4"><p><strong>RESOURCE LINKS</strong></p>
<ul>
<li><a href="http://www.bls.gov/cpi/" title="http://www.bls.gov/cpi/">Bureau of
Labor Statistics</a></li>
<li><a href="https://percentcalculators.com/" title="Percentage
Calculators">Percent Calculators</a></li>
<li><a href="https://www.federalreserve.gov/monetarypolicy.htm" title="Federal
Reserve Monetary Policy">Reserve Monetary Policy</a></li>
</ul></aside><aside class="widget widget_block" id="block-3"><script async=""
crossorigin="anonymous"
src="https://pagead2.googlesyndication.com/pagead/js/adsbygoogle.js?client=ca-
pub-0374335159561115"></script>
<!-- USInflat2 -->
<ins class="adsbygoogle" data-ad-client="ca-pub-0374335159561115" data-ad-
slot="9022634993" style="display:inline-block;width:160px;height:600px"></ins>
<script>
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</script></aside> </div><!-- #primary-sidebar -->
</div><!-- #secondary -->
</div><!-- #main -->
<footer class="site-footer" id="colophon" role="contentinfo">
<div class="site-info">
<p align="center">US <a href="http://www.usinflationcalculator.com/"
title="Inflation Calculator">INFLATION CALCULATOR</a> · COPYRIGHT © 2008-2022
COINNEWS MEDIA GROUP LLC (<a href="http://www.coinnews.net/" title="Coin
News">COIN NEWS</a>) · ALL RIGHTS RESERVED</p>
<p> </p>
</div><!-- .site-info -->
</footer><!-- #colophon -->
</div><!-- #page -->
<script type="text/javascript">
                window.WPCOM_sharing_counts =
{"https:\/\/www.usinflationcalculator.com\/inflation\/current-inflation-
rates\/":75};
        </script>
<div id="sharing_email" style="display: none;">
<form action="/inflation/current-inflation-rates/" method="post">
<label for="target_email">Send to Email Address</label>
<input id="target_email" name="target_email" type="email" value=""/>
<label for="source_name">Your Name</label>
<input id="source_name" name="source_name" type="text" value=""/>
<label for="source_email">Your Email Address</label>
```

```
<input id="source_email" name="source_email" type="email" value=""/>
<input autocomplete="off" class="input" id="jetpack-source_f_name"
name="source_f_name" size="25" title="This field is for validation and should
not be changed" type="text" value=""/>
<img alt="loading" class="loading" height="16"
src="https://www.usinflationcalculator.com/wp-
content/plugins/jetpack/modules/sharedaddy/images/loading.gif" style="float:
right; display: none" width="16">
<input class="sharing_send" type="submit" value="Send Email"/>
<a class="sharing_cancel" href="#cancel" rel="nofollow" role="button">Cancel</a>
<div class="errors errors-1" style="display: none;">
                                Post was not sent - check your email addresses!
</div>
<div class="errors errors-2" style="display: none;">
                                Email check failed, please try again
</div>
<div class="errors errors-3" style="display: none;">
                                Sorry, your blog cannot share posts by email.
</div>
</img></form>
</div>
<script id="twentyfourteen-script-js"
src="https://www.usinflationcalculator.com/wp-
content/themes/twentyfourteen/js/functions.js?ver=20171218"></script>
<script id="sharing-js-js-extra">
var sharing_js_options = {"lang":"en","counts":"1","is_stats_active":"1"};
</script>
<script id="sharing-js-js" src="https://www.usinflationcalculator.com/wp-
content/plugins/jetpack/_inc/build/sharedaddy/sharing.min.js?ver=10.9"></script>
<script id="sharing-js-js-after">
var windowOpen;
                        ( function () {
                                function matches( el, sel ) {
                                        return !! (
                                                el.matches && el.matches( sel )
||
                                                el.msMatchesSelector &&
el.msMatchesSelector( sel )
                                        );
                                }

                                document.body.addEventListener( 'click',
function ( event ) {
                                        if ( ! event.target ) {
                                                return;
                                        }
```

```
                                        var el;
                                        if ( matches( event.target, 'a.share-
facebook' ) ) {
                                                el = event.target;
                                        } else if ( event.target.parentNode &&
matches( event.target.parentNode, 'a.share-facebook' ) ) {
                                                el = event.target.parentNode;
                                        }

                                        if ( el ) {
                                                event.preventDefault();

                                                // If there's another sharing
window open, close it.
                                                if ( typeof windowOpen !==
'undefined' ) {
                                                        windowOpen.close();
                                                }
                                                windowOpen = window.open(
el.getAttribute( 'href' ), 'wpcomfacebook',
'menubar=1,resizable=1,width=600,height=400' );
                                                return false;
                                        }
                                } );
                        } )();
var windowOpen;
                        ( function () {
                                function matches( el, sel ) {
                                        return !! (
                                                el.matches && el.matches( sel )
||
                                                el.msMatchesSelector &&
el.msMatchesSelector( sel )
                                        );
                                }

                                document.body.addEventListener( 'click',
function ( event ) {
                                        if ( ! event.target ) {
                                                return;
                                        }

                                        var el;
                                        if ( matches( event.target, 'a.share-
twitter' ) ) {
                                                el = event.target;
                                        } else if ( event.target.parentNode &&
```

```
matches( event.target.parentNode, 'a.share-twitter' ) ) {
                                                el = event.target.parentNode;
                                        }

                                        if ( el ) {
                                                event.preventDefault();

                                                // If there's another sharing
window open, close it.
                                                if ( typeof windowOpen !==
'undefined' ) {
                                                        windowOpen.close();
                                                }
                                                windowOpen = window.open(
el.getAttribute( 'href' ), 'wpcomtwitter',
'menubar=1,resizable=1,width=600,height=350' );
                                                return false;
                                        }
                                } );
                        } )();
</script>
<script defer="" src="https://stats.wp.com/e-202222.js"></script>
<script>
        _stq = window._stq || [];
        _stq.push([ 'view', {v:'ext',j:'1:10.9',blog:'5955919',post:'75',tz:'-
4',srv:'www.usinflationcalculator.com'} ]);
        _stq.push([ 'clickTrackerInit', '5955919', '75' ]);
</script>
</body>
</html>
```

[ ]:
```
#using prettify() method to turn a Beautiful Soup parse tree into a nicely␣
 ↪formatted Unicode string,
#with a separate line for each tag and each string:
print(soup.prettify())
```

```
<!DOCTYPE html>
<!--[if IE 7]>
<html class="ie ie7" dir="ltr" lang="en-US"
        prefix="og: https://ogp.me/ns#" >
<![endif]-->
<!--[if IE 8]>
<html class="ie ie8" dir="ltr" lang="en-US"
        prefix="og: https://ogp.me/ns#" >
<![endif]-->
<!--[if !(IE 7) | !(IE 8) ]><!-->
<html dir="ltr" lang="en-US" prefix="og: https://ogp.me/ns#">
 <!--<![endif]-->
```

```
 <head>
  <!-- Global site tag (gtag.js) - Google Analytics -->
  <script async=""
src="https://www.googletagmanager.com/gtag/js?id=UA-2181571-7">
  </script>
  <script>
   window.dataLayer = window.dataLayer || [];
  function gtag(){dataLayer.push(arguments);}
  gtag('js', new Date());

  gtag('config', 'UA-2181571-7');
  </script>
  <meta charset="utf-8"/>
  <meta content="width=device-width" name="viewport"/>
  <link href="http://gmpg.org/xfn/11" rel="profile"/>
  <link href="https://www.usinflationcalculator.com/xmlrpc.php" rel="pingback"/>
  <!--[if lt IE 9]>
        <script src="https://www.usinflationcalculator.com/wp-
content/themes/twentyfourteen/js/html5.js"></script>
        <![endif]-->
  <!-- All in One SEO 4.2.0 -->
  <title>
   Current US Inflation Rates: 2000-2022 | US Inflation Calculator
  </title>
  <meta content="The annual inflation rate for the United States is 8.3% for the
12 months ended April 2022 after rising 8.5% previously, according to U.S. Labor
Department data published May 11. The next inflation update is scheduled for
release on June 10 at 8:30 a.m. ET. It will offer the rate of inflation over the
12" name="description">
   <meta content="max-image-preview:large" name="robots">
    <link href="https://www.usinflationcalculator.com/inflation/current-
inflation-rates/" rel="canonical">
     <meta content="en_US" property="og:locale"/>
     <meta content="US Inflation Calculator |" property="og:site_name"/>
     <meta content="article" property="og:type"/>
     <meta content="Current US Inflation Rates: 2000-2022 | US Inflation
Calculator" property="og:title"/>
     <meta content="The annual inflation rate for the United States is 8.3% for
the 12 months ended April 2022 after rising 8.5% previously, according to U.S.
Labor Department data published May 11. The next inflation update is scheduled
for release on June 10 at 8:30 a.m. ET. It will offer the rate of inflation over
the 12" property="og:description"/>
     <meta content="https://www.usinflationcalculator.com/inflation/current-
inflation-rates/" property="og:url"/>
     <meta content="2008-07-23T03:07:58+00:00"
property="article:published_time"/>
     <meta content="2022-05-11T13:01:22+00:00"
property="article:modified_time"/>
```

<meta content="summary" name="twitter:card"/>
<meta content="Current US Inflation Rates: 2000-2022 | US Inflation Calculator" name="twitter:title"/>
<meta content="The annual inflation rate for the United States is 8.3% for the 12 months ended April 2022 after rising 8.5% previously, according to U.S. Labor Department data published May 11. The next inflation update is scheduled for release on June 10 at 8:30 a.m. ET. It will offer the rate of inflation over the 12" name="twitter:description"/>
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.grid .featured-content .entry-header,
.ie8 .grid .featured-content .entry-header {
        border-color: #1a4e88;
}

.slider-control-paging a:before {
        background-color: rgba(255,255,255,.33);
}

.hentry .mejs-mediaelement,
.widget .mejs-mediaelement,
.hentry .mejs-container .mejs-controls,
.widget .mejs-container .mejs-controls {
        background: #1a4e88;
}

/* Player controls need separation from the contrast background
*/
.primary-sidebar .mejs-controls,
.site-footer .mejs-controls {
        border: 1px solid;
}

        .content-sidebar .widget_twentyfourteen_ephemera
.widget-title:before {
                background: #1a4e88;
        }

        .paging-navigation,
        .content-sidebar .widget .widget-title {
                border-top-color: #1a4e88;
        }

        .content-sidebar .widget .widget-title,
        .content-sidebar .widget .widget-title a,
```

```
                        .paging-navigation,
                        .paging-navigation a:hover,
                        .paging-navigation a {
                                color: #1a4e88;
                        }

                        /* Override the site title color option with an over-
qualified selector, as the option is hidden. */
                        h1.site-title a {
                                color: #fff;
                        }

                .menu-toggle:active,
                .menu-toggle:focus,
                .menu-toggle:hover {
                        background-color: #5e92cc;
                }
                /* Custom accent color. */
                button,
                .button,
                .contributor-posts-link,
                input[type="button"],
                input[type="reset"],
                input[type="submit"],
                .search-toggle,
                .hentry .mejs-controls .mejs-time-rail .mejs-time-current,
                .widget .mejs-controls .mejs-time-rail .mejs-time-current,
                .hentry .mejs-overlay:hover .mejs-overlay-button,
                .widget .mejs-overlay:hover .mejs-overlay-button,
                .widget button,
                .widget .button,
                .widget input[type="button"],
                .widget input[type="reset"],
                .widget input[type="submit"],
                .widget_calendar tbody a,
                .content-sidebar .widget input[type="button"],
                .content-sidebar .widget input[type="reset"],
                .content-sidebar .widget input[type="submit"],
                .slider-control-paging .slider-active:before,
                .slider-control-paging .slider-active:hover:before,
                .slider-direction-nav a:hover,
                .ie8 .primary-navigation ul ul,
                .ie8 .secondary-navigation ul ul,
                .ie8 .primary-navigation li:hover > a,
                .ie8 .primary-navigation li.focus > a,
                .ie8 .secondary-navigation li:hover > a,
                .ie8 .secondary-navigation li.focus > a,
                .wp-block-file .wp-block-file__button,
```

```
.wp-block-button__link,
.has-green-background-color {
	background-color: #2c6db7;
}

.site-navigation a:hover,
.is-style-outline .wp-block-button__link:not(.has-text-color),
.has-green-color {
	color: #2c6db7;
}

::-moz-selection {
	background: #2c6db7;
}

::selection {
	background: #2c6db7;
}

.paging-navigation .page-numbers.current {
	border-color: #2c6db7;
}

@media screen and (min-width: 782px) {
	.primary-navigation li:hover > a,
	.primary-navigation li.focus > a,
	.primary-navigation ul ul {
		background-color: #2c6db7;
	}
}

@media screen and (min-width: 1008px) {
	.secondary-navigation li:hover > a,
	.secondary-navigation li.focus > a,
	.secondary-navigation ul ul {
		background-color: #2c6db7;
	}
}

	.contributor-posts-link,
	button,
	.button,
	input[type="button"],
	input[type="reset"],
	input[type="submit"],
	.search-toggle:before,
	.hentry .mejs-overlay:hover .mejs-overlay-button,
	.widget .mejs-overlay:hover .mejs-overlay-button,
```

```
.widget button,
.widget .button,
.widget input[type="button"],
.widget input[type="reset"],
.widget input[type="submit"],
.widget_calendar tbody a,
.widget_calendar tbody a:hover,
.site-footer .widget_calendar tbody a,
.content-sidebar .widget input[type="button"],
.content-sidebar .widget input[type="reset"],
.content-sidebar .widget input[type="submit"],
button:hover,
button:focus,
.button:hover,
.button:focus,
.widget a.button:hover,
.widget a.button:focus,
.widget a.button:active,
.content-sidebar .widget a.button,
.content-sidebar .widget a.button:hover,
.content-sidebar .widget a.button:focus,
.content-sidebar .widget a.button:active,
.contributor-posts-link:hover,
.contributor-posts-link:active,
input[type="button"]:hover,
input[type="button"]:focus,
input[type="reset"]:hover,
input[type="reset"]:focus,
input[type="submit"]:hover,
input[type="submit"]:focus,
.slider-direction-nav a:hover:before {
        color: #fff;
}

@media screen and (min-width: 782px) {
        .primary-navigation ul ul a,
        .primary-navigation li:hover > a,
        .primary-navigation li.focus > a,
        .primary-navigation ul ul {
                color: #fff;
        }
}

@media screen and (min-width: 1008px) {
        .secondary-navigation ul ul a,
        .secondary-navigation li:hover > a,
        .secondary-navigation li.focus > a,
        .secondary-navigation ul ul {
```

```
                        color: #fff;
                }
        }

/* Generated variants of custom accent color. */
a,
.content-sidebar .widget a {
        color: #2c6db7;
}

.contributor-posts-link:hover,
.button:hover,
.button:focus,
.slider-control-paging a:hover:before,
.search-toggle:hover,
.search-toggle.active,
.search-box,
.widget_calendar tbody a:hover,
button:hover,
button:focus,
input[type="button"]:hover,
input[type="button"]:focus,
input[type="reset"]:hover,
input[type="reset"]:focus,
input[type="submit"]:hover,
input[type="submit"]:focus,
.widget button:hover,
.widget .button:hover,
.widget button:focus,
.widget .button:focus,
.widget input[type="button"]:hover,
.widget input[type="button"]:focus,
.widget input[type="reset"]:hover,
.widget input[type="reset"]:focus,
.widget input[type="submit"]:hover,
.widget input[type="submit"]:focus,
.content-sidebar .widget input[type="button"]:hover,
.content-sidebar .widget input[type="button"]:focus,
.content-sidebar .widget input[type="reset"]:hover,
.content-sidebar .widget input[type="reset"]:focus,
.content-sidebar .widget input[type="submit"]:hover,
.content-sidebar .widget input[type="submit"]:focus,
.ie8 .primary-navigation ul ul a:hover,
.ie8 .primary-navigation ul ul li.focus > a,
.ie8 .secondary-navigation ul ul a:hover,
.ie8 .secondary-navigation ul ul li.focus > a,
.wp-block-file .wp-block-file__button:hover,
.wp-block-file .wp-block-file__button:focus,
```

```
                .wp-block-button__link:not(.has-text-color):hover,
                .wp-block-button__link:not(.has-text-color):focus,
                .is-style-outline .wp-block-button__link:not(.has-text-
color):hover,
                .is-style-outline .wp-block-button__link:not(.has-text-
color):focus {
                        background-color: #498ad4;
                }

                .featured-content a:hover,
                .featured-content .entry-title a:hover,
                .widget a:hover,
                .widget-title a:hover,
                .widget_twentyfourteen_ephemera .entry-meta a:hover,
                .hentry .mejs-controls .mejs-button button:hover,
                .widget .mejs-controls .mejs-button button:hover,
                .site-info a:hover,
                .featured-content a:hover,
                .wp-block-latest-comments_comment-meta a:hover,
                .wp-block-latest-comments_comment-meta a:focus {
                        color: #498ad4;
                }

                a:active,
                a:hover,
                .entry-title a:hover,
                .entry-meta a:hover,
                .cat-links a:hover,
                .entry-content .edit-link a:hover,
                .post-navigation a:hover,
                .image-navigation a:hover,
                .comment-author a:hover,
                .comment-list .pingback a:hover,
                .comment-list .trackback a:hover,
                .comment-metadata a:hover,
                .comment-reply-title small a:hover,
                .content-sidebar .widget a:hover,
                .content-sidebar .widget .widget-title a:hover,
                .content-sidebar .widget_twentyfourteen_ephemera .entry-meta
a:hover {
                        color: #498ad4;
                }

                .page-links a:hover,
                .paging-navigation a:hover {
                        border-color: #498ad4;
                }
```

```
.entry-meta .tag-links a:hover:before {
	border-right-color: #498ad4;
}

.page-links a:hover,
.entry-meta .tag-links a:hover {
	background-color: #498ad4;
}

@media screen and (min-width: 782px) {
	.primary-navigation ul ul a:hover,
	.primary-navigation ul ul li.focus > a {
		background-color: #498ad4;
	}
}

@media screen and (min-width: 1008px) {
	.secondary-navigation ul ul a:hover,
	.secondary-navigation ul ul li.focus > a {
		background-color: #498ad4;
	}
}

button:active,
.button:active,
.contributor-posts-link:active,
input[type="button"]:active,
input[type="reset"]:active,
input[type="submit"]:active,
.widget input[type="button"]:active,
.widget input[type="reset"]:active,
.widget input[type="submit"]:active,
.content-sidebar .widget input[type="button"]:active,
.content-sidebar .widget input[type="reset"]:active,
.content-sidebar .widget input[type="submit"]:active,
.wp-block-file .wp-block-file__button:active,
.wp-block-button__link:active {
	background-color: #5d9ee8;
}

.site-navigation .current_page_item > a,
.site-navigation .current_page_ancestor > a,
.site-navigation .current-menu-item > a,
.site-navigation .current-menu-ancestor > a {
	color: #5d9ee8;
}

/* Higher contrast Accent Color against contrast color */
```

```
                .site-navigation .current_page_item > a,
                .site-navigation .current_page_ancestor > a,
                .site-navigation .current-menu-item > a,
                .site-navigation .current-menu-ancestor > a,
                .site-navigation a:hover,
                .featured-content a:hover,
                .featured-content .entry-title a:hover,
                .widget a:hover,
                .widget-title a:hover,
                .widget_twentyfourteen_ephemera .entry-meta a:hover,
                .hentry .mejs-controls .mejs-button button:hover,
                .widget .mejs-controls .mejs-button button:hover,
                .site-info a:hover,
                .featured-content a:hover {
                        color: #64a5ef;
                }

                .hentry .mejs-controls .mejs-time-rail .mejs-time-current,
                .widget .mejs-controls .mejs-time-rail .mejs-time-current,
                .slider-control-paging a:hover:before,
                .slider-control-paging .slider-active:before,
                .slider-control-paging .slider-active:hover:before {
                        background-color: #64a5ef;
                }
      </style>
      <style>
       @media screen and (min-width: 783px){.primary-navigation{float:
left;margin-left: 20px;}a { transition: all .5s ease; }}
      </style>
      <style>
       .site {margin: 0 auto;max-width: 1260px;width: 100%;}.site-header{max-
width: 1260px;}
                @media screen and (min-width: 1110px) {.archive-
header,.comments-area,.image-navigation,.page-header,.page-content,.post-
navigation,.site-content .entry-header,
            .site-content .entry-content,.site-content .entry-summary,.site-
content footer.entry-meta{padding-left: 55px;}}
      </style>
      <style>
       .site-content .entry-header,.site-content .entry-content,.site-content
.entry-summary,.site-content .entry-meta,.page-content
                {max-width: 600px;}.comments-area{max-width: 600px;}.post-
navigation, .image-navigation{max-width: 600px;}
      </style>
      <style>
       .content-area{padding-top: 30px;}.content-sidebar{padding-top: 30px;}
                @media screen and (min-width: 846px) {.content-area,.content-
sidebar{padding-top: 30px;}}
```

```
      </style>
      <style>
       .hentry{max-width: 1260px;}
            img.size-full,img.size-large,.wp-post-image,.post-thumbnail
img,.site-content .post-thumbnail img{max-height: 572px;}
      </style>
      <style>
       .slider .featured-content .hentry{max-height: 500px;}.slider .featured-
content{max-width: 1600px;
               margin: 0px auto;}.slider .featured-content .post-thumbnail
img{max-width: 1600px;width: 100%;}
               .slider .featured-content .post-
thumbnail{background:none;}.slider .featured-content a.post-
thumbnail:hover{background-color:transparent;}
      </style>
      <style>
       .featured-content{background:none;}
      </style>
      <style>
       .featured-content{display:none; visibility: hidden;}
      </style>
      <meta content="The annual inflation rate for the United States is 8.3% for
the 12 months ended April 2022 after rising 8.5% previously, according to U.S.
Labor Department data published May 11. …" name="description"/>
      <style type="text/css">
       img#wpstats{display:none}
      </style>
      <style id="twentyfourteen-header-css" type="text/css">
       .site-title,
               .site-description {
                       clip: rect(1px 1px 1px 1px); /* IE7 */
                       clip: rect(1px, 1px, 1px, 1px);
                       position: absolute;
               }
      </style>
      <style id="custom-background-css">
       body.custom-background { background-color: #f7f7f7; }
      </style>
      <link href="https://www.usinflationcalculator.com/wp-
content/uploads/2021/12/cropped-usinflation-fav-32x32.jpg" rel="icon"
sizes="32x32"/>
      <link href="https://www.usinflationcalculator.com/wp-
content/uploads/2021/12/cropped-usinflation-fav-192x192.jpg" rel="icon"
sizes="192x192"/>
      <link href="https://www.usinflationcalculator.com/wp-
content/uploads/2021/12/cropped-usinflation-fav-180x180.jpg" rel="apple-touch-
icon"/>
      <meta content="https://www.usinflationcalculator.com/wp-
```

```
content/uploads/2021/12/cropped-usinflation-fav-270x270.jpg"
name="msapplication-TileImage"/>
      <script async="" data-ad-client="ca-pub-6084777151829107"
src="https://pagead2.googlesyndication.com/pagead/js/adsbygoogle.js">
      </script>
     </link>
    </link>
   </meta>
  </meta>
 </head>
 <body class="page-template-default page page-id-75 page-child parent-pageid-19
custom-background wp-embed-responsive header-image singular">
  <div class="hfeed site" id="page">
   <div id="site-header">
    <a href="https://www.usinflationcalculator.com/" rel="home">
     <img alt="" height="110" src="https://www.usinflationcalculator.com/wp-
content/uploads/2015/05/USInflationHeader6.jpg" width="1260"/>
    </a>
   </div>
   <header class="site-header" id="masthead" role="banner">
    <div class="header-main">
     <h1 class="site-title">
      <a href="https://www.usinflationcalculator.com/" rel="home">
       US Inflation Calculator
      </a>
     </h1>
     <div class="search-toggle">
      <a class="screen-reader-text" href="#search-container">
       Search
      </a>
     </div>
     <nav class="site-navigation primary-navigation" id="primary-navigation"
role="navigation">
      <h1 class="menu-toggle">
       Primary Menu
      </h1>
      <a class="screen-reader-text skip-link" href="#content">
       Skip to content
      </a>
      <div class="menu-mainmen-container">
       <ul class="nav-menu" id="menu-mainmen">
        <li class="menu-item menu-item-type-custom menu-item-object-custom menu-
item-home menu-item-1343" id="menu-item-1343">
         <a href="http://www.usinflationcalculator.com/">
          US Inflation Home
         </a>
        </li>
        <li class="menu-item menu-item-type-custom menu-item-object-custom
```

```
current-menu-ancestor current-menu-parent menu-item-has-children menu-item-1344"
id="menu-item-1344">
         <a href="http://www.usinflationcalculator.com/inflation/">
          Inflation and Prices
         </a>
         <ul class="sub-menu">
          <li class="menu-item menu-item-type-post_type menu-item-object-page
current-menu-item page_item page-item-75 current_page_item menu-item-1349"
id="menu-item-1349">
           <a aria-current="page"
href="https://www.usinflationcalculator.com/inflation/current-inflation-rates/">
            Current US Inflation Rates: 2000-2022
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-1348" id="menu-item-1348">
           <a href="https://www.usinflationcalculator.com/inflation/historical-
inflation-rates/">
            Historical Inflation Rates: 1914-2022
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-1352" id="menu-item-1352">
           <a href="https://www.usinflationcalculator.com/inflation/consumer-
price-index-and-annual-percent-changes-from-1913-to-2008/">
            Consumer Price Index Data from 1913 to 2022
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-1351" id="menu-item-1351">
           <a href="https://www.usinflationcalculator.com/inflation/consumer-
price-index-release-schedule/">
            Consumer Price Index - Release Schedule (2018-2022)
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-1353" id="menu-item-1353">
           <a href="https://www.usinflationcalculator.com/inflation/inflation-
vs-consumer-price-index-cpi-how-they-are-different/">
            Inflation vs. Consumer Price Index (CPI), How They Are Different
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-15703" id="menu-item-15703">
           <a href="https://www.usinflationcalculator.com/inflation/united-
states-core-inflation-rates/">
            Core Inflation Rates (1957-2022)
           </a>
```

```
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-22750" id="menu-item-22750">
           <a href="https://www.usinflationcalculator.com/inflation/average-
prices-for-selected-grocery-store-items-2015-present/">
            Grocery Store Food Prices (2015-Present)
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-22769" id="menu-item-22769">
           <a href="https://www.usinflationcalculator.com/inflation/energy-
prices-gasoline-electricity-and-fuel-oil-2015-present/">
            Energy Prices: Gasoline, Electricity and Fuel Oil (2015-Present)
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-1350" id="menu-item-1350">
           <a href="https://www.usinflationcalculator.com/inflation/annual-
averages-for-rate-of-inflation/">
            Annual Averages for Rates of Inflation
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-1739" id="menu-item-1739">
           <a href="https://www.usinflationcalculator.com/monthly-us-inflation-
rates-1913-present/">
            Monthly US Inflation Rates: 1913-Present
           </a>
          </li>
         </ul>
        </li>
        <li class="menu-item menu-item-type-custom menu-item-object-custom menu-
item-has-children menu-item-15728" id="menu-item-15728">
         <a href="#">
          Energy, Food &amp;amp; Health Care Inflation
         </a>
         <ul class="sub-menu">
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-15726" id="menu-item-15726">
           <a href="https://www.usinflationcalculator.com/inflation/gasoline-
inflation-in-the-united-states/">
            Gasoline Inflation (1968-2022)
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-15714" id="menu-item-15714">
           <a href="https://www.usinflationcalculator.com/inflation/food-
inflation-in-the-united-states/">
```

```
            Food Inflation (1968-2022)
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-20964" id="menu-item-20964">
           <a href="https://www.usinflationcalculator.com/inflation/health-care-
inflation-in-the-united-states/">
            Health Care Inflation in the United States (1948-2022)
           </a>
          </li>
         </ul>
        </li>
        <li class="menu-item menu-item-type-custom menu-item-object-custom menu-
item-has-children menu-item-20992" id="menu-item-20992">
         <a href="#">
          Items Adjusted for Inflation
         </a>
         <ul class="sub-menu">
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-15779" id="menu-item-15779">
           <a href="https://www.usinflationcalculator.com/gasoline-prices-
adjusted-for-inflation/">
            Gasoline Prices Adjusted for Inflation
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-20990" id="menu-item-20990">
           <a href="https://www.usinflationcalculator.com/inflation/electricity-
prices-adjusted-for-inflation/">
            Electricity Prices By Year And Adjusted For Inflation
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-20977" id="menu-item-20977">
           <a href="https://www.usinflationcalculator.com/inflation/milk-prices-
adjusted-for-inflation/">
            Milk Prices By Year And Adjusted For Inflation
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-21034" id="menu-item-21034">
           <a href="https://www.usinflationcalculator.com/inflation/coffee-
prices-by-year-and-adjust-for-inflation/">
            Coffee Prices By Year And Adjusted For Inflation
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-21043" id="menu-item-21043">
```

```
          <a href="https://www.usinflationcalculator.com/inflation/bacon-
prices-by-year-and-adjusted-for-inflation/">
            Bacon Prices By Year And Adjusted For Inflation
           </a>
          </li>
          <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-20997" id="menu-item-20997">
           <a href="https://www.usinflationcalculator.com/inflation/egg-prices-
adjusted-for-inflation/">
            Egg Prices By Year And Adjusted For Inflation
           </a>
          </li>
         </ul>
        </li>
        <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-1345" id="menu-item-1345">
         <a href="https://www.usinflationcalculator.com/frequently-asked-
questions-faqs/">
          Inflation FAQ's
         </a>
        </li>
        <li class="menu-item menu-item-type-post_type menu-item-object-page
menu-item-1346" id="menu-item-1346">
         <a href="https://www.usinflationcalculator.com/about/">
          About
         </a>
        </li>
       </ul>
      </div>
     </nav>
    </div>
    <div class="search-box-wrapper hide" id="search-container">
     <div class="search-box">
      <form action="https://www.usinflationcalculator.com/" class="search-form"
method="get" role="search">
       <label>
        <span class="screen-reader-text">
         Search for:
        </span>
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type="search" value=""/>
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    </div>
   </header>
   <!-- #masthead -->
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     <div class="content-area" id="primary">
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id="post-75">
        <header class="entry-header">
         <h1 class="entry-title">
          Current US Inflation Rates: 2000-2022
         </h1>
        </header>
        <!-- .entry-header -->
        <div class="entry-content">
         <p>
          The annual inflation rate for the United States is 8.3% for the 12
months ended April 2022 after rising 8.5% previously, according to U.S. Labor
Department data published May 11. The next inflation update is scheduled for
release on June 10 at 8:30 a.m. ET. It will offer the rate of inflation over the
12 months ended May 2022.
         </p>
         <p>
          The chart and table below display
          <strong>
           annual US inflation rates
          </strong>
          for calendar years from 2000 and 2012 to 2022. (For prior years, see
          <a href="https://www.usinflationcalculator.com/inflation/historical-
inflation-rates/" title="Historical US Inflation Rates">
           historical inflation rates
          </a>
          .) If you would like to calculate accumulated rates between two
different dates, use the
          <a href="https://www.usinflationcalculator.com/" title="US Inflation
Calculator">
           US Inflation Calculator
          </a>
          .
         </p>
         <div style="margin-left:-50px">
          <iframe frameborder="0" height="450" scrolling="yes" seamless=""
src="https://www.usinflationcalculator.com/charts/inflation/inflation-
chart.html" width="580">
          </iframe>
         </div>
         <p>
          *The latest inflation data (12-month based) is always displayed in the
chart's final column.
         </p>
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         <p>
          <strong>
           Table: Annual Inflation Rates by Month and Year
          </strong>
         </p>
         <p>
          Since figures below are 12-month periods, look to the December column
to find inflation rates by calendar year. For example, the rate of inflation in
2021 was 7.0%.
         </p>
         <p>
          The last column, "Ave," shows the average inflation rate for each year
          <a href="https://www.usinflationcalculator.com/inflation/consumer-
price-index-and-annual-percent-changes-from-1913-to-2008/" title="Consumer Price
Index Data">
           using CPI data
          </a>
          , which was 4.7% in 2021. They are published by the BLS but are rarely
discussed in news media, taking a back seat to a calendar year's actual rate of
inflation.
         </p>
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   3.5
  </td>
  <td align="right">
   3.4
  </td>
  <td align="right">
   3.4
  </td>
  <td align="right">
   3.4
  </td>
  <td align="right">
   3.4
  </td>
 </tr>
</table>
```

```
         </div>
         <p>
         </p>
         <p>
          <strong>
           Calculating Annual Inflation Rates
          </strong>
         </p>
         <p>
          Annual rates of inflation are calculated using 12-month selections of
the
          <a href="http://www.usinflationcalculator.com/inflation/consumer-
price-index-and-annual-percent-changes-from-1913-to-2008/" title="Consumer Price
Index Data from 1913 to Present">
           Consumer Price Index
          </a>
          which is
          <a href="https://www.usinflationcalculator.com/inflation/consumer-
price-index-release-schedule/" title="Consumer Price Index Release Schedule">
           published monthly
          </a>
          by the Labor Department's Bureau of Labor Statistics (
          <a href="http://www.bls.gov/cpi/" title="Bureau of Labor Statistics
(BLS) - Consumer Price Index">
           BLS
          </a>
          ).
         </p>
         <p>
          For example, to calculate the inflation rate for January 2017,
subtract  the January 2016 CPI of "236.916" from the January 2017 CPI of
"242.839." The result is "5.923." Divide this number by the January 2016 CPI and
then multiply by 100 and add a % sign.
         </p>
         <p>
          The result is January's annual inflation rate of 2.5%.
         </p>
         <div class="sharedaddy sd-sharing-enabled">
          <div class="robots-nocontent sd-block sd-social sd-social-icon-text
sd-sharing">
           <h3 class="sd-title">
            Share this:
           </h3>
           <div class="sd-content">
            <ul>
             <li class="share-facebook">
              <a class="share-facebook sd-button share-icon" data-
shared="sharing-facebook-75"
```

```
href="https://www.usinflationcalculator.com/inflation/current-inflation-
rates/?share=facebook" rel="nofollow noopener noreferrer" target="_blank"
title="Click to share on Facebook">
               <span>
                Facebook
               </span>
              </a>
             </li>
             <li class="share-twitter">
              <a class="share-twitter sd-button share-icon" data-
shared="sharing-twitter-75"
href="https://www.usinflationcalculator.com/inflation/current-inflation-
rates/?share=twitter" rel="nofollow noopener noreferrer" target="_blank"
title="Click to share on Twitter">
               <span>
                Twitter
               </span>
              </a>
             </li>
             <li class="share-reddit">
              <a class="share-reddit sd-button share-icon" data-shared=""
href="https://www.usinflationcalculator.com/inflation/current-inflation-
rates/?share=reddit" rel="nofollow noopener noreferrer" target="_blank"
title="Click to share on Reddit">
               <span>
                Reddit
               </span>
              </a>
             </li>
             <li>
              <a class="sharing-anchor sd-button share-more" href="#">
               <span>
                More
               </span>
              </a>
             </li>
             <li class="share-end">
             </li>
            </ul>
            <div class="sharing-hidden">
             <div class="inner" style="display: none;">
              <ul>
               <li class="share-print">
                <a class="share-print sd-button share-icon" data-shared=""
href="https://www.usinflationcalculator.com/inflation/current-inflation-
rates/#print" rel="nofollow noopener noreferrer" target="_blank" title="Click to
print">
                 <span>
```

```
                Print
               </span>
              </a>
             </li>
             <li class="share-email">
              <a class="share-email sd-button share-icon" data-shared=""
href="https://www.usinflationcalculator.com/inflation/current-inflation-
rates/?share=email" rel="nofollow noopener noreferrer" target="_blank"
title="Click to email this to a friend">
               <span>
                Email
               </span>
              </a>
             </li>
             <li class="share-end">
             </li>
             <li class="share-end">
             </li>
            </ul>
           </div>
          </div>
         </div>
        </div>
       </div>
       <!-- .entry-content -->
      </article>
      <!-- #post-75 -->
     </div>
     <!-- #content -->
    </div>
    <!-- #primary -->
    <div class="content-sidebar widget-area" id="content-sidebar"
role="complementary">
     <aside class="widget widget_text" id="text-176465771">
      <div class="textwidget">
       <style type="text/css">
        <!--
.smallBox5{
        border-right-width: 1px;
        border-top-width: 1px;
        border-bottom-width: 1px;
        border-left-width: 1px;
        border-top-style: solid;
        border-right-style: solid;
        border-bottom-style: solid;
        border-left-style: solid;
}
```

```
.style1 {font-size: xx-small}
-->
        </style>
        <div align="center">
         <table ;="" class="smallBox5" width="180px">
          <tr>
           <td valign="middle">
            <h3 ;="" align="center" style="margin-bottom:2px; border-
bottom:none">
             <a href="https://www.usinflationcalculator.com/" title="US
Inflation Calculator">
              Try Inflation Calculator!
             </a>
            </h3>
            <p ;="" align="center" style="margin-bottom:2px; border-
bottom:none">
            </p>
           </td>
          </tr>
         </table>
        </div>
       </div>
      </aside>
      <aside class="widget widget_text" id="text-176031101">
       <div class="textwidget">
        <style type="text/css">
         <!-- .smallBox5{ border-right-width: 1px; border-top-width: 1px;
border-bottom-width: 1px; border-left-width: 1px; border-top-style: solid;
border-right-style: solid; border-bottom-style: solid; border-left-style: solid;
} hr { border-top:1px dotted #000; width:85%; align="center"; margin-bottom:7px;
margin-top:7px; /*Rest of stuff here*/ } .style1 {font-size: xx-small} --><br />
        </style>
        <div align="center">
         <table class="smallBox5" width="230px">
          <tbody>
           <tr>
            <td>
             <h3 align="center" style="margin-bottom: 0px;">
              <a href="http://www.usinflationcalculator.com/inflation/current-
inflation-rates/" title="Current US Inflation Rates">
               Inflation Rate
              </a>
              <u>
               8.3%
              </u>
             </h3>
            </td>
           </tr>
```

```
           <tr>
            <td>
             <hr/>
            </td>
           </tr>
           <tr>
            <td>
             <h3 align="center" style="margin-bottom: 0px; margin-top: 0px;
padding-top: 2px;">
              Consumer Price Index (CPI) 289.109
             </h3>
            </td>
           </tr>
           <tr>
            <td>
             <hr/>
            </td>
           </tr>
           <tr>
            <td>
             <p align="center" class="style1">
              Released on May 11 for  April 2022.
              <br/>
              <a href="http://www.usinflationcalculator.com/inflation/consumer-
price-index-release-schedule/" title="Consumer Price Index Release Schedule">
               Next release
              </a>
              on June 10 for May 2022.
             </p>
            </td>
           </tr>
          </tbody>
         </table>
        </div>
       </div>
      </aside>
      <aside class="widget widget_text" id="text-430430986">
       <div class="textwidget">
        <div align="center">
         <script async="" crossorigin="anonymous"
src="https://pagead2.googlesyndication.com/pagead/js/adsbygoogle.js?client=ca-
pub-0374335159561115">
         </script>
         <!-- USInflationCalc300x600 -->
         <ins class="adsbygoogle" data-ad-client="ca-pub-0374335159561115" data-
ad-format="auto" data-ad-slot="9115547791" style="display:block">
         </ins>
         <script>
```

```
          (adsbygoogle = window.adsbygoogle || []).push({});
         </script>
        </div>
       </div>
      </aside>
      <aside class="widget widget_recent_entries" id="recent-posts-2">
       <h1 class="widget-title">
        US Inflation Reports (Monthly CPI)
       </h1>
       <nav aria-label="US Inflation Reports (Monthly CPI)">
        <ul>
         <li>
          <a href="https://www.usinflationcalculator.com/inflation/u-s-
inflation-remains-near-40-year-highs-as-april-cpi-tops-expectations/100022650/">
           U.S. Inflation Remains Near 40-Year Highs as April CPI Tops
Expectations
          </a>
         </li>
         <li>
          <a href="https://www.usinflationcalculator.com/inflation/u-s-
inflation-highest-since-1981-as-cpi-hits-8-5-in-march/100022605/">
           U.S. Inflation Highest Since 1981 as CPI Hits 8.5% in March
          </a>
         </li>
         <li>
          <a href="https://www.usinflationcalculator.com/inflation/u-s-
inflation-at-7-9-highest-since-1982-as-prices-surge-for-gas-food-and-
shelter/100022175/">
           U.S. Inflation at 7.9% Highest Since 1982 as Prices Surge for Gas,
Food and Shelter
          </a>
         </li>
         <li>
          <a href="https://www.usinflationcalculator.com/inflation/u-s-
inflation-rate-at-7-5-hits-40-year-high/100021757/">
           U.S. Inflation Rate at 7.5% Hits 40-Year High
          </a>
         </li>
         <li>
          <a href="https://www.usinflationcalculator.com/inflation/u-s-
inflation-rises-7-in-2021-marking-highest-rate-since-1982/100021708/">
           U.S. Inflation Rises 7% in 2021, Marking Highest Rate Since 1982
          </a>
         </li>
         <li>
          <a href="https://www.usinflationcalculator.com/inflation/u-s-rate-of-
inflation-soars-to-39-year-high-as-consumer-prices-jump-in-november/100021666/">
           U.S. Rate of Inflation Soars to 39-Year High as Consumer Prices Jump
```

```
in November
          </a>
         </li>
         <li>
          <a href="https://www.usinflationcalculator.com/inflation/u-s-rate-of-
inflation-highest-since-1990/100021620/">
           U.S. Rate of Inflation Highest Since 1990
          </a>
         </li>
         <li>
          <a href="https://www.usinflationcalculator.com/inflation/u-s-
inflation-resumes-quicker-pace-in-september/100021573/">
           U.S. Inflation Resumes Quicker Pace in September
          </a>
         </li>
         <li>
          <a href="https://www.usinflationcalculator.com/inflation/u-s-
inflation-cools-slightly-consumer-price-gains-ease-in-august/100021451/">
           Annual U.S. Inflation Cools Slightly; Consumer Price Gains Ease in
August
          </a>
         </li>
         <li>
          <a href="https://www.usinflationcalculator.com/inflation/u-s-consumer-
price-gains-slow-in-july-annual-inflation-remains-near-13-year-high/100021394/">
           U.S. Consumer Price Gains Slow in July; Annual Inflation Remains Near
13-Year High
          </a>
         </li>
         <li>
          <a href="https://www.usinflationcalculator.com/inflation/annual-
inflation-and-consumer-prices-in-june-rise-most-since-2008/100021352/">
           Annual Inflation and Consumer Prices in June Rise Most Since 2008
          </a>
         </li>
         <li>
          <a href="https://www.usinflationcalculator.com/inflation/u-s-
inflation-hottest-annually-since-august-2008-consumer-prices-in-may-rise-
strongly/100021287/">
           U.S. Inflation Hottest Annually Since August 2008; Consumer Prices in
May Rise Strongly
          </a>
         </li>
         <li>
          <a href="https://www.usinflationcalculator.com/inflation/inflation-
marks-quickest-pace-since-2008-consumer-prices-surge-in-april/100021243/">
           Inflation Marks Quickest Pace Since 2008; Consumer Prices Surge in
April
```

```
          </a>
         </li>
        </ul>
       </nav>
      </aside>
      <aside class="widget widget_search" id="search-3">
       <form action="https://www.usinflationcalculator.com/" class="search-form"
method="get" role="search">
        <label>
         <span class="screen-reader-text">
          Search for:
         </span>
         <input class="search-field" name="s" placeholder="Search …"
type="search" value=""/>
        </label>
        <input class="search-submit" type="submit" value="Search"/>
       </form>
      </aside>
      <aside class="widget widget_top-posts" id="top-posts-2">
       <h1 class="widget-title">
        Popular US Inflation Pages
       </h1>
       <ul>
        <li>
         <a aria-current="page" class="bump-view" data-bump-view="tp"
href="https://www.usinflationcalculator.com/inflation/current-inflation-rates/">
          Current US Inflation Rates: 2000-2022
         </a>
        </li>
        <li>
         <a class="bump-view" data-bump-view="tp"
href="https://www.usinflationcalculator.com/inflation/historical-inflation-
rates/">
          Historical Inflation Rates: 1914-2022
         </a>
        </li>
        <li>
         <a class="bump-view" data-bump-view="tp"
href="https://www.usinflationcalculator.com/gasoline-prices-adjusted-for-
inflation/">
          Gasoline Prices Adjusted for Inflation
         </a>
        </li>
        <li>
         <a class="bump-view" data-bump-view="tp"
href="https://www.usinflationcalculator.com/inflation/consumer-price-index-and-
annual-percent-changes-from-1913-to-2008/">
          Consumer Price Index Data from 1913 to 2022
```

```
         </a>
        </li>
        <li>
         <a class="bump-view" data-bump-view="tp"
href="https://www.usinflationcalculator.com/inflation/consumer-price-index-
release-schedule/">
          Consumer Price Index - Release Schedule (2021-2022)
         </a>
        </li>
       </ul>
      </aside>
      <aside class="widget widget_block" id="block-7">
       <hr class="wp-block-separator is-style-wide"/>
      </aside>
      <aside class="widget widget_block" id="block-5">
       <p>
        <strong>
         **NEW**
        </strong>
       </p>
       <ul>
        <li>
         <a href="https://www.usinflationcalculator.com/inflation/inflation-in-
the-los-angeles-long-beach-anaheim-metropolitan-area/" title="Inflation in the
Los Angeles-Long Beach-Anaheim Metropolitan Area">
          Los Angeles Area Inflation Data and Calculator
         </a>
        </li>
        <br/>
        <li>
         <a href="https://www.usinflationcalculator.com/inflation/inflation-in-
new-york-newark-and-jersey-city-metropolitan-area/" title="Inflation in New
York, Newark and Jersey City Metropolitan Area">
          New York-Newark-Jersey City Area Inflation Data and Calculator
         </a>
        </li>
       </ul>
      </aside>
     </div>
     <!-- #content-sidebar -->
    </div>
    <!-- #main-content -->
    <div id="secondary">
     <div class="primary-sidebar widget-area" id="primary-sidebar"
role="complementary">
      <aside class="widget widget_block" id="block-2">
       <script async="" crossorigin="anonymous"
src="https://pagead2.googlesyndication.com/pagead/js/adsbygoogle.js?client=ca-
```

```
pub-0374335159561115">
       </script>
       <!-- 160x600, created 7/16/08 -->
       <ins class="adsbygoogle" data-ad-client="ca-pub-0374335159561115" data-
ad-slot="5338972341" style="display:inline-block;width:160px;height:600px">
       </ins>
       <script>
        (adsbygoogle = window.adsbygoogle || []).push({});
       </script>
      </aside>
      <aside class="widget widget_block" id="block-4">
       <p>
        <strong>
         RESOURCE LINKS
        </strong>
       </p>
       <ul>
        <li>
         <a href="http://www.bls.gov/cpi/" title="http://www.bls.gov/cpi/">
          Bureau of Labor Statistics
         </a>
        </li>
        <li>
         <a href="https://percentcalculators.com/" title="Percentage
Calculators">
          Percent Calculators
         </a>
        </li>
        <li>
         <a href="https://www.federalreserve.gov/monetarypolicy.htm"
title="Federal Reserve Monetary Policy">
          Reserve Monetary Policy
         </a>
        </li>
       </ul>
      </aside>
      <aside class="widget widget_block" id="block-3">
       <script async="" crossorigin="anonymous"
src="https://pagead2.googlesyndication.com/pagead/js/adsbygoogle.js?client=ca-
pub-0374335159561115">
       </script>
       <!-- USInflat2 -->
       <ins class="adsbygoogle" data-ad-client="ca-pub-0374335159561115" data-
ad-slot="9022634993" style="display:inline-block;width:160px;height:600px">
       </ins>
       <script>
        (adsbygoogle = window.adsbygoogle || []).push({});
       </script>
```

```
      </aside>
     </div>
     <!-- #primary-sidebar -->
    </div>
    <!-- #secondary -->
   </div>
   <!-- #main -->
   <footer class="site-footer" id="colophon" role="contentinfo">
    <div class="site-info">
     <p align="center">
      US
      <a href="http://www.usinflationcalculator.com/" title="Inflation
Calculator">
       INFLATION CALCULATOR
      </a>
      · COPYRIGHT © 2008-2022 COINNEWS MEDIA GROUP LLC (
      <a href="http://www.coinnews.net/" title="Coin News">
       COIN NEWS
      </a>
      ) · ALL RIGHTS RESERVED
     </p>
     <p>
     </p>
    </div>
    <!-- .site-info -->
   </footer>
   <!-- #colophon -->
  </div>
  <!-- #page -->
  <script type="text/javascript">
   window.WPCOM_sharing_counts =
{"https:\/\/www.usinflationcalculator.com\/inflation\/current-inflation-
rates\/":75};
  </script>
  <div id="sharing_email" style="display: none;">
   <form action="/inflation/current-inflation-rates/" method="post">
    <label for="target_email">
     Send to Email Address
    </label>
    <input id="target_email" name="target_email" type="email" value=""/>
    <label for="source_name">
     Your Name
    </label>
    <input id="source_name" name="source_name" type="text" value=""/>
    <label for="source_email">
     Your Email Address
    </label>
    <input id="source_email" name="source_email" type="email" value=""/>
```

```
    <input autocomplete="off" class="input" id="jetpack-source_f_name"
name="source_f_name" size="25" title="This field is for validation and should
not be changed" type="text" value=""/>
    <img alt="loading" class="loading" height="16"
src="https://www.usinflationcalculator.com/wp-
content/plugins/jetpack/modules/sharedaddy/images/loading.gif" style="float:
right; display: none" width="16">
     <input class="sharing_send" type="submit" value="Send Email"/>
     <a class="sharing_cancel" href="#cancel" rel="nofollow" role="button">
      Cancel
     </a>
     <div class="errors errors-1" style="display: none;">
      Post was not sent - check your email addresses!
     </div>
     <div class="errors errors-2" style="display: none;">
      Email check failed, please try again
     </div>
     <div class="errors errors-3" style="display: none;">
      Sorry, your blog cannot share posts by email.
     </div>
    </img>
   </form>
  </div>
  <script id="twentyfourteen-script-js"
src="https://www.usinflationcalculator.com/wp-
content/themes/twentyfourteen/js/functions.js?ver=20171218">
  </script>
  <script id="sharing-js-js-extra">
   var sharing_js_options = {"lang":"en","counts":"1","is_stats_active":"1"};
  </script>
  <script id="sharing-js-js" src="https://www.usinflationcalculator.com/wp-
content/plugins/jetpack/_inc/build/sharedaddy/sharing.min.js?ver=10.9">
  </script>
  <script id="sharing-js-js-after">
   var windowOpen;
                        ( function () {
                                function matches( el, sel ) {
                                        return !! (
                                                el.matches && el.matches( sel )
||
                                                el.msMatchesSelector &&
el.msMatchesSelector( sel )
                                        );
                                }

                                document.body.addEventListener( 'click',
function ( event ) {
                                        if ( ! event.target ) {
```

```
                                        return;
                                }

                                var el;
                                if ( matches( event.target, 'a.share-
facebook' ) ) {
                                        el = event.target;
                                } else if ( event.target.parentNode &&
matches( event.target.parentNode, 'a.share-facebook' ) ) {
                                        el = event.target.parentNode;
                                }

                                if ( el ) {
                                        event.preventDefault();

                                        // If there's another sharing
window open, close it.
                                        if ( typeof windowOpen !==
'undefined' ) {
                                                windowOpen.close();
                                        }
                                        windowOpen = window.open(
el.getAttribute( 'href' ), 'wpcomfacebook',
'menubar=1,resizable=1,width=600,height=400' );
                                        return false;
                                }
                        } );
                } )();
var windowOpen;
                ( function () {
                        function matches( el, sel ) {
                        return !! (
                                el.matches && el.matches( sel )
||
                                el.msMatchesSelector &&
el.msMatchesSelector( sel )
                        );
                        }

                        document.body.addEventListener( 'click',
function ( event ) {
                                if ( ! event.target ) {
                                        return;
                                }

                                var el;
                                if ( matches( event.target, 'a.share-
twitter' ) ) {
```

```
                                                el = event.target;
                                        } else if ( event.target.parentNode &&
matches( event.target.parentNode, 'a.share-twitter' ) ) {
                                                el = event.target.parentNode;
                                        }

                                        if ( el ) {
                                                event.preventDefault();

                                                // If there's another sharing
window open, close it.
                                                if ( typeof windowOpen !==
'undefined' ) {
                                                        windowOpen.close();
                                                }
                                                windowOpen = window.open(
el.getAttribute( 'href' ), 'wpcomtwitter',
'menubar=1,resizable=1,width=600,height=350' );
                                                return false;
                                        }
                                } );
                        } )();
  </script>
  <script defer="" src="https://stats.wp.com/e-202222.js">
  </script>
  <script>
   _stq = window._stq || [];
        _stq.push([ 'view', {v:'ext',j:'1:10.9',blog:'5955919',post:'75',tz:'-
4',srv:'www.usinflationcalculator.com'} ]);
        _stq.push([ 'clickTrackerInit', '5955919', '75' ]);
  </script>
 </body>
</html>
```

[ ]:
```
# Exporting the HTML to a file
with open('output/inflation_rate_response.html', 'wb') as file:
    file.write(soup.prettify('utf-8'))
```

[ ]:
```
# creating list with all tables
tables = soup.find_all('table')
```

[ ]:
```
# Inspect the value of the variable
tables
```

[ ]:
```
[<table cellpadding="0" cellspacing="0" width="110%">
 <tr height="17">
 <td align="right" height="17"><strong>Year</strong></td>
 <td align="right"><strong>Jan</strong></td>
```

```
<td align="right"><strong>Feb</strong></td>
<td align="right"><strong>Mar</strong></td>
<td align="right"><strong>Apr</strong></td>
<td align="right"><strong>May</strong></td>
<td align="right"><strong>Jun</strong></td>
<td align="right"><strong>Jul</strong></td>
<td align="right"><strong>Aug</strong></td>
<td align="right"><strong>Sep</strong></td>
<td align="right"><strong>Oct</strong></td>
<td align="right"><strong>Nov</strong></td>
<td align="right"><strong>Dec</strong></td>
<td align="right"><strong>Ave</strong></td>
</tr>
<tr>
<td align="right" height="17"><strong>2022</strong></td>
<td align="right">7.5</td>
<td align="right">7.9</td>
<td align="right">8.5</td>
<td align="right">8.3</td>
<td align="right"><em>Avail.<br/>
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href="https://www.usinflationcalculator.com/" title="US Inflation
Calculator">Try Inflation Calculator!</a></h3>
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 <a href="http://www.usinflationcalculator.com/inflation/consumer-price-index-
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release</a> on June 10 for May 2022.</p>
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#display table
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     June<br/>
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[ ]:
```
# extracting all rows
table.find_all('tr')
```

[ ]:
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 <td align="right"><em>Avail.<br/>
```

```
     June<br/>
     10</em></td>
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<td align="right">3.4</td>
<td align="right">3.4</td>
<td align="right">3.4</td>
</tr>]
```

[ ]:
```
#Gets all the column headers of our table
#create an empty list name it headers
headers = []
#loop through the first row which containts the header names
#save the text in the table header tag after stripping any extra spaces as title
#append this title to the headers list
for i in table.find_all('tr')[0]:
    title = i.text.strip()
    if title != '':
        headers.append(title)

#display headers in a list
```

```
headers
```

[ ]:
```
['Year',
 'Jan',
 'Feb',
 'Mar',
 'Apr',
 'May',
 'Jun',
 'Jul',
 'Aug',
 'Sep',
 'Oct',
 'Nov',
 'Dec',
 'Ave']
```

[ ]:
```
#Creates a dataframe using the column headers from our table
df = pd.DataFrame(columns = headers)

#display the header in a dataframe
df
```

[ ]:
```
Empty DataFrame
Columns: [Year, Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec, Ave]
Index: []
```

[ ]:
```
#create a for loop to iterate all the rows in the table
#retrieve the text in the row which is the value we want
#get the length of the dataframe
#populate the contents of the dataframe iteratively by reading each row
#increment the length of the dataframe and add the row to the end of the␣
 ↪dataframe
for j in table.find_all('tr')[1:]:
    row_data = j.find_all('td')
    row = [tr.text for tr in row_data]
    length = len(df)
    df.loc[length] = row
```

[ ]:
```
#display the dataframe
df.head()
```

[ ]:

	Year	Jan	Feb	Mar	Apr			May	Jun	Jul	Aug	Sep	\
0	2022	7.5	7.9	8.5	8.3	Avail.\n	June\n	10					
1	2021	1.4	1.7	2.6	4.2			5.0	5.4	5.4	5.3	5.4	
2	2020	2.5	2.3	1.5	0.3			0.1	0.6	1.0	1.3	1.4	
3	2019	1.6	1.5	1.9	2.0			1.8	1.6	1.8	1.7	1.7	

```
4  2018  2.1  2.2  2.4  2.5                          2.8  2.9  2.9  2.7  2.3

   Oct  Nov  Dec  Ave
0
1  6.2  6.8  7.0  4.7
2  1.2  1.2  1.4  1.2
3  1.8  2.1  2.3  1.8
4  2.5  2.2  1.9  2.4
```

[ ]:
```
# set year, month and inflaiton rate as the column name and remove unneeded␣
 ↪value
months=['Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'Jul', 'Aug', 'Sep', 'Oct',␣
 ↪'Nov', 'Dec']
df_inflation = pd.melt(df, id_vars = 'Year',␣
 ↪value_vars=months,var_name='Month', value_name='Inflation Rate')
df_inflation['Month']=pd.Categorical(df_inflation['Month'], categories=months,␣
 ↪ordered=True)
df_inflation.sort_values(by=['Year','Month'], inplace=True)
```

[ ]:
```
# display the head of the dataframe
df_inflation.head()
```

[ ]:
```
     Year Month Inflation Rate
22   2000   Jan            2.7
45   2000   Feb            3.2
68   2000   Mar            3.8
91   2000   Apr            3.1
114  2000   May            3.2
```

[ ]:
```
# save it to a csv file
# df_inflation.to_csv('data/inflation_rate_clean.csv')
```

Scrape the Gas Price Website

[ ]:
```
# Define a variable for the url of the site
site_gas = "https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?
 ↪n=pet&s=emm_epm0_pte_nus_dpg&f=m"
```

[ ]:
```
# Making a get request and assign the result to a variable response
response_gas = requests.get(site_gas)

#Check that the response was processed correctly
response_gas.status_code
```

[ ]:
```
200
```

[ ]:
```
# Extracting the HTML
#assign a variable html to response content.
```

```
html_gas = response_gas.content

# Checking that the reply is indeed an HTML code by inspecting the first 200␣
 ↪symbols
html_gas[:500]
```

[ ]:
```
b"<!DOCTYPE HTML PUBLIC '-//W3C//DTD HTML 4.01 Transitional//EN'>\r <html>\r
<head>\r <meta http-equiv='X-UA-Compatible' content='IE=9' />\r <title>U.S. All
Grades All Formulations Retail Gasoline Prices (Dollars per Gallon)</title>\r
<script src='../includes/TableFloaterTitle.js'></script>\r <link
rel='StyleSheet' href='../Styles/Pet_wrapper3.css' TYPE='text/css'>\r <link
rel='StyleSheet' href='../Styles/leaf_new2.css' TYPE='text/css'>\r <link
rel='StyleSheet' href='/styles/Eia_sitewideF.css' type='text/"
```

[ ]:
```
#Convert HTML to a BeautifulSoup object, using the default parser of html
#Create a BeautifulSoup object and store it in a variable named soup.
soup_gas = BeautifulSoup(html_gas, "html.parser")
```

[ ]:
```
#using prettify() method to turn a Beautiful Soup parse tree into a nicely␣
 ↪formatted Unicode string,
#with a separate line for each tag and each string:
print(soup_gas.prettify())
```

```
<!DOCTYPE HTML PUBLIC '-//W3C//DTD HTML 4.01 Transitional//EN'>
<html>
 <head>
  <meta content="IE=9" http-equiv="X-UA-Compatible"/>
  <title>
   U.S. All Grades All Formulations Retail Gasoline Prices (Dollars per Gallon)
  </title>
  <script src="../includes/TableFloaterTitle.js">
  </script>
  <link href="../Styles/Pet_wrapper3.css" rel="StyleSheet" type="text/css"/>
  <link href="../Styles/leaf_new2.css" rel="StyleSheet" type="text/css"/>
  <link href="/styles/Eia_sitewideF.css" rel="StyleSheet" type="text/css">
   <!-- Header Script -->
   <script language="JavaScript" src="/styles/eia_header.js"
type="text/javascript">
   </script>
   <!--/ Header Script -->
   <script src="/global/includes/dnavs/leaf_handler.cfm" type="text/javascript">
   </script>
   <!-- Footer Script -->
   <script language="JavaScript" src="/styles/eia_footer.js"
type="text/javascript">
   </script>
   <!--/ Footer Script -->
  </link>
```

```
 </head>
 <body>
  <script language="JavaScript" type="text/javascript">
   InsertEIAHeaderCode();
  </script>
  <table border="0" cellpadding="0" cellspacing="0" width="675">
   <tr>
    <td class="K">
    </td>
   </tr>
   <tr>
    <td height="12">
    </td>
   </tr>
   <tr>
    <td>
     <table border="0" cellpadding="0" cellspacing="0" width="675">
      <tr>
       <td width="400">
        <table border="2" bordercolordark="#6699cc" bordercolorlight="#6699cc"
cellpadding="0" cellspacing="0" style="border: thin;">
         <tr>
          <td>
           <table border="0" cellpadding="0" cellspacing="0">
            <tr>
             <td class="J">
              View History:
             </td>
             <td>
              <a
href="LeafHandler.ashx?n=pet&amp;s=emm_epm0_pte_nus_dpg&amp;f=w">
               <img alt="" border="0" height="13" src="../img/RadioL_I.jpg"
width="12"/>
              </a>
             </td>
             <td class="F">
              <a class="NavChunk"
href="LeafHandler.ashx?n=pet&amp;s=emm_epm0_pte_nus_dpg&amp;f=w">
               Weekly
              </a>
             </td>
             <td>
              <a
href="LeafHandler.ashx?n=pet&amp;s=emm_epm0_pte_nus_dpg&amp;f=m">
               <img alt="" border="0" height="13" src="../img/RadioL_A.jpg"
width="12"/>
              </a>
             </td>
```

```
             <td class="F">
              <a class="NavChunk"
href="LeafHandler.ashx?n=pet&amp;s=emm_epm0_pte_nus_dpg&amp;f=m">
               Monthly
              </a>
             </td>
             <td>
              <a
href="LeafHandler.ashx?n=pet&amp;s=emm_epm0_pte_nus_dpg&amp;f=a">
               <img alt="" border="0" height="13" src="../img/RadioL_I.jpg"
width="12"/>
              </a>
             </td>
             <td class="F">
              <a class="NavChunk"
href="LeafHandler.ashx?n=pet&amp;s=emm_epm0_pte_nus_dpg&amp;f=a">
               Annual
              </a>
             </td>
            </tr>
           </table>
          </td>
         </tr>
        </table>
       </td>
       <td align="right" class="F" width="375">
        <a class="crumb" href="../hist_xls/EMM_EPM0_PTE_NUS_DPGm.xls">
         Download Data (XLS File)
        </a>
       </td>
      </tr>
     </table>
    </td>
   </tr>
   <tr>
    <td height="15">
    </td>
   </tr>
   <tr>
    <td>
     <img alt="U.S. All Grades All Formulations Retail Gasoline Prices (Dollars
per Gallon)" height="275" src="../hist_chart/EMM_EPM0_PTE_NUS_DPGM.jpg"
width="675"/>
    </td>
   </tr>
   <tr>
    <td height="15">
    </td>
```

```
   </tr>
 -->r>idth='95%'></td> use back button to return to prior data </td>
   <tr>
    <td align="center" bgcolor="#ffffff" class="Title1">
     U.S. All Grades All Formulations Retail Gasoline Prices (Dollars per
Gallon)
    </td>
   </tr>
   <tr>
    <td height="2">
    </td>
   </tr>
  </table>
  <table (dollars="" all="" border="0" cellpadding="2" cellspacing="0"
formulations="" gallon)="" gasoline="" grades="" per="" prices="" retail=""
summary="U.S." width="600">
   <table border="0" cellpadding="2" cellspacing="0" width="675">
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width="675">
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        Year
       </th>
       <th class="G">
        Jan
       </th>
       <th class="G">
        Feb
       </th>
       <th class="G">
        Mar
       </th>
       <th class="G">
        Apr
       </th>
       <th class="G">
        May
       </th>
       <th class="G">
        Jun
       </th>
       <th class="G">
        Jul
       </th>
       <th class="G">
        Aug
       </th>
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  <th class="G">
   Sep
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  <th class="G">
   Oct
  </th>
  <th class="G">
   Nov
  </th>
  <th class="G">
   Dec
  </th>
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```
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```

```
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  3.102
 </td>
 <td class="B3">
  3.011
 </td>
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```

```
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  3.293
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  3.756
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  3.112
```

```
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  2.208
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  1.745
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</tr>
<tr>
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  2009
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<td class="B3">2.272</td> <td class="B3">2.274</td> <td class="B3">2.248</td>
<td class="B3">2.200</td> <td class="B3">2.284</td> </tr> <tr> <td
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class="B3">3.157</td> <td class="B3">3.231</td> <td class="B3">3.255</td> <td
class="B3">3.272</td> <td class="B3">3.384</td> <td class="B3">3.491</td> <td
class="B3">3.406</td> </tr> <tr> <td class="B4">  2022</td> <td
class="B3">3.413</td> <td class="B3">3.611</td> <td class="B3">4.322</td> <td
class="B3">4.213</td> <td class="B3"></td> <td class="B3"></td> <td
class="B3"></td> <td class="B3"></td> <td class="B3"></td> <td class="B3"></td>
<td class="B3"></td> <td class="B3"></td> </tr> </tbody> </table>,
 <table border="0" cellpadding="0" cellspacing="0" width="680"> <tr> <td
class="F2"> <span class="FNlabel">-</span> = No Data Reported;
  <span class="FNlabel">--</span> = Not Applicable;
  <span class="FNlabel">NA</span> = Not Available;
  <span class="FNlabel">W</span> = Withheld to avoid disclosure of individual
company data.
  </td> </tr> <tr> <td height="10"></td> </tr> </table>,
 <table border="0" cellpadding="0" cellspacing="0" width="675"> <tr> <td
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Date: 5/31/2022</td> </tr> </table>]
```

[ ]:
```
# print all the classes for each table
print('Classes of each table:')
```

```
for table in soup_gas.find_all('table'):
    print(table.get('class'))
```

```
Classes of each table:
None
None
None
None
None
None
['FloatTitle']
None
None
```

[ ]:
```
# our table is located under class 'FloatTitle'
# retrieve the table which has the class
table_gas = soup_gas.find('table', class_='FloatTitle')
```

[ ]:
```
# display the gas table
table_gas
```

[ ]:
```
<table border="0" cellpadding="2" cellspacing="0" class="FloatTitle"
width="675"> <thead> <tr bgcolor="#993333"> <th class="G2">Year</th> <th
class="G">Jan</th> <th class="G">Feb</th> <th class="G">Mar</th> <th
class="G">Apr</th> <th class="G">May</th> <th class="G">Jun</th> <th
class="G">Jul</th> <th class="G">Aug</th> <th class="G">Sep</th> <th
class="G">Oct</th> <th class="G">Nov</th> <th class="G">Dec</th> </tr> </thead>
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class="B3"></td> <td class="B3"></td> <td class="B3">1.078</td> <td
class="B3">1.100</td> <td class="B3">1.097</td> <td class="B3">1.078</td> <td
class="B3">1.062</td> <td class="B3">1.050</td> <td class="B3">1.092</td> <td
class="B3">1.066</td> <td class="B3">1.014</td> </tr> <tr> <td
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class="B3">1.008</td> <td class="B3">1.027</td> <td class="B3">1.047</td> <td
class="B3">1.078</td> <td class="B3">1.106</td> <td class="B3">1.155</td> <td
class="B3">1.144</td> <td class="B3">1.114</td> <td class="B3">1.119</td> <td
class="B3">1.129</td> </tr> <tr> <td colspan="13" height="5"></td> </tr> <tr>
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<td class="B3">1.239</td> <td class="B3">1.201</td> <td class="B3">1.170</td>
<td class="B3">1.158</td> <td class="B3">1.134</td> <td class="B3">1.109</td>
<td class="B3">1.118</td> </tr> <tr> <td class="B4">  1996</td> <td
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class="B3">1.275</td> <td class="B3">1.324</td> <td class="B3">1.300</td> <td
class="B3">1.272</td> <td class="B3">1.251</td> <td class="B3">1.247</td> <td
class="B3">1.249</td> <td class="B3">1.278</td> <td class="B3">1.282</td> </tr>
<tr> <td class="B4">  1997</td> <td class="B3">1.283</td> <td
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class="B3">1.064</td> <td class="B3">1.077</td> <td class="B3">1.105</td> <td
class="B3">1.103</td> <td class="B3">1.094</td> <td class="B3">1.065</td> <td
class="B3">1.049</td> <td class="B3">1.059</td> <td class="B3">1.036</td> <td
class="B3">0.987</td> </tr> <tr> <td class="B4"> 1999</td> <td
class="B3">0.980</td> <td class="B3">0.962</td> <td class="B3">1.022</td> <td
class="B3">1.171</td> <td class="B3">1.171</td> <td class="B3">1.154</td> <td
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class="B3">1.506</td> <td class="B3">1.526</td> <td class="B3">1.666</td> <td
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class="B4"> 2002</td> <td class="B3">1.148</td> <td class="B3">1.155</td> <td
class="B3">1.289</td> <td class="B3">1.439</td> <td class="B3">1.434</td> <td
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class="B3">3.357</td> </tr> <tr> <td class="B4"> 2014</td> <td
class="B3">3.392</td> <td class="B3">3.434</td> <td class="B3">3.606</td> <td
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<tr> <td colspan="13" height="5"></td> </tr> <tr> <td class="B4"> 2015</td> <td
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height="5"></td> </tr> <tr> <td class="B4">  2020</td> <td class="B3">2.636</td>
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<td class="B3">1.961</td> <td class="B3">2.170</td> <td class="B3">2.272</td>
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class="B3">3.272</td> <td class="B3">3.384</td> <td class="B3">3.491</td> <td
class="B3">3.406</td> </tr> <tr> <td class="B4">  2022</td> <td
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class="B3"></td> <td class="B3"></td> <td class="B3"></td> <td class="B3">
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[ ]:
```
# extracting all rows
table_gas.find_all('tr')
```

[ ]:
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[<tr bgcolor="#993333"> <th class="G2">Year</th> <th class="G">Jan</th> <th
class="G">Feb</th> <th class="G">Mar</th> <th class="G">Apr</th> <th
class="G">May</th> <th class="G">Jun</th> <th class="G">Jul</th> <th
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class="G">Nov</th> <th class="G">Dec</th> </tr>,
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class="B3">1.014</td> </tr>,
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 <tr> <td colspan="13" height="5"></td> </tr>,
```

<tr> <td class="B4"> 1995</td> <td class="B3">1.130</td> <td
class="B3">1.120</td> <td class="B3">1.119</td> <td class="B3">1.157</td> <td
class="B3">1.225</td> <td class="B3">1.239</td> <td class="B3">1.201</td> <td
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class="B3">1.109</td> <td class="B3">1.118</td> </tr>,
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class="B3">1.136</td> <td class="B3">1.183</td> <td class="B3">1.275</td> <td
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class="B3">1.216</td> <td class="B3">1.177</td> </tr>,
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class="B3">1.096</td> <td class="B3">1.064</td> <td class="B3">1.077</td> <td
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class="B3">2.693</td> <td class="B3">2.645</td> </tr>,
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class="B3">1.961</td> <td class="B3">2.170</td> <td class="B3">2.272</td> <td
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class="B3">2.200</td> <td class="B3">2.284</td> </tr>,
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class="B3">3.491</td> <td class="B3">3.406</td> </tr>,
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```
class="B3">3.611</td> <td class="B3">4.322</td> <td class="B3">4.213</td> <td
class="B3"></td> <td class="B3"></td> <td class="B3"></td> <td class="B3"></td>
<td class="B3"></td> <td class="B3"></td> <td class="B3"></td> <td
class="B3"></td> </tr>]
```

[ ]:
```
# Inspecting the contents of first row
table_gas.find_all('tr')[0].contents
```

[ ]:
```
[' ',
 <th class="G2">Year</th>,
 ' ',
 <th class="G">Jan</th>,
 ' ',
 <th class="G">Feb</th>,
 ' ',
 <th class="G">Mar</th>,
 ' ',
 <th class="G">Apr</th>,
 ' ',
 <th class="G">May</th>,
 ' ',
 <th class="G">Jun</th>,
 ' ',
 <th class="G">Jul</th>,
 ' ',
 <th class="G">Aug</th>,
 ' ',
 <th class="G">Sep</th>,
 ' ',
 <th class="G">Oct</th>,
 ' ',
 <th class="G">Nov</th>,
 ' ',
 <th class="G">Dec</th>,
 ' ']
```

[ ]:
```
#Gets all the column headers of our table
#create an empty list name it headers
headers_gas = []
#loop through the first row which containts the header names
#save the text in the table header tag after stripping any extra spaces as title
#append this title to the headers list
for i in table_gas.find_all('th'):
    title = i.text.strip()
    if title != '':
        headers_gas.append(title)
```

```
#display headers in a list
headers_gas
```

[ ]:
```
['Year',
 'Jan',
 'Feb',
 'Mar',
 'Apr',
 'May',
 'Jun',
 'Jul',
 'Aug',
 'Sep',
 'Oct',
 'Nov',
 'Dec']
```

[ ]:
```
#Creates a dataframe using the column headers from our table
df_gas = pd.DataFrame(columns = headers_gas[:14])

#display the header in a dataframe
df_gas
```

[ ]:
```
Empty DataFrame
Columns: [Year, Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec]
Index: []
```

[ ]:
```
# Get all the rows of table_gas
# create an empty table that will store all the data
table_data=[]
for tr in table_gas.find_all('tr'):
    t_row={}
    #Each table row is stored in the form of
    #t_row= {'Year': '', 'Jan': '', 'Feb': ''......'Dec': ''}

    #find all td's(13) in tr and zip it with headers_gas
    for td, th in zip(tr.find_all('td'), headers_gas):
        t_row[th] = td.text.strip()
    table_data.append(t_row)
```

[ ]:
```
# display table_data
table_data
```

[ ]:
```
[{},
 {'Year': '1993',
  'Jan': '',
  'Feb': '',
```

```
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 'May': '1.100',
 'Jun': '1.097',
 'Jul': '1.078',
 'Aug': '1.062',
 'Sep': '1.050',
 'Oct': '1.092',
 'Nov': '1.066',
 'Dec': '1.014'},
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 'Sep': '1.144',
 'Oct': '1.114',
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 'Nov': '2.997',
 'Dec': '2.632'},
{'Year': ''},
{'Year': '2015',
 'Jan': '2.208',
 'Feb': '2.301',
 'Mar': '2.546',
 'Apr': '2.555',
 'May': '2.802',
 'Jun': '2.885',
 'Jul': '2.880',
 'Aug': '2.726',
 'Sep': '2.462',
 'Oct': '2.387',
 'Nov': '2.260',
 'Dec': '2.144'},
{'Year': '2016',
 'Jan': '2.057',
 'Feb': '1.872',
 'Mar': '2.071',
 'Apr': '2.216',
 'May': '2.371',
 'Jun': '2.467',
 'Jul': '2.345',
 'Aug': '2.284',
 'Sep': '2.327',
 'Oct': '2.359',
 'Nov': '2.295',
 'Dec': '2.366'},
{'Year': '2017',
 'Jan': '2.458',
 'Feb': '2.416',
 'Mar': '2.437',
 'Apr': '2.528',
 'May': '2.503',
 'Jun': '2.460',
 'Jul': '2.414',
 'Aug': '2.494',
 'Sep': '2.761',
 'Oct': '2.621',
 'Nov': '2.678',
 'Dec': '2.594'},
{'Year': '2018',
 'Jan': '2.671',
```

```
 'Feb': '2.705',
 'Mar': '2.709',
 'Apr': '2.873',
 'May': '2.987',
 'Jun': '2.970',
 'Jul': '2.928',
 'Aug': '2.914',
 'Sep': '2.915',
 'Oct': '2.943',
 'Nov': '2.736',
 'Dec': '2.457'},
{'Year': '2019',
 'Jan': '2.338',
 'Feb': '2.393',
 'Mar': '2.594',
 'Apr': '2.881',
 'May': '2.946',
 'Jun': '2.804',
 'Jul': '2.823',
 'Aug': '2.707',
 'Sep': '2.681',
 'Oct': '2.724',
 'Nov': '2.693',
 'Dec': '2.645'},
{'Year': ''},
{'Year': '2020',
 'Jan': '2.636',
 'Feb': '2.533',
 'Mar': '2.329',
 'Apr': '1.938',
 'May': '1.961',
 'Jun': '2.170',
 'Jul': '2.272',
 'Aug': '2.272',
 'Sep': '2.274',
 'Oct': '2.248',
 'Nov': '2.200',
 'Dec': '2.284'},
{'Year': '2021',
 'Jan': '2.420',
 'Feb': '2.587',
 'Mar': '2.898',
 'Apr': '2.948',
 'May': '3.076',
 'Jun': '3.157',
 'Jul': '3.231',
 'Aug': '3.255',
```

```
  'Sep': '3.272',
  'Oct': '3.384',
  'Nov': '3.491',
  'Dec': '3.406'},
 {'Year': '2022',
  'Jan': '3.413',
  'Feb': '3.611',
  'Mar': '4.322',
  'Apr': '4.213',
  'May': '',
  'Jun': '',
  'Jul': '',
  'Aug': '',
  'Sep': '',
  'Oct': '',
  'Nov': '',
  'Dec': ''}]
```

[ ]:
```
# create a dataframe called df_gas and store table_data in it
df_gas = pd.DataFrame(table_data)

# display df_gas
df_gas
```

[ ]:

	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
0	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1	1993				1.078	1.100	1.097	1.078	1.062	1.050
2	1994	0.998	1.009	1.008	1.027	1.047	1.078	1.106	1.155	1.144
3		NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
4	1995	1.130	1.120	1.119	1.157	1.225	1.239	1.201	1.170	1.158
5	1996	1.137	1.136	1.183	1.275	1.324	1.300	1.272	1.251	1.247
6	1997	1.283	1.276	1.251	1.244	1.245	1.242	1.220	1.268	1.276
7	1998	1.132	1.096	1.064	1.077	1.105	1.103	1.094	1.065	1.049
8	1999	0.980	0.962	1.022	1.171	1.171	1.154	1.197	1.260	1.295
9		NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
10	2000	1.329	1.415	1.556	1.506	1.526	1.666	1.591	1.506	1.588
11	2001	1.487	1.490	1.450	1.591	1.738	1.658	1.466	1.461	1.557
12	2002	1.148	1.155	1.289	1.439	1.434	1.424	1.438	1.438	1.441
13	2003	1.500	1.655	1.734	1.633	1.539	1.533	1.554	1.661	1.721
14	2004	1.614	1.690	1.778	1.839	2.023	2.013	1.954	1.920	1.912
15		NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
16	2005	1.875	1.953	2.120	2.285	2.205	2.198	2.333	2.529	2.951
17	2006	2.360	2.326	2.468	2.787	2.953	2.930	3.025	2.999	2.606
18	2007	2.289	2.323	2.609	2.891	3.187	3.102	3.011	2.834	2.849
19	2008	3.095	3.078	3.293	3.507	3.815	4.105	4.114	3.833	3.756
20	2009	1.840	1.975	2.011	2.102	2.316	2.681	2.582	2.670	2.609
21		NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

22	2010	2.769	2.699	2.824	2.900	2.890	2.785	2.782	2.783	2.757
23	2011	3.148	3.264	3.615	3.852	3.960	3.735	3.705	3.696	3.667
24	2012	3.440	3.640	3.907	3.958	3.791	3.596	3.498	3.780	3.910
25	2013	3.391	3.736	3.779	3.638	3.675	3.689	3.661	3.645	3.604
26	2014	3.392	3.434	3.606	3.735	3.750	3.766	3.688	3.565	3.484
27		NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
28	2015	2.208	2.301	2.546	2.555	2.802	2.885	2.880	2.726	2.462
29	2016	2.057	1.872	2.071	2.216	2.371	2.467	2.345	2.284	2.327
30	2017	2.458	2.416	2.437	2.528	2.503	2.460	2.414	2.494	2.761
31	2018	2.671	2.705	2.709	2.873	2.987	2.970	2.928	2.914	2.915
32	2019	2.338	2.393	2.594	2.881	2.946	2.804	2.823	2.707	2.681
33		NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
34	2020	2.636	2.533	2.329	1.938	1.961	2.170	2.272	2.272	2.274
35	2021	2.420	2.587	2.898	2.948	3.076	3.157	3.231	3.255	3.272
36	2022	3.413	3.611	4.322	4.213					

	Oct	Nov	Dec
0	NaN	NaN	NaN
1	1.092	1.066	1.014
2	1.114	1.119	1.129
3	NaN	NaN	NaN
4	1.134	1.109	1.118
5	1.249	1.278	1.282
6	1.242	1.216	1.177
7	1.059	1.036	0.987
8	1.285	1.292	1.313
9	NaN	NaN	NaN
10	1.571	1.557	1.483
11	1.357	1.212	1.127
12	1.486	1.461	1.429
13	1.606	1.555	1.522
14	2.042	2.023	1.887
15	NaN	NaN	NaN
16	2.765	2.303	2.229
17	2.293	2.275	2.359
18	2.853	3.128	3.070
19	3.112	2.208	1.745
20	2.605	2.706	2.663
21	NaN	NaN	NaN
22	2.853	2.913	3.048
23	3.506	3.443	3.326
24	3.812	3.521	3.381
25	3.420	3.322	3.357
26	3.255	2.997	2.632
27	NaN	NaN	NaN
28	2.387	2.260	2.144
29	2.359	2.295	2.366

```
30  2.621  2.678  2.594
31  2.943  2.736  2.457
32  2.724  2.693  2.645
33    NaN    NaN    NaN
34  2.248  2.200  2.284
35  3.384  3.491  3.406
36
```

[ ]:
```
#remove all the rows that contain null values
df_gas = df_gas.dropna()
df_gas
```

[ ]:
```
    Year    Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep  \
1   1993                         1.078  1.100  1.097  1.078  1.062  1.050
2   1994  0.998  1.009  1.008  1.027  1.047  1.078  1.106  1.155  1.144
4   1995  1.130  1.120  1.119  1.157  1.225  1.239  1.201  1.170  1.158
5   1996  1.137  1.136  1.183  1.275  1.324  1.300  1.272  1.251  1.247
6   1997  1.283  1.276  1.251  1.244  1.245  1.242  1.220  1.268  1.276
7   1998  1.132  1.096  1.064  1.077  1.105  1.103  1.094  1.065  1.049
8   1999  0.980  0.962  1.022  1.171  1.171  1.154  1.197  1.260  1.295
10  2000  1.329  1.415  1.556  1.506  1.526  1.666  1.591  1.506  1.588
11  2001  1.487  1.490  1.450  1.591  1.738  1.658  1.466  1.461  1.557
12  2002  1.148  1.155  1.289  1.439  1.434  1.424  1.438  1.438  1.441
13  2003  1.500  1.655  1.734  1.633  1.539  1.533  1.554  1.661  1.721
14  2004  1.614  1.690  1.778  1.839  2.023  2.013  1.954  1.920  1.912
16  2005  1.875  1.953  2.120  2.285  2.205  2.198  2.333  2.529  2.951
17  2006  2.360  2.326  2.468  2.787  2.953  2.930  3.025  2.999  2.606
18  2007  2.289  2.323  2.609  2.891  3.187  3.102  3.011  2.834  2.849
19  2008  3.095  3.078  3.293  3.507  3.815  4.105  4.114  3.833  3.756
20  2009  1.840  1.975  2.011  2.102  2.316  2.681  2.582  2.670  2.609
22  2010  2.769  2.699  2.824  2.900  2.890  2.785  2.782  2.783  2.757
23  2011  3.148  3.264  3.615  3.852  3.960  3.735  3.705  3.696  3.667
24  2012  3.440  3.640  3.907  3.958  3.791  3.596  3.498  3.780  3.910
25  2013  3.391  3.736  3.779  3.638  3.675  3.689  3.661  3.645  3.604
26  2014  3.392  3.434  3.606  3.735  3.750  3.766  3.688  3.565  3.484
28  2015  2.208  2.301  2.546  2.555  2.802  2.885  2.880  2.726  2.462
29  2016  2.057  1.872  2.071  2.216  2.371  2.467  2.345  2.284  2.327
30  2017  2.458  2.416  2.437  2.528  2.503  2.460  2.414  2.494  2.761
31  2018  2.671  2.705  2.709  2.873  2.987  2.970  2.928  2.914  2.915
32  2019  2.338  2.393  2.594  2.881  2.946  2.804  2.823  2.707  2.681
34  2020  2.636  2.533  2.329  1.938  1.961  2.170  2.272  2.272  2.274
35  2021  2.420  2.587  2.898  2.948  3.076  3.157  3.231  3.255  3.272
36  2022  3.413  3.611  4.322  4.213

      Oct    Nov    Dec
1   1.092  1.066  1.014
2   1.114  1.119  1.129
```

```
4   1.134  1.109  1.118
5   1.249  1.278  1.282
6   1.242  1.216  1.177
7   1.059  1.036  0.987
8   1.285  1.292  1.313
10  1.571  1.557  1.483
11  1.357  1.212  1.127
12  1.486  1.461  1.429
13  1.606  1.555  1.522
14  2.042  2.023  1.887
16  2.765  2.303  2.229
17  2.293  2.275  2.359
18  2.853  3.128  3.070
19  3.112  2.208  1.745
20  2.605  2.706  2.663
22  2.853  2.913  3.048
23  3.506  3.443  3.326
24  3.812  3.521  3.381
25  3.420  3.322  3.357
26  3.255  2.997  2.632
28  2.387  2.260  2.144
29  2.359  2.295  2.366
30  2.621  2.678  2.594
31  2.943  2.736  2.457
32  2.724  2.693  2.645
34  2.248  2.200  2.284
35  3.384  3.491  3.406
36
```

[ ]:
```
# drop data in year 1993-1999 and Apr in 2022
df_gas = df_gas.drop([1, 2, 4, 5, 6, 7, 8])
```

[ ]:
```
# change the format of the dataframe
months=['Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'Jul', 'Aug', 'Sep', 'Oct',␣
 ↪'Nov', 'Dec']

df_gas_new = pd.melt(df_gas, id_vars = 'Year', value_vars=months,␣
 ↪var_name='Month', value_name='Gas Price')

df_gas_new['Month']=pd.Categorical(df_gas_new['Month'], categories=months,␣
 ↪ordered=True)
df_gas_new.sort_values(by=['Year','Month'], inplace=True)
df_gas_new
```

[ ]:
```
    Year Month Gas Price
0   2000   Jan     1.329
23  2000   Feb     1.415
```

```
46   2000   Mar     1.556
69   2000   Apr     1.506
92   2000   May     1.526
..    …    …       …
183  2022   Aug
206  2022   Sep
229  2022   Oct
252  2022   Nov
275  2022   Dec

[276 rows x 3 columns]
```

0.2.5 Load/Clean Data

[ ]:
```
# load dfs - data will be 01/2000 to 03/2022, 22 years and 3 month is 267␣
↪month,
df_bs = pd.read_excel('data/df_cvx_bs_quarter.xlsx', engine='openpyxl')
df_is = pd.read_excel('data/df_cvx_is_quarter.xlsx', engine='openpyxl')
df_stock = pd.read_csv('data/CVXstockPrice.csv')
df_inflation = pd.read_csv('data/clean_inflation_rate.csv')
df_gas = pd.read_excel('data/gasPrices.xlsx', engine='openpyxl')
```

Stcok DF

[ ]:
```
# we just need adjusted close , volumn
dfstock1 = df_stock.iloc[:,[0,5,6]]

# create year column and month column
dfstock1['year'] = df_stock.date.apply(lambda x : x.split('-')[0])
dfstock1['month'] = df_stock.date.apply(lambda x : x.split('-')[1])
dfstock1.tail()

# drop useless columns
dfstock2 = dfstock1.iloc[2:-1,1:]
# reset index
dfstock3 = dfstock2.reset_index(drop=True)

# convert month into int
dfstock3.month = dfstock3.month.apply(lambda x: int(x))

#assign to finaldf
dfstockf = dfstock3.sort_values(by=['year','month'])
dfstockf
```

[ ]:
```
     5. adjusted close    6. volume  year  month
266            18.2953   37687500.0  2000      1
265            16.4760   42961800.0  2000      2
```

```
264            20.3915   51176100.0  2000      3
263            18.7790   31502600.0  2000      4
262            20.5234   30692800.0  2000      5
..                 …          …     …    …
4             110.7529  224686287.0  2021     11
3             115.1489  221128758.0  2021     12
2             128.8667  300049707.0  2022      1
1             142.7935  282783725.0  2022      2
0             161.4657  526661468.0  2022      3

[267 rows x 4 columns]
```

Balance Sheet DF

[ ]:
```
# df_BalanceSheet - Clean Balance Sheet
# transpose df
df_bs1 = df_bs.T

# assign column names
df_bs1.columns = df_bs1.iloc[0,:]

# reset index and drop first row
df_bs2 = df_bs1.reset_index().iloc[1:,:]
df_bs2.head(3)
```

[ ]:
```
Unnamed: 0    index Cash & Short-Term Investments Cash Only  \
1           MAR '22                          12.02     11.99
2           DEC '21                           6.01      5.97
3           SEP '21                           6.28      6.24

Unnamed: 0 Total Short Term Investments Short-Term Receivables  \
1                                  0.03                  23.26
2                                  0.04                  18.42
3                                  0.03                  16.57

Unnamed: 0 Accounts Receivables, Net Accounts Receivables, Gross  \
1                               23.2                        23.51
2                              18.17                        18.47
3                              16.16                        16.45

Unnamed: 0 Bad Debt/Doubtful Accounts Other Receivables Inventories  …  \
1                              -0.3             0.05        6.53  …
2                              -0.3             0.25        6.31  …
3                             -0.29              0.4        6.13  …

Unnamed: 0 Other Appropriated Reserves Treasury Stock Repurchased Stock Value  \
1                              -3.71        -39.16                    1.25
2                              -3.96        -41.46                    0.75
```

```
3                                -4.51        -41.42                    0.63

Unnamed: 0 Total Shareholders' Equity Accumulated Minority Interest  \
1                             146.22                          0.88
2                             139.07                          0.87
3                             135.86                          0.86

Unnamed: 0 Total Equity Total Liabilities & Shareholders' Equity Per Share  \
1                147.1                                 249.05       NaN
2               139.94                                 239.54       NaN
3               136.72                                 239.95       NaN

Unnamed: 0 Book Value per Share Tangible Book Value per Share
1                        74.42                         72.19
2                        72.06                         69.79
3                        70.48                          68.2

[3 rows x 60 columns]
```

[ ]:
```
# see the columns
df_bs2.columns
```

[ ]:
```
Index(['index', 'Cash & Short-Term Investments', 'Cash Only',
       'Total Short Term Investments', 'Short-Term Receivables',
       'Accounts Receivables, Net', 'Accounts Receivables, Gross',
       'Bad Debt/Doubtful Accounts', 'Other Receivables', 'Inventories',
       'Finished Goods', 'Raw Materials', 'Other Current Assets',
       'Miscellaneous Current Assets', 'Total Current Assets',
       'Net Property, Plant & Equipment',
       'Property, Plant & Equipment - Gross',
       'Operating Lease Right-of-Use Assets', 'Accumulated Depreciation',
       'Total Long-Term Investments ', 'LT Investment - Affiliate Companies',
       'Other Long-Term Investments', 'Long-Term Note Receivable',
       'Intangible Assets', 'Goodwill', 'Deferred Tax Assets', 'Other Assets',
       'Tangible Other Assets', 'Total Assets',
       'Liabilities & Shareholders' Equity', 'ST Debt & Curr. Portion LT Debt',
       'Accounts Payable', 'Income Tax Payable', 'Other Current Liabilities',
       'Miscellaneous Current Liabilities', 'Total Current Liabilities',
       'Long-Term Debt', 'Long-Term Debt excl Lease Obligations',
       'Capital and Operating Lease Obligations',
       'Provision for Risks & Charges', 'Deferred Tax Liabilities',
       'Other Liabilities', 'Other Liabilities (excl. Deferred Income)',
       'Total Liabilities', 'Common Equity', 'Common Stock Par/Carry Value',
       'Additional Paid-In Capital/Capital Surplus', 'Retained Earnings',
       'Cumulative Translation Adjustment/Unrealized For. Exch. Gain',
       'Unrealized Gain/Loss Marketable Securities',
       'Other Appropriated Reserves', 'Treasury Stock',
```

```
       'Repurchased Stock Value', 'Total Shareholders' Equity',
       'Accumulated Minority Interest', 'Total Equity',
       'Total Liabilities & Shareholders' Equity', 'Per Share',
       'Book Value per Share', 'Tangible Book Value per Share'],
      dtype='object', name='Unnamed: 0')
```

[ ]:
```
# select the needed columns
df_bs3 = df_bs2[['index','Total Assets', 'Total Equity']].iloc[:89,:]
df_bs3.shape
```

[ ]:
```
(89, 3)
```

[ ]:
```
# since data is quarterly, we will append the data until we have 267 month
dfbs4 = df_bs3
dfbs5 = dfbs4.append(df_bs3)
dfbs6 = dfbs5.append(df_bs3)
dfbs6.shape
```

[ ]:
```
(267, 3)
```

[ ]:
```
# convert year and month
dfbs6['year'] = dfbs6['index'].apply(lambda x : int(x.split(' \'')[1]) + 2000)
dfbs6['month'] = dfbs6['index'].apply(lambda x : convMonth(x.split(' \'')[0]))
dfbs6.head()
```

[ ]:

Unnamed: 0	index	Total Assets	Total Equity	year	month
1	MAR '22	249.05	147.1	2022	3
2	DEC '21	239.54	139.94	2021	12
3	SEP '21	239.95	136.72	2021	9
4	JUN '21	242.81	133.91	2021	6
5	MAR '21	241.65	132.93	2021	3

[ ]:
```
dfbsf = dfbs6.sort_values(by=['year','month'])
dfbsf.shape
```

[ ]:
```
(267, 5)
```

[ ]:
```

```

Income Statement DF

[ ]:
```
# Income Statement - Clean Balance Sheet
# transpose df
df_is1 = df_is.T

# assign column names
df_is1.columns = df_is1.iloc[0,:]
```

```
# reset index and drop first row
df_is2 = df_is1.reset_index().iloc[1:,:]
df_is2.head(3)
```

[ ]:
```
Unnamed: 0    index    Sales Cost of Goods Sold (COGS) incl. D&A  \
1           MAR '22  53187.0                              42045.0
2           DEC '21  46207.0                              37420.0
3           SEP '21  42349.0                              33628.0

Unnamed: 0 COGS excluding D&A Depreciation & Amortization Expense  \
1                     38256.0                               3789.0
2                     32958.0                               4462.0
3                     29288.0                               4340.0

Unnamed: 0 Depreciation Gross Income SG&A Expense Other SG&A  \
1                3789.0      11142.0       1031.0     1031.0
2                4462.0       8787.0       1357.0     1357.0
3                4340.0       8721.0        757.0      757.0

Unnamed: 0 Other Operating Expense  … EPS (diluted)  \
1                           2002.0  …        3.2188
2                           1779.0  …          2.63
3                           2075.0  …         3.181

Unnamed: 0 Diluted Shares Outstanding Total Shares Outstanding  \
1                           1944.542              1964.813456
2                           1922.082              1929.806057
3                           1921.095              1927.685919

Unnamed: 0 Earnings Persistence Dividends per Share Payout Ratio EBITDA  \
1                       89.786                1.42     44.11582    NaN
2                       89.972                1.34     50.95057    NaN
3                       89.344                1.34    42.125118    NaN

Unnamed: 0   EBITDA    EBIT Depreciation & Amortization Expense
1           11898.0  8109.0                              3789.0
2           10113.0  5651.0                              4462.0
3           10229.0  5889.0                              4340.0

[3 rows x 48 columns]
```

[ ]:
```
# see the columns
df_is2.columns
```

[ ]:
```
Index(['index', 'Sales', 'Cost of Goods Sold (COGS) incl. D&A',
       'COGS excluding D&A', 'Depreciation & Amortization Expense',
       'Depreciation', 'Gross Income', 'SG&A Expense', 'Other SG&A',
```

```
       'Other Operating Expense', 'EBIT (Operating Income)',
       'Nonoperating Income - Net', 'Equity in Earnings of Affiliates',
       'Other Income (Expense)', 'Interest Expense', 'Gross Interest Expense',
       'Interest Capitalized', 'Unusual Expense - Net', 'Impairments',
       'Property,Plant & Equipment', 'Financial Fixed Assets',
       'Restructuring Expense', 'Unrealized Valuation Gain/Loss',
       'Hedges/Derivatives', 'Excpl Chrgs - Others', 'Calamitous Events',
       'Pretax Income', 'Income Taxes', 'Equity in Earnings of Affiliates',
       'Consolidated Net Income', 'Minority Interest', 'Net Income',
       'Discontinued Operations', 'Net Income available to Common',
       'Per Share', 'EPS (recurring)', 'Basic Shares Outstanding',
       'Total Shares Outstanding', 'EPS (diluted)',
       'Diluted Shares Outstanding', 'Total Shares Outstanding',
       'Earnings Persistence', 'Dividends per Share', 'Payout Ratio', 'EBITDA',
       'EBITDA', 'EBIT', 'Depreciation & Amortization Expense'],
      dtype='object', name='Unnamed: 0')
```

[ ]:
```
# select needed columns
df_is3 = df_is2[['index','Sales','Net Income']].iloc[:89,:]
df_is3.shape
```

[ ]:
```
(89, 3)
```

[ ]:
```
# append df to 267 month
dfis4 = df_is3
dfis5 = dfis4.append(df_is3)
dfis6 = dfis5.append(df_is3)
```

[ ]:
```
# 22 year 3 month = 267 month
dfis6.shape
```

[ ]:
```
(267, 3)
```

[ ]:
```
# create year and month columns
dfis6['year'] = dfis6['index'].apply(lambda x : int(x.split(' \'')[1]) + 2000)
dfis6['month'] = dfis6['index'].apply(lambda x : convMonth(x.split(' \'')[0]))
dfis6.head()
```

[ ]:

Unnamed: 0	index	Sales	Net Income	year	month
1	MAR '22	53187.0	6259.0	2022	3
2	DEC '21	46207.0	5055.0	2021	12
3	SEP '21	42349.0	6111.0	2021	9
4	JUN '21	36385.0	3082.0	2021	6
5	MAR '21	31350.0	1377.0	2021	3

[ ]:
```
# sort by values
dfisf = dfis6.sort_values(by=['year','month'])
dfisf.shape
```

[ ]: (267, 5)

Inflation DF

[ ]:
```
# format inflation df
dfi1 = df_inflation.iloc[:267,:]
dfi1
```

[ ]:
```
     Unnamed: 0  Year Month Inflation Rate
0            22  2000   Jan            2.7
1            45  2000   Feb            3.2
2            68  2000   Mar            3.8
3            91  2000   Apr            3.1
4           114  2000   May            3.2
..          …   …   …             …
262         231  2021   Nov            6.8
263         254  2021   Dec            7.0
264           0  2022   Jan            7.5
265          23  2022   Feb            7.9
266          46  2022   Mar            8.5

[267 rows x 4 columns]
```

Gas DF

[ ]:
```
df_gas.Date = df_gas.Date.astype(str)
```

[ ]:
```
df_gas['year'] = df_gas.Date.apply(lambda x : x.split('-')[0])
df_gas['month'] = df_gas.Date.apply(lambda x : x.split('-')[1])
df_gas
```

[ ]:
```
           Date  \
0    1993-04-15
1    1993-05-15
2    1993-06-15
3    1993-07-15
4    1993-08-15
..          …
343  2021-11-15
344  2021-12-15
345  2022-01-15
346  2022-02-15
347  2022-03-15

     U.S. All Grades All Formulations Retail Gasoline Prices (Dollars per
Gallon)  \
0                                                    1.078
1                                                    1.100
```

```
2                                                    1.097
3                                                    1.078
4                                                    1.062
..                                                     …
343                                                  3.491
344                                                  3.406
345                                                  3.413
346                                                  3.611
347                                                  4.322

     year month
0    1993    04
1    1993    05
2    1993    06
3    1993    07
4    1993    08
..    …    …
343  2021    11
344  2021    12
345  2022    01
346  2022    02
347  2022    03

[348 rows x 4 columns]
```

[ ]:
```
# get dfgas1
dfgas1 = df_gas.iloc[81:,:]
```

[ ]:
```
# create merged df
dfmerge = dfstockf

#rewrite quartly month into 12 month
dfmerge['sales'] = list(dfisf.Sales)
dfmerge['netIncome'] = list(dfisf['Net Income'])
dfmerge['Total Assets'] = list(dfbsf['Total Assets'])
dfmerge['Total Equity'] = list(dfbsf['Total Equity'])
dfmerge['inflation'] = list(dfi1['Inflation Rate'])
dfmerge['gas'] = list(dfgas1['U.S. All Grades All Formulations Retail Gasoline␣
 ↪Prices (Dollars per Gallon)'])

# create the dfmerge1 reset index, rename columns
dfmerge1 = dfmerge.reset_index(drop=True).rename(columns={'5. adjusted close':
 ↪'adjustedClose','6. volume':'volume','Total Assets': 'assets','Total Equity':
 ↪ 'equity'})

''' Units
sales - millions
```

```
netIncome - millions
asset - billions
equity - billions

'''

# assign new df
dfmerge2 = dfmerge1

# convert into millions
dfmerge2.equity = dfmerge1.equity * 1000
dfmerge2.assets = dfmerge1.assets * 1000
# convert into 3 month average
dfmerge2.sales = dfmerge1.sales/3
dfmerge2.netIncome = dfmerge1.netIncome/3
dfmerge2.year = dfmerge2.year.astype(int)
dfmerge2.inflation = dfmerge2.inflation.astype(float)
```

[ ]:
```
dfmerge2.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 267 entries, 0 to 266
Data columns (total 10 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   adjustedClose  267 non-null    float64
 1   volume         267 non-null    float64
 2   year           267 non-null    int32
 3   month          267 non-null    int64
 4   sales          267 non-null    float64
 5   netIncome      267 non-null    float64
 6   assets         267 non-null    float64
 7   equity         267 non-null    float64
 8   inflation      267 non-null    float64
 9   gas            267 non-null    float64
dtypes: float64(8), int32(1), int64(1)
memory usage: 19.9 KB
```

[ ]:
```
# save to csv
# dfmerge2.to_csv('data/final_df.csv')
```

Make Final DF after cleaning

[ ]:
```
# read csv file into a dataframe
df_merge = pd.read_csv('data/final_df.csv', index_col=0)

# change the column names
```

```
df_merge.rename(columns = {'adjustedClose':'AdjustedClose', 'volume':'Volume',␣
 ↪'year':'Year', 'month':'Month',
                            'sales':'Sales', 'netIncome':'NetIncome','assets':
 ↪'Assets', 'equity':'Equity','inflation':'InflationRate',
                            'gas':'GasPrice'}, inplace = True)

# show the renamed dataframe
df_merge
```

[ ]:

```
     AdjustedClose       Volume  Year  Month         Sales    NetIncome  \
0          18.2953   37687500.0  2000      1   3481.000000   348.000000
1          16.4760   42961800.0  2000      2   3481.000000   348.000000
2          20.3915   51176100.0  2000      3   3481.000000   348.000000
3          18.7790   31502600.0  2000      4   3987.333333   372.000000
4          20.5234   30692800.0  2000      5   3987.333333   372.000000
..             …          …   …    …           …          …
262       110.7529  224686287.0  2021     11  15402.333333  1685.000000
263       115.1489  221128758.0  2021     12  15402.333333  1685.000000
264       128.8667  300049707.0  2022      1  17729.000000  2086.333333
265       142.7935  282783725.0  2022      2  17729.000000  2086.333333
266       161.4657  526661468.0  2022      3  17729.000000  2086.333333

       Assets    Equity  InflationRate  GasPrice
0     41250.0   18010.0            2.7     1.329
1     41250.0   18010.0            3.2     1.415
2     41250.0   18010.0            3.8     1.556
3     41380.0   18750.0            3.1     1.506
4     41380.0   18750.0            3.2     1.526
..        …         …              …       …
262  239540.0  139940.0            6.8     3.491
263  239540.0  139940.0            7.0     3.406
264  249050.0  147100.0            7.5     3.413
265  249050.0  147100.0            7.9     3.611
266  249050.0  147100.0            8.5     4.322

[267 rows x 10 columns]
```

[ ]:

```
# reorder the column
df_merge=df_merge[['Year', 'Month', 'InflationRate', 'GasPrice', 'Sales',␣
 ↪'NetIncome', 'Assets', 'Equity',
             'Volume', 'AdjustedClose']]
# display the final dataframe
df_merge.head()
```

[ ]:

```
   Year  Month  InflationRate  GasPrice        Sales  NetIncome   Assets  \
0  2000      1            2.7     1.329  3481.000000      348.0  41250.0
1  2000      2            3.2     1.415  3481.000000      348.0  41250.0
```

```
2  2000      3            3.8     1.556  3481.000000      348.0  41250.0
3  2000      4            3.1     1.506  3987.333333      372.0  41380.0
4  2000      5            3.2     1.526  3987.333333      372.0  41380.0

    Equity      Volume  AdjustedClose
0  18010.0  37687500.0        18.2953
1  18010.0  42961800.0        16.4760
2  18010.0  51176100.0        20.3915
3  18750.0  31502600.0        18.7790
4  18750.0  30692800.0        20.5234
```

[ ]:
```
# change the volume unit to million
df_merge.Volume = df_merge.Volume/1000000
df_merge
```

[ ]:
```
     Year  Month  InflationRate  GasPrice         Sales    NetIncome  \
0    2000      1            2.7     1.329   3481.000000   348.000000
1    2000      2            3.2     1.415   3481.000000   348.000000
2    2000      3            3.8     1.556   3481.000000   348.000000
3    2000      4            3.1     1.506   3987.333333   372.000000
4    2000      5            3.2     1.526   3987.333333   372.000000
..    …    …              …       …            …           …
262  2021     11            6.8     3.491  15402.333333  1685.000000
263  2021     12            7.0     3.406  15402.333333  1685.000000
264  2022      1            7.5     3.413  17729.000000  2086.333333
265  2022      2            7.9     3.611  17729.000000  2086.333333
266  2022      3            8.5     4.322  17729.000000  2086.333333

       Assets    Equity      Volume  AdjustedClose
0     41250.0   18010.0   37.687500        18.2953
1     41250.0   18010.0   42.961800        16.4760
2     41250.0   18010.0   51.176100        20.3915
3     41380.0   18750.0   31.502600        18.7790
4     41380.0   18750.0   30.692800        20.5234
..        …       …         …              …
262  239540.0  139940.0  224.686287       110.7529
263  239540.0  139940.0  221.128758       115.1489
264  249050.0  147100.0  300.049707       128.8667
265  249050.0  147100.0  282.783725       142.7935
266  249050.0  147100.0  526.661468       161.4657

[267 rows x 10 columns]
```

[ ]:
```
#formatting float column
#change the value of sales column to two decimal digits
df_merge[['Sales', 'NetIncome']]=df_merge[['Sales', 'NetIncome']].
 ↪round(decimals=2)
```

```
# display the cleaned dataframe
df_merge
```

[ ]:

	Year	Month	InflationRate	GasPrice	Sales	NetIncome	Assets	\
0	2000	1	2.7	1.329	3481.00	348.00	41250.0	
1	2000	2	3.2	1.415	3481.00	348.00	41250.0	
2	2000	3	3.8	1.556	3481.00	348.00	41250.0	
3	2000	4	3.1	1.506	3987.33	372.00	41380.0	
4	2000	5	3.2	1.526	3987.33	372.00	41380.0	
..	…	…	…	…	…	…	…	
262	2021	11	6.8	3.491	15402.33	1685.00	239540.0	
263	2021	12	7.0	3.406	15402.33	1685.00	239540.0	
264	2022	1	7.5	3.413	17729.00	2086.33	249050.0	
265	2022	2	7.9	3.611	17729.00	2086.33	249050.0	
266	2022	3	8.5	4.322	17729.00	2086.33	249050.0	

	Equity	Volume	AdjustedClose
0	18010.0	37.687500	18.2953
1	18010.0	42.961800	16.4760
2	18010.0	51.176100	20.3915
3	18750.0	31.502600	18.7790
4	18750.0	30.692800	20.5234
..	…	…	…
262	139940.0	224.686287	110.7529
263	139940.0	221.128758	115.1489
264	147100.0	300.049707	128.8667
265	147100.0	282.783725	142.7935
266	147100.0	526.661468	161.4657

[267 rows x 10 columns]

[ ]:
```
# save it to a csv file
# df_merge.to_csv('data/df_final_merge.csv')
```

0.3 Exploratory Data Analysis (EDA)

[ ]:
```
df_merge = pd.read_csv('data/df_final_merge.csv',index_col=0)
```

[ ]:
```
# Get the basic information about the data
df_merge.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 267 entries, 0 to 266
Data columns (total 10 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   Year            267 non-null    int64
 1   Month           267 non-null    int64
```

```
 2   InflationRate  267 non-null    float64
 3   GasPrice       267 non-null    float64
 4   Sales          267 non-null    float64
 5   NetIncome      267 non-null    float64
 6   Assets         267 non-null    float64
 7   Equity         267 non-null    float64
 8   Volume         267 non-null    float64
 9   AdjustedClose  267 non-null    float64
dtypes: float64(8), int64(2)
memory usage: 22.9 KB
```

[ ]:
```
# Get the statistics of the data
df_merge.describe()
```

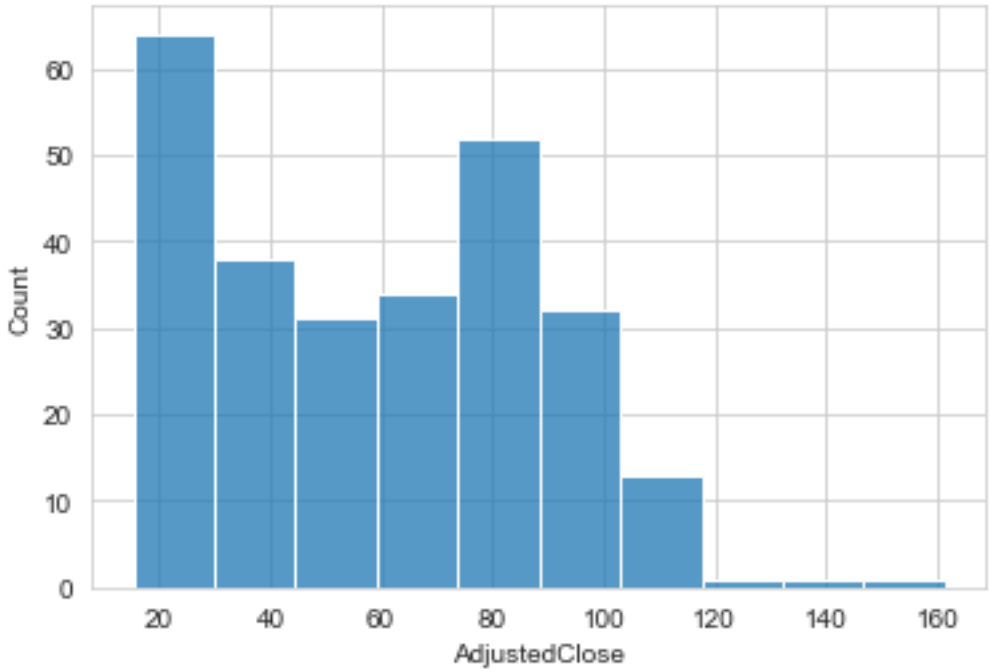
[ ]:

	Year	Month	InflationRate	GasPrice	Sales	\
count	267.000000	267.000000	267.000000	267.000000	267.000000	
mean	2010.629213	6.449438	2.310487	2.586599	13405.051910	
std	6.436004	3.472809	1.500965	0.745405	5095.207885	
min	2000.000000	1.000000	-2.100000	1.127000	3481.000000	
25%	2005.000000	3.000000	1.500000	2.023000	10054.330000	
50%	2011.000000	6.000000	2.100000	2.606000	13271.670000	
75%	2016.000000	9.000000	3.150000	3.098500	17659.000000	
max	2022.000000	12.000000	8.500000	4.322000	26987.330000	

	NetIncome	Assets	Equity	Volume	AdjustedClose
count	267.000000	267.000000	267.000000	267.000000	267.000000
mean	1021.059213	179078.202247	100914.044944	159.266501	58.870619
std	911.020372	75466.124685	48334.965201	85.342422	30.419139
min	-2756.670000	40970.000000	18010.000000	30.692800	15.289600
25%	510.330000	124810.000000	60190.000000	105.080532	30.431300
50%	1157.000000	194740.000000	110850.000000	151.300019	59.739500
75%	1650.000000	253810.000000	147390.000000	208.137200	82.971850
max	2631.000000	269600.000000	157450.000000	559.132000	161.465700

[ ]:
```
# check the distribution of our target column
sns.histplot(df_merge['AdjustedClose'])
```

[ ]:
```
<AxesSubplot:xlabel='AdjustedClose', ylabel='Count'>
```



It looks like the chevron stock price is not normally distributed. The average price is falling somewhat around 60 dollars, with more price falling on 20 dollars.

[ ]:
```
# We want to know the yearly sales change
# we need to group the rows by year
df_merge.groupby(['Year']).sum()
```

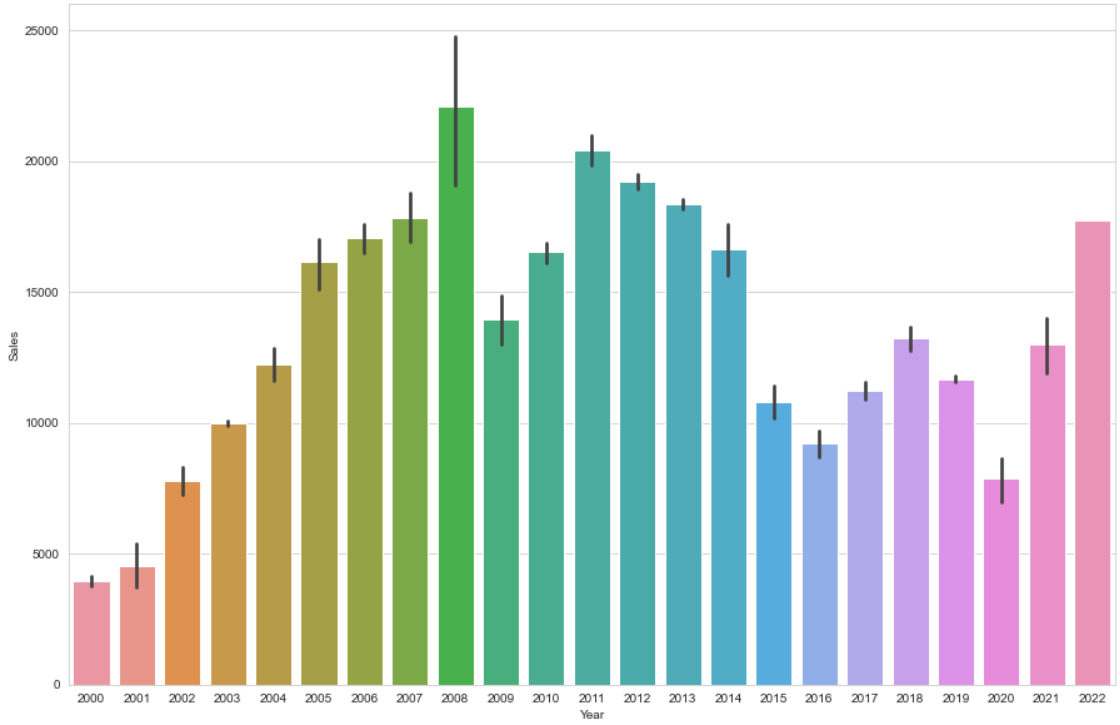
[ ]:

Year	Month	InflationRate	GasPrice	Sales	NetIncome	Assets
2000	78	40.5	18.294	47526.99	5184.99	495750.0
2001	78	33.8	17.594	54343.02	1716.96	625740.0
2002	78	19.0	16.582	93484.98	1132.02	928980.0
2003	78	27.3	19.213	120031.98	7425.96	972090.0
2004	78	32.2	22.695	146814.99	12688.02	1071390.0
2005	78	40.6	27.746	193640.97	14098.98	1336470.0
2006	78	38.8	31.381	204891.99	17137.98	1577010.0
2007	78	34.4	34.146	214091.01	18687.99	1691910.0
2008	78	46.2	39.661	264957.99	23931.03	1928400.0
2009	78	-4.2	28.760	167497.02	10482.99	1943430.0
2010	78	19.5	34.003	198295.98	19023.99	2107950.0
2011	78	38.0	42.917	245014.02	26895.00	2430090.0
2012	78	25.0	44.234	230638.98	26178.99	2682330.0
2013	78	17.8	42.917	220263.99	21422.97	2949150.0
2014	78	19.6	41.304	199940.97	19240.98	3155250.0
2015	78	1.5	30.156	129648.00	4587.00	3211830.0

```
2016     78           15.2    27.030  110484.00    -497.01  3135780.0
2017     78           25.4    30.364  134778.99    9195.00  3068040.0
2018     78           29.4    33.808  158766.99   14823.99  3074520.0
2019     78           21.8    32.229  140156.04    2924.01  3019980.0
2020     78           14.8    27.117   94401.99   -5543.01  2768790.0
2021     78           56.4    37.125  156290.97   15624.99  2891850.0
2022      6           23.9    11.346   53187.00    6258.99   747150.0

          Equity       Volume  AdjustedClose
Year
2000   226830.0   459.414600       224.7643
2001   302130.0   667.807600       245.1884
2002   398370.0   731.539200       222.9465
2003   418890.0   733.306700       209.9216
2004   504360.0   947.448650       296.2792
2005   654000.0  2082.211800       364.5763
2006   810870.0  2293.198000       416.4492
2007   893040.0  2511.090100       559.9599
2008  1005270.0  3900.184200       594.1090
2009  1080240.0  2987.314100       501.5349
2010  1215360.0  2601.802600       576.8331
2011  1413420.0  2300.147100       790.4580
2012  1589010.0  1622.782500       855.6546
2013  1746450.0  1446.169700       991.8342
2014  1860180.0  1645.389372      1021.9810
2015  1868160.0  2330.550128       841.9817
2016  1783440.0  2029.783638       935.6630
2017  1777230.0  1387.003718      1075.2993
2018  1845780.0  1667.063566      1194.3538
2019  1847010.0  1597.740600      1237.8876
2020  1632210.0  2832.904814       931.2553
2021  1630500.0  2639.808056      1196.3984
2022   441300.0  1109.494900       433.1259
```

[ ]:
```
# let's plot the yearly sales change with a scatterplot
plt.figure(figsize=(15, 10))
sns.barplot(data=df_merge, x='Year', y='Sales')
```

[ ]:
```
<AxesSubplot:xlabel='Year', ylabel='Sales'>
```



The highest sales happened in 2008, and the lowest sales was in year 2000. After year 2020, the sales is very robust, increasing tremendously.

[ ]:
```
#add a new column named date to df_merge
#assign day as 1 so that the datatype of date becomes datetime
#this column is for implementing time series plotting
df_merge['Date']=pd.to_datetime(df_merge[['Year', 'Month']].assign(Day=1))
```

[ ]:
```
#display the new dataframe
df_merge
```

[ ]:

	Year	Month	InflationRate	GasPrice	Sales	NetIncome	Assets	\
0	2000	1	2.7	1.329	3481.00	348.00	41250.0	
1	2000	2	3.2	1.415	3481.00	348.00	41250.0	
2	2000	3	3.8	1.556	3481.00	348.00	41250.0	
3	2000	4	3.1	1.506	3987.33	372.00	41380.0	
4	2000	5	3.2	1.526	3987.33	372.00	41380.0	
..	…	…	…	…	…	…	…	
262	2021	11	6.8	3.491	15402.33	1685.00	239540.0	
263	2021	12	7.0	3.406	15402.33	1685.00	239540.0	
264	2022	1	7.5	3.413	17729.00	2086.33	249050.0	
265	2022	2	7.9	3.611	17729.00	2086.33	249050.0	
266	2022	3	8.5	4.322	17729.00	2086.33	249050.0	

```
       Equity      Volume  AdjustedClose       Date
0     18010.0   37.687500        18.2953 2000-01-01
1     18010.0   42.961800        16.4760 2000-02-01
2     18010.0   51.176100        20.3915 2000-03-01
3     18750.0   31.502600        18.7790 2000-04-01
4     18750.0   30.692800        20.5234 2000-05-01
..        …         …              …         …
262  139940.0  224.686287       110.7529 2021-11-01
263  139940.0  221.128758       115.1489 2021-12-01
264  147100.0  300.049707       128.8667 2022-01-01
265  147100.0  282.783725       142.7935 2022-02-01
266  147100.0  526.661468       161.4657 2022-03-01

[267 rows x 11 columns]
```

[ ]:
```
#create a new dataframe to store columns for time series analysis
#setting the Date as index
df_timeseries=df_merge[['Date','GasPrice', 'Sales', 'AdjustedClose']].
 ↪set_index('Date')

#display the dataframe
df_timeseries
```

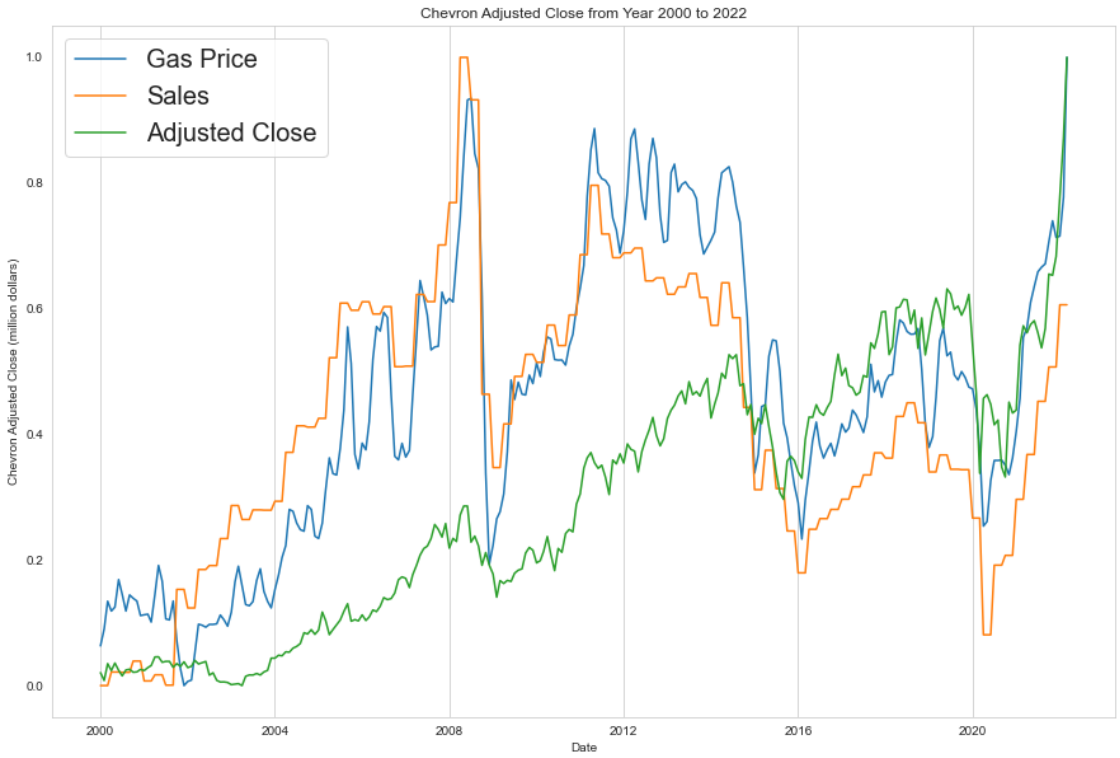
[ ]:
```
            GasPrice     Sales  AdjustedClose
Date
2000-01-01     1.329   3481.00        18.2953
2000-02-01     1.415   3481.00        16.4760
2000-03-01     1.556   3481.00        20.3915
2000-04-01     1.506   3987.33        18.7790
2000-05-01     1.526   3987.33        20.5234
…                …         …              …
2021-11-01     3.491  15402.33       110.7529
2021-12-01     3.406  15402.33       115.1489
2022-01-01     3.413  17729.00       128.8667
2022-02-01     3.611  17729.00       142.7935
2022-03-01     4.322  17729.00       161.4657

[267 rows x 3 columns]
```

[ ]:
```
# normalize all the column data and plot them together to see the different␣
 ↪trends
df_scaled = df_timeseries

# construct a scaler
scaler= MinMaxScaler()
df_scaled.iloc[:,:] = scaler.fit_transform(df_timeseries)
```

[ ]:
```
df_scaled
```

[ ]:
```
            GasPrice     Sales  AdjustedClose
Date
2000-01-01  0.063224  0.000000       0.020562
2000-02-01  0.090141  0.000000       0.008116
2000-03-01  0.134272  0.000000       0.034902
2000-04-01  0.118623  0.021540       0.023871
2000-05-01  0.124883  0.021540       0.035805
…                …         …              …
2021-11-01  0.739906  0.507154       0.653071
2021-12-01  0.713302  0.507154       0.683144
2022-01-01  0.715493  0.606135       0.776988
2022-02-01  0.777465  0.606135       0.872262
2022-03-01  1.000000  0.606135       1.000000

[267 rows x 3 columns]
```

[ ]:
```
plt.figure(figsize=(15, 10))
plt.plot(df_scaled['GasPrice'])
plt.plot(df_scaled['Sales'])
plt.plot(df_scaled['AdjustedClose'])

plt.grid(axis='y')
plt.title('Chevron Adjusted Close from Year 2000 to 2022')
plt.xlabel('Date')
plt.ylabel('Chevron Adjusted Close (million dollars)')
plt.legend(['Gas Price', 'Sales', 'Adjusted Close'], prop={'size':20})
plt.show()
```



The gas price, sales, and adjusted close are very consistent in value, especially the gas price and sales.

Explore the Relationship between Inflation Rate and Stock Price

- Examine whether inflation rate can predict stock price
- Convert stock price to a percent change since inflation rate is a percent change

[ ]:
```
# create a list for monthly data
df_merge['AdjustedCloseChange']=df_merge['AdjustedClose']/
  ↪df_merge['AdjustedClose'].shift(1)*100 - 100
df_change=df_merge[['Date', 'AdjustedCloseChange', 'InflationRate']].
  ↪set_index('Date')
```

[ ]:
```
df_change
```

[ ]:
```
            AdjustedCloseChange  InflationRate
Date
2000-01-01                  NaN            2.7
2000-02-01            -9.944084            3.2
2000-03-01            23.764870            3.8
2000-04-01            -7.907707            3.1
2000-05-01             9.289100            3.2
…                            …              …
```

```
2021-11-01            -0.270411            6.8
2021-12-01             3.969196            7.0
2022-01-01            11.913097            7.5
2022-02-01            10.807136            7.9
2022-03-01            13.076366            8.5

[267 rows x 2 columns]
```

[ ]:
```
# drop the first row that contains null value
df_change.drop(index='2000-01-01')
```

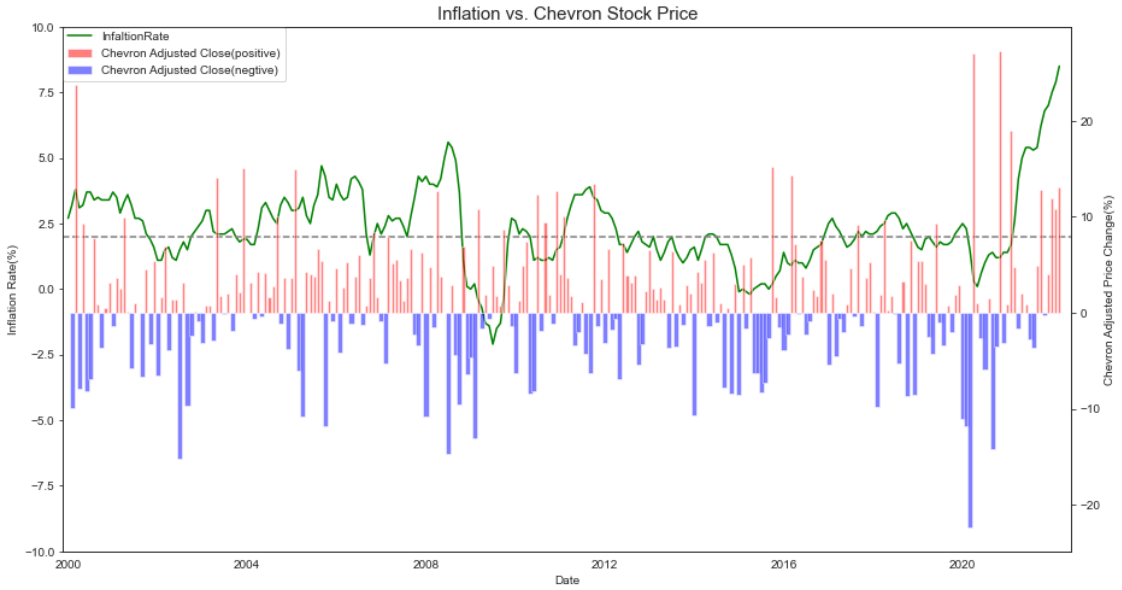
[ ]:
```
            AdjustedCloseChange  InflationRate
Date
2000-02-01            -9.944084            3.2
2000-03-01            23.764870            3.8
2000-04-01            -7.907707            3.1
2000-05-01             9.289100            3.2
2000-06-01            -8.194549            3.7
…                           …             …
2021-11-01            -0.270411            6.8
2021-12-01             3.969196            7.0
2022-01-01            11.913097            7.5
2022-02-01            10.807136            7.9
2022-03-01            13.076366            8.5

[266 rows x 2 columns]
```

Visualize the infaltion rate and stock price change and their relationships

[ ]:
```
# set the style of the plot to be white
sns.set_style('white')

# set the figure size of the plot to be 15 width and 8 height
fig, ax1 = plt.subplots(figsize=(15, 8))

# create a twin axes sharing the xaxis
# create a new axes with an invisible x-axis and an independent y-axis␣
 ↪positioned opposite to the original one
ax2 = ax1.twinx()

# plot inflation rate on ax1
ax1.plot(df_change.index, df_change.InflationRate,
         color="green", label="InfaltionRate")

#set positive adjusted close change as df_change_plus
df_change_plus=df_change[df_change['AdjustedCloseChange']>=0]

#position positive adjusted close change above x-axis
```

```
#set the line of color to be red
ax2.bar(df_change_plus.index, df_change_plus['AdjustedCloseChange'],
       color='red', alpha=0.5, width=20, label='Chevron Adjusted␣
 ↪Close(positive)')

#create a dataframe to store negative adjusted close change
df_change_minus = df_change[df_change['AdjustedCloseChange']<0]

#position negative adjusted close change below x-axis
#set the line of color to be blue
ax2.bar(df_change_minus.index, df_change_minus['AdjustedCloseChange'],
       color='blue', alpha=0.5, width=40, label='Chevron Adjusted␣
 ↪Close(negtive)')

#set a line of value 2 in ax1 as a baseline to see the deviation of inflation␣
 ↪rate
ax1.axhline(2, color='gray', linestyle='--')

#set the font size of tick labels
plt.tick_params(labelsize=10)

#set title and fontsize
plt.title("Inflation vs. Chevron Stock Price", fontsize=15)

#get the handler and label of legend for ax1 and ax2
handler1, label1 = ax1.get_legend_handles_labels()
handler2, label2 = ax2.get_legend_handles_labels()

#set the corresponding legend for both ax1 and ax2
#set the location to be upper left, which is location code 2
#set the pad between the axes and legend border to be 0
ax1.legend(handler1 + handler2, label1 + label2, loc=2, borderaxespad=0.)

#set x label to be Date
ax1.set_xlabel("Date")

#set y label for ax1
ax1.set_ylabel("Inflation Rate(%)")

#set y label for ax2
ax2.set_ylabel("Chevron Adjusted Price Change(%)")

#set ylim for ax1
ax1.set_ylim([-10, 10])

#set xlim for ax1, add a little time difference from both the left and right␣
 ↪y-axis
```

```
ax1.set_xlim([min(df_change.index) - dt.timedelta(days=40),
              max(df_change.index) + dt.timedelta(days=100)])

#display the plot
plt.show()
```



- Both inflation rate and Chevron stock price are volatile.
- The inflation rate is positive most of the time, but plummets after year 2008 to a negative value. It increases dramatically after year 2020 to an unprecedented high value.
- The Chevron stock price change has more positive values than negative values, meaning it is increasing generally.However, it plummets in 2020 and rebounces in 2022.
- Although it appears that blue bars appear when inflation is bad, red bars are also present.

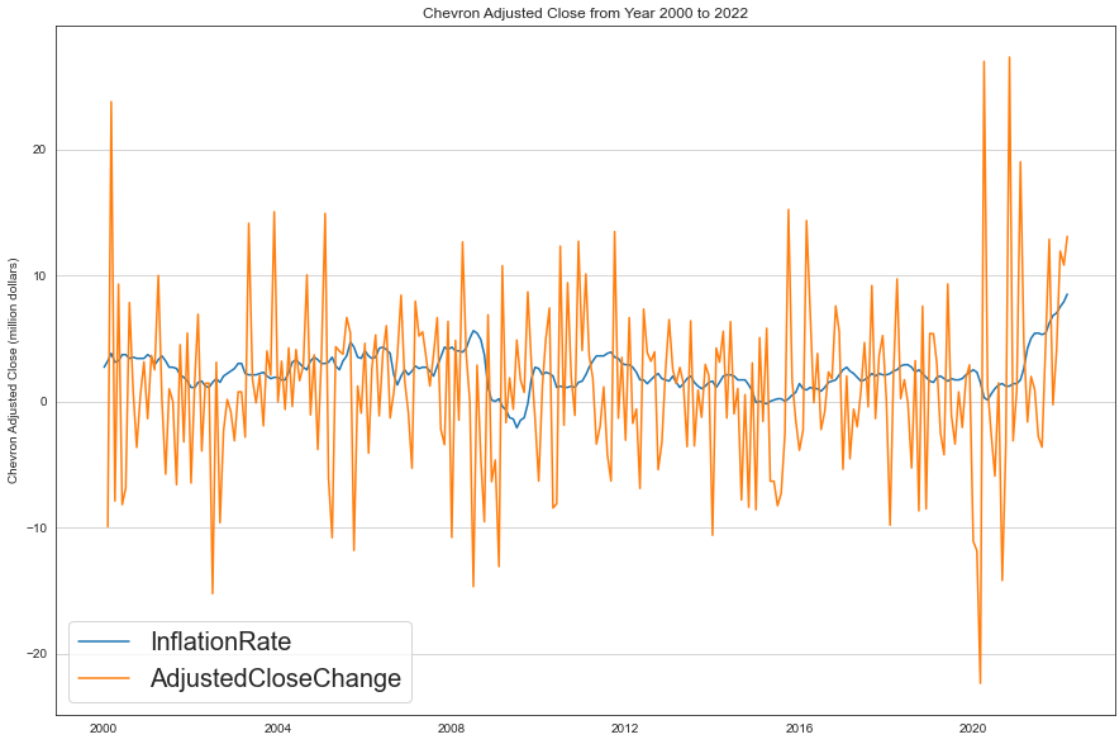
[ ]:
```
change_scaler = MinMaxScaler(feature_range=(-1,1))
df_change2 = df_change.copy()
df_change2.iloc[:,:] = change_scaler.fit_transform(df_change2)
df_change2
```

[ ]:

Date	AdjustedCloseChange	InflationRate
2000-01-01	NaN	-9.433962e-02
2000-02-01	-0.499646	1.110223e-16
2000-03-01	0.857734	1.132075e-01
2000-04-01	-0.417646	-1.886792e-02
2000-05-01	0.274829	1.110223e-16
…	…	…
2021-11-01	-0.110110	6.792453e-01
2021-12-01	0.060609	7.169811e-01

```
2022-01-01              0.380491    8.113208e-01
2022-02-01              0.335957    8.867925e-01
2022-03-01              0.427333    1.000000e+00

[267 rows x 2 columns]
```

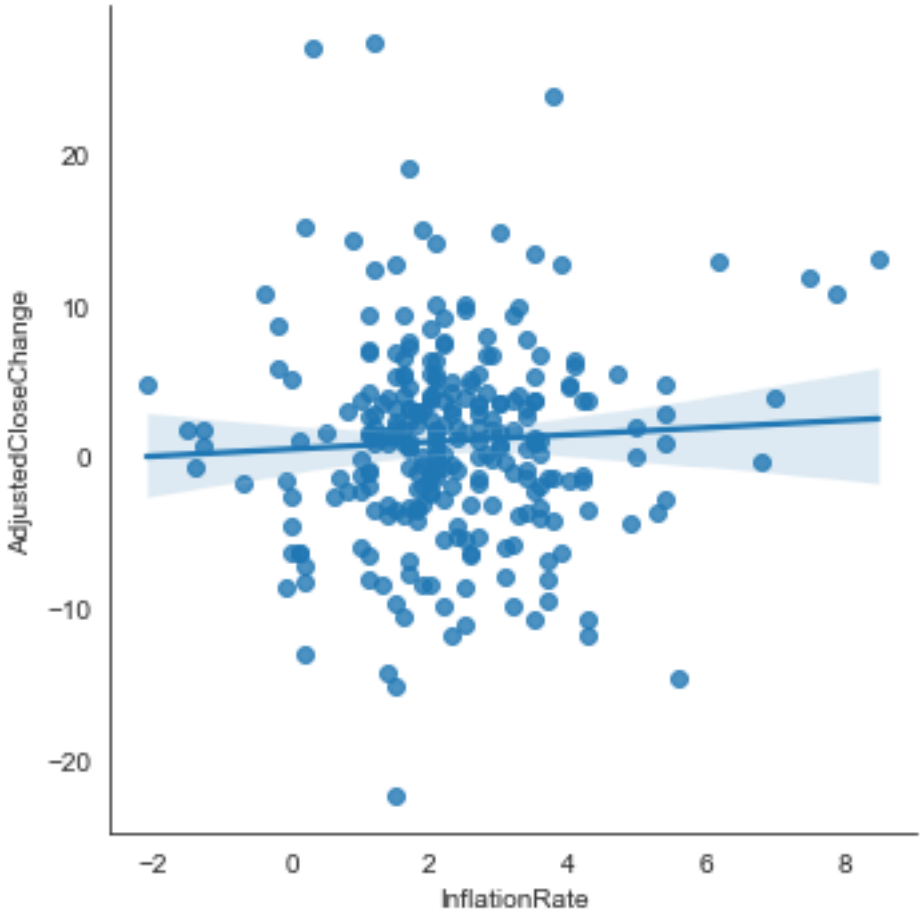
[ ]:
```
plt.figure(figsize=(15, 10))
plt.plot(df_change['InflationRate'])
plt.plot(df_change['AdjustedCloseChange'])
plt.grid(axis='y')
plt.title('Chevron Adjusted Close from Year 2000 to 2022')

plt.ylabel('Chevron Adjusted Close (million dollars)')
plt.legend(['InflationRate', 'AdjustedCloseChange'], prop={'size':20})
plt.show()
```



As you can see stock market is way more volitile than inflation.

[ ]:
```
# Let's draw a linear regression plot to examine the relationship between␣
↪inflation rate and adjusted close change
sns.lmplot(x='InflationRate', y='AdjustedCloseChange', data=df_change)
```

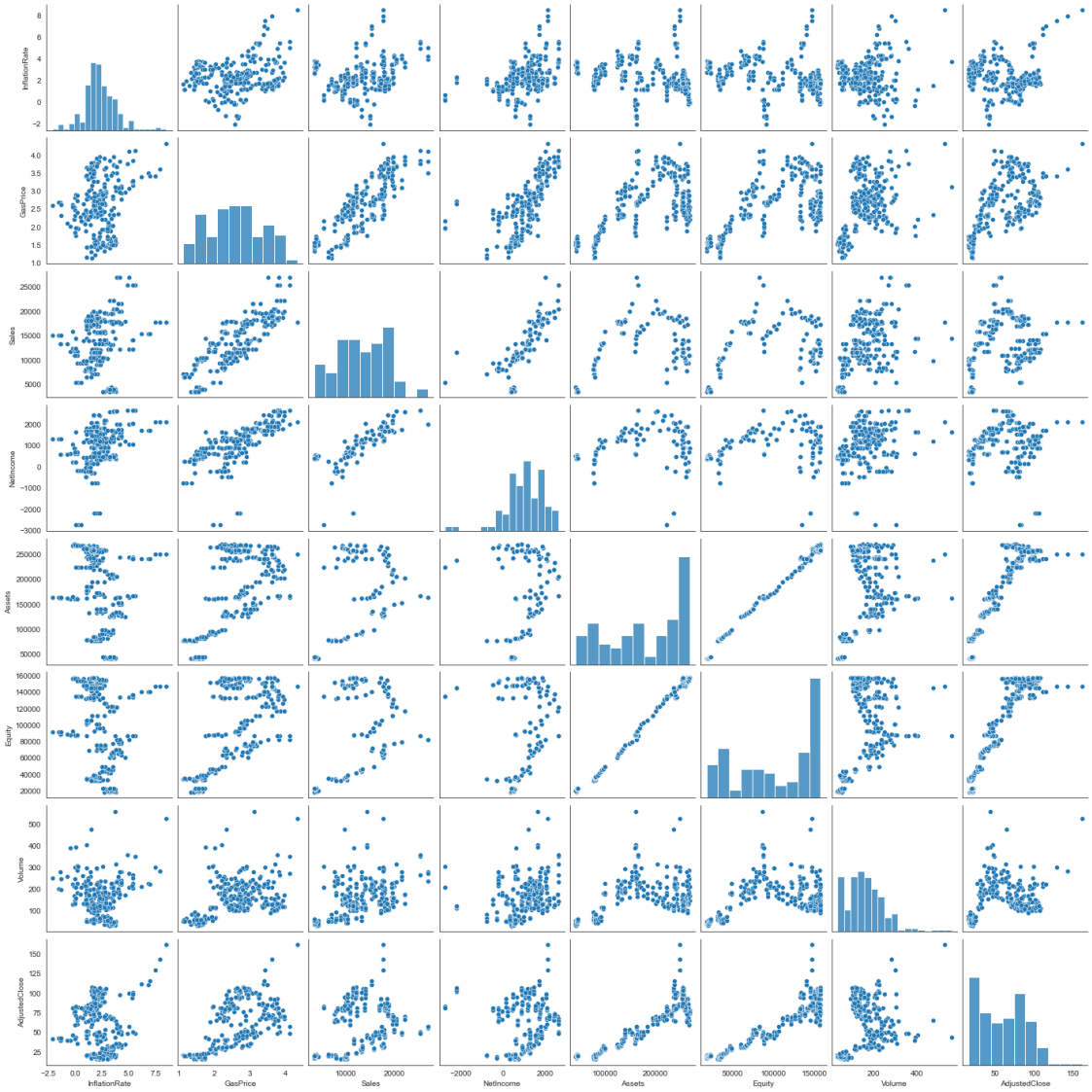
[ ]:
```
<seaborn.axisgrid.FacetGrid at 0x2c355a3a530>
```



The trend line shows that there is a positive correlation between inflation rate and chevson stock price change. When inflation rate increases, the adjusted close change increases. However, the correlation is very weak. When inflation rate is high, it doesn't necessarily mean the stock performance is good.

Pairplot

[ ]:
```
# create a column variable to store the columns that we want to retrieve
cols = ['InflationRate', 'GasPrice', 'Sales', 'NetIncome',␣
 ↪'Assets','Equity','Volume','AdjustedClose']

# create a pairplot to visualze the relationship between any two columns
sns.pairplot(df_merge[cols], height = 2.5)

# show the plot
plt.show()
```

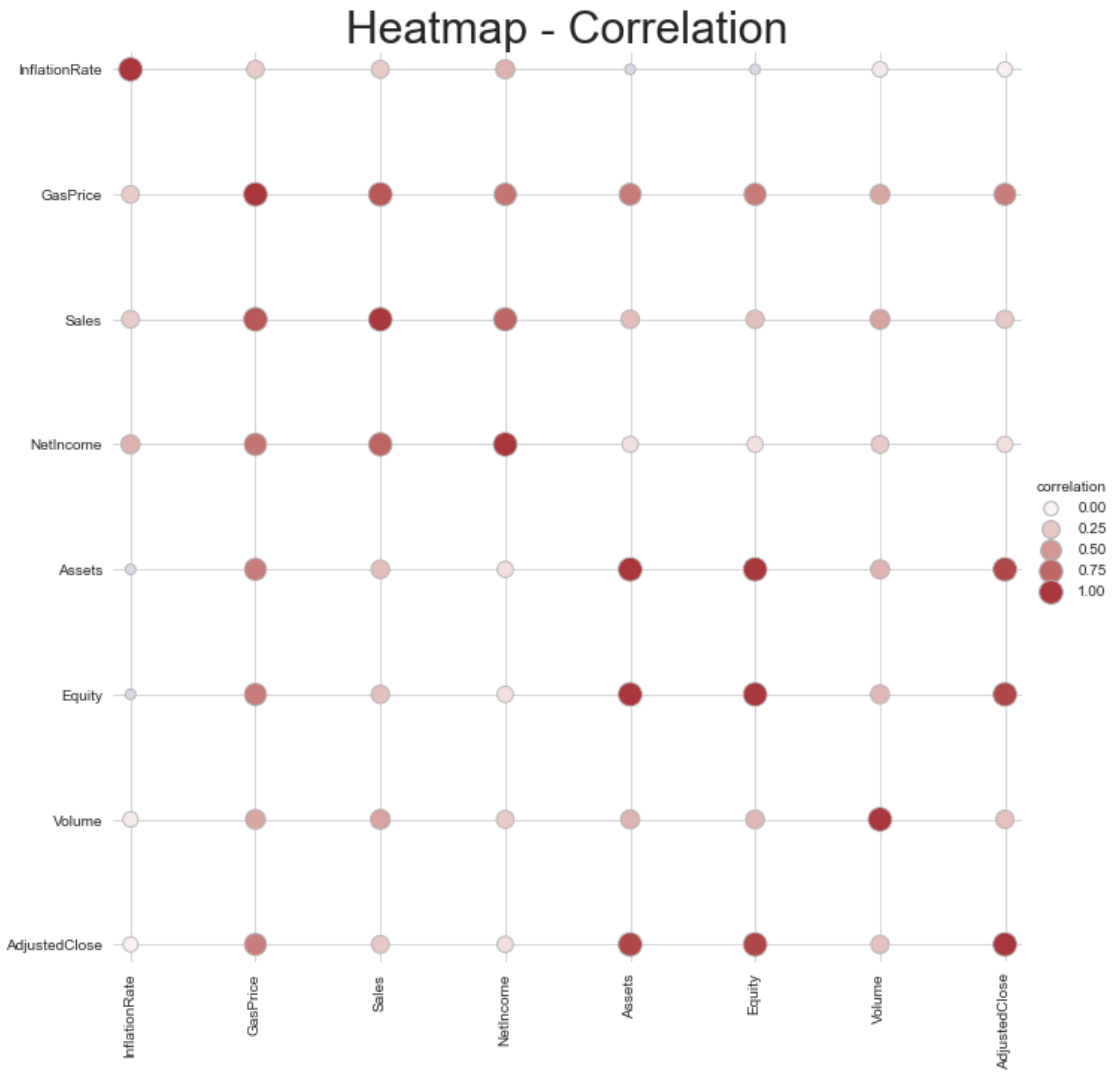


- The adjusted close has positive correlation with gas price, sales, net income, assets and equity.
- Let's draw a heatmap to see how strong they are correlated.

[ ]:
```
# plot a heatmap to explicitly show the correlation between any two features
# Compute a correlation matrix and convert to long-form
corr_mat = df_merge[cols].corr().stack().reset_index(name="correlation")
sns.set_style('whitegrid')
# Draw each cell as a scatter point with varying size and color
g = sns.relplot(data=corr_mat,x="level_0", y="level_1", hue="correlation",␣
 ↪size="correlation",palette="vlag", hue_norm=(-1, 1), edgecolor=".
 ↪7",height=10, sizes=(50, 250), size_norm=(-.2, .8),)

# Tweak the figure to finalize
```

```
g.set(xlabel="", ylabel="", aspect="equal")
g.despine(left=True, bottom=True)
g.ax.margins(.02)
for label in g.ax.get_xticklabels():
    label.set_rotation(90)
for artist in g.legend.legendHandles:
    artist.set_edgecolor(".7")
plt.title('Heatmap - Correlation', fontsize=30)
```

[ ]: Text(0.5, 1.0, 'Heatmap - Correlation')



- The Chevron sales has a strong correlation with gas price.
- The adjusted close has moderate to strong correlation with gas price, assets, and equity.

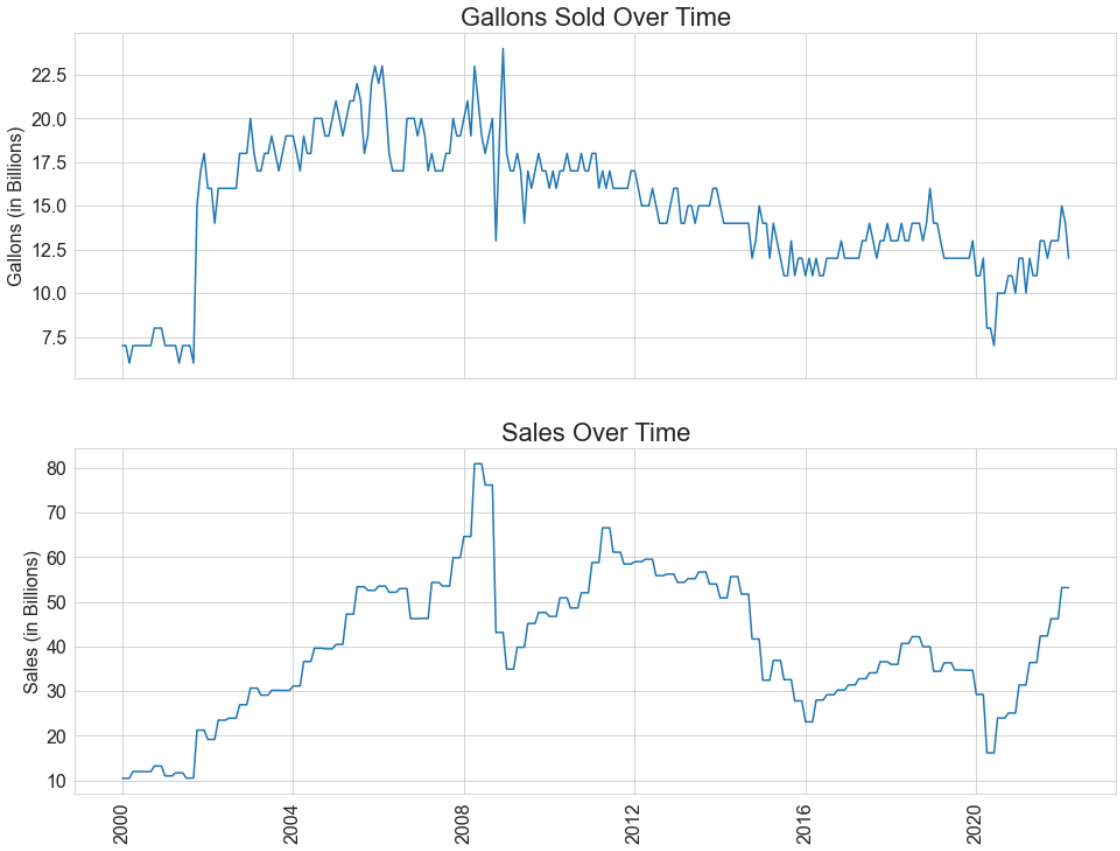
[ ]:
```
df_merge.head()
```

[ ]:
```
   Year  Month  InflationRate  GasPrice    Sales  NetIncome   Assets   Equity  \
0  2000      1            2.7     1.329  3481.00      348.0  41250.0  18010.0
1  2000      2            3.2     1.415  3481.00      348.0  41250.0  18010.0
2  2000      3            3.8     1.556  3481.00      348.0  41250.0  18010.0
3  2000      4            3.1     1.506  3987.33      372.0  41380.0  18750.0
4  2000      5            3.2     1.526  3987.33      372.0  41380.0  18750.0

    Volume  AdjustedClose       Date  AdjustedCloseChange
0  37.6875        18.2953 2000-01-01                  NaN
1  42.9618        16.4760 2000-02-01            -9.944084
2  51.1761        20.3915 2000-03-01            23.764870
3  31.5026        18.7790 2000-04-01            -7.907707
4  30.6928        20.5234 2000-05-01             9.289100
```

[ ]:
```
# create gallons Sold
df_merge['RegSales'] = (df_merge.Sales * 3) / 1000
df_merge['GallonsSold'] = (df_merge.RegSales/df_merge.GasPrice)
df_merge.GallonsSold = df_merge.GallonsSold.astype(int)
df_merge['DateYM'] = pd.to_datetime(df_merge.Date).dt.to_period('M')
df_merge.head(1)
```

[ ]:
```
   Year  Month  InflationRate  GasPrice   Sales  NetIncome   Assets   Equity  \
0  2000      1            2.7     1.329  3481.0      348.0  41250.0  18010.0

    Volume  AdjustedClose       Date  AdjustedCloseChange  RegSales  \
0  37.6875        18.2953 2000-01-01                  NaN    10.443

   GallonsSold   DateYM
0            7  2000-01
```

[ ]:
```
fig, (axes1,axes2) = plt.subplots(2,1,figsize=(16,12),sharex=True)
# plt.tick_params(axis='both', which='major', labelsize=22)
plt.subplot(2,1,1)
# plt.subplots_adjust(wspace=.9,hspace=2)
axes1.plot(df_merge.Date, df_merge.GallonsSold)
axes1.set_title('Gallons Sold Over Time',fontsize=22)
axes1.set_ylabel('Gallons (in Billions)', fontsize = 16)
axes1.tick_params(axis='both', which='both',labelsize=16)

axes2.plot(df_merge.Date, df_merge.RegSales)
axes2.set_title('Sales Over Time',fontsize=22)
axes2.set_ylabel('Sales (in Billions)', fontsize = 16)
axes2.tick_params(axis='both', which='both',labelsize=16)
axes2.tick_params(axis='x', labelrotation=90)
```



The Gallons of Gas is declining slowly, in the recent price hike, the consumption of gallons of gas decreased.

0.4 Machine Learning

0.4.1 Build Linear Regression Model to Predict Stock Price

[ ]:
```
# Build linear regression model using gas price, assets and equity as predictors
# Split data into predictors X and output y
predictors = ['GasPrice','Equity']
X = df_merge[predictors]
y = df_merge['AdjustedClose']
```

[ ]:
```
# split the dataset into training and testing data to verify the model
# test_size indicates the % of data placed in the test split

# since this is times series, we should not shuffle it, and not set random state
X_train_reg, X_test_reg, y_train_reg, y_test_reg = train_test_split(X, y,␣
 ↪test_size=0.3, shuffle = False)
```

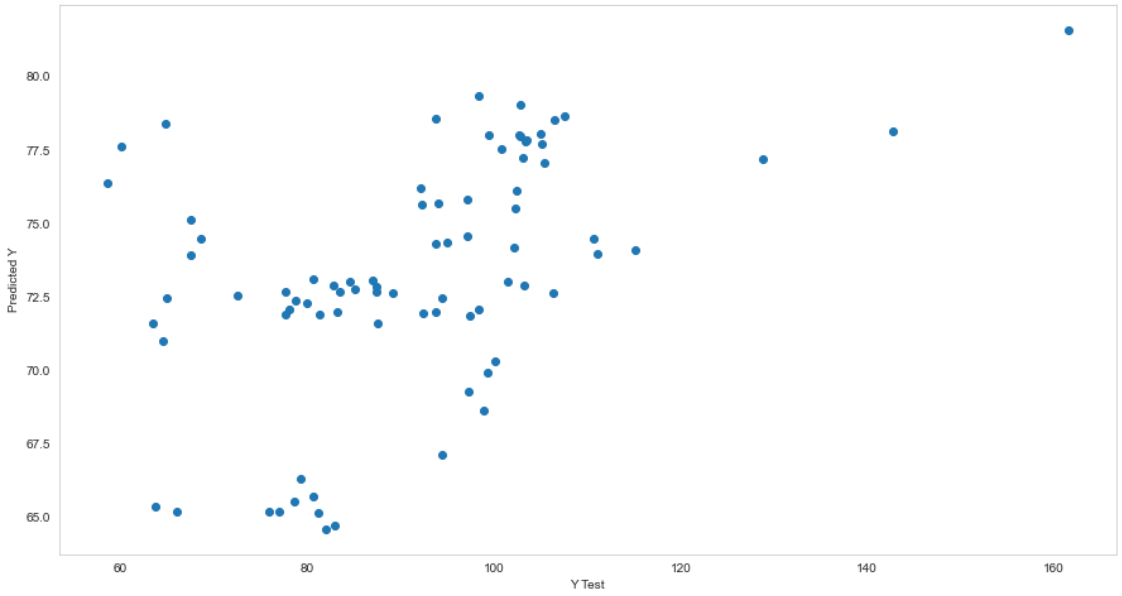
[ ]:
```
# Initialize and fit model
lm = LinearRegression()
# train the linear regression model using the training data
lm.fit(X_train_reg, y_train_reg)
```

[ ]:
```
LinearRegression()
```

[ ]:
```
# use lm.predict() to predict off the X_test set of the data
y_pred_reg = lm.predict(X_test_reg)
y_pred_reg
```

[ ]:
```
array([78.38128086, 77.63488183, 76.35534064, 75.11492836, 74.4993915 ,
       73.93716885, 72.48460232, 71.58795413, 72.55245678, 71.90779377,
       72.65903954, 73.12432725, 72.37047565, 72.07482408, 72.2832342 ,
       71.91218635, 71.60199455, 71.94611358, 72.84971659, 72.64615322,
       72.7479349 , 73.01788522, 72.89671654, 72.68830642, 72.68779082,
       73.07553058, 74.36961201, 74.29420784, 74.57047242, 74.16334567,
       75.49900327, 75.66379267, 75.68317965, 77.25229021, 77.80481937,
       77.72242467, 78.0706706 , 78.00281614, 78.00766289, 78.55829818,
       77.55502156, 76.20277916, 75.83134066, 76.09791174, 77.07210788,
       79.03204392, 79.34708248, 78.65884441, 78.51138748, 77.94916483,
       77.82314941, 73.03533268, 72.88508352, 72.65243967, 72.4804912 ,
       71.98127626, 70.99253988, 64.59743558, 64.70891076, 65.72188088,
       65.21101507, 65.21101507, 65.22070856, 65.38984695, 65.1572031 ,
       65.56432984, 66.30903926, 67.118446  , 68.6257843 , 69.28732562,
       69.90770923, 70.30029573, 71.86095821, 71.97728014, 72.05967484,
       73.97989495, 74.49849688, 74.08652339, 77.18320612, 78.14286201,
       81.5888991 ])
```

[ ]:
```
#create a scatterplot of the real test values versus the predicted values
plt.figure(figsize=(15, 8))
plt.scatter(x=y_test_reg, y=y_pred_reg)
plt.xlabel('Y Test')
plt.ylabel('Predicted Y')
plt.grid()
```



Evaluate the model

[ ]:
```
#calculate the Mean Absolute Error, Mean Squared Error, and the Root Mean␣
↪Squared Error
print('MAE:', metrics.mean_absolute_error(y_test_reg, y_pred_reg))
print('MSE:', metrics.mean_squared_error(y_test_reg, y_pred_reg))
print('RMSE:', np.sqrt(metrics.mean_squared_error(y_test_reg, y_pred_reg)))
```

```
MAE: 20.23129392880364
MSE: 574.0950527206932
RMSE: 23.960280731257996
R2 Score: -0.8974622732747306
```

Deep Learning

[ ]:
```
# load final df
dfmerge3 = pd.read_csv('data/df_final_merge.csv',index_col=0)

dffinal = dfmerge3
dffinal.head()
```

[ ]:

	Year	Month	InflationRate	GasPrice	Sales	NetIncome	Assets	Equity	\
0	2000	1	2.7	1.329	3481.00	348.0	41250.0	18010.0	
1	2000	2	3.2	1.415	3481.00	348.0	41250.0	18010.0	
2	2000	3	3.8	1.556	3481.00	348.0	41250.0	18010.0	
3	2000	4	3.1	1.506	3987.33	372.0	41380.0	18750.0	
4	2000	5	3.2	1.526	3987.33	372.0	41380.0	18750.0	

	Volume	AdjustedClose

```
0  37.6875        18.2953
1  42.9618        16.4760
2  51.1761        20.3915
3  31.5026        18.7790
4  30.6928        20.5234
```

[ ]:
```
############################## MANUAL Train Test Split␣
 ↪##############################
# Since this is Time Series, we need split manually
# calculate train_size and test_size
train_size = int(len(dffinal)*0.8)
test_size = len(dffinal)-train_size

# split df
traindf, testdf = dffinal.iloc[0:train_size], dffinal.iloc[train_size:]

# columns needed
featureColumns = ['NetIncome','Equity','GasPrice']
targetColumns = ['AdjustedClose']

# Since data has wide range, apply Standard Scale
# X Scaler
featureScaler = StandardScaler()
X_train = traindf[featureColumns] = featureScaler.
 ↪fit_transform(traindf[featureColumns].to_numpy())
X_test = testdf[featureColumns] = featureScaler.
 ↪transform(testdf[featureColumns].to_numpy())

# y Scaler
targetScaler = StandardScaler()
y_train = traindf[targetColumns] = targetScaler.
 ↪fit_transform(traindf[targetColumns])
y_test = testdf[targetColumns] = targetScaler.transform(testdf[targetColumns])
```

[ ]:
```
# saving to pickle file
with open('output/featureScaler.pickle', 'wb') as handle1:
    pickle.dump(featureScaler, handle1, protocol=pickle.HIGHEST_PROTOCOL)

with open('output/targetScaler.pickle', 'wb') as handle2:
    pickle.dump(targetScaler, handle2, protocol=pickle.HIGHEST_PROTOCOL)
```

[ ]:
```
# Convert dimension for LSTM
Xt, yt = convSeq(traindf[featureColumns], traindf[targetColumns],6)

Xv, yv = convSeq(testdf[featureColumns], testdf[targetColumns] ,6)

print(X_train.shape)
```

```
print(Xt.shape)
```

```
(213, 3)
(207, 6, 3)
```

0.4.2 Machine Learning

[ ]:
```
linear = LinearRegression()
ridge = Ridge()
randomForest = RandomForestRegressor()
xgb = XGBRegressor()
```

[ ]:
```
# ml
runML(linear,X_train,y_train,X_test,y_test)
runML(ridge,X_train,y_train,X_test,y_test)
runML(randomForest,X_train,y_train,X_test,y_test)
runML(xgb,X_train,y_train,X_test,y_test)
```

```
LinearRegression()
MAE score: 0.9271496729554565
MSE score: 1.151998081648884
R2 score: -1.5612892097385478

Ridge()
MAE score: 0.9319955936396292
MSE score: 1.1614463406598476
R2 score: -1.5822959494554736

RandomForestRegressor()
MAE score: 0.8899420312477238
MSE score: 1.0565876440111095
R2 score: -1.3491588873787341

XGBRegressor(base_score=0.5, booster='gbtree', callbacks=None,
             colsample_bylevel=1, colsample_bynode=1, colsample_bytree=1,
             early_stopping_rounds=None, enable_categorical=False,
             eval_metric=None, gamma=0, gpu_id=-1, grow_policy='depthwise',
             importance_type=None, interaction_constraints='',
             learning_rate=0.300000012, max_bin=256, max_cat_to_onehot=4,
             max_delta_step=0, max_depth=6, max_leaves=0, min_child_weight=1,
             missing=nan, monotone_constraints='()', n_estimators=100, n_jobs=0,
             num_parallel_tree=1, predictor='auto', random_state=0, reg_alpha=0,
             reg_lambda=1, …)
MAE score: 0.872378366008754
MSE score: 1.013667332343835
R2 score: -1.253732225734769
```

0.4.3 Deep Learning

ANN

[ ]:
```
# since ANN takes two dimension, we use X_train
# Features and optimizers
optimizer = 'rmsprop'

# Model
ann = Sequential()

# Hidden layer 1
ann.add(Flatten(input_shape= (traindf[featureColumns].shape[1], 1)))
ann.add(Dense(16))
ann.add(LeakyReLU(alpha=0.05))

# Hidden layer 2
ann.add(Dense(4))
ann.add(LeakyReLU(alpha=0.05))

# output layer
ann.add(Dense(1))

### compile the model using: optimizer = 'adam', loss = 'binary_crossentropy',␣
 ↪metrics = ['accuracy']
ann.compile(loss='mse', optimizer=optimizer, metrics=['mse','mae'])

# model summary
ann.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 flatten (Flatten)           (None, 3)                 0

 dense (Dense)               (None, 16)                64

 leaky_re_lu (LeakyReLU)     (None, 16)                0

 dense_1 (Dense)             (None, 4)                 68

 leaky_re_lu_1 (LeakyReLU)   (None, 4)                 0

 dense_2 (Dense)             (None, 1)                 5

=================================================================
Total params: 137
Trainable params: 137
```

```
Non-trainable params: 0
_________________________________________________________________
```

```
[ ]: history = ann.fit(traindf[featureColumns], traindf[targetColumns], epochs=50,␣
     ↪batch_size=2, validation_data=(testdf[featureColumns],␣
     ↪testdf[targetColumns]),verbose=1)
```

```
Epoch 1/50
107/107 [==============================] - 1s 3ms/step - loss: 0.5889 - mse:
0.5889 - mae: 0.6029 - val_loss: 4.2499 - val_mse: 4.2499 - val_mae: 1.9328
Epoch 2/50
107/107 [==============================] - 0s 1ms/step - loss: 0.3793 - mse:
0.3793 - mae: 0.4509 - val_loss: 3.5887 - val_mse: 3.5887 - val_mae: 1.7282
Epoch 3/50
107/107 [==============================] - 0s 1ms/step - loss: 0.3158 - mse:
0.3158 - mae: 0.4115 - val_loss: 3.2739 - val_mse: 3.2739 - val_mae: 1.6353
Epoch 4/50
107/107 [==============================] - 0s 1ms/step - loss: 0.2731 - mse:
0.2731 - mae: 0.3863 - val_loss: 3.2231 - val_mse: 3.2231 - val_mae: 1.6424
Epoch 5/50
107/107 [==============================] - 0s 2ms/step - loss: 0.2428 - mse:
0.2428 - mae: 0.3679 - val_loss: 2.7911 - val_mse: 2.7911 - val_mae: 1.4978
Epoch 6/50
107/107 [==============================] - 0s 1ms/step - loss: 0.2089 - mse:
0.2089 - mae: 0.3459 - val_loss: 2.4485 - val_mse: 2.4485 - val_mae: 1.4100
Epoch 7/50
107/107 [==============================] - 0s 1ms/step - loss: 0.1354 - mse:
0.1354 - mae: 0.2856 - val_loss: 1.8600 - val_mse: 1.8600 - val_mae: 1.2267
Epoch 8/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0919 - mse:
0.0919 - mae: 0.2440 - val_loss: 1.6994 - val_mse: 1.6994 - val_mae: 1.1745
Epoch 9/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0735 - mse:
0.0735 - mae: 0.2190 - val_loss: 1.7085 - val_mse: 1.7085 - val_mae: 1.1893
Epoch 10/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0621 - mse:
0.0621 - mae: 0.1956 - val_loss: 1.5284 - val_mse: 1.5284 - val_mae: 1.1146
Epoch 11/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0564 - mse:
0.0564 - mae: 0.1885 - val_loss: 1.5182 - val_mse: 1.5182 - val_mae: 1.1190
Epoch 12/50
107/107 [==============================] - 0s 2ms/step - loss: 0.0525 - mse:
0.0525 - mae: 0.1745 - val_loss: 1.4908 - val_mse: 1.4908 - val_mae: 1.1044
Epoch 13/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0506 - mse:
0.0506 - mae: 0.1744 - val_loss: 1.6493 - val_mse: 1.6493 - val_mae: 1.1680
Epoch 14/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0517 - mse:
```

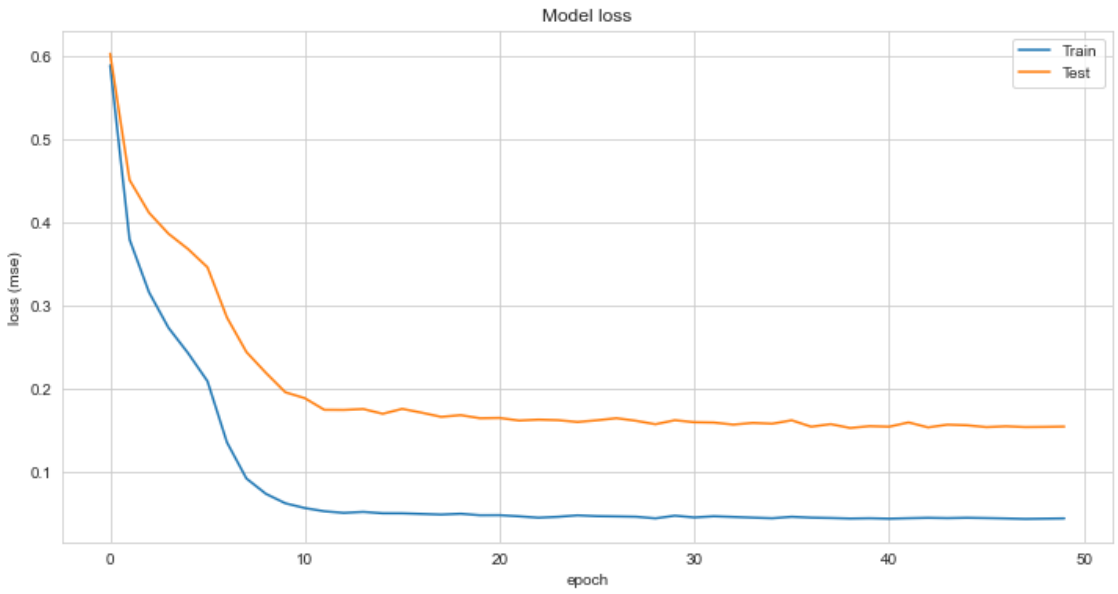
```
0.0517 - mae: 0.1754 - val_loss: 1.5501 - val_mse: 1.5501 - val_mae: 1.1319
Epoch 15/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0501 - mse:
0.0501 - mae: 0.1697 - val_loss: 1.4423 - val_mse: 1.4423 - val_mae: 1.0865
Epoch 16/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0500 - mse:
0.0500 - mae: 0.1757 - val_loss: 1.3389 - val_mse: 1.3389 - val_mae: 1.0461
Epoch 17/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0493 - mse:
0.0493 - mae: 0.1711 - val_loss: 1.4864 - val_mse: 1.4864 - val_mae: 1.1072
Epoch 18/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0485 - mse:
0.0485 - mae: 0.1660 - val_loss: 1.5620 - val_mse: 1.5620 - val_mae: 1.1370
Epoch 19/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0495 - mse:
0.0495 - mae: 0.1681 - val_loss: 1.4044 - val_mse: 1.4044 - val_mae: 1.0727
Epoch 20/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0477 - mse:
0.0477 - mae: 0.1644 - val_loss: 1.3542 - val_mse: 1.3542 - val_mae: 1.0505
Epoch 21/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0478 - mse:
0.0478 - mae: 0.1647 - val_loss: 1.4882 - val_mse: 1.4882 - val_mae: 1.1061
Epoch 22/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0464 - mse:
0.0464 - mae: 0.1616 - val_loss: 1.5195 - val_mse: 1.5195 - val_mae: 1.1210
Epoch 23/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0447 - mse:
0.0447 - mae: 0.1627 - val_loss: 1.5392 - val_mse: 1.5392 - val_mae: 1.1324
Epoch 24/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0458 - mse:
0.0458 - mae: 0.1620 - val_loss: 1.4795 - val_mse: 1.4795 - val_mae: 1.1111
Epoch 25/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0476 - mse:
0.0476 - mae: 0.1599 - val_loss: 1.3286 - val_mse: 1.3286 - val_mae: 1.0361
Epoch 26/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0466 - mse:
0.0466 - mae: 0.1619 - val_loss: 1.2798 - val_mse: 1.2798 - val_mae: 1.0208
Epoch 27/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0463 - mse:
0.0463 - mae: 0.1644 - val_loss: 1.3441 - val_mse: 1.3441 - val_mae: 1.0447
Epoch 28/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0459 - mse:
0.0459 - mae: 0.1613 - val_loss: 1.3460 - val_mse: 1.3460 - val_mae: 1.0467
Epoch 29/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0440 - mse:
0.0440 - mae: 0.1572 - val_loss: 1.2290 - val_mse: 1.2290 - val_mae: 0.9923
Epoch 30/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0472 - mse:
```

```
0.0472 - mae: 0.1620 - val_loss: 1.2552 - val_mse: 1.2552 - val_mae: 1.0120
Epoch 31/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0451 - mse:
0.0451 - mae: 0.1596 - val_loss: 1.4233 - val_mse: 1.4233 - val_mae: 1.0807
Epoch 32/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0465 - mse:
0.0465 - mae: 0.1592 - val_loss: 1.2939 - val_mse: 1.2939 - val_mae: 1.0249
Epoch 33/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0457 - mse:
0.0457 - mae: 0.1567 - val_loss: 1.2935 - val_mse: 1.2935 - val_mae: 1.0282
Epoch 34/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0448 - mse:
0.0448 - mae: 0.1588 - val_loss: 1.2916 - val_mse: 1.2916 - val_mae: 1.0181
Epoch 35/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0441 - mse:
0.0441 - mae: 0.1578 - val_loss: 1.3041 - val_mse: 1.3041 - val_mae: 1.0275
Epoch 36/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0459 - mse:
0.0459 - mae: 0.1619 - val_loss: 1.1992 - val_mse: 1.1992 - val_mae: 0.9807
Epoch 37/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0448 - mse:
0.0448 - mae: 0.1542 - val_loss: 1.3608 - val_mse: 1.3608 - val_mae: 1.0526
Epoch 38/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0444 - mse:
0.0444 - mae: 0.1573 - val_loss: 1.2112 - val_mse: 1.2112 - val_mae: 0.9799
Epoch 39/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0437 - mse:
0.0437 - mae: 0.1527 - val_loss: 1.4048 - val_mse: 1.4048 - val_mae: 1.0688
Epoch 40/50
107/107 [==============================] - 0s 2ms/step - loss: 0.0441 - mse:
0.0441 - mae: 0.1548 - val_loss: 1.1587 - val_mse: 1.1587 - val_mae: 0.9609
Epoch 41/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0436 - mse:
0.0436 - mae: 0.1542 - val_loss: 1.2667 - val_mse: 1.2667 - val_mae: 1.0101
Epoch 42/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0441 - mse:
0.0441 - mae: 0.1594 - val_loss: 1.1882 - val_mse: 1.1882 - val_mae: 0.9701
Epoch 43/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0446 - mse:
0.0446 - mae: 0.1534 - val_loss: 1.3091 - val_mse: 1.3091 - val_mae: 1.0274
Epoch 44/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0442 - mse:
0.0442 - mae: 0.1567 - val_loss: 1.3553 - val_mse: 1.3553 - val_mae: 1.0496
Epoch 45/50
107/107 [==============================] - 0s 2ms/step - loss: 0.0447 - mse:
0.0447 - mae: 0.1559 - val_loss: 1.2805 - val_mse: 1.2805 - val_mae: 1.0113
Epoch 46/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0443 - mse:
```

```
0.0443 - mae: 0.1537 - val_loss: 1.2677 - val_mse: 1.2677 - val_mae: 1.0082
Epoch 47/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0438 - mse:
0.0438 - mae: 0.1547 - val_loss: 1.1835 - val_mse: 1.1835 - val_mae: 0.9668
Epoch 48/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0433 - mse:
0.0433 - mae: 0.1537 - val_loss: 1.1756 - val_mse: 1.1756 - val_mae: 0.9602
Epoch 49/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0436 - mse:
0.0436 - mae: 0.1540 - val_loss: 1.4416 - val_mse: 1.4416 - val_mae: 1.0867
Epoch 50/50
107/107 [==============================] - 0s 1ms/step - loss: 0.0439 - mse:
0.0439 - mae: 0.1543 - val_loss: 1.1918 - val_mse: 1.1918 - val_mae: 0.9749
```

[ ]:
```
plt.figure(figsize=(12,6))
plt.plot(ann.history.history['loss'][:])
plt.plot(ann.history.history['mae'][:])
plt.title('Model loss')
plt.xlabel('epoch')
plt.ylabel('loss (mse)')
plt.legend(['Train', 'Test'], loc='upper right')
```

[ ]:
```
<matplotlib.legend.Legend at 0x2c35d7e8a00>
```



[ ]:
```
# NN - this model takes in 3 dimension
inputs = Input(shape=(Xt.shape[1], Xt.shape[2]))
x = Flatten()(inputs)
x = Dense(16, activation=LeakyReLU(alpha=0.05))(x)
```

```
outputs = Dense(1)(x)
model = Model(inputs, outputs)

model.summary()

model.compile(optimizer=optimizer, loss="mse", metrics=['mse',"mae"])
history = model.fit(Xt, yt, epochs=50)
```

```
Model: "model"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_1 (InputLayer)        [(None, 6, 3)]            0

 flatten_1 (Flatten)         (None, 18)                0

 dense_3 (Dense)             (None, 16)                304

 dense_4 (Dense)             (None, 1)                 17

=================================================================
Total params: 321
Trainable params: 321
Non-trainable params: 0
_________________________________________________________________
Epoch 1/50
7/7 [==============================] - 0s 1ms/step - loss: 0.6585 - mse: 0.6585
- mae: 0.6286
Epoch 2/50
7/7 [==============================] - 0s 1000us/step - loss: 0.3245 - mse:
0.3245 - mae: 0.4267
Epoch 3/50
7/7 [==============================] - 0s 2ms/step - loss: 0.1996 - mse: 0.1996
- mae: 0.3349
Epoch 4/50
7/7 [==============================] - 0s 1ms/step - loss: 0.1397 - mse: 0.1397
- mae: 0.2832
Epoch 5/50
7/7 [==============================] - 0s 1ms/step - loss: 0.1119 - mse: 0.1119
- mae: 0.2604
Epoch 6/50
7/7 [==============================] - 0s 1ms/step - loss: 0.1018 - mse: 0.1018
- mae: 0.2526
Epoch 7/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0965 - mse: 0.0965
- mae: 0.2463
Epoch 8/50
7/7 [==============================] - 0s 2ms/step - loss: 0.0941 - mse: 0.0941
```

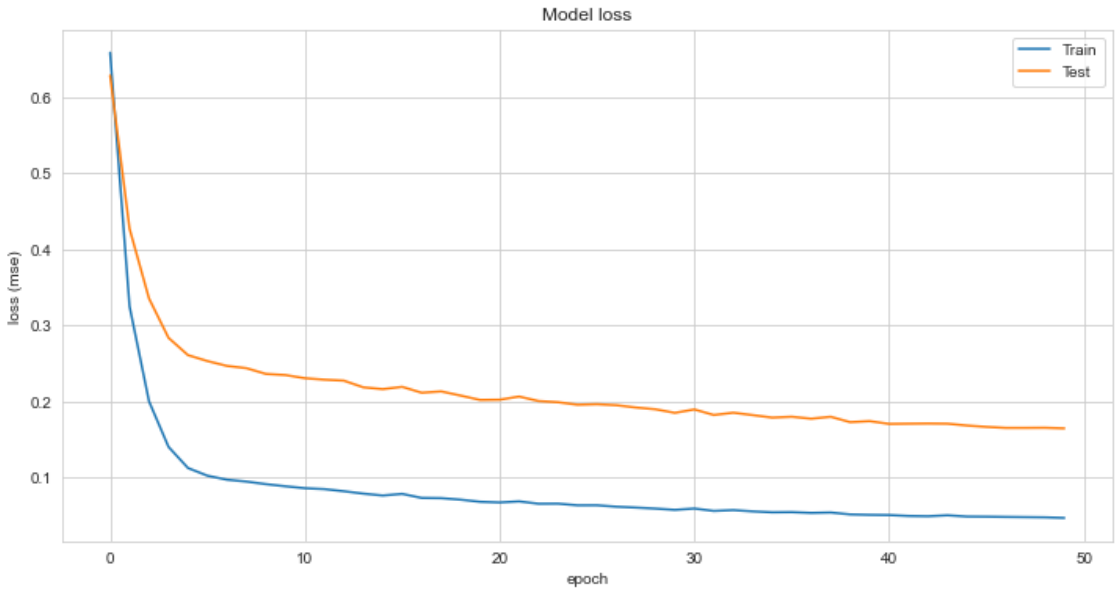
```
- mae: 0.2433
Epoch 9/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0907 - mse: 0.0907
- mae: 0.2357
Epoch 10/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0879 - mse: 0.0879
- mae: 0.2342
Epoch 11/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0853 - mse: 0.0853
- mae: 0.2301
Epoch 12/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0841 - mse: 0.0841
- mae: 0.2282
Epoch 13/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0813 - mse: 0.0813
- mae: 0.2269
Epoch 14/50
7/7 [==============================] - 0s 999us/step - loss: 0.0782 - mse:
0.0782 - mae: 0.2181
Epoch 15/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0757 - mse: 0.0757
- mae: 0.2157
Epoch 16/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0779 - mse: 0.0779
- mae: 0.2187
Epoch 17/50
7/7 [==============================] - 0s 999us/step - loss: 0.0725 - mse:
0.0725 - mae: 0.2110
Epoch 18/50
7/7 [==============================] - 0s 999us/step - loss: 0.0722 - mse:
0.0722 - mae: 0.2127
Epoch 19/50
7/7 [==============================] - 0s 999us/step - loss: 0.0702 - mse:
0.0702 - mae: 0.2072
Epoch 20/50
7/7 [==============================] - 0s 2ms/step - loss: 0.0674 - mse: 0.0674
- mae: 0.2015
Epoch 21/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0666 - mse: 0.0666
- mae: 0.2018
Epoch 22/50
7/7 [==============================] - 0s 999us/step - loss: 0.0680 - mse:
0.0680 - mae: 0.2060
Epoch 23/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0649 - mse: 0.0649
- mae: 0.2001
Epoch 24/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0650 - mse: 0.0650
```

```
- mae: 0.1985
Epoch 25/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0628 - mse: 0.0628
- mae: 0.1952
Epoch 26/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0629 - mse: 0.0629
- mae: 0.1958
Epoch 27/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0610 - mse: 0.0610
- mae: 0.1945
Epoch 28/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0598 - mse: 0.0598
- mae: 0.1915
Epoch 29/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0585 - mse: 0.0585
- mae: 0.1892
Epoch 30/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0568 - mse: 0.0568
- mae: 0.1845
Epoch 31/50
7/7 [==============================] - 0s 999us/step - loss: 0.0586 - mse:
0.0586 - mae: 0.1890
Epoch 32/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0554 - mse: 0.0554
- mae: 0.1817
Epoch 33/50
7/7 [==============================] - 0s 999us/step - loss: 0.0565 - mse:
0.0565 - mae: 0.1847
Epoch 34/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0548 - mse: 0.0548
- mae: 0.1815
Epoch 35/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0536 - mse: 0.0536
- mae: 0.1782
Epoch 36/50
7/7 [==============================] - 0s 999us/step - loss: 0.0538 - mse:
0.0538 - mae: 0.1794
Epoch 37/50
7/7 [==============================] - 0s 999us/step - loss: 0.0528 - mse:
0.0528 - mae: 0.1768
Epoch 38/50
7/7 [==============================] - 0s 999us/step - loss: 0.0534 - mse:
0.0534 - mae: 0.1793
Epoch 39/50
7/7 [==============================] - 0s 2ms/step - loss: 0.0508 - mse: 0.0508
- mae: 0.1723
Epoch 40/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0503 - mse: 0.0503
```

```
- mae: 0.1736
Epoch 41/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0500 - mse: 0.0500
- mae: 0.1700
Epoch 42/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0488 - mse: 0.0488
- mae: 0.1702
Epoch 43/50
7/7 [==============================] - 0s 1000us/step - loss: 0.0484 - mse:
0.0484 - mae: 0.1705
Epoch 44/50
7/7 [==============================] - 0s 999us/step - loss: 0.0497 - mse:
0.0497 - mae: 0.1702
Epoch 45/50
7/7 [==============================] - 0s 1000us/step - loss: 0.0480 - mse:
0.0480 - mae: 0.1678
Epoch 46/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0479 - mse: 0.0479
- mae: 0.1660
Epoch 47/50
7/7 [==============================] - 0s 999us/step - loss: 0.0475 - mse:
0.0475 - mae: 0.1647
Epoch 48/50
7/7 [==============================] - 0s 999us/step - loss: 0.0473 - mse:
0.0473 - mae: 0.1647
Epoch 49/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0470 - mse: 0.0470
- mae: 0.1649
Epoch 50/50
7/7 [==============================] - 0s 1ms/step - loss: 0.0462 - mse: 0.0462
- mae: 0.1641
```

[ ]:
```
plt.figure(figsize=(12,6))
plt.plot(model.history.history['loss'][:])
plt.plot(model.history.history['mae'][:])
plt.title('Model loss')
plt.xlabel('epoch')
plt.ylabel('loss (mse)')
plt.legend(['Train', 'Test'], loc='upper right')
```

[ ]:
```
<matplotlib.legend.Legend at 0x2c35a169210>
```



[ ]:

LSTM

[ ]:
```
optimizer = 'adam'

# Model
lstm = Sequential()

# # Hideen layers
lstm.add(LSTM(units=16,activation = LeakyReLU(alpha=0.05), return_sequences =␣
 ↪True, input_shape= (Xt.shape[1], Xt.shape[2])))
lstm.add(LSTM(units=8,activation = LeakyReLU(alpha=0.05),input_shape= (Xt.
 ↪shape[1], 16)))
lstm.add(Dense(units=3, activation = LeakyReLU(alpha=0.05)))
lstm.add(Dense(units=1, activation = LeakyReLU(alpha=0.05)))

checkpoint = ModelCheckpoint('output/lstm.h5', monitor='mse',␣
 ↪save_best_only=True, verbose=1)

lstm.compile(optimizer=optimizer, loss='mse',metrics=['mse','mae'])
lstm.summary()
history = lstm.fit(Xt, yt, epochs=50, batch_size=2,verbose=1,␣
 ↪callbacks=checkpoint)
```

```
Model: "sequential_11"
_________________________________________________________________
 Layer (type)                 Output Shape              Param #
```

```
=================================================================
 lstm_17 (LSTM)              (None, 6, 16)             1280

 lstm_18 (LSTM)              (None, 8)                 800

 dense_30 (Dense)            (None, 3)                 27

 dense_31 (Dense)            (None, 1)                 4

=================================================================
Total params: 2,111
Trainable params: 2,111
Non-trainable params: 0
_________________________________________________________________
Epoch 1/50
 99/104 [===========================>..] - ETA: 0s - loss: 0.7397 - mse: 0.7397
- mae: 0.7351
Epoch 1: mse improved from inf to 0.73403, saving model to output\lstm.h5
104/104 [==============================] - 4s 5ms/step - loss: 0.7340 - mse:
0.7340 - mae: 0.7315
Epoch 2/50
100/104 [===========================>..] - ETA: 0s - loss: 0.4982 - mse: 0.4982
- mae: 0.5571
Epoch 2: mse improved from 0.73403 to 0.49121, saving model to output\lstm.h5
104/104 [==============================] - 0s 5ms/step - loss: 0.4912 - mse:
0.4912 - mae: 0.5482
Epoch 3/50
 96/104 [==========================>…] - ETA: 0s - loss: 0.4585 - mse: 0.4585
- mae: 0.5265
Epoch 3: mse improved from 0.49121 to 0.45987, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.4599 - mse:
0.4599 - mae: 0.5284
Epoch 4/50
 96/104 [==========================>…] - ETA: 0s - loss: 0.1698 - mse: 0.1698
- mae: 0.3142
Epoch 4: mse improved from 0.45987 to 0.16060, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.1606 - mse:
0.1606 - mae: 0.3043
Epoch 5/50
100/104 [===========================>..] - ETA: 0s - loss: 0.0810 - mse: 0.0810
- mae: 0.2196
Epoch 5: mse improved from 0.16060 to 0.08058, saving model to output\lstm.h5
104/104 [==============================] - 0s 5ms/step - loss: 0.0806 - mse:
0.0806 - mae: 0.2201
Epoch 6/50
 99/104 [===========================>..] - ETA: 0s - loss: 0.0715 - mse: 0.0715
- mae: 0.2046
Epoch 6: mse improved from 0.08058 to 0.07321, saving model to output\lstm.h5
```

```
104/104 [==============================] - 1s 5ms/step - loss: 0.0732 - mse:
0.0732 - mae: 0.2068
Epoch 7/50
 95/104 [==========================>...] - ETA: 0s - loss: 0.0676 - mse: 0.0676
- mae: 0.1977
Epoch 7: mse improved from 0.07321 to 0.06890, saving model to output\lstm.h5
104/104 [==============================] - 1s 6ms/step - loss: 0.0689 - mse:
0.0689 - mae: 0.2004
Epoch 8/50
 98/104 [===========================>..] - ETA: 0s - loss: 0.0703 - mse: 0.0703
- mae: 0.2032
Epoch 8: mse did not improve from 0.06890
104/104 [==============================] - 1s 5ms/step - loss: 0.0690 - mse:
0.0690 - mae: 0.2022
Epoch 9/50
104/104 [==============================] - ETA: 0s - loss: 0.0623 - mse: 0.0623
- mae: 0.1926
Epoch 9: mse improved from 0.06890 to 0.06225, saving model to output\lstm.h5
104/104 [==============================] - 1s 6ms/step - loss: 0.0623 - mse:
0.0623 - mae: 0.1926
Epoch 10/50
 97/104 [==========================>...] - ETA: 0s - loss: 0.0613 - mse: 0.0613
- mae: 0.1919
Epoch 10: mse improved from 0.06225 to 0.06023, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0602 - mse:
0.0602 - mae: 0.1901
Epoch 11/50
101/104 [============================>.] - ETA: 0s - loss: 0.0584 - mse: 0.0584
- mae: 0.1896
Epoch 11: mse improved from 0.06023 to 0.05758, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0576 - mse:
0.0576 - mae: 0.1873
Epoch 12/50
100/104 [===========================>..] - ETA: 0s - loss: 0.0570 - mse: 0.0570
- mae: 0.1829
Epoch 12: mse improved from 0.05758 to 0.05646, saving model to output\lstm.h5
104/104 [==============================] - 0s 5ms/step - loss: 0.0565 - mse:
0.0565 - mae: 0.1825
Epoch 13/50
103/104 [============================>.] - ETA: 0s - loss: 0.0551 - mse: 0.0551
- mae: 0.1819
Epoch 13: mse improved from 0.05646 to 0.05486, saving model to output\lstm.h5
104/104 [==============================] - 0s 5ms/step - loss: 0.0549 - mse:
0.0549 - mae: 0.1814
Epoch 14/50
 97/104 [==========================>...] - ETA: 0s - loss: 0.0554 - mse: 0.0554
- mae: 0.1799
Epoch 14: mse improved from 0.05486 to 0.05392, saving model to output\lstm.h5
```

```
104/104 [==============================] - 1s 5ms/step - loss: 0.0539 - mse:
0.0539 - mae: 0.1783
Epoch 15/50
100/104 [===========================>..] - ETA: 0s - loss: 0.0558 - mse: 0.0558
- mae: 0.1804
Epoch 15: mse did not improve from 0.05392
104/104 [==============================] - 1s 5ms/step - loss: 0.0546 - mse:
0.0546 - mae: 0.1782
Epoch 16/50
100/104 [===========================>..] - ETA: 0s - loss: 0.0504 - mse: 0.0504
- mae: 0.1755
Epoch 16: mse improved from 0.05392 to 0.05069, saving model to output\lstm.h5
104/104 [==============================] - 1s 6ms/step - loss: 0.0507 - mse:
0.0507 - mae: 0.1767
Epoch 17/50
 99/104 [===========================>..] - ETA: 0s - loss: 0.0529 - mse: 0.0529
- mae: 0.1813
Epoch 17: mse did not improve from 0.05069
104/104 [==============================] - 1s 5ms/step - loss: 0.0519 - mse:
0.0519 - mae: 0.1791
Epoch 18/50
102/104 [============================>.] - ETA: 0s - loss: 0.0496 - mse: 0.0496
- mae: 0.1733
Epoch 18: mse improved from 0.05069 to 0.04976, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0498 - mse:
0.0498 - mae: 0.1740
Epoch 19/50
 96/104 [==========================>…] - ETA: 0s - loss: 0.0479 - mse: 0.0479
- mae: 0.1701
Epoch 19: mse improved from 0.04976 to 0.04626, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0463 - mse:
0.0463 - mae: 0.1670
Epoch 20/50
 96/104 [==========================>…] - ETA: 0s - loss: 0.0505 - mse: 0.0505
- mae: 0.1739
Epoch 20: mse did not improve from 0.04626
104/104 [==============================] - 0s 4ms/step - loss: 0.0489 - mse:
0.0489 - mae: 0.1714
Epoch 21/50
 95/104 [==========================>…] - ETA: 0s - loss: 0.0481 - mse: 0.0481
- mae: 0.1701
Epoch 21: mse improved from 0.04626 to 0.04567, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0457 - mse:
0.0457 - mae: 0.1649
Epoch 22/50
 97/104 [==========================>…] - ETA: 0s - loss: 0.0465 - mse: 0.0465
- mae: 0.1628
Epoch 22: mse improved from 0.04567 to 0.04530, saving model to output\lstm.h5
```

```
104/104 [==============================] - 1s 5ms/step - loss: 0.0453 - mse:
0.0453 - mae: 0.1615
Epoch 23/50
 96/104 [========================>...] - ETA: 0s - loss: 0.0425 - mse: 0.0425
- mae: 0.1550
Epoch 23: mse improved from 0.04530 to 0.04337, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0434 - mse:
0.0434 - mae: 0.1583
Epoch 24/50
104/104 [==============================] - ETA: 0s - loss: 0.0468 - mse: 0.0468
- mae: 0.1655
Epoch 24: mse did not improve from 0.04337
104/104 [==============================] - 0s 5ms/step - loss: 0.0468 - mse:
0.0468 - mae: 0.1655
Epoch 25/50
103/104 [============================>.] - ETA: 0s - loss: 0.0429 - mse: 0.0429
- mae: 0.1601
Epoch 25: mse improved from 0.04337 to 0.04269, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0427 - mse:
0.0427 - mae: 0.1596
Epoch 26/50
 97/104 [==========================>...] - ETA: 0s - loss: 0.0382 - mse: 0.0382
- mae: 0.1521
Epoch 26: mse improved from 0.04269 to 0.03867, saving model to output\lstm.h5
104/104 [==============================] - 1s 6ms/step - loss: 0.0387 - mse:
0.0387 - mae: 0.1526
Epoch 27/50
 96/104 [========================>...] - ETA: 0s - loss: 0.0415 - mse: 0.0415
- mae: 0.1545
Epoch 27: mse did not improve from 0.03867
104/104 [==============================] - 0s 4ms/step - loss: 0.0410 - mse:
0.0410 - mae: 0.1552
Epoch 28/50
101/104 [============================>.] - ETA: 0s - loss: 0.0384 - mse: 0.0384
- mae: 0.1508
Epoch 28: mse did not improve from 0.03867
104/104 [==============================] - 1s 5ms/step - loss: 0.0387 - mse:
0.0387 - mae: 0.1522
Epoch 29/50
 94/104 [==========================>...] - ETA: 0s - loss: 0.0379 - mse: 0.0379
- mae: 0.1479
Epoch 29: mse improved from 0.03867 to 0.03803, saving model to output\lstm.h5
104/104 [==============================] - 1s 6ms/step - loss: 0.0380 - mse:
0.0380 - mae: 0.1489
Epoch 30/50
 94/104 [==========================>...] - ETA: 0s - loss: 0.0349 - mse: 0.0349
- mae: 0.1414
Epoch 30: mse improved from 0.03803 to 0.03509, saving model to output\lstm.h5
```

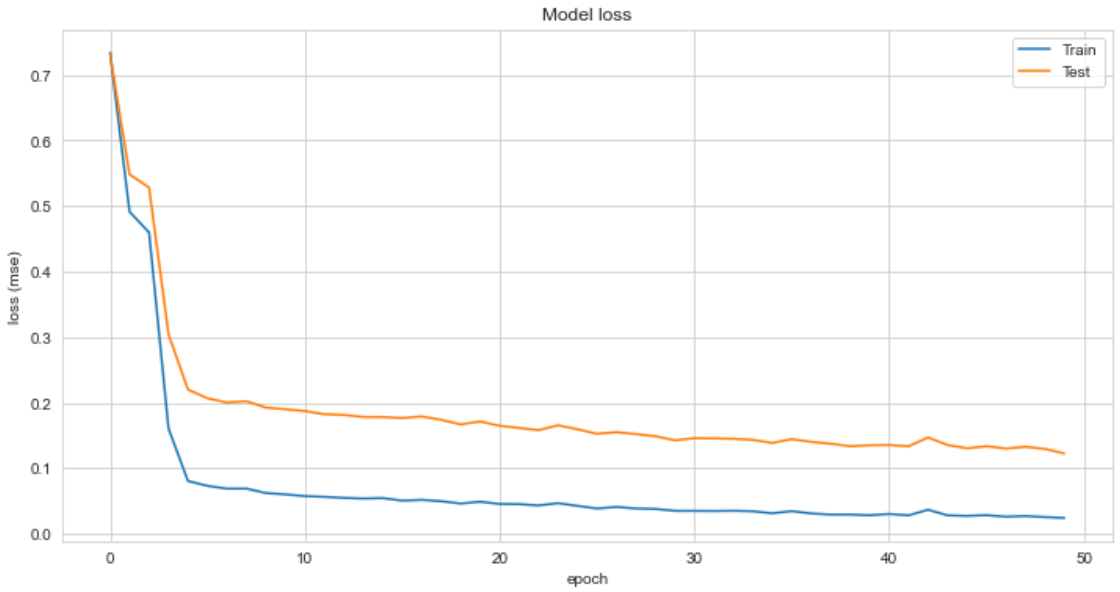
```
104/104 [==============================] - 1s 5ms/step - loss: 0.0351 - mse:
0.0351 - mae: 0.1427
Epoch 31/50
 96/104 [=========================>…] - ETA: 0s - loss: 0.0341 - mse: 0.0341
- mae: 0.1418
Epoch 31: mse improved from 0.03509 to 0.03504, saving model to output\lstm.h5
104/104 [==============================] - 1s 6ms/step - loss: 0.0350 - mse:
0.0350 - mae: 0.1459
Epoch 32/50
 96/104 [=========================>…] - ETA: 0s - loss: 0.0329 - mse: 0.0329
- mae: 0.1430
Epoch 32: mse improved from 0.03504 to 0.03482, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0348 - mse:
0.0348 - mae: 0.1456
Epoch 33/50
 95/104 [==========================>…] - ETA: 0s - loss: 0.0352 - mse: 0.0352
- mae: 0.1449
Epoch 33: mse did not improve from 0.03482
104/104 [==============================] - 0s 4ms/step - loss: 0.0352 - mse:
0.0352 - mae: 0.1450
Epoch 34/50
103/104 [============================>.] - ETA: 0s - loss: 0.0345 - mse: 0.0345
- mae: 0.1433
Epoch 34: mse improved from 0.03482 to 0.03453, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0345 - mse:
0.0345 - mae: 0.1434
Epoch 35/50
101/104 [============================>.] - ETA: 0s - loss: 0.0309 - mse: 0.0309
- mae: 0.1381
Epoch 35: mse improved from 0.03453 to 0.03140, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0314 - mse:
0.0314 - mae: 0.1387
Epoch 36/50
100/104 [===========================>..] - ETA: 0s - loss: 0.0347 - mse: 0.0347
- mae: 0.1438
Epoch 36: mse did not improve from 0.03140
104/104 [==============================] - 1s 7ms/step - loss: 0.0347 - mse:
0.0347 - mae: 0.1445
Epoch 37/50
 98/104 [===========================>..] - ETA: 0s - loss: 0.0304 - mse: 0.0304
- mae: 0.1382
Epoch 37: mse improved from 0.03140 to 0.03112, saving model to output\lstm.h5
104/104 [==============================] - 1s 7ms/step - loss: 0.0311 - mse:
0.0311 - mae: 0.1403
Epoch 38/50
 97/104 [==========================>…] - ETA: 0s - loss: 0.0299 - mse: 0.0299
- mae: 0.1384
Epoch 38: mse improved from 0.03112 to 0.02943, saving model to output\lstm.h5
```

```
104/104 [==============================] - 1s 7ms/step - loss: 0.0294 - mse:
0.0294 - mae: 0.1376
Epoch 39/50
101/104 [============================>.] - ETA: 0s - loss: 0.0289 - mse: 0.0289
- mae: 0.1316
Epoch 39: mse did not improve from 0.02943
104/104 [==============================] - 1s 8ms/step - loss: 0.0295 - mse:
0.0295 - mae: 0.1337
Epoch 40/50
103/104 [============================>.] - ETA: 0s - loss: 0.0284 - mse: 0.0284
- mae: 0.1351
Epoch 40: mse improved from 0.02943 to 0.02835, saving model to output\lstm.h5
104/104 [==============================] - 1s 6ms/step - loss: 0.0284 - mse:
0.0284 - mae: 0.1353
Epoch 41/50
103/104 [============================>.] - ETA: 0s - loss: 0.0300 - mse: 0.0300
- mae: 0.1346
Epoch 41: mse did not improve from 0.02835
104/104 [==============================] - 1s 6ms/step - loss: 0.0304 - mse:
0.0304 - mae: 0.1356
Epoch 42/50
 97/104 [==========================>...] - ETA: 0s - loss: 0.0270 - mse: 0.0270
- mae: 0.1349
Epoch 42: mse improved from 0.02835 to 0.02826, saving model to output\lstm.h5
104/104 [==============================] - 1s 6ms/step - loss: 0.0283 - mse:
0.0283 - mae: 0.1336
Epoch 43/50
 93/104 [=========================>...] - ETA: 0s - loss: 0.0389 - mse: 0.0389
- mae: 0.1507
Epoch 43: mse did not improve from 0.02826
104/104 [==============================] - 0s 5ms/step - loss: 0.0368 - mse:
0.0368 - mae: 0.1470
Epoch 44/50
 92/104 [=========================>...] - ETA: 0s - loss: 0.0281 - mse: 0.0281
- mae: 0.1348
Epoch 44: mse improved from 0.02826 to 0.02825, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0283 - mse:
0.0283 - mae: 0.1356
Epoch 45/50
 96/104 [==========================>...] - ETA: 0s - loss: 0.0275 - mse: 0.0275
- mae: 0.1300
Epoch 45: mse improved from 0.02825 to 0.02739, saving model to output\lstm.h5
104/104 [==============================] - 0s 5ms/step - loss: 0.0274 - mse:
0.0274 - mae: 0.1305
Epoch 46/50
 96/104 [==========================>...] - ETA: 0s - loss: 0.0292 - mse: 0.0292
- mae: 0.1357
Epoch 46: mse did not improve from 0.02739
```

```
104/104 [==============================] - 0s 5ms/step - loss: 0.0285 - mse:
0.0285 - mae: 0.1336
Epoch 47/50
 99/104 [===========================>..] - ETA: 0s - loss: 0.0255 - mse: 0.0255
- mae: 0.1283
Epoch 47: mse improved from 0.02739 to 0.02615, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0261 - mse:
0.0261 - mae: 0.1302
Epoch 48/50
104/104 [==============================] - ETA: 0s - loss: 0.0271 - mse: 0.0271
- mae: 0.1327
Epoch 48: mse did not improve from 0.02615
104/104 [==============================] - 0s 5ms/step - loss: 0.0271 - mse:
0.0271 - mae: 0.1327
Epoch 49/50
 98/104 [===========================>..] - ETA: 0s - loss: 0.0253 - mse: 0.0253
- mae: 0.1285
Epoch 49: mse improved from 0.02615 to 0.02560, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0256 - mse:
0.0256 - mae: 0.1297
Epoch 50/50
 95/104 [==========================>...] - ETA: 0s - loss: 0.0239 - mse: 0.0239
- mae: 0.1218
Epoch 50: mse improved from 0.02560 to 0.02429, saving model to output\lstm.h5
104/104 [==============================] - 1s 5ms/step - loss: 0.0243 - mse:
0.0243 - mae: 0.1226
```

[ ]:
```
plt.figure(figsize=(12,6))
plt.plot(lstm.history.history['loss'][:])
plt.plot(lstm.history.history['mae'][:])
plt.title('Model loss')
plt.xlabel('epoch')
plt.ylabel('loss (mse)')
plt.legend(['Train', 'Test'], loc='upper right')
```

[ ]:
```
<matplotlib.legend.Legend at 0x1b1424922b0>
```



[ ]:
```
inputs = Input(shape=(Xt.shape[1], Xt.shape[2]))
x = LSTM(16)(inputs)
outputs = Dense(1)(x)
model = Model(inputs, outputs)

model.compile(optimizer="rmsprop", loss="mse", metrics=['mse',"mae"])
history = model.fit(Xt,yt,epochs=50)
```

```
Epoch 1/50
7/7 [==============================] - 2s 4ms/step - loss: 0.6062 - mse: 0.6062
- mae: 0.6789
Epoch 2/50
7/7 [==============================] - 0s 3ms/step - loss: 0.4419 - mse: 0.4419
- mae: 0.5642
Epoch 3/50
7/7 [==============================] - 0s 4ms/step - loss: 0.3479 - mse: 0.3479
- mae: 0.4940
Epoch 4/50
7/7 [==============================] - 0s 3ms/step - loss: 0.2792 - mse: 0.2792
- mae: 0.4285
Epoch 5/50
7/7 [==============================] - 0s 4ms/step - loss: 0.2216 - mse: 0.2216
- mae: 0.3695
Epoch 6/50
7/7 [==============================] - 0s 3ms/step - loss: 0.1764 - mse: 0.1764
- mae: 0.3212
Epoch 7/50
7/7 [==============================] - 0s 3ms/step - loss: 0.1387 - mse: 0.1387
```

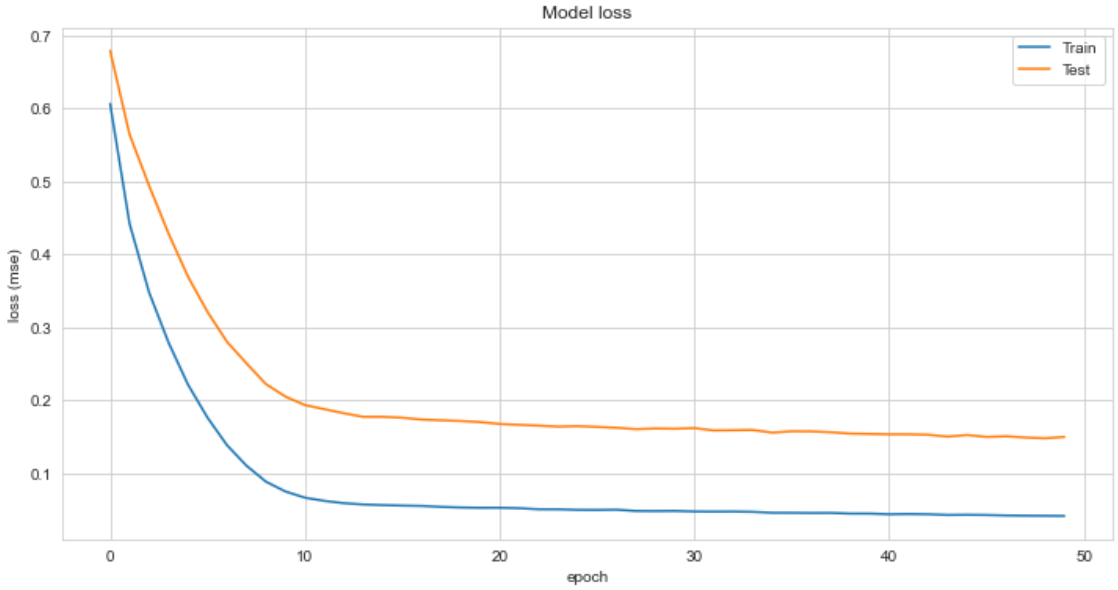
```
- mae: 0.2803
Epoch 8/50
7/7 [==============================] - 0s 4ms/step - loss: 0.1106 - mse: 0.1106
- mae: 0.2507
Epoch 9/50
7/7 [==============================] - 0s 4ms/step - loss: 0.0887 - mse: 0.0887
- mae: 0.2223
Epoch 10/50
7/7 [==============================] - 0s 4ms/step - loss: 0.0753 - mse: 0.0753
- mae: 0.2052
Epoch 11/50
7/7 [==============================] - 0s 4ms/step - loss: 0.0667 - mse: 0.0667
- mae: 0.1936
Epoch 12/50
7/7 [==============================] - 0s 4ms/step - loss: 0.0624 - mse: 0.0624
- mae: 0.1880
Epoch 13/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0592 - mse: 0.0592
- mae: 0.1824
Epoch 14/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0574 - mse: 0.0574
- mae: 0.1774
Epoch 15/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0566 - mse: 0.0566
- mae: 0.1774
Epoch 16/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0559 - mse: 0.0559
- mae: 0.1762
Epoch 17/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0555 - mse: 0.0555
- mae: 0.1737
Epoch 18/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0542 - mse: 0.0542
- mae: 0.1727
Epoch 19/50
7/7 [==============================] - 0s 4ms/step - loss: 0.0533 - mse: 0.0533
- mae: 0.1717
Epoch 20/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0529 - mse: 0.0529
- mae: 0.1703
Epoch 21/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0529 - mse: 0.0529
- mae: 0.1677
Epoch 22/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0523 - mse: 0.0523
- mae: 0.1665
Epoch 23/50
7/7 [==============================] - 0s 9ms/step - loss: 0.0509 - mse: 0.0509
```

```
- mae: 0.1654
Epoch 24/50
7/7 [==============================] - 0s 5ms/step - loss: 0.0508 - mse: 0.0508
- mae: 0.1641
Epoch 25/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0501 - mse: 0.0501
- mae: 0.1647
Epoch 26/50
7/7 [==============================] - 0s 5ms/step - loss: 0.0500 - mse: 0.0500
- mae: 0.1636
Epoch 27/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0503 - mse: 0.0503
- mae: 0.1625
Epoch 28/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0485 - mse: 0.0485
- mae: 0.1606
Epoch 29/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0484 - mse: 0.0484
- mae: 0.1615
Epoch 30/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0486 - mse: 0.0486
- mae: 0.1611
Epoch 31/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0478 - mse: 0.0478
- mae: 0.1620
Epoch 32/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0477 - mse: 0.0477
- mae: 0.1588
Epoch 33/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0478 - mse: 0.0478
- mae: 0.1591
Epoch 34/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0473 - mse: 0.0473
- mae: 0.1595
Epoch 35/50
7/7 [==============================] - 0s 5ms/step - loss: 0.0461 - mse: 0.0461
- mae: 0.1558
Epoch 36/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0460 - mse: 0.0460
- mae: 0.1576
Epoch 37/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0458 - mse: 0.0458
- mae: 0.1575
Epoch 38/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0459 - mse: 0.0459
- mae: 0.1563
Epoch 39/50
7/7 [==============================] - 0s 6ms/step - loss: 0.0450 - mse: 0.0450
```

```
- mae: 0.1545
Epoch 40/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0450 - mse: 0.0450
- mae: 0.1540
Epoch 41/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0441 - mse: 0.0441
- mae: 0.1535
Epoch 42/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0444 - mse: 0.0444
- mae: 0.1535
Epoch 43/50
7/7 [==============================] - 0s 4ms/step - loss: 0.0440 - mse: 0.0440
- mae: 0.1530
Epoch 44/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0431 - mse: 0.0431
- mae: 0.1503
Epoch 45/50
7/7 [==============================] - 0s 5ms/step - loss: 0.0433 - mse: 0.0433
- mae: 0.1526
Epoch 46/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0430 - mse: 0.0430
- mae: 0.1499
Epoch 47/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0424 - mse: 0.0424
- mae: 0.1508
Epoch 48/50
7/7 [==============================] - 0s 4ms/step - loss: 0.0421 - mse: 0.0421
- mae: 0.1491
Epoch 49/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0419 - mse: 0.0419
- mae: 0.1481
Epoch 50/50
7/7 [==============================] - 0s 3ms/step - loss: 0.0418 - mse: 0.0418
- mae: 0.1499
```

[ ]:
```
plt.figure(figsize=(12,6))
plt.plot(model.history.history['loss'][:])
plt.plot(model.history.history['mae'][:])
plt.title('Model loss')
plt.xlabel('epoch')
plt.ylabel('loss (mse)')
plt.legend(['Train', 'Test'], loc='upper right')
```

[ ]:
```
<matplotlib.legend.Legend at 0x1b133ce3070>
```



RNN Bidirectional LSTM

[ ]:
```
biLSTM = Sequential()
# biLSTM.add(Bidirectional(LSTM(units=64,dropout=0.5, recurrent_dropout=0.
  ↪5),input_shape=(Xt.shape[1], Xt.shape[2])))
biLSTM.add(Bidirectional(LSTM(units=64),input_shape=(Xt.shape[1],Xt.shape[2])))
biLSTM.add(Dense(units=32, activation='swish'))
biLSTM.add(Dense(units=16, activation='swish'))
biLSTM.add(Dense(units=8, activation='swish'))
biLSTM.add(Dense(units=1, activation='swish'))

biLSTM.compile(optimizer=optimizer, loss='mse', metrics=['mse','mae'])

biLSTM.summary()

history = biLSTM.fit(Xt, yt, epochs=50, batch_size=2,verbose=1)
```

```
Model: "sequential_12"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 bidirectional_4 (Bidirectio  (None, 128)              34816
 nal)

 dense_32 (Dense)            (None, 32)                4128

 dense_33 (Dense)            (None, 16)                528

 dense_34 (Dense)            (None, 8)                 136
```

```
 dense_35 (Dense)            (None, 1)                 9

=================================================================
Total params: 39,617
Trainable params: 39,617
Non-trainable params: 0
_________________________________________________________________
Epoch 1/50
104/104 [==============================] - 4s 4ms/step - loss: 0.4169 - mse:
0.4169 - mae: 0.5307
Epoch 2/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2903 - mse:
0.2903 - mae: 0.4285
Epoch 3/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2827 - mse:
0.2827 - mae: 0.4144
Epoch 4/50
104/104 [==============================] - 0s 5ms/step - loss: 0.2814 - mse:
0.2814 - mae: 0.4159
Epoch 5/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2799 - mse:
0.2799 - mae: 0.4081
Epoch 6/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2805 - mse:
0.2805 - mae: 0.4099
Epoch 7/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2787 - mse:
0.2787 - mae: 0.4091
Epoch 8/50
104/104 [==============================] - 0s 5ms/step - loss: 0.2796 - mse:
0.2796 - mae: 0.4086
Epoch 9/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2734 - mse:
0.2734 - mae: 0.4000
Epoch 10/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2689 - mse:
0.2689 - mae: 0.3934
Epoch 11/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2722 - mse:
0.2722 - mae: 0.4003
Epoch 12/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2837 - mse:
0.2837 - mae: 0.4138
Epoch 13/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2756 - mse:
0.2756 - mae: 0.4016
Epoch 14/50
```

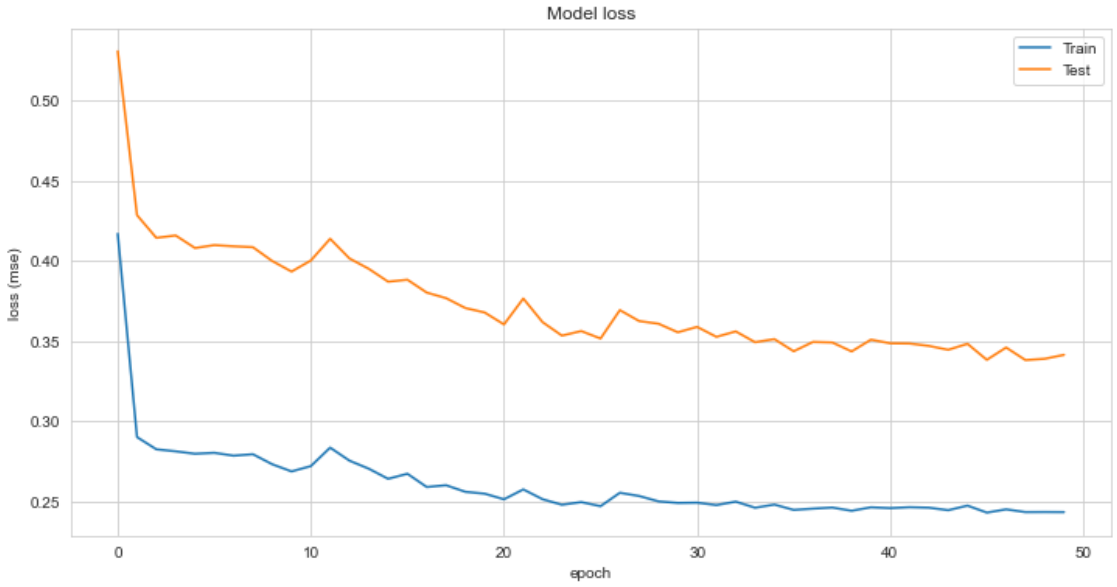
```
104/104 [==============================] - 0s 4ms/step - loss: 0.2706 - mse:
0.2706 - mae: 0.3951
Epoch 15/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2643 - mse:
0.2643 - mae: 0.3871
Epoch 16/50
104/104 [==============================] - 0s 5ms/step - loss: 0.2674 - mse:
0.2674 - mae: 0.3883
Epoch 17/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2592 - mse:
0.2592 - mae: 0.3803
Epoch 18/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2603 - mse:
0.2603 - mae: 0.3768
Epoch 19/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2562 - mse:
0.2562 - mae: 0.3707
Epoch 20/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2550 - mse:
0.2550 - mae: 0.3679
Epoch 21/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2515 - mse:
0.2515 - mae: 0.3605
Epoch 22/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2577 - mse:
0.2577 - mae: 0.3766
Epoch 23/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2516 - mse:
0.2516 - mae: 0.3619
Epoch 24/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2481 - mse:
0.2481 - mae: 0.3535
Epoch 25/50
104/104 [==============================] - 0s 5ms/step - loss: 0.2498 - mse:
0.2498 - mae: 0.3563
Epoch 26/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2472 - mse:
0.2472 - mae: 0.3517
Epoch 27/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2556 - mse:
0.2556 - mae: 0.3694
Epoch 28/50
104/104 [==============================] - 0s 3ms/step - loss: 0.2536 - mse:
0.2536 - mae: 0.3625
Epoch 29/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2502 - mse:
0.2502 - mae: 0.3609
Epoch 30/50
```

```
104/104 [==============================] - 0s 4ms/step - loss: 0.2493 - mse:
0.2493 - mae: 0.3556
Epoch 31/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2494 - mse:
0.2494 - mae: 0.3589
Epoch 32/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2479 - mse:
0.2479 - mae: 0.3527
Epoch 33/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2501 - mse:
0.2501 - mae: 0.3561
Epoch 34/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2463 - mse:
0.2463 - mae: 0.3494
Epoch 35/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2483 - mse:
0.2483 - mae: 0.3513
Epoch 36/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2449 - mse:
0.2449 - mae: 0.3437
Epoch 37/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2457 - mse:
0.2457 - mae: 0.3496
Epoch 38/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2464 - mse:
0.2464 - mae: 0.3492
Epoch 39/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2444 - mse:
0.2444 - mae: 0.3436
Epoch 40/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2465 - mse:
0.2465 - mae: 0.3510
Epoch 41/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2460 - mse:
0.2460 - mae: 0.3487
Epoch 42/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2466 - mse:
0.2466 - mae: 0.3486
Epoch 43/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2463 - mse:
0.2463 - mae: 0.3471
Epoch 44/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2447 - mse:
0.2447 - mae: 0.3447
Epoch 45/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2476 - mse:
0.2476 - mae: 0.3484
Epoch 46/50
```

```
104/104 [==============================] - 0s 4ms/step - loss: 0.2433 - mse:
0.2433 - mae: 0.3384
Epoch 47/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2453 - mse:
0.2453 - mae: 0.3461
Epoch 48/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2436 - mse:
0.2436 - mae: 0.3383
Epoch 49/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2436 - mse:
0.2436 - mae: 0.3391
Epoch 50/50
104/104 [==============================] - 0s 4ms/step - loss: 0.2436 - mse:
0.2436 - mae: 0.3415
```

[ ]:
```
plt.figure(figsize=(12,6))
plt.plot(biLSTM.history.history['loss'][:])
plt.plot(biLSTM.history.history['mae'][:])
plt.title('Model loss')
plt.xlabel('epoch')
plt.ylabel('loss (mse)')
plt.legend(['Train', 'Test'], loc='upper right')
```

[ ]:
```
<matplotlib.legend.Legend at 0x1b1427eba00>
```

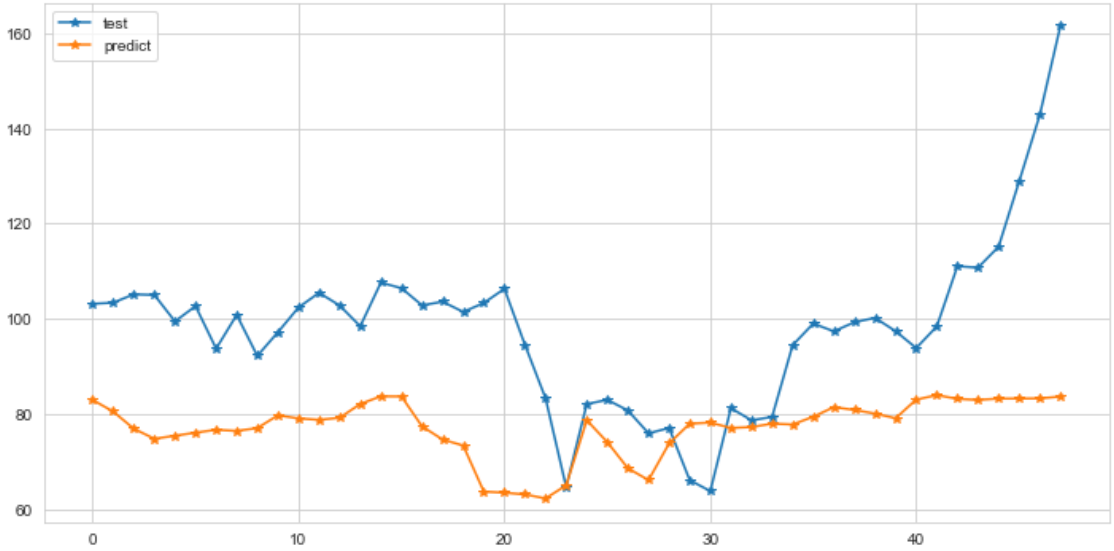


Predict

[ ]:
```
# y_predict using Bidirectional LSTM model
y_predict = biLSTM.predict(Xv)
yt_inverse = targetScaler.inverse_transform(yt.reshape(1,-1))
yv_inverse = targetScaler.inverse_transform(yv.reshape(1,-1))
y_predict_inv = targetScaler.inverse_transform(y_predict)
```

[ ]:
```
plt.figure(figsize=(12,6))
plt.plot(yv_inverse.flatten(),marker = '*', label='test')
plt.plot(y_predict_inv.flatten(),marker = '*', label='predict')
plt.legend()
```

[ ]:
```
<matplotlib.legend.Legend at 0x1b1579a03d0>
```



0.5 Conclusion

1. Alpha Vantage is one of the best python module to pull stock-related data.
2. pd.melt is great tool to split dataframes into a list/column view
3. The Sales of Chevron has never reached back to 2008 level (Since Great Reccession).
4. Stock market percent change is way more volitile than inflation
5. Gas Price and Sales has strong positive correlation, also Gas Price has positive correlation to all other columns.
6. Recent Gas Price surge has increased Sales dramatically, however gallons of gas sold declined. Sales increase due to price change and not gallons sold.
7. Since it is time series, we should not shuffle/randomize the data for machine learning.
8. Data pre-processing for machine learning will be energy and time consuming, converting data to the right scale and reshape to correct dimension without interupting data itself.
9. Model engineering requires high level of topic understanding, data understanding, and math.

0.6 References

- Mr. Paul obtaining certain Chevron public data from FactSet (Paid Service, easier to pull certain public data)
- Alpha Vantage API certain Chevron (CVX) Data
- Inflation Data https://www.usinflationcalculator.com/inflation/current-inflation-rates/#:~:text=The%20annual%20inflation%20rate%20for,at%208%3A30%20a.m.%20ET.
- Gas Prices https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=emm_epm0_pte_nus_dpg&f=