Assignment #7
Angela Zorro Medina[1]

1. Unit Testing in Python (3 points). Read Chapter 7 "Unit Testing" from Humpherys and Jarvis (2018, Ch. 7). This is a chapter from an open access set of labs that accompany a great applied math textbook Humpherys et al. (2017). Do Problems 1, 2, and 3 from this Chapter. Submit your code and a description of your answers.

Problem 1.
When we run the code as the book has it, we found that the function did not pass the test that we designed.

```
(pytest-env) C:\Users\Angela\pytest_project>py.test --cov
============================= test session starts =============================
platform win32 -- Python 3.7.1, pytest-4.0.0, py-1.7.0, pluggy-0.8.0
rootdir: C:\Users\Angela\pytest_project, inifile:
plugins: cov-2.6.0
collected 1 item

test_smallest_factor.py F                                                [100%]

================================== FAILURES ===================================
_____________________________ test_smallest_factor _____________________________

    def test_smallest_factor():
        assert smallest_factor(0)==None, "error"
>       assert smallest_factor(-1)==None, "error"

test_smallest_factor.py:18:
_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

n = -1

    def smallest_factor(n):
        """Return the smallest prime factor of the positive integer n."""
        if n==1: return 1
>       for i in range(2, int(n**.5)):
E       TypeError: can't convert complex to int

test_smallest_factor.py:11: TypeError

---------- coverage: platform win32, python 3.7.1-final-0 -----------
Name                     Stmts   Miss  Cover
--------------------------------------------
test_smallest_factor.py      9      2    78%

========================== 1 failed in 0.10 seconds ===========================
```

After fixing the function it passed the test. Please see the codes in the respective folders.

[1] **I worked with Maria Adelaida Martinez in this assignment. This means that the codes were developed by the two of us and our results are the same for these questions.**

Original code:

```
def smallest_factor(n):
    """Return the smallest prime factor of the positive integer n."""
    if n==1: return 1
    for i in range(2, int(n**.5)):
        if n % i == 0: return i
        return n
```

Fixed Code

```
def smallest_factor(n):

    if n <= 0 or n-int(n)!= 0:
        #print("Non positive")
        return None

    if n == 1: return 1
    for i in range(2, int(n**.5)):
        if n%i == 0: return i

    return n
```

By comparing both codes, we observe that in the original code a first condition was missing. We know that the smallest prime number is 2, and because we are looking only for positive integers, we need to exclude all negative integers and zero (because zero is not a positive integer). By adding a condition that tells python that excludes every non-positive integer or zero we guarantee that our function is going to get only positive integers. Because we noticed that the problem of the function was related to the negative integers and zero, we designed a test that allowed us to verified that we solved that problem with our new code.

```
(pytest-env) C:\Users\Angela\pytest_project>py.test --cov
============================= test session starts =============================
platform win32 -- Python 3.7.1, pytest-4.0.0, py-1.7.0, pluggy-0.8.0
rootdir: C:\Users\Angela\pytest_project, inifile:
plugins: cov-2.6.0
collected 1 item

test_smallest_factor_fixed.py .                                          [100%]

---------- coverage: platform win32, python 3.7.1-final-0 -----------
Name                            Stmts   Miss  Cover
---------------------------------------------------
test_smallest_factor_fixed.py      11      4    64%


========================== 1 passed in 0.09 seconds ===========================
```

Question 2.[2]

```
(pytest-env) C:\Users\Angela\pytest_project>py.test --cov
============================= test session starts =============================
platform win32 -- Python 3.7.1, pytest-4.0.0, py-1.7.0, pluggy-0.8.0
rootdir: C:\Users\Angela\pytest_project, inifile:
plugins: cov-2.6.0
collected 1 item

test_month_length.py .                                                   [100%]

---------- coverage: platform win32, python 3.7.1-final-0 -----------
Name                    Stmts   Miss  Cover
-----------------------------------------
test_month_length.py       18      0   100%


========================== 1 passed in 0.15 seconds ===========================

(pytest-env) C:\Users\Angela\pytest_project>
```

In this case, I reported the coverage document of the smallest prime in the previous question. So, in this question I will only discuss the month_length. Here what we did was to used some of the discussions that existed online related to this topic and combined their solution with the code that the book gave us.
After testing some of the values manually with the function print, we designed a test and verified that our month length was corrected. Because we added an additional part to the test (we defined leap-years and no leap-years), we designed a test that gave us the accurate length of the months in 2003 and 2004 (2003 no leap-year and 2004 leap-year). For both scenarios our function passed the test.

Question 3.

```
(pytest-env) C:\Users\Angela\pytest_project>py.test --cov
============================= test session starts =============================
platform win32 -- Python 3.7.1, pytest-4.0.0, py-1.7.0, pluggy-0.8.0
rootdir: C:\Users\Angela\pytest_project, inifile:
plugins: cov-2.6.0
collected 1 item

test_operate.py .                                                        [100%]

---------- coverage: platform win32, python 3.7.1-final-0 -----------
Name              Stmts   Miss  Cover
-----------------------------------
test_operate.py      27      3    89%


========================== 1 passed in 0.16 seconds ===========================
```

For this question what we did was basically used the previous examples of the book (addition and division particularly) and extend the test to other possible outcomes like: negative*negative, positive*negative, negative-negative, positive-negative, etc. And after running the test with the examples of addition and division of

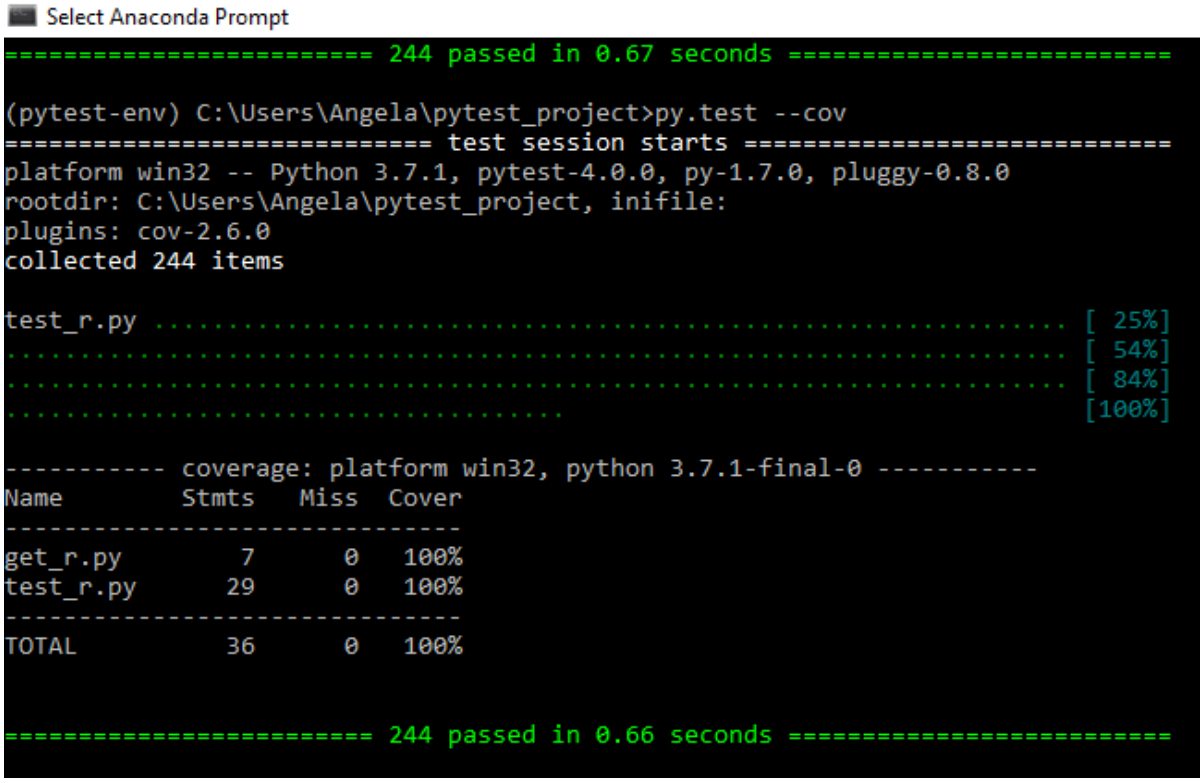
[2] To solve this question, I used this forum as guide: https://stackoverflow.com/questions/18325705/printing-the-number-of-days-in-a-given-month-and-year-python

the book, plus our new conditions we verified that the function passed the tests.

2. Test driven development (3 points). Test driven development is a paradigm that helps ensure that submitted code satisfies certain requirements. Pretend that you are my research assistant. I want you to write a Python function that has the following properties, and it must pass the following test. Write this function. Copy this test file into the folder where your function resides and make sure that all tests pass. Submit your function and the testing output showing that it passed. (a) In the theory of the firm in economics, the interest rate in a given period rt in equilibrium is a function of the aggregate capital stock Kt, aggregate labor Lt, and parameters of the model α (capital share of income), Z (total factor productivity), and δ (depreciation rate). (b) A python script that contains only functions is called a "module". Write a Python module entitled get r.py. Inside that module, define a function get r() that takes as inputs K, L, α, Z, and δ and returns the corresponding interest rate. Furthermore, this function must work for values of α, $\delta \in (0, 1)$ and K,L,Z > 0. Furthermore, if K and L are both scalars, this function should return a scalar interest rate. And if K and L are both vectors, this function should return a corresponding vector of interest rates. (c) Put the file test r.py in the same folder as the module you created in part (b). Use the py.test --cov command from the pytest package to test whether your function does what it is supposed to. Edit your function until it passes all the tests. Report your pytest test results.

Please find below the screen shots of the code that generates r and the report that shows that the function passed the test. Additionally you can find the original files (.coverage and get_r.py) separately.

```
1  # -*- coding: utf-8 -*-
2  """
3  Created on Wed Nov 21 18:18:41 2018
4
5  @author: Angela
6  """
7
8  #Import packages
9  import numpy as np
10
11 def get_r(K, L, alpha, Z, delta):
12     '''
13     This function generates the interest rate or vector of interest rates
14     '''
15     K = np.array(K)
16     L = np.array(L)
17     r = alpha*Z*np.divide(L,K)**(1-alpha)-delta
18     return r
```


Select Anaconda Prompt
========== 244 passed in 0.67 seconds ==========
(pytest-env) C:\Users\Angela\pytest_project>py.test --cov
========== test session starts ==========
platform win32 -- Python 3.7.1, pytest-4.0.0, py-1.7.0, pluggy-0.8.0
rootdir: C:\Users\Angela\pytest_project, inifile:
plugins: cov-2.6.0
collected 244 items
test_r.py [25%]
[54%]
[84%]
[100%]
---------- coverage: platform win32, python 3.7.1-final-0 ----------
Name Stmts Miss Cover
get_r.py 7 0 100%
test_r.py 29 0 100%
TOTAL 36 0 100%
========== 244 passed in 0.66 seconds ==========

3. Watts (2014) (4 points). Read Watts (2014). This paper focuses on the importance of having a model, making assumptions explicit, causal inference, and prediction. In a one-to-two-page written response, answer the following questions. (a) When initially introduced in the 1960s, rational choice theory imposed a framework of theoretical assumptions that fit with or "rationalized" observed behavior. What were some of the criticisms of this approach? (b) What is the main pitfall that Watts sees in using commonsense theories of action? [Hint: A good explanation of the answer is in the last half of the section entitled, "Theorizing by Mental Simulation".] The answer to this question precedes its decomposition into three parts in the Section, "Three Problems with Rationalizable Action as Causal Explanation." (c) What is Watts' proposed solution to the issues with rational choice modeling and causal explanation? (d) Although this paper does a good job or relating causality to prediction, I don't like its disdain for theory that specifically outlines the assumptions and mechanisms of process being modeled. Write a short addendum to the paper about how theoretical models—with their necessary simplifications and their specific assumptions about mechanisms—could benefit causal inference and prediction.

In his paper "Common Sense and Sociological Explanations," Watts develops a critic of the current sociological approach to understand and explain the social action. The core of Watts' critic of the sociological theoretical framework is the existing tension between the empirical data and the theoretical model. According to Watts (2014), sociology has systematically moved toward a "scientific approach" under which formality and objectivity have become the center of the reproduction of social knowledge. However, Watts states that despite the efforts of sociology to leave behind "unscientific" methods that rely on our interpretations of the social context, sociologists still rely on "common sense or folk theory." Watts argues that many sophisticated and extremely formalized sociological theories have been constructed based on common sense, which means that were constructed based on the way common people interpret the everyday behavior of others and how they learn to anticipate others' behavior based on their interpretations. Watts calls these interpretation and anticipation processes the "rationalization of action" because by interpreting and predicting behaviors based on "intentions, beliefs, circumstances and the actors involve" people are making sense of what is happening in the social moment (Watts 2014, p. 314).

In his paper, Watts (2014) explains that the current approach that sociologists have toward the understanding of the social action has evolved over time. He starts talking about the rational theories used by sociologists before 1969. According to Harsanyi (1969), rational behavior in rational theories refers to "choosing the appropriate mean for achieving some given end" (Harsanyi 1969, p. 515).[3] Based on this Weberian definition of rationality, Harsanyi explains that by 1969, rational choice theories have a "tendency to take a hypothetic-deductive form, and to explain a wide variety of empirical facts regarding a small number of theoretical assumptions" (Harsanyi 1969, p. 515). This rational choice theory faced several critics based on the unrealistic assumptions about exogenous preferences, the computational abilities of the individuals and the knowledge available to them. In addition to the critics based on the "implausible or empirically invalid" assumptions, other critics to the rational theory have focused on the fact that some predictions that

[3] Harsanyi explains how economics have expanded the notion of rational behavior and this has increased the explanatory power of this theory. He explains that departing from the classical economists the concept of rational behavior has extended from "choices between alternative means to a given end, to choices between alternative ends" (Harsanyi 1969, p. 515). However, the commonsense level of the concept rational behavior continues to be the foundation of the theory and therefore, Watts (2014) point continues to apply to it beyond the rational behavior theory of the classics.

have been done under this theoretical model some social scientists have made predictions that "were also demonstrably at odds with empirical evidence" (Watts 2014, p. 320).

In light of those critics, sociologists have adapted over time and move away from this traditional approach of rational theory and have focused on a more noneconomic theory that privileges the social moment instead of the individual. Watts argues that as a response to the previously mentioned critics, sociologist shifted from a "scientific to an empathetic view of explanation" of the social moment (Watts 2014, p. 320), but never abandoned their scientific aspirations. In other words, sociologists shifted to a more commonsense based theory by making emphasis on understanding and making sense of the social action but keep drawing conclusions similar to those found in natural sciences. At this point is where Watts critic to the "new sociological rational theory" approach comes into the panorama.

Watts argued that the shift toward that new more commonsense approach in sociology leads to sociologists to perceive as true those commonsense notions and give them universal validity, when in fact their claims are just commonsensical statements that have been constructed under an empathetic non-explicit framework. To Watts (2014) the biggest problem of the commonsense theories is not the fact that sociologists used commonsense to rationalized the actions, but the fact that the process of making sense of what they observe in society is incorporated into the sociological theories without any explicit acknowledgment. Moreover, Watts claims that often those common-sense explanations survived rigorous scrutinous to the theories in which they have been incorporated.

The reason why introducing the common-sense analysis without making its inclusion explicit is that not all explanations that make sense of something that is observed in society are generalizable, and therefore the mechanisms that are identified as the cause of an event could not be the real cause of what it is observed. Moreover, Watts argues that "not just because an explanation makes sense of some observed outcome" it is generalizable as a causal mechanism, and those reasons that ex-post seems obvious were not apparent ex-ante. Watts' critic can be perfectly summarized in the title of his book "everything is obvious once you know the answer." This means that it is easy to explain the conditions that were presented when a dictatorial regime arise, but if we use those causal mechanisms that we identified in previous historical moments, we will end up with bad predictors of future dictatorship regimes (Manza 2012). In the end, Watts' critic states that rational choice theory offers causal explanations that are highly contextually dependent and therefore not accurate predictions of future behavior.

The interesting thing about Watts analysis is that he does not stay in the critic area solely, in fact, he proposes a solution to overcome the problems of rational choice theory to find causal relationships and to make accurate predictions. To Watts (2014) sociologists must rely more on experimental methods than in theoretical frameworks. Moreover, Watts points out that sociologists must look for field experiments in particular because in those types of experiments "causal effects can be identified by virtue of random assignment" (Watts 2014, p. 336). According to Watts (2014), sociologists must differentiate between understandability and scientific validity, which means that rational choice theory can only contribute to understandability, but scientific validity would come from satisficing the standards of causal inference or predictability. To Watts (2014) experiments and out-of-sampling testing are the key methods to satisfy those scientific standards of causal inference because they allow to separate empathetic explanations and isolated the causal mechanism to make accurate predictions of future behavior.

Although it is true that experiments are a useful mechanism to find causal relationships and draw predictions (using the definition of predictions given by Watts), without a theory that accompanies those results, then we only have information of that particular population in that particular context. But, because the results are not generalizable under a theoretical framework, it could be that every experiment that we do can only account for information in that particular time and in that particular context and useless in other scenarios. Let's consider Lieberson's (1985) critic of empirical methods based on the irreversible social process. According to Liberson, an asymmetrical relation exists between the dependent and independent variables and therefore, once a social process has happened its effect cannot be removed from the society. If we used experimental analysis without a theoretical framework that allows us to interpret the data to generalize the results and we are behind an irreversible social process, then the knowledge that we found and the "predictions" are no longer useless because the scenario under which we could draw these conclusions have disappeared forever.

Despite the pertinence of Watts' critic, he does not entirely respond to the objections to solely rely on causal stories by separating the theory from the statistical analysis done by experiments. The main weaknesses in Watts's approach are that he overestimates the importance of data and identifying causal relationships. Under Watts's view having the capacity to make predictions (under his definition of prediction) is valuable in itself, even if we cannot extend those predictions to other populations or over time. However, in most of the causes, the social value of producing predictions is based on the notions of predictions that he discards. Watts dismissed the important role of theory in giving relevance to empirical findings using experimental data because knowing that A causes B in a particular context in a particular situation that may not be replicable somewhere else does not have a value in itself.

Watts forgets that the reason behind producing social knowledge is to be able to apply it somewhere else, or to a different population than the one we observed in our data, and to do that we need some theoretical framework that allows us to extend our analysis to other contexts. Moreover, Watts appears to assume that when we do not need to make sense of the data, we find in social experiments in the same way we make senses of other observational data. If at the end we recognize that making sense is part of the way our brains work, then we need to recognize that we cannot escape common-sense, not even using experimental methods. With this in mind, the necessity to have a theoretical framework that allows us to have a consensus under which we are going to make that common-sense process becomes a crucial factor to social sciences. Without theory we do not have standards that allow us to have a common pattern of interpretation, we have data that can be freely interpreted by each person common-sense. Finally, when we remember the purpose of social science and our limitations as human beings to understand the world, then we inevitably have to conclude that data in itself cannot be useful to humankind without a theoretical framework that helps us understand what it means homogeneous standards.

References

Harsanyi, J. C. (1969). Rational-choice models of political behavior vs. functionalist and conformist theories. *World politics*, *21*(4), 513-538. Retrieved from https://doi.org/10.2307/2009665

Lieberson, S. (1985). Making It Count: The Improvement of Social Research and Theory. University of California Press. Retrieved from http://www.jstor.org/stable/10.1525/j.ctt7zw42g

MANZA, J. (2012). EVERYTHING IS OBVIOUS ONCE YOU KNOW THE ANSWER. *European Journal of Sociology / Archives Européennes De Sociologie / Europäisches Archiv Für Soziologie,53*(3), 418-422. Retrieved from http://www.jstor.org/stable/43282254