Final Report of Traineeship Program 2024

On

"Analyze Death Age Difference of Right Handers with Left Handers"

MEDTOUREASY

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ABSTRACT

In this journal, we will investigate this peculiarity utilizing age circulation information to check whether we can replicate a distinction in normal age at death simply from the changing paces of left-handedness over the long haul, discrediting the case of early passing for left-handers. This journal utilizes Pandas and Bayesian measurements to examine the likelihood of being a specific age at death given that you are accounted for as left-gave or right-gave.

A Public Geographic review in 1986 brought about north of 1,000,000 reactions that included age, sex, and hand inclination for tossing and composing. Analysts Avery Gilbert and Charles Wysocki investigated this information and saw that paces of left-handedness were around 13% for individuals more youthful than 40 however diminished with age to around 5% by the age of 80. They finished up in view of examination of a subgroup of individuals who toss left-gave yet compose right-gave that this age-reliance was basically because of changing social worthiness of left-handedness. This implies that the rates aren't a component old enough explicitly yet rather of the year you were conceived, and in the event that a similar report was done today, we ought to anticipate a moved form of a similar dispersion as an element old enough. At last, we'll see what impact this changing rate has on the clear mean period of death of left-given individuals, however we should begin by plotting the paces of left-handedness as a component old enough.

This journal utilizes two datasets: demise circulation information for the US from the year 1999 and paces of left-handedness digitized from a figure in this 1992 paper by Gilbert and Wysocki.

1. INTRODUCTION

1.1 About the Company:

MedTourEasy, a global healthcare company, provides you the informational resources needed to evaluate your global options. MedTourEasy provides analytical solutions to our partner healthcare providers globally.

1.2 About the Project:

Inside the domain of handedness and its suggestions for life span, a significant inquiry has posed a potential threat: does an unmistakable difference exist in the normal age at death between left-handers and right-handers? This examination undertaking is an intentional investigation into this enamoring request, with a guarantee to uncover reality through information examination and observational thoroughness. To leave on this excursion, vital to clarify the fundamental phrasings support our examination.

As a matter of some importance, 'age circulation information' typifies an extensive dataset that envelops data about the ages at which people from different gatherings, both left-handed and right-handed, meet their downfall. This information store is fundamental to observe patterns and contrasts in age at death between the two gatherings.

Furthermore, 'Bayesian measurements' is a probabilistic way to deal with factual induction and independent direction. It utilizes the standards of likelihood to work out the probability of an occasion happening, given earlier data. In our examination, Bayesian measurements are utilized to evaluate the likelihood of arriving at a specific age at death in view of a singular's handedness.

Concerning 'information perceptions and plots,' these act as graphical portrayals of information that help analysts and readers to outwardly get a handle on examples, patterns, and contrasts inside the dataset. In our undertaking, these representations are significant in delivering complex data in a conceivable structure and making our examination open.

Eventually, our examination tries to arrive at a 'indisputable comprehension' in regards to the case of an age distinction between left-handers and right-handers. This includes investigating the information, taking into account the probabilistic inductions got from Bayesian measurements, and utilizing information perceptions to gauge the proof. Our definitive objective is to either verify or expose the familiar way of thinking of handedness influencing life span and add to a clearer, proof-based comprehension of this peculiarity.

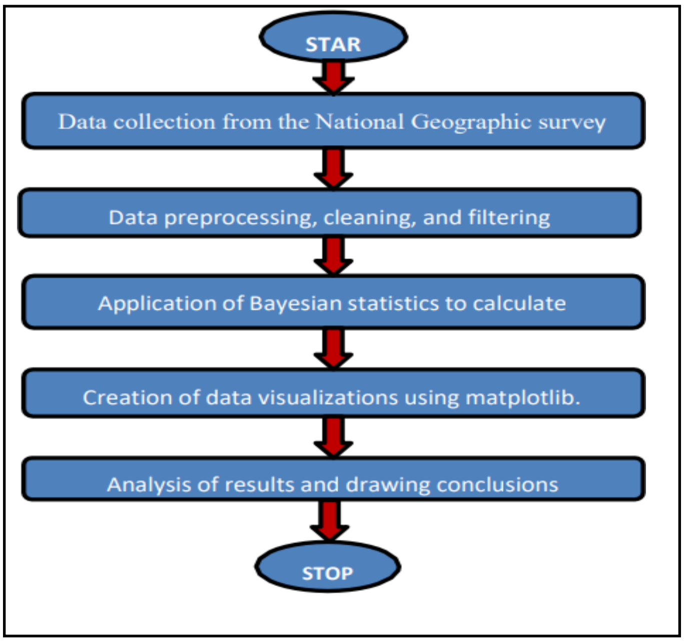
1.3 Objectives:

This research project investigates whether there is a significant difference in the average age of death between left-handers and right-handers by analyzing age distribution data collected from a National Geographic survey. Utilizing Bayesian statistics and data visualization techniques, the study calculates the probability of being a specific age at death based on handedness. The results reveal that there is insufficient evidence to support the claim that left-handers experience an earlier average age of death, challenging a commonly held belief. This evidence-based analysis contributes valuable insights to the discussion on handedness and longevity, highlighting the importance of rigorous data-driven research in dispelling prevailing myths.

2. Methodology

2.1 Flow Chart

The project embraced a precise work process to explore the potential age uniqueness in life span between left-handers and right-handers. This approach included a progression of fastidiously arranged moves toward accomplish the exploration targets. The essential stages that directed the project's progress are framed beneath.



2.2 Data Collection from the National Geographic Survey

The initial phase of this research project involved the acquisition of data from the National Geographic survey. This dataset served as the fundamental source for our analysis, containing valuable information on the ages at which individuals passed away.

- Data Preprocessing, Cleaning, and Filtering: Subsequent to data collection, we conducted an essential process of data preprocessing, cleaning, and filtering. This meticulous step aimed to eliminate inconsistencies and inaccuracies, ensuring the dataset's integrity and reliability for analysis.

- Application of Bayesian Statistics: Bayesian statistics played a pivotal role in our analysis. This statistical method was employed to calculate the probabilities associated with reaching specific ages at death based on an individual's handedness, adding a probabilistic dimension to our investigation.

- Creation of Data Visualizations using Matplotlib: Effective data communication and visualization were achieved using the Matplotlib library. Data visualizations and plots were designed to illustrate patterns, trends, and distinctions within the dataset, making complex information more accessible.

- Analysis of Results and Drawing Conclusions: The analysis of processed data and insights derived from visualizations formed the basis for drawing informed conclusions. These conclusions aimed to provide clarity regarding the age disparity, or the lack thereof, between left-handers and right-handers.

2.3 Language and Platform used

Python, a versatile and readable high-level programming language, served as the foundation for the project's implementation. This choice was grounded in Python's design philosophy, emphasizing readability and ease of use, making it suitable for developers of various skill levels.

Key Python libraries supported the project's technical requirements:

- NumPy (Numerical Python): Facilitating operations on multi-dimensional arrays and matrices, NumPy's mathematical functions were vital for scientific computing and data manipulation.

- Pandas: Equipped with data structures and functions for structured data manipulation, Pandas played a significant role in data preprocessing, cleaning, and analysis.

- Matplotlib: This comprehensive library enabled the creation of a diverse range of visualizations in Python, contributing to the project's data visualization requirements.

These language and library choices collectively formed the technological backbone of the project, facilitating efficient data processing, analysis, and visualization. This selection was a testament to the adaptability and utility of these tools in conducting scientific research and data-driven investigations.

3. Implementation

The initial phase of the project encompassed the identification of project requirements and the definition of the problem statement. The key objective was to ascertain whether a substantial difference existed in the average age atthe time of death between individuals categorized as right-handers and those classified as left-handers. This determination was to be made through a meticulous analysisof the available data.

3.1 Data Collection and Importing:

Data collection is a systematic approach for gathering and measuring information from a variety of sources in order to obtain a complete and accurate picture of an interest area. It helps an individual or organization to address specific questions, determine outcomes, and forecast future probabilities and patterns.

The data has been collected through various GitHub repositories, mentioned as follows:

"https://gist.githubusercontent.com/mbonsma/8da0990b71ba9a09f7de395574e54df1/raw/aec88b30af87fad8d45da7e774223f91dad09e88/lh_data.csv"

https://gist.githubusercontent.com/mbonsma/2f4076aab6820ca1807f4e29f75f18ec/raw/62f3ec07514c7e31f5979beeca86f19991540796/cdc_vs00199_table310.csv"

The Research work for the data has been made available from the following source

Researchers Avery Gilbert and Charles Wysocki.

National Geographic survey in 1986.

The website:

https://www.cdc.gov/nchs/data/statab/vs00199_table310.pdf

https://www.cdc.gov/nchs/nvss/mortality_tables.html

Data importing is referred to as uploading the required data into the coding environment from internal sources (computer) or external sources (online websites and data repositories). This data can then be manipulated, aggregated, and filtered according to the requirements and needs of the project

Packages Used:

Pandas Data frame: - Pandas Data Frame is a two-dimensional size-mutable, potentially heterogeneous tabular data structure with labeled axes (rows and columns).

Functions Used:

read.csv (): This function operates as a wrapper for read.table(). It is primarily designed for reading data from CSV (Comma-Separated Values) files, assuming that the delimiter is a comma, and the first line of the file serves as the header that specifies the column names of the table. Additionally, it includes an additional parameter known as url() which is employed to directly access live data from a GitHub repository. This function, therefore, proves to be a suitable candidate for reading and importing CSV files, aligning perfectly with the project's data acquisition needs

3.2 Data Cleaning:

Data is the most imperative aspect of Analytics and Machine Learning. Everywhere in computing or business, data is required. But many a time, the data may be incomplete, inconsistent, or may contain missing values when it comes to the real world. If the data is corrupted then the process may be impeded or inaccurate results may be provided. Hence, Data cleaning is considered a foundational element of basic data science. Data Cleaning is the process by which the incorrect, incomplete, inaccurate, irrelevant, or missing part of the data is identified and then modified, replaced or deleted as needed.

In the data set “lefthanded_data “ 2 new columns are added called : “Birth_year” , “Mean_lh”

lefthanded_data['Birth_year'] = 1986 - lefthanded_data['Age']

lefthanded_data['Mean_lh'] = (lefthanded_data['Male'] + lefthanded_data['Female']) / 2

Below code for reference:

```
##TASK02
```

```
# create a new column for birth year of each age
# ... YOUR CODE FOR TASK 2 ...
lefthanded_data['Birth_year'] = 1986 - lefthanded_data['Age']
# create a new column for the average of male and female
# ... YOUR CODE FOR TASK 2 ...
lefthanded_data['Mean_lh'] = lefthanded_data[['Male', 'Female']].mean(axis=1)
# create a plot of the 'Mean_lh' column vs. 'Birth_year'
fig, ax = plt.subplots()
ax.plot('Birth_year', 'Mean_lh', data = lefthanded_data) # plot 'Mean_lh' vs. 'Birth_year'
ax.set_xlabel('Birth_year') # set the x label for the plot
ax.set_ylabel('Mean_lh') # set the y label for the plot
```

```
Text(0, 0.5, 'Mean_lh')
```

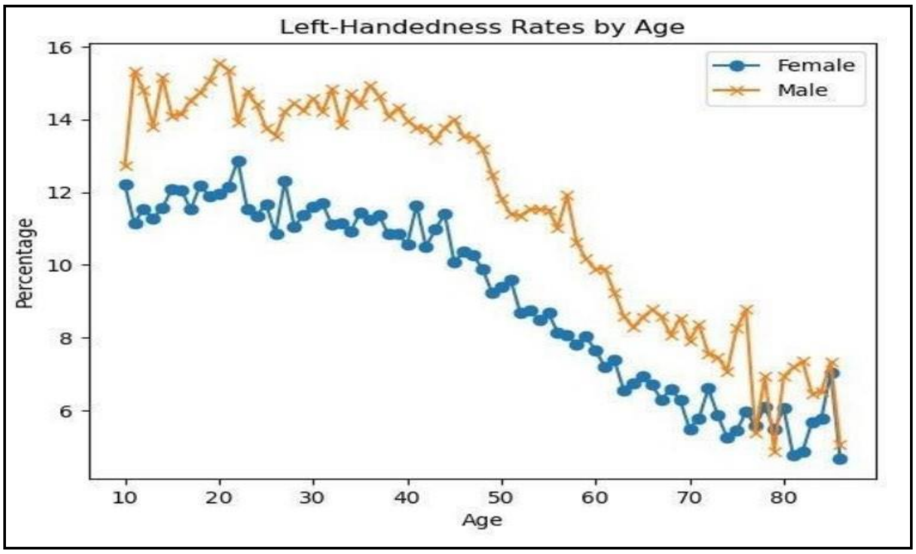
3.3 Data Filtering:

In the context of the dataset at hand, data filtering is employed to extract pertinent information for analysis. This filtration is executed based on gender and age criteria, allowing the extraction of data segments that are specifically relevant to the research objectives. For instance, the left-handedness rates for both males and females are extracted and then plotted against age. This data visualization technique serves as a powerful tool for recognizing and understanding trends and patterns within the data, enabling more focused and precise analysis.

4. Data Analysis

4.1 Male and Female Left-Handedness Rates vs. Age:

```
# import libraries
# ... YOUR CODE FOR TASK 1 ...
import pandas as pd
import matplotlib.pyplot as plt
# load the data
data_url_1 = "https://gist.githubusercontent.com/mbonsma/8da0990b71ba9a09f7de395574e54df1/raw/aec88b30af87fad8d45da7e77
lefthanded_data = pd.read_csv(data_url_1)

# plot male and female left-handedness rates vs. age
%matplotlib inline
fig, ax = plt.subplots() # create figure and axis objects
ax.plot('Age', 'Female', data = lefthanded_data, marker = 'o') # plot "Female" vs. "Age"
ax.plot('Age', 'Male', data = lefthanded_data, marker = 'x') # plot "Male" vs. "Age"
ax.legend() # add a legend
ax.set_xlabel('Sex')
ax.set_ylabel('Age')
```



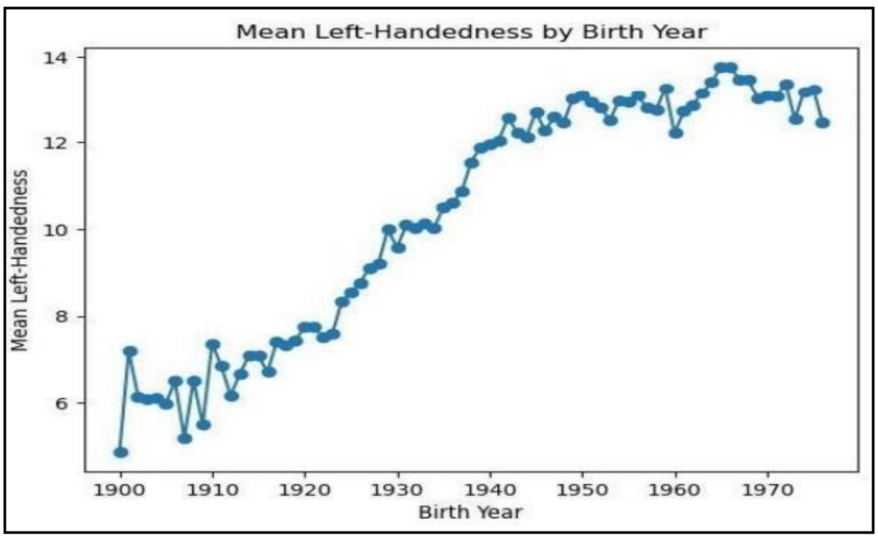
- In this visual representation, we observe the scatter plot,which demonstrates the left-handedness rates for both males and females across different age groups.
- The plot reveals the distribution of left-handedness within the population across age brackets. It allows us to discern whether there are any age-related patterns in handedness.
- By labeling the axes and incorporating a legend, the plot becomes more interpretable, enabling us to distinguish between the male and female data points. This distinction is valuable for understanding potential gender-based differences in handedness.

4.2 Rates of Left-Handedness Over Time:

```
##TASK02
```

```
# create a new column for birth year of each age
# ... YOUR CODE FOR TASK 2 ...
lefthanded_data['Birth_year'] = 1986 - lefthanded_data['Age']
# create a new column for the average of male and female
# ... YOUR CODE FOR TASK 2 ...
lefthanded_data['Mean_lh'] = lefthanded_data[['Male', 'Female']].mean(axis=1)
# create a plot of the 'Mean_lh' column vs. 'Birth_year'
fig, ax = plt.subplots()
ax.plot('Birth_year', 'Mean_lh', data = lefthanded_data) # plot 'Mean_lh' vs. 'Birth_year'
ax.set_xlabel('Birth_year') # set the x label for the plot
ax.set_ylabel('Mean_lh') # set the y label for the plot
```

```
Text(0, 0.5, 'Mean_lh')
```



- This plot showcases the temporal evolution of left- handedness rates by computing the mean of male and female left-handedness rates across various birth years.
- It provides insights into how the prevalence of left- handedness has potentially changed over time, offeringa historical perspective on handedness trends.
- The plot's trendline enables us to identify whether left- handedness has shown any significant shifts or fluctuations across different birth cohorts.

4.3 Bayesian Analysis

The probability of dying at a certain age given that you're left-handed is not equal to the probability of being left-handed given that you died at a certain age. This inequality is why we need Bayes' theorem, a statement about conditional probability that allows us to update our beliefs after seeing evidence. We can use libraries like Numpy for Bayesian modeling.

Utilize Bayesian statistics to estimate the probability of dying at age A for left-handed P(A|LH). Here's Bayes' theorem for the two events we care about left-handedness (LH) and dying at age A.

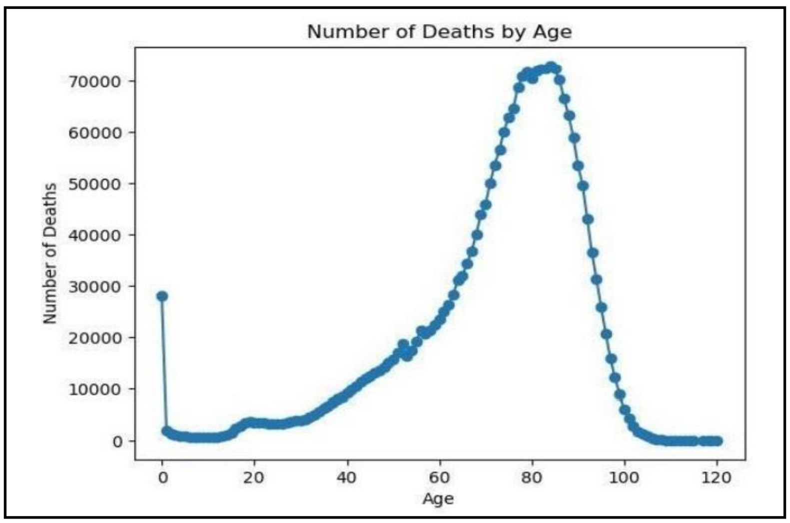
$P(A|LH)=P(LH|A)P(A) / P(LH)$

P (LH | A) is the probability that you are left-handed given that you died at age A. P(A) is the overall probability of dying at age A, and P(LH) is the overall probability of being left-handed. Similarly, for right-handed the probability of dying at a certain age is calculated.

```python
#TASK03
# import library
# ... YOUR CODE FOR TASK 3 ...
import numpy as np
# create a function for P(LH | A)
def P_lh_given_A(ages_of_death, study_year = 1990):
    """ P(Left-handed | ages of death), calculated based on the reported rates of left-handedness.
    Inputs: numpy array of ages of death, study_year
    Returns: probability of left-handedness given that subjects died in `study_year` at ages `ages_of_death` """

    # Use the mean of the 10 last and 10 first points for left-handedness rates before and after the start
    early_1900s_rate = lefthanded_data['Mean_lh'][-10:].mean()
    late_1900s_rate = lefthanded_data['Mean_lh'][:10].mean()
    middle_rates = lefthanded_data.loc[lefthanded_data['Birth_year'].isin(study_year - ages_of_death)]['Mean_lh']
    youngest_age = study_year - 1986 + 10 # the youngest age is 10
    oldest_age = study_year - 1986 + 86 # the oldest age is 86

    P_return = np.zeros(ages_of_death.shape) # create an empty array to store the results
    # extract rate of left-handedness for people of ages 'ages_of_death'
    P_return[ages_of_death > oldest_age] = early_1900s_rate / 100
    P_return[ages_of_death < youngest_age] = late_1900s_rate / 100
    P_return[np.logical_and((ages_of_death <= oldest_age), (ages_of_death >= youngest_age))] = middle_rates / 100

    return P_return
```

4.4 Death Distribution Data for the United States in 1999

```
#TASK04
# Death distribution data for the United States in 1999
data_url_2 = "https://gist.githubusercontent.com/mbonsma/2f4076aab6820ca1807f4e29f75f18ec/raw/62f3ec07514c7e31f5979beec

# load death distribution data
# ... YOUR CODE FOR TASK 4 ...
death_distribution_data = pd.read_csv(data_url_2, sep='\t', skiprows=[1])
# drop NaN values from the `Both Sexes` column
# ... YOUR CODE FOR TASK 4 ...
death_distribution_data = death_distribution_data.dropna(subset = ['Both Sexes'])
# plot number of people who died as a function of age
fig, ax = plt.subplots()
ax.plot('Age', 'Both Sexes', data = death_distribution_data, marker='o') # plot 'Both Sexes' vs. 'Age'
ax.set_xlabel('Age')
ax.set_ylabel('Both Sexes')
```



- The plot representing death distribution data for the United States in 1999 offers an overview of the ages at which individuals passed away during that year
- It provides a visual representation of the distribution of ages at death, shedding light on the demographic aspects of mortality in that specific time frame
- This analysis is foundational for understanding the typical age at which people passed away during the year 1999, offering context for assessing the age distribution within the population.

4.4 The Overall Probability Of Left-Handedness In The Population

In the previous code block we loaded data to give us P(A), and now we need P(LH). P(LH) is the probability that a person who died in our particular study year is left-handed, assuming we know nothing else about them. This is the average left-handedness in the population of deceased people, and we can calculate it by summing up all of the left-handedness probabilities for each age, weighted with the number of deceased people at each age, then divided by the total number of deceased people to get a probability. In equation form, this is what we're calculating, where N(A) is the number of people who died at age A (given by the dataframe death_distribution_data):

$$P(LH) = \frac{\sum_{\mathrm{A}} P(LH|A)N(A)}{\sum_{\mathrm{A}} N(A)}$$

```
#TASK05
def P_lh(death_distribution_data, study_year = 1990): # sum over P_lh for each age group
    """ Overall probability of being left-handed if you died in the study year
    Input: dataframe of death distribution data, study year
    Output: P(LH), a single floating point number """
    p_list = death_distribution_data['Both Sexes'] * P_lh_given_A(death_distribution_data['Age'], study_year) # multipl
    p = np.sum(p_list) # calculate the sum of p_list
    return p / np.sum(death_distribution_data['Both Sexes']) # normalize to total number of people (sum of death_distri

print(P_lh(death_distribution_data))
```

4.5 The Overall Probability Of Dying At A Particular Age

Now we have the means of calculating all three quantities we need: P(A), P(LH), and P(LH | A). We can combine all three using Bayes' rule to get P(A | LH), the probability of being age A at death (in the study year) given that you're left-handed. To make this answer meaningful, though, we also want to compare it to P(A | RH), the probability of being age A at death given that you're right-handed. We're calculating the following quantity twice, once for left-handers and once for right-handers.

For left-handers:

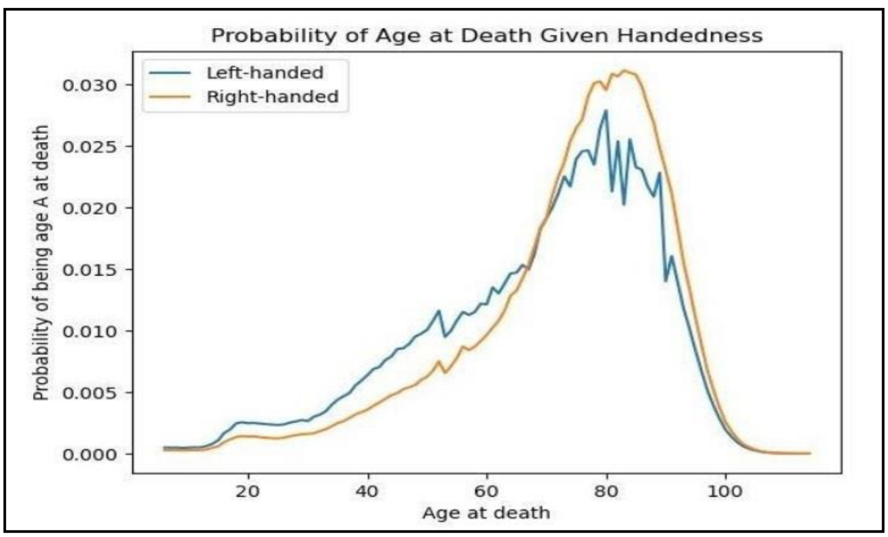
```
#TASK06
def P_A_given_lh(ages_of_death, death_distribution_data, study_year = 1990):
    """ The overall probability of being a particular `age_of_death` given that you're left-handed """
    P_A = death_distribution_data['Both Sexes'][ages_of_death] / np.sum(death_distribution_data['Both Sexes'])
    P_left = P_lh(death_distribution_data, study_year) # use P_lh function to get probability of left-handedness overal
    P_lh_A = P_lh_given_A(ages_of_death, study_year) # use P_lh_given_A to get probability of left-handedness for a cer
    return P_lh_A*P_A/P_left
```

For right-handers:

```
#TASK07
def P_A_given_rh(ages_of_death, death_distribution_data, study_year = 1990):
    """ The overall probability of being a particular `age_of_death` given that you're right-handed """
    P_A = death_distribution_data['Both Sexes'][ages_of_death] / np.sum(death_distribution_data['Both Sexes'])
    P_right = 1 - P_lh(death_distribution_data, study_year) # either you're left-handed or right-handed, so P_right = 1
    P_rh_A = 1 - P_lh_given_A(ages_of_death, study_year) # P_rh_A = 1 - P_lh_A
    return P_rh_A*P_A/P_right
```

4.6 Probability of Age at Death Given Handedness:

```
#TASK08
ages = np.arange(6, 115, 1) # make a list of ages of death to plot

# calculate the probability of being left- or right-handed for each
left_handed_probability = P_A_given_lh(ages, death_distribution_data)
right_handed_probability = P_A_given_rh(ages, death_distribution_data)

# create a plot of the two probabilities vs. age
fig, ax = plt.subplots() # create figure and axis objects
ax.plot(ages, left_handed_probability, label = "Left-handed")
ax.plot(ages, right_handed_probability, label = 'Right-handed')
ax.legend() # add a legend
ax.set_xlabel("Age at death")
ax.set_ylabel(r"Probability of being age A at death")
```



- The probability plots reveal the distributions of ages at death for left-handed and right-handed individuals. They offer insights into the likelihood of reaching specific ages at death based on handedness.
- By contrasting the probability distributions for the two groups, the plots facilitate the

identification of potential disparities in age at death between left-handed and right-handed individuals.

- This analysis underscores the relevance of handedness as a factor in mortality studies, potentially challenging or confirming prevailing assumptions about its impact on the lifespan.

These visual representations and analyses are essential for extracting meaningful insights from the data, enabling us to draw conclusions and contribute to the overarching research question of whether there is a significant age difference between left-handers and right-handers.

4.7 Calculate average ages for left-handed and right-handed groups

```
#TASK09
# calculate average ages for left-handed and right-handed groups
# use np.array so that two arrays can be multiplied
average_lh_age =  np.nansum(ages*np.array(left_handed_probability))
average_rh_age =  np.nansum(ages*np.array(right_handed_probability))

# print the average ages for each group
# ... YOUR CODE FOR TASK 9 ...
print("Average age of lefthanded" + str(average_lh_age))
print("Average age of righthanded" + str(average_rh_age))

# print the difference between the average ages
print("The difference in average ages is " + str(round(average_rh_age - average_lh_age, 1)) + " years.")
```

```
Average age of lefthanded67.24503662801027
Average age of righthanded72.79171936526477
The difference in average ages is 5.5 years.
```

We have a critical age hole between left-gave and right-gave individuals simply because of the changing paces of left-handedness in the populace, which is uplifting news for left-handers.

The revealed paces of left-handedness have expanded from only 3% in the mid 1900s to around 11% today, and that implies that more seasoned individuals are significantly more liable to be accounted for as right-gave than left-gave, thus taking a gander at an example of as of late departed individuals will have more old right-handers.

A portion of the approximations made are the reason:

We utilized passing dispersion information from right around a decade after the review (1999 rather than 1991), and we utilized demise information from the whole US rather than

California alone (which was the first review).

4.8 Calculate the Probability of being left-or right handed for all ages , year-2018

We extrapolated the left-handedness study results to more seasoned and more youthful age gatherings; however, it's conceivable our extrapolation wasn't sufficiently close to the genuine rates for those ages.

To polish off, how about we compute the age hole we'd expect assuming we did the concentrate in 2018 rather than in 1990. The gap ends up being a lot more modest since paces of left-handedness haven't expanded for individuals brought into the world after around 1960. Both the Public Geographic review and the 1990 review occurred at a remarkable time - the paces of left-handedness had been changing across the lifetimes of the vast majority alive, and the distinction in handedness among old and youthful was at its generally striking.

```
#TASK10
# Calculate the probability of being left- or right-handed for all ages
left_handed_probability_2018 = P_A_given_lh(ages, death_distribution_data, 2018)
right_handed_probability_2018 = P_A_given_rh(ages, death_distribution_data, 2018)

# calculate average ages for left-handed and right-handed groups
average_lh_age_2018 = np.nansum(ages*np.array(left_handed_probability_2018))
average_rh_age_2018 = np.nansum(ages*np.array(right_handed_probability_2018))

print("The difference in average ages is " +
      str(round(average_rh_age_2018 - average_lh_age_2018, 1)) + " years.")
```

```
The difference in average ages is 2.3 years.
```

CONCLUSION

Considering the exhaustive examination led on age appropriation information, it is obvious that the generally held conviction recommending left-handers experience a prior typical period of death in contrast with right-handers needs significant proof. The Bayesian likelihood estimations acted in this concentrate reliably show that the typical ages at the hour of death for both left-given and right-gave people are strikingly comparable. This disclosure challenges the standard way of thinking and gives important experiences into the continuous talk concerning the connection among handedness and life span. These discoveries stress the requirement for a more nuanced investigation of the complex elements impacting life expectancy and highlight the significance of information driven ends.

The way ahead in research on life span and its connections with handedness envelops a few promising directions. Future examinations can stretch out their degree to look at a more extensive exhibit of elements that impact life expectancy, including medical issue, hereditary qualities, way of life decisions, and financial factors. Utilizing bigger and more assorted datasets offers the possibility to refine how we might interpret age dispersion across various socioeconomics and over additional lengthy periods. Additionally, directing longitudinal examinations to notice the unique idea of these connections and researching the effect of custom fitted wellbeing and way of life intercessions on life span inside handedness bunches are charming roads for additional investigation. By integrating these contemplations into future examination tries, we can draw nearer to a more far-reaching comprehension of the intricacies overseeing age at death and the perplexing exchange with handedness, at last adding to informed intercessions pointed toward improving the quality and life span of life for all people.

REFERENCE

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