TUTORIAL 4 Pre-EXERCISE

PART 1

Example 9.2a | Propellant Burning Rate

- Air crew escape systems are powered by a solid propellant. The burning rate of this propellant is an important product characteristic. Specifications require that the mean burning rate must be 50 centimeters per second and the standard deviation is $\sigma = 2$ centimeters per second. The significance level of $\alpha = 0.05$ and a random sample of $n = 25$ has a sample average burning rate of $\bar{x} = 51.3$ centimeters per second. Draw conclusions.
- The seven-step procedure is
  1. **Parameter of interest:** The parameter of interest is μ, the mean burning rate.
  2. **Null hypothesis:** H_0: $\mu = 50$ centimeters per second
  3. **Alternative hypothesis:** H_1: $\mu \neq 50$ centimeters per second

What is the appropriate statistical test for this data?

One sample Mean Z test.

Importing relevant libraries!

In [12]:
```
import pandas as pd #library to work with data frames
import numpy as np #library to work with data frames
import matplotlib.pyplot as plt #library to plot figure
import matplotlib.dates as mdates #library for visualization
import seaborn as sns #library to plot figures
import scipy
from scipy import stats
from scipy.stats import t
import statsmodels.api as sm
```

PART 2

What assumptions are you making by choosing this test? Justify why they are acceptable.

Known population stanadrd deviation. Sample from Normal population.

PART 3: Provide the 7 steps of the Procedures for Hypothesis Tests

1. Paramater of Interest

2. State the null hypothesis

3. State the null hypothesis

4. Determine appropriate test statistic

5. State the rejection criteria for null hypothesis

6. Computations

7. Draw Conclusions

Step 1: parameter of interest is mean buring rate = μ

mean of burning rate

Step 2: state the null hypothesis

Is it a one-sided test or a two-sided test?

two sided

Null hypthesis= H0= $\mu1$=50

Step 3: state the alternative hypothesis

Alternative hypothesis - HA = $\mu1$ $\neq$ 50

Step 4: test statistic is:

The z statistic to test whether the mean is different than a population mean of 50 cm per sec

$$z_0 = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}}$$

Step 5: Reject Ho if p-value less than 0.05. The critical values at this alhpa value are z=

Reject H_0 if: Reject H_0 if the *P*-value is less than 0.05. The boundaries of the critical region would be $z_{0.975} = 1.96$ *and* $z_{0.025} = -1.96$.

In [29]:
```
# critical value of z at alpha/2 = 0.025
stats.norm.ppf(0.025)
```

Out[29]:
```
-1.9599639845400545
```

In [33]:
```
# critical value of Z at at alpha/2 = 0.975
stats.norm.ppf(0.975)
```

Out[33]:
```
1.959963984540054
```

Step 6 Computations

Computations: Since $\bar{x} = 51.3$ and $\sigma = 2$,

$$z_0 = \frac{51.3 - 50}{2/\sqrt{25}} = 3.25$$

In [57]:
```
# computation in python
z= (51.3-50) /(2/np.sqrt(25))
z
```

Out[57]:
```
3.249999999999993
```

Step 7: Conclusions

Conclusion: Since $z_0 = 3.25$ and the p-value is $= 2[1 - \Phi(3.25)] = 0.0012$, we reject H_0: $\mu = 50$ at the 0.05 level of significance.

Practical Interpretation: The mean burning rate differs from 50 centimeters per second, based on a sample of 25 measurements.

In [60]:
```
# look up in a z-table the p-value at z=3.25, or ask python for this as below
1-stats.norm.cdf(3.25)
```

Out[60]:
```
0.0005770250423907664
```

In [62]:
```
# multiply by 2 for 2-sided test
2* (1-stats.norm.cdf(3.25))
```

Out[62]:
```
0.0011540500847815327
```

In [ ]:

In [ ]: