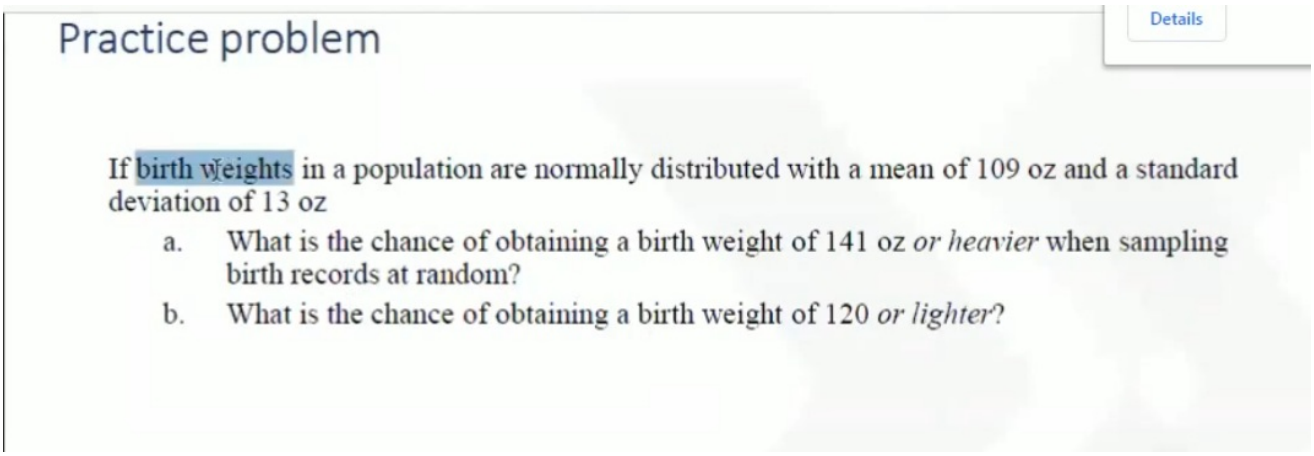
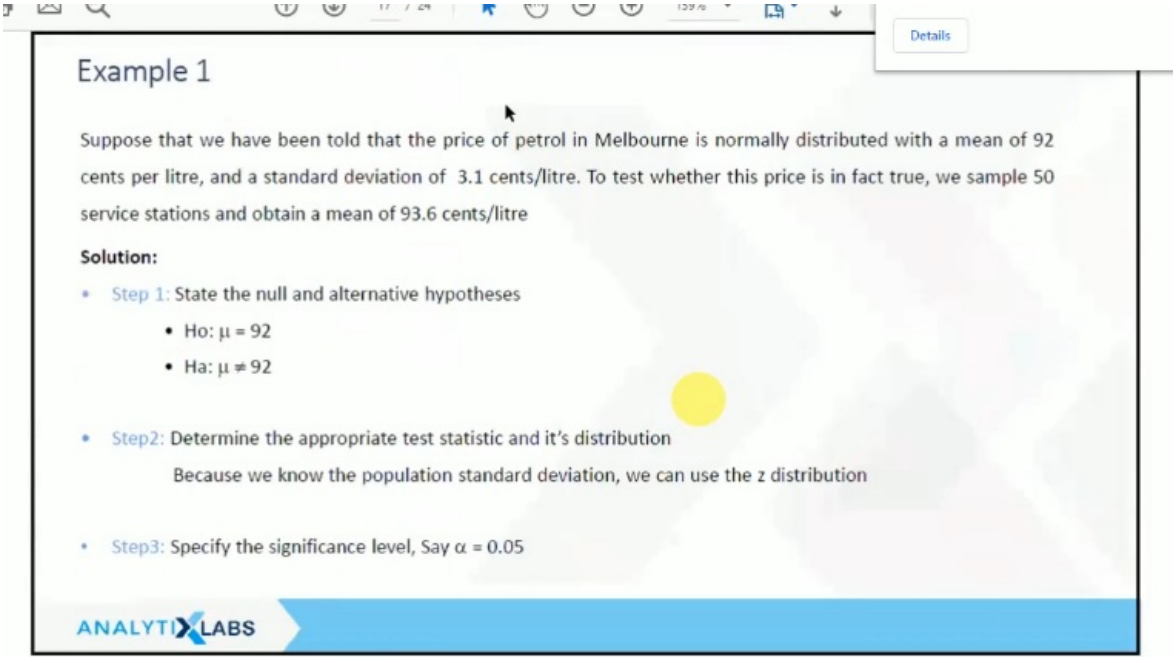
In [ ]:

```
'''probability distribution
let we have a data 10000 customers - Age(min=12, max=96)
0% = 12
5% = 14
10% = 18
20% = 22
25% = 24.6
50% = 36
75% = 58
90% = 66
95% = 72
99% = 88
100 = 96
p(age<66) : 90%
p(age>72) : 100% - p(age<72)=100-95 = 5%
p(age>22 and age<66) = 70%



what if the p(age>25)
p(age>30 and age<60)

      bins                                          freq
      ------                                       ------
      12-14      (smaller intervel binning)     let 5
      14-16                                        3
      16-18                                        8
      18-20                                        9
      20-22                                        11
      ..
      ..
      ..
      92-94                                        2
      94-96                                        1



we draw a bar graph
binning intervwls in x axis   and frequency in y axis


we draw a curve which roughly connects all points
   This is how Histagram is generated



we get f(x) curve

the integration of the f(x) will give us area under the curve


------------------------------------------------------------------------
 f(x) :probability Distribution funcion
    -There are ~20 commonly occuring probability functions
    -Almost 99% of the data follows either one of those 20
    This is an emerical rule
    we have those f(x) for the PDcurves, so we can apply that to the                suitable data
    we have also defined standard scales and corresponding probability %

    whatever is the data points and its distribution , we can convert data            into its standard form
        E.g., If age follows exponential curve can be converted to standard exp curve


------------------------------------------------------------------------
Normal Distrubtion
    -displot gives bell curve
let say we have data points whose size is > 30
         Tendence
         ~68% of the data lies between mean +/- sd
         LC = mean -sd
         UC = mean +sd
         data[data > LC | data < UC]
         mean+/- sd : 68%
         mean+/- 2*sd : 95%
         mean+/- 3*sd : 99.7%
       - curve is perfectly symmtric
          - skew close to zero
          - kurtosis : -2 to +2
          - mean==median==mode
   - Hypothesis testing to prove normality
       - Shapiro wilk's Test
       - Anderson-Darling Test

   -Any distribution can be converted to normal distribution using suitable           transformation


 Standard normal distrubtions
```

```
      - a normal distribution so converted that its new mean =0  sd=1
      -this transformation : Z transform
          Z_value  = x_value  - mean
                     --------------
                         std
if age follows a normal distrubtion

p(weight>141)
     1-p(weight<141)
     p(weight<141)  = 141 - 109
                      ---------  = 2.46  =0.99266%
                         13
p(weight>141)  =0.00744



p(weight<120)  = 120-109
                 -------  = 0.8461   =79.955%'''
                 13
```



p(weight>141) 1-p(weight<141) p(weight<141) = 141 - 109 --------- = 2.46 =0.99266% 13 p(weight>141) =0.00744 p(weight<120) = 120-109 ------- = 0.8461 =79.955%Central Limit Theorm ---------- A data follows any distribution , if we take enough samples E.g. whats the price of i kg of rice in Maxico Sample1 : 5 variants of rice : mean_s1 Sample2 : 10 variants of rice : mean_s2 Sample3 : 1 variants of rice : mean_s3 ... ... s50: :mean_s50 ---------- mean(all samples) 1. the mean of all samples follow normal distribution 2. the mean of all sample means is equal to population Mean 3. the SD of samples mean is error factor = Standard error Standard error = SD(population)/sqrt(sample_size) z-Test and T-test- -z-test is a test to prove if a sample mean is significantely different from population mean or not - It is applicable if data is normally distributed - sample size is atleast 30 - we know the population mean and std div Student 's t test is a test to prove if a sample mean is significantely different from population mean or not - It is applicable if data is not normally distributed- t distribution - sample size is < 30 - we dont know the population mean and std div when to use : - to compare a sample estimation with a population - to compare 2 estimators from a sample E.g. score_test1 vs score_test2 jan_spend vs mar_spend for 200 customers -python -ttest - one sample t test -two sample t test - independ sample t test E.g jan_spend(male) vs jan_spend(female)



Hypothesis Testing

-Step1 : Define the null and alt hypothesis Null/H)/Ho : mostly checks equality Alt/H1/Ha : mostly checks for different/ inequality check for > check for < -Step2 : see which stats method can we apply? Z-Test T test F test X2 test

-step3 : what is the test statistics and p value? and level of confidence Z-Test T test F test X2 test

-Step4 : what to do with the Null Hypothesis based on the above values??

```
  - do we reject null hypothesis
  - Do we fail to reject the null hypothesisn (accept)

If p is high we fail to reject the null
If p is loww we reject the null
```

-step 5 : Conclusion

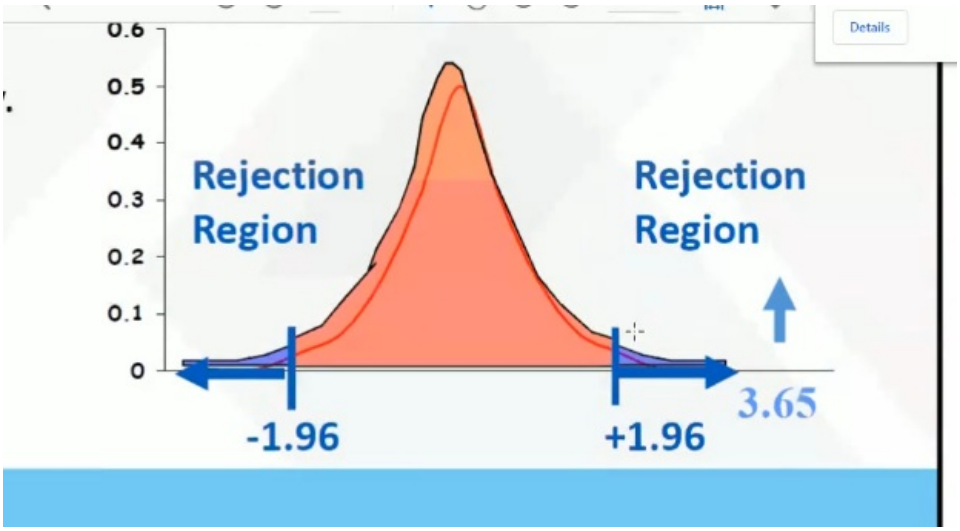
Ans: 1 H0: pop mean is exactly 92(u=92) Ha: pop mean is not equal to 92,its different u!=92

2 - Normally dis ?? Yes

```
- Do we have pop info?? yes
- is the same size> 30? yes
- So which test? Z test
```

3. Test Stastics? Z Score = sample mean-pop_mean

```
                    SD/sqrt(n)

                    93.6-92
                    --------       = 3.65
                    3.1/sqrt(50)
for the decided CI of 95% the upper and lower cutoff
UC=mean+1.96*SE
LC=mean-1.96*SE
```



conclusion : we reject the Null Hypothesis

```
The petrol price in melbourn is diff from 92
```

In [1]:
```
import numpy as np
import pandas as pd
import seaborn as sns
from matplotlib import pyplot as plt
```

```
A module that was compiled using NumPy 1.x cannot be run in
NumPy 2.0.2 as it may crash. To support both 1.x and 2.x
versions of NumPy, modules must be compiled with NumPy 2.0.
Some module may need to rebuild instead e.g. with 'pybind11>=2.12'.

If you are a user of the module, the easiest solution will be to
downgrade to 'numpy<2' or try to upgrade the affected module.
We expect that some modules will need time to support NumPy 2.

Traceback (most recent call last):  File "C:\Users\sival\anaconda3\lib\runpy.py", line 197, in _run_module_as_m
ain
    return _run_code(code, main_globals, None,
  File "C:\Users\sival\anaconda3\lib\runpy.py", line 87, in _run_code
    exec(code, run_globals)
  File "C:\Users\sival\anaconda3\lib\site-packages\ipykernel_launcher.py", line 16, in <module>
    app.launch_new_instance()
  File "C:\Users\sival\anaconda3\lib\site-packages\traitlets\config\application.py", line 846, in launch_instan
ce
    app.start()
  File "C:\Users\sival\anaconda3\lib\site-packages\ipykernel\kernelapp.py", line 677, in start
    self.io_loop.start()
  File "C:\Users\sival\anaconda3\lib\site-packages\tornado\platform\asyncio.py", line 199, in start
    self.asyncio_loop.run_forever()
  File "C:\Users\sival\anaconda3\lib\asyncio\base_events.py", line 601, in run_forever
    self._run_once()
  File "C:\Users\sival\anaconda3\lib\asyncio\base_events.py", line 1905, in _run_once
    handle._run()
  File "C:\Users\sival\anaconda3\lib\asyncio\events.py", line 80, in _run
    self._context.run(self._callback, *self._args)
  File "C:\Users\sival\anaconda3\lib\site-packages\ipykernel\kernelbase.py", line 471, in dispatch_queue
    await self.process_one()
  File "C:\Users\sival\anaconda3\lib\site-packages\ipykernel\kernelbase.py", line 460, in process_one
    await dispatch(*args)
  File "C:\Users\sival\anaconda3\lib\site-packages\ipykernel\kernelbase.py", line 367, in dispatch_shell
    await result
  File "C:\Users\sival\anaconda3\lib\site-packages\ipykernel\kernelbase.py", line 662, in execute_request
    reply_content = await reply_content
  File "C:\Users\sival\anaconda3\lib\site-packages\ipykernel\ipkernel.py", line 360, in do_execute
    res = shell.run_cell(code, store_history=store_history, silent=silent)
  File "C:\Users\sival\anaconda3\lib\site-packages\ipykernel\zmqshell.py", line 532, in run_cell
    return super().run_cell(*args, **kwargs)
  File "C:\Users\sival\anaconda3\lib\site-packages\IPython\core\interactiveshell.py", line 2863, in run_cell
    result = self._run_cell(
  File "C:\Users\sival\anaconda3\lib\site-packages\IPython\core\interactiveshell.py", line 2909, in _run_cell
    return runner(coro)
  File "C:\Users\sival\anaconda3\lib\site-packages\IPython\core\async_helpers.py", line 129, in _pseudo_sync_ru
nner
    coro.send(None)
  File "C:\Users\sival\anaconda3\lib\site-packages\IPython\core\interactiveshell.py", line 3106, in run_cell_as
ync
    has_raised = await self.run_ast_nodes(code_ast.body, cell_name,
  File "C:\Users\sival\anaconda3\lib\site-packages\IPython\core\interactiveshell.py", line 3309, in run_ast_nod
es
    if await self.run_code(code, result, async_=asy):
  File "C:\Users\sival\anaconda3\lib\site-packages\IPython\core\interactiveshell.py", line 3369, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "C:\Users\sival\AppData\Local\Temp\ipykernel_30892\2193719592.py", line 2, in <cell line: 2>
    import pandas as pd
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\__init__.py", line 80, in <module>
    from pandas.core.api import (
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\core\api.py", line 28, in <module>
    from pandas.core.arrays import Categorical
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\core\arrays\__init__.py", line 1, in <module>
    from pandas.core.arrays.arrow import ArrowExtensionArray
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\core\arrays\arrow\__init__.py", line 5, in <module>
    from pandas.core.arrays.arrow.array import ArrowExtensionArray
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\core\arrays\arrow\array.py", line 50, in <module>
    from pandas.core import (
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\core\ops\__init__.py", line 8, in <module>
    from pandas.core.ops.array_ops import (
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\core\ops\array_ops.py", line 56, in <module>
    from pandas.core.computation import expressions
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\core\computation\expressions.py", line 21, in <module
>
    from pandas.core.computation.check import NUMEXPR_INSTALLED
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\core\computation\check.py", line 5, in <module>
    ne = import_optional_dependency("numexpr", errors="warn")
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\compat\_optional.py", line 135, in import_optional_de
pendency
    module = importlib.import_module(name)
  File "C:\Users\sival\anaconda3\lib\importlib\__init__.py", line 127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "C:\Users\sival\anaconda3\lib\site-packages\numexpr\__init__.py", line 24, in <module>
    from numexpr.interpreter import MAX_THREADS, use_vml, __BLOCK_SIZE1__
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
AttributeError: _ARRAY_API not found
```

```
A module that was compiled using NumPy 1.x cannot be run in
NumPy 2.0.2 as it may crash. To support both 1.x and 2.x
versions of NumPy, modules must be compiled with NumPy 2.0.
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  File "C:\Users\sival\anaconda3\lib\site-packages\IPython\core\async_helpers.py", line 129, in _pseudo_sync_ru
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    coro.send(None)
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  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\core\arrays\__init__.py", line 1, in <module>
    from pandas.core.arrays.arrow import ArrowExtensionArray
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\core\arrays\arrow\__init__.py", line 5, in <module>
    from pandas.core.arrays.arrow.array import ArrowExtensionArray
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\core\arrays\arrow\array.py", line 64, in <module>
    from pandas.core.arrays.masked import BaseMaskedArray
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\core\arrays\masked.py", line 60, in <module>
    from pandas.core import (
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\core\nanops.py", line 52, in <module>
    bn = import_optional_dependency("bottleneck", errors="warn")
  File "C:\Users\sival\anaconda3\lib\site-packages\pandas\compat\_optional.py", line 135, in import_optional_de
pendency
    module = importlib.import_module(name)
  File "C:\Users\sival\anaconda3\lib\importlib\__init__.py", line 127, in import_module
    return _bootstrap._gcd_import(name[level:], package, level)
  File "C:\Users\sival\anaconda3\lib\site-packages\bottleneck\__init__.py", line 7, in <module>
    from .move import (move_argmax, move_argmin, move_max, move_mean, move_median,
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
AttributeError: _ARRAY_API not found
```
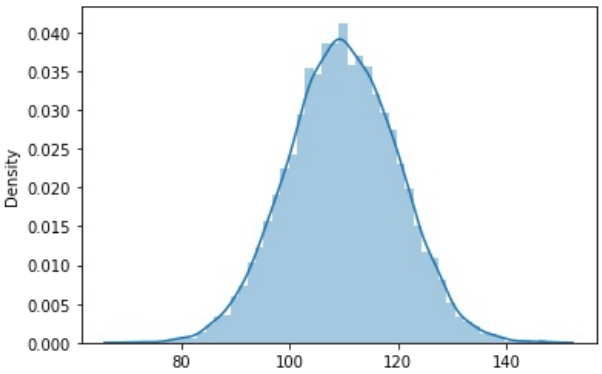

In [2]:
```
data=pd.Series(np.random.normal(loc=110 ,scale = 10, size=10000))
# loc means central tendncy
# scale means std deviation
```

In [3]:
```
data
```

Out[3]:
```
0       106.815679
1       112.765677
2       102.912704
3       122.161152
4       113.942089
           ...
9995    100.888295
9996    117.934763
9997    106.499901
9998    109.883819
9999    107.993178
Length: 10000, dtype: float64
```

In [24]:
```
sns.distplot(data)
plt.show()
```

```
C:\Users\sival\AppData\Local\Temp\ipykernel_30892\2883516215.py:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(data)
```



In [10]:
```
data.mean()
```

Out[10]:
```
np.float64(109.81953872823456)
```

In [11]:
```
data.std()
```

Out[11]:
```
np.float64(10.098677297465043)
```

In [12]:
```
LC=data.mean()-data.std()
UC=data.mean()+data.std()
```

In [13]:
```
len(data[(data>LC)&(data<UC)])/len(data)*100
```

Out[13]:
```
68.05
```

In [15]:
```
LC=data.mean()-2*data.std()
UC=data.mean()+2*data.std()
len(data[(data>LC)&(data<UC)])/len(data)*100
```

Out[15]:
```
95.65
```

In [16]:
```
LC=data.mean()-3*data.std()
UC=data.mean()+3*data.std()
len(data[(data>LC)&(data<UC)])/len(data)*100
```

Out[16]:
```
99.72999999999999
```

In [18]:
```
data.skew()
```

Out[18]:
```
np.float64(-0.009189262514076894)
```

In [19]:
```
data.kurtosis()
```

Out[19]:
```
np.float64(-0.002579663020549905)
```

In [20]:
```
data.median()
```

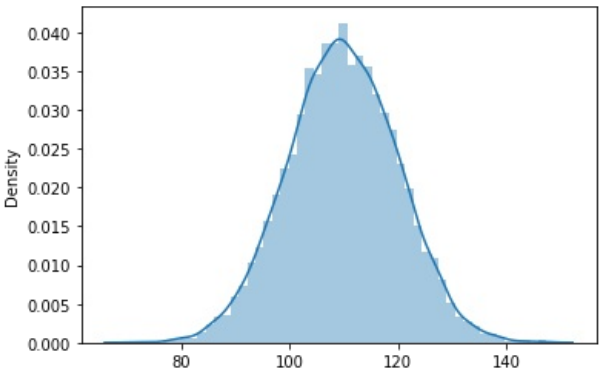
Out[20]:
```
np.float64(109.79850151241288)
```

In [23]:
```
#Standard Gaussian/Normal
```

```
z_data = (data-data.mean())/data.std()
```

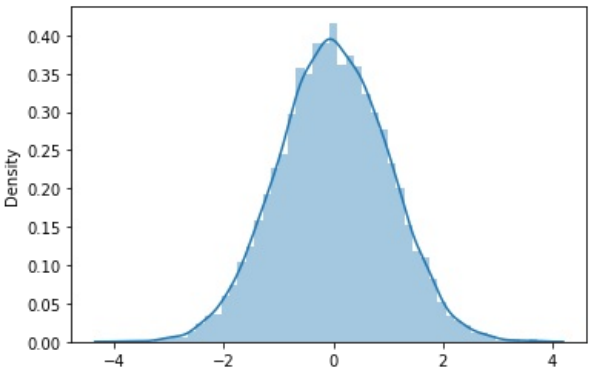
In [27]:
```
sns.distplot(data)

plt.show()
```

```
C:\Users\sival\AppData\Local\Temp\ipykernel_30892\275652812.py:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(data)
```



In [26]:
```
sns.distplot(z_data)
plt.show()
```

```
C:\Users\sival\AppData\Local\Temp\ipykernel_30892\2040845632.py:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(z_data)
```



In [28]:
```
z_data.mean()
```

Out[28]:
```
np.float64(-2.3110402480597257e-16)
```

In [29]:
```
z_data.std()
```

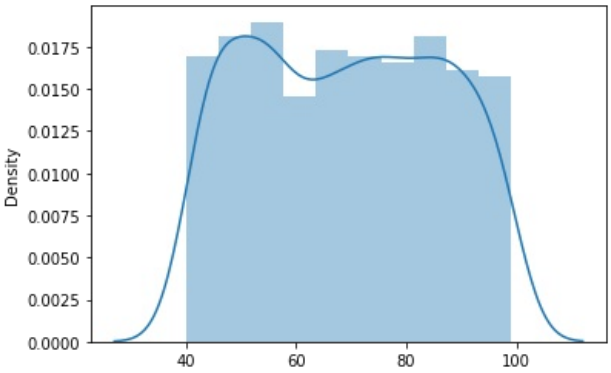
Out[29]:
```
np.float64(1.0)
```

In [36]:
```
data2=pd.Series(np.random.randint(40,high=100,size=1000,dtype=int))
```

In [37]:
```
sns.distplot(data2)
```

```
C:\Users\sival\AppData\Local\Temp\ipykernel_30892\4141362572.py:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(data2)
```

Out[37]:
```
<Axes: ylabel='Density'>
```



In [38]:
```
s1_mean = data2.sample(n=10).mean()
```

In [42]:
```
all_sample_means=[]
for i in range(0,150):
    all_sample_means.append(data2.sample(n=10).mean())
all_sample_means = pd.Series(all_sample_means)
len(all_sample_means)
```

Out[42]:
```
150
```

In [43]:
```
sns.distplot(all_sample_means)
```

```
C:\Users\sival\AppData\Local\Temp\ipykernel_30892\2369821419.py:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

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  sns.distplot(all_sample_means)
```
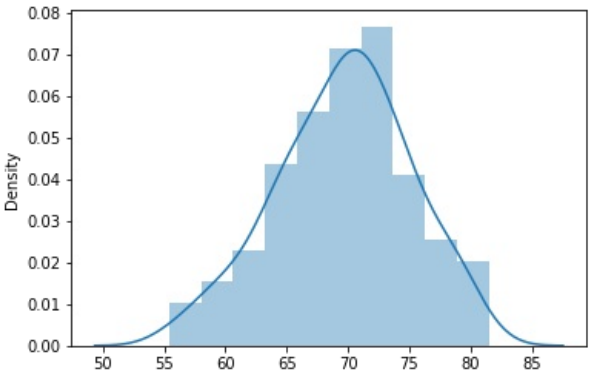

Out[43]:
```
<Axes: ylabel='Density'>
```



In [44]:
```
data2.mean()
```

Out[44]:
```
np.float64(69.037)
```

In [45]:
```
all_sample_means.mean()
```

Out[45]:
```
np.float64(69.64266666666666)
```

In [46]:
```
data2.mean()-all_sample_means.mean()
```

Out[46]:
```
np.float64(-0.6056666666666501)
```

In [49]:
```
data2.std()/np.sqrt(150)
```

Out[49]: np.float64(1.4102196966878102)

In [ ]: