5.2.5 Exam: More fun with the bimodal uniform distribution

Bookmark this page

Exams due Sep 27, 2023 05:00 IST Completed

The following function implements the bimodal uniform distribution which we considered in previous Finger Exercises in Sections 3.9.4 and 3.9.6.

And, here is a file with that function implemented.

```
import numpy as np
import matplotlib.pyplot as plt

def biuniform(xmode0, xmode1, Pmode0=0.5, N=1, seed=None):
    """
    Returns an array of size N of random numbers x which have two modes
    (i.e. the distribution is bimodal) from:
        xmode0[0] < x < xmode0[1]
        xmode1[0] < x < xmode1[1]

    where the probability of being in mode0 is Pmode0, and within either mode,
    the distributions are uniform.

    Args:
        xmode0 (tuple): range of mode0 = xmode0[0] to xmode0[1]
        xmode1 (tuple): range of mode1 = xmode1[0] to xmode1[1]
        Pmode0 (float): probability of being in mode0
        N (shape): either an integer or shape tuple giving the size of the
                   random number array to generate
        seed (int or None): seed to be used for random number generator
    """
    rng = np.random.default_rng(seed)
    Pmode = rng.uniform(0,1,N)
    mode0 = rng.uniform(xmode0[0],xmode0[1],N)
    mode1 = rng.uniform(xmode1[0],xmode1[1],N)
    x = np.where(Pmode>Pmode0, mode1, mode0)

    return x
```

Problem: Which arrays are correct?

3.0/3.0 points (graded)

Consider a bimodal uniform distribution with 50% of the values between $-2 < x < -1$ and the other 50% between $1 < x < 2$. Suppose the desired result is to produce a NumPy array with exactly 100 elements drawn from this distribution. Which of the following arrays correctly produce the desired result?

```
xA = biuniform( (-2,-1), (1,2))
xB = biuniform( (-2,-1), (1,2), Pmode0=0.5)
xC = biuniform( (-2,-1), (1,2), Pmode0=0.5, N=100)
xD = biuniform( (-2,-1), (1,2), N=100)
xE = biuniform( (-2,-1), (1,2), Pmode0=0.5, N=100, seed=314)
xF = biuniform( (-2,-1), (1,2), N=100, seed=314)
```

- ○ xA is correct
- ◉ xA is not correct

✔

- ○ xB is correct
- ◉ xB is not correct

✔

- ◉ xC is correct
- ○ xC is not correct

✔

- ◉ xD is correct
- ○ xD is not correct

✔

- ◉ xE is correct
- ○ xE is not correct

✔

- ◉ xF is correct
- ○ xF is not correct

✔

Submit

Problem: Checking equality

1.5/1.5 points (graded)

Consider again the arrays generated above. Choose the answer that describes the most likely result from the following print statements.

```
print(xA==xB)
```

- ○ 0
- ○ 1
- ◉ [False]
- ○ [True]
- ○ An error occurs

✔

```
print(xC==xE)
```

- [0 0 0 ... 0 0 0]
- [1 1 1 ... 1 1 1]
- [False False False ... False False False]
- [True True True ... True True True]
- An error occurs

✔

```
print(xE==xF)
```

- [0 0 0 ... 0 0 0]
- [1 1 1 ... 1 1 1]
- [False False False ... False False False]
- [True True True ... True True True]
- An error occurs

✔

Submit

Answers are displayed within the problem

Problem: Finding the mean and confidence intervals using xE

2.5/2.5 points (graded)

In these questions, please use the NumPy array xE generated using the statement above.

What is the sample mean of xE? Give your answer with four digits of precision (i.e. in scientific notation, your answer should be in the form W.XYZeP).

-0.162849 ✔ Answer: -1.628491e-01

What is the standard deviation of xE? Note: calculate the standard deviation using an unbiased estimate of the variance of x. Give your answer with four digits of precision (i.e. in scientific notation, your answer should be in the form W.XYZeP).

1.579747 ✔ Answer: 1.579747e+00

Estimate the standard error of the mean of x (estimate this using your answer for the standard deviation of xE in the previous problem)? Give your answer with four digits of precision (i.e. in scientific notation, your answer should be in the form W.XYZeP).

0.1579747 ✔ Answer: 1.579747e-01

Using the approach described in Section 15.3.7, calculate the 95% confidence interval for mean of x, μ_x, which will have the following form:

$$(\mu_x)_{\text{low}} < \mu_x < (\mu_x)_{\text{high}} \tag{5.30}$$

What is $(\mu_x)_{\text{low}}$? Give your answer with four digits of precision (i.e. in scientific notation, your answer should be in the form W.XYZeP).

-0.47248 ✔ Answer: -4.724796e-01

What is $(\mu_x)_{\text{high}}$? Give your answer with four digits of precision (i.e. in scientific notation, your answer should be in the form W.XYZeP).

0.14678 ✔ Answer: 1.467814e-01

Submit

Answers are displayed within the problem

Problem: Finding the mean of a function of x using xE

2.5/2.5 points (graded)
In these questions, again please use the NumPy array xE generated using the statement above.

Consider the following function of x: $f(x) = x^2$.

Using the array xE, generate the corresponding sample of f values. Suppose you store that sample in a NumPy array called fE.

What is the sample mean of fE? Give your answer with four digits of precision (i.e. in scientific notation, your answer should be in the form W.XYZeP).

2.49717 ✔ Answer: 2.497166e+00

What is the standard deviation of fE? Note: calculate the standard deviation using an unbiased estimate of the variance of f. Give your answer with four digits of precision (i.e. in scientific notation, your answer should be in the form W.XYZeP).

0.852668 ✔ Answer: 8.526685e-01

Estimate the standard error of the mean of f (estimate this using your answer for the standard deviation of fE in the previous problem)? Give your answer with four digits of precision (i.e. in scientific notation, your answer should be in the form W.XYZeP).

0.0852668 ✔ Answer: 8.526685e-02

Using the approach described in Section 15.3.7, calculate the 95% confidence interval for mean of f, μ_f, which will have the following form:

$$(\mu_f)_{\text{low}} < \mu_f < (\mu_f)_{\text{high}} \tag{5.31}$$

What is $(\mu_f)_{\text{low}}$? Give your answer with four digits of precision (i.e. in scientific notation, your answer should be in the form W.XYZeP).

2.33004 ✔ Answer: 2.330043e+00

What is $(\mu_f)_{\text{high}}$? Give your answer with four digits of precision (i.e. in scientific notation, your answer should be in the form W.XYZeP).

2.6642887 ✔ Answer: 2.664289e+00

Submit

Answers are displayed within the problem

Previous Next