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The bivariate copula (`Bicop`) API

Import the library

```
[1]: import pyvinecopulib as pv  
import numpy as np
```

Create an independence bivariate copula

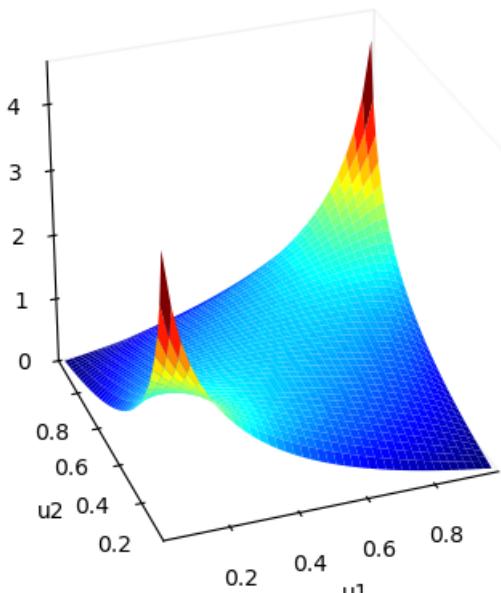
The default constructor of the `Bicop` class creates an independence bivariate copula.

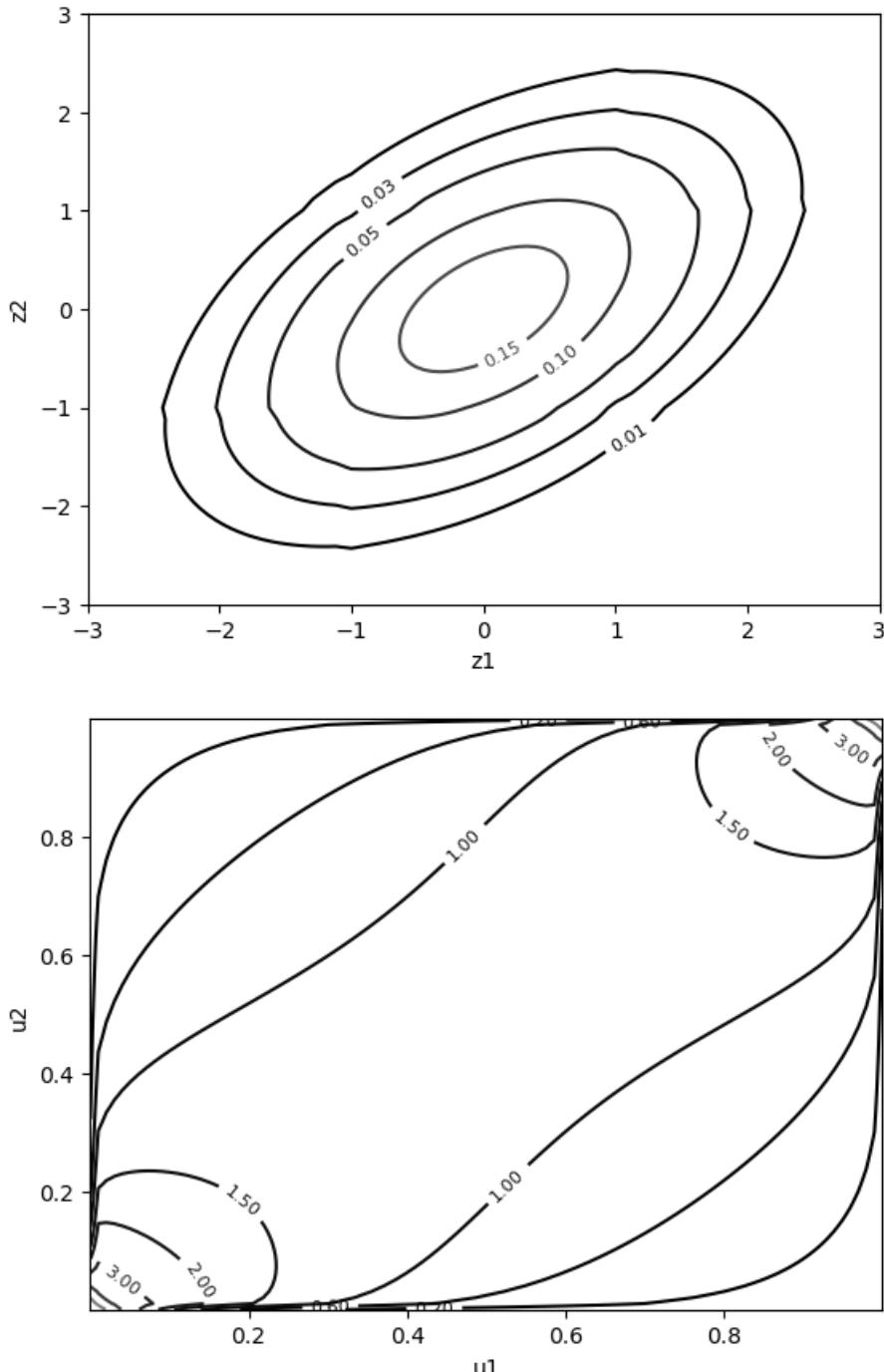
```
[2]: pv.Bicop()  
  
[2]: <pyvinecopulib.Bicop> Bivariate copula:  
      family = Independence  
      rotation = 0  
      var_types = c,c
```

Create and plot a Gaussian copula

See `help(pv.BicopFamily)` for the available families

```
[3]: cop = pv.Bicop(family=pv.gaussian, parameters=np.array([[0.5]]))  
print(cop)  
cop.plot() # surface plot of copula density  
cop.plot(type="contour", margin_type="norm") # contour plot with normal margins  
cop.plot(type="contour", margin_type="unif") # contour plot of copula density  
  
<pyvinecopulib.Bicop> Bivariate copula:  
      family = Gaussian  
      rotation = 0  
      var_types = c,c  
      parameters = 0.5
```





Some other families

- A 90 degrees rotated Clayton copula with parameter = 3
- A t copula with correlation of 0.5 and 4 degrees of freedom and showcase some methods

```
[4]: print(pv.Bicop(family=pv.clayton, rotation=90, parameters=np.array([[3.0]])))

cop = pv.Bicop(family=pv.student, parameters=np.array([[0.5], [4]]))
print(cop)
u = cop.simulate(n=10, seeds=[1, 2, 3])
fcts = [
    cop.pdf,
    cop.cdf,
    cop.hfunc1,
    cop.hfunc2,
    cop.hinv1,
    cop.hinv2,
    cop.loglik,
    cop.aic,
    cop.bic,
]
[f(u) for f in fcts]
```

```

<pyvinecopulib.Bicop> Bivariate copula:
  family = Clayton
  rotation = 90
  var_types = c,c
  parameters = 3

<pyvinecopulib.Bicop> Bivariate copula:
  family = Student
  rotation = 0
  var_types = c,c
  parameters = 0.5
  4

[4]: [array([1.28047174, 1.58894473, 1.69217442, 1.40160547, 1.17446536,
   0.96780094, 8.19750257, 1.32347107, 1.66596506, 2.07799487]),
 array([0.2750684 , 0.02106385, 0.07488511, 0.70780857, 0.33949178,
   0.24858048, 0.97062947, 0.63834876, 0.08386428, 0.04462121]),
 array([0.55248667, 0.03952828, 0.36602719, 0.48023317, 0.3370985 ,
   0.19787956, 0.76550606, 0.85523898, 0.24959629, 0.17627362]),
 array([0.37503714, 0.54267378, 0.21210291, 0.89486116, 0.69088997,
   0.76006434, 0.89560217, 0.46993889, 0.3418731 , 0.32312404]),
 array([0.44025059, 0.02898393, 0.11295503, 0.89143942, 0.50405325,
   0.40079956, 0.99794745, 0.85485225, 0.12284869, 0.056674 ]),
 array([0.41647535, 0.02999122, 0.10770379, 0.90572466, 0.55533854,
   0.49348202, 0.99776998, 0.83131508, 0.12656995, 0.05818589]),
 5.327910944678247,
-6.655821889356494,
-6.050651703368402]

```

Different ways to fit a copula...

```

[5]: u = cop.simulate(n=1000, seeds=[1, 2, 3])

# Create a new object and sets its parameters by fitting afterwards
cop2 = pv.Bicop(pv.student)
cop2.fit(data=u)
print(cop2)

# Otherwise, define first an object to control the fits:
#   - pv.FitControlsBicop objects store the controls
#   - here, we only restrict the parametric family
#   - see help(pv.FitControlsBicop) for more details
# Then, create a copula from the data
controls = pv.FitControlsBicop(family_set=[pv.student])
print(controls)
cop3 = pv.Bicop.from_data(data=u, controls=controls)
print(cop3)

<pyvinecopulib.Bicop> Bivariate copula:
  family = Student
  rotation = 0
  var_types = c,c
  parameters = 0.48
  3.7

<pyvinecopulib.FitControlsBicop>
Family set: Student
Parametric method: mle
Nonparametric method: constant
Nonparametric multiplier: 1
Weights: no
Selection criterion: bic
Preselect families: yes
mBIC prior probability: 0.9
Number of threads: 1

<pyvinecopulib.Bicop> Bivariate copula:
  family = Student
  rotation = 0
  var_types = c,c
  parameters = 0.48
  3.7

```

Similarly, when the family is unknown, there are two ways to also do model selection...

```
[6]:
```

```
# Create a new object and selects both its family and parameters afterwards
cop4 = pv.Bicop()
cop4.select(data=u)
print(cop4)

# Or create directly from data
cop5 = pv.Bicop.from_data(data=u)
print(cop5)

<pyvinecopulib.Bicop> Bivariate copula:
family = Student
rotation = 0
var_types = c,c
parameters = 0.48
3.7

<pyvinecopulib.Bicop> Bivariate copula:
family = Student
rotation = 0
var_types = c,c
parameters = 0.48
3.7
```