Convex Optimization

Tutorial 2

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In [ ]:
```
#Importing required Libraries
import numpy as np
import matplotlib.pyplot as plt
import cvxpy as cp
```

In [ ]:
```
#Importing data from python file
from currency_exchange_data import *
```

In [ ]:
```
print("Total Number of Currencies n: ", n)
print("Initial Number of Currencies: ")
print(c_init)
print("Required Number of Currencies: ")
print(c_req)

#Variable X
# X = cp.Variable((n,n), integer = True)
X = cp.Variable((n,n))

#post exchange amount of currencies
pea = c_init - (X.T)@(np.ones(n)) + (X/F)@(np.ones(n))

#cost of exchange of currencies
#coe = np.sum((c_init - pea)@(np.sqrt(F[0:None, 0] / F[0, 0:None])))
coe = (c_init - pea)@(np.sqrt(F[0:None, 0] / F[0, 0:None]))
```

```
Total Number of Currencies n:  10
Initial Number of Currencies:
[1818.18181818 1636.36363636 1454.54545455 1272.72727273 1090.90909091
  909.09090909  727.27272727  545.45454545  363.63636364  181.81818182]
Required Number of Currencies:
[ 181.81818182  363.63636364  545.45454545  727.27272727  909.09090909
 1090.90909091 1272.72727273 1454.54545455 1636.36363636 1818.18181818]
```

In [ ]:
```
#Objective is to minimize the cost of exchange i.e. coe
MyObjective = cp.Minimize(coe)

#The constraints given in the question
MyConstraint = [
    X >= 0,
    cp.diag(X) == 0,
    c_init >= (X.T)@(np.ones(n)),
    pea >= c_req
]
```

In [ ]:
```
# Solving the Convex Optimization
prob = cp.Problem(MyObjective, MyConstraint)
value = prob.solve()
```

In [ ]:
```
print("The minimum cost of exchange in USD: ", value)
```

```
The minimum cost of exchange in USD:  7.720059340057868
```

In [ ]:
```
# a = (X.T)@(np.ones(n))
# print(a.value)
# print(pea.value)
```

In [ ]:
```
print("The value of each currency exchanged: ")
# print(np.rint(((X.T)@(np.ones(n))).value))
print(np.round(((X.T)@(np.ones(n))).value, 2))


print("Post exchange amount of currency: ")
# print(np.rint(pea.value))
print(np.round(pea.value, 2))


print("The value of X: ")
print(np.round(X.value, 2))
# print(X.value)
```

```
The value of each currency exchanged:
[560.69   0.     0.   545.45 181.82   0.   727.27 369.09   0.   181.82]
Post exchange amount of currency:
[1257.5  1636.36 1771.67  727.27  909.09 1090.91 1272.73 1454.55 1636.36
 1818.18]
The value of X:
[[  0.     0.     0.     0.     0.     0.     0.     0.     0.     0.  ]
 [  0.     0.     0.     0.     0.     0.     0.     0.     0.     0.  ]
 [  0.     0.     0.   545.45   0.     0.     0.     0.     0.     0.  ]
 [  0.     0.     0.     0.     0.     0.     0.     0.     0.     0.  ]
 [  0.     0.     0.     0.     0.     0.     0.     0.     0.     0.  ]
 [ 16.5    0.     0.     0.     0.     0.   727.27   0.     0.     0.  ]
 [  0.     0.     0.     0.     0.     0.     0.   369.09   0.     0.  ]
 [ 15.69   0.     0.     0.   181.82   0.     0.     0.     0.   181.82]
 [ 18.52   0.     0.     0.     0.     0.     0.     0.     0.     0.  ]
 [509.98   0.     0.     0.     0.     0.     0.     0.     0.     0.  ]]
```