Math Modeling LB1
Zhuravkov Vladislav

[1]:
```
import math
import matplotlib.pyplot as plt
%matplotlib inline
```

[2]:
```
def func(x, y):
        return x*math.exp(-x*x)-2*x*y
```

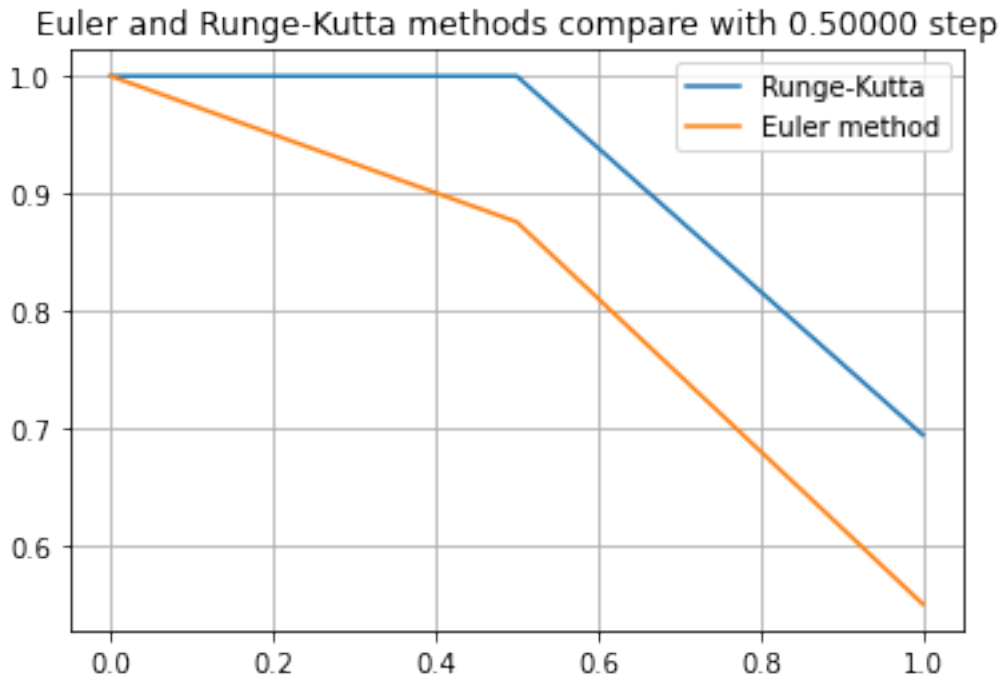
[3]:
```
def euler(x0, y0, h):
        n = int(((y0-x0)/h))
        x, y = [], []
        x.append(x0)
        y.append(y0)
        for i in range(1, n + 1):
            y.append(y[i - 1] + h * func(x[i - 1], y[i - 1]))
            x.append(x[i - 1] + h)
        print("Euler method: \t\th = %.3f" %h, "y = %.5f" %y[n])
        plt.plot(x, y, label="Runge-Kutta")
```

[4]:
```
def rungekutta(x0, y0, h):
        n = int(((y0-x0)/h))
        xgraph, ygraph = [], []
        x = x0
        y = y0
        xgraph.append(x)
        ygraph.append(y)
        for i in range(1, n + 1):
            k1 = h*func(x, y)
            k2 = h*func(x+0.5*h, y+0.5*k1)
            k3 = h*func(x+0.5*h, y+0.5*k2)
            k4 = h*func(x+h, y+k3)
            y = y + (1.0 / 6.0) * (k1 + 2 * k2 + 2 * k3 + k4)
            x = x + h
            xgraph.append(x)
            ygraph.append(y)
        print("Runge-Kutta method: \th = %.3f" %h, "y = %.5f" %y)
        plt.plot(xgraph, ygraph, label="Euler method")
```

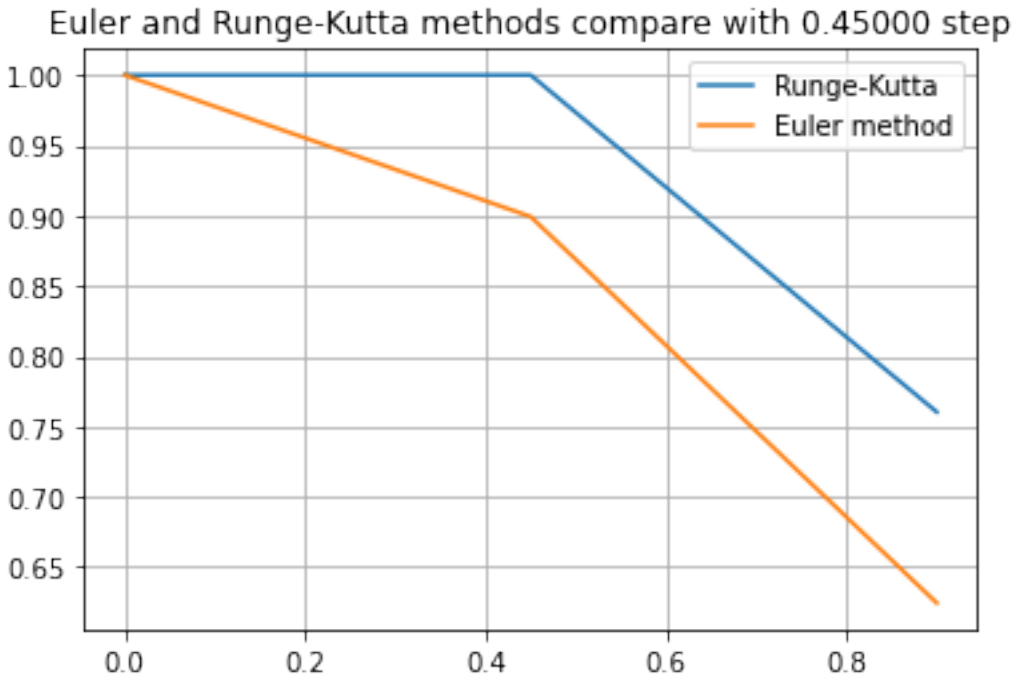
[5]:
```
def graphshow(h):
    plt.title('Euler and Runge-Kutta methods compare with %.5f step' % h)
    plt.legend()
    plt.grid()
    plt.show()
```

[6]:
```
x0=0
y0=1
h=0.5
while (h >= 0.01):
    euler(x0, y0, h)
    rungekutta(x0, y0, h)
    graphshow(h)
    h-=0.05
```

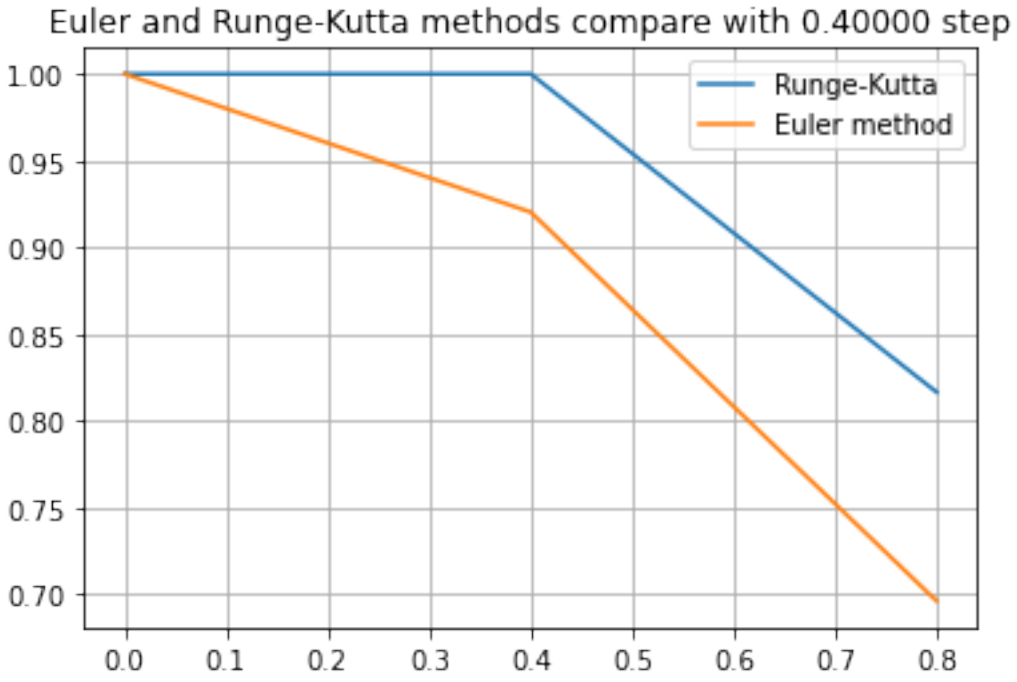
```
Euler method:           h = 0.500 y = 0.69470
Runge-Kutta method:     h = 0.500 y = 0.55082
```



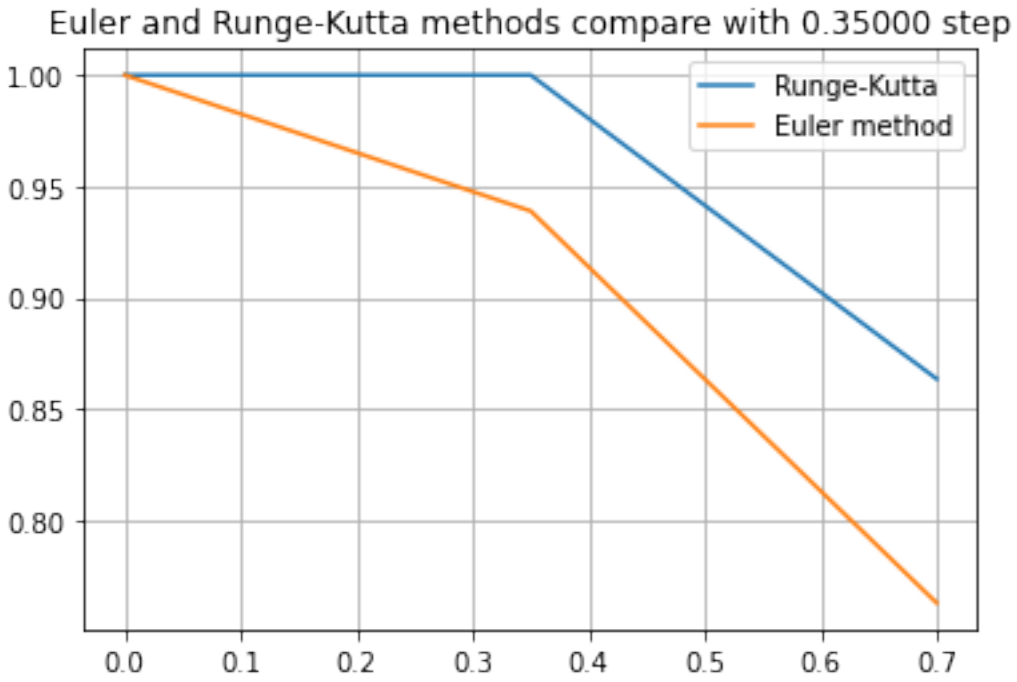
```
Euler method:            h = 0.450 y = 0.76038
Runge-Kutta method:      h = 0.450 y = 0.62450
```



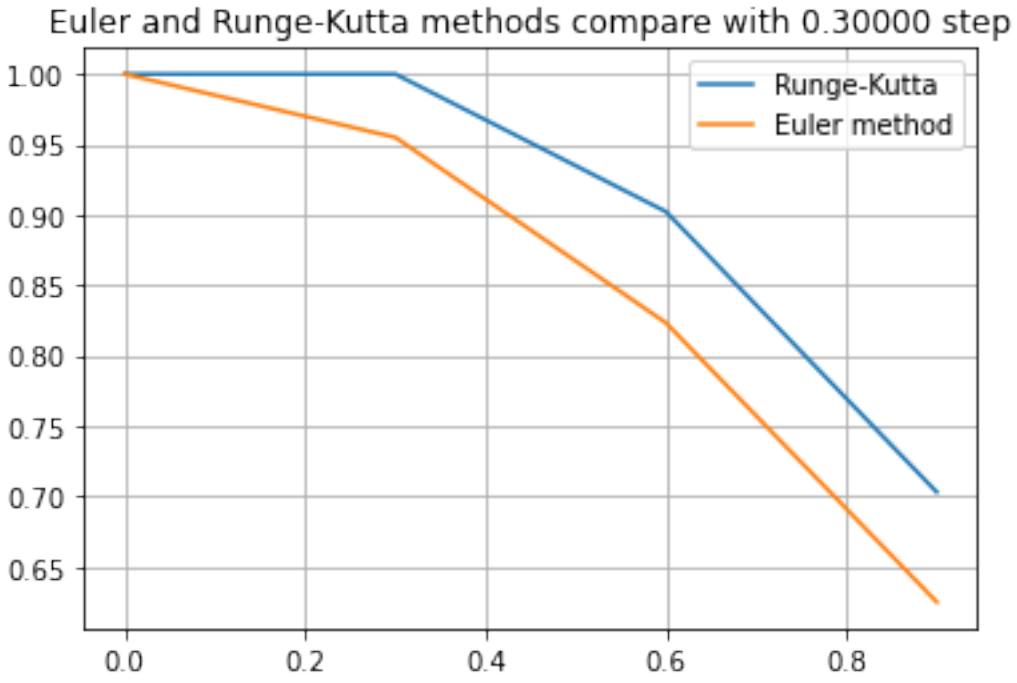

```
Euler method:            h = 0.400 y = 0.81634
Runge-Kutta method:      h = 0.400 y = 0.69578
```



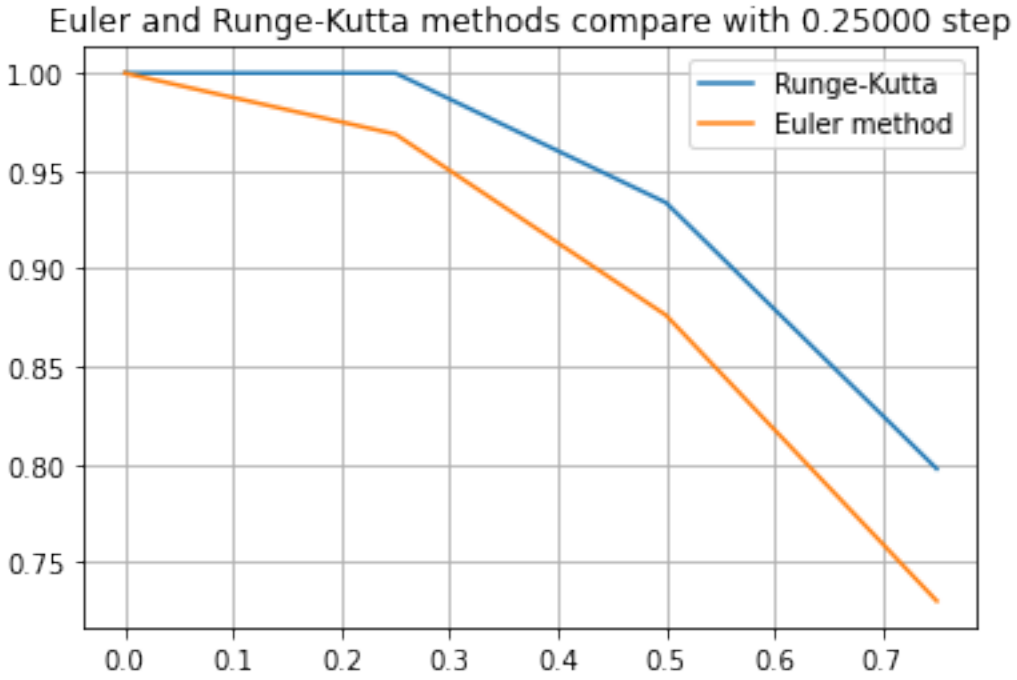
```
Euler method:            h = 0.350 y = 0.86338
Runge-Kutta method:      h = 0.350 y = 0.76261
```



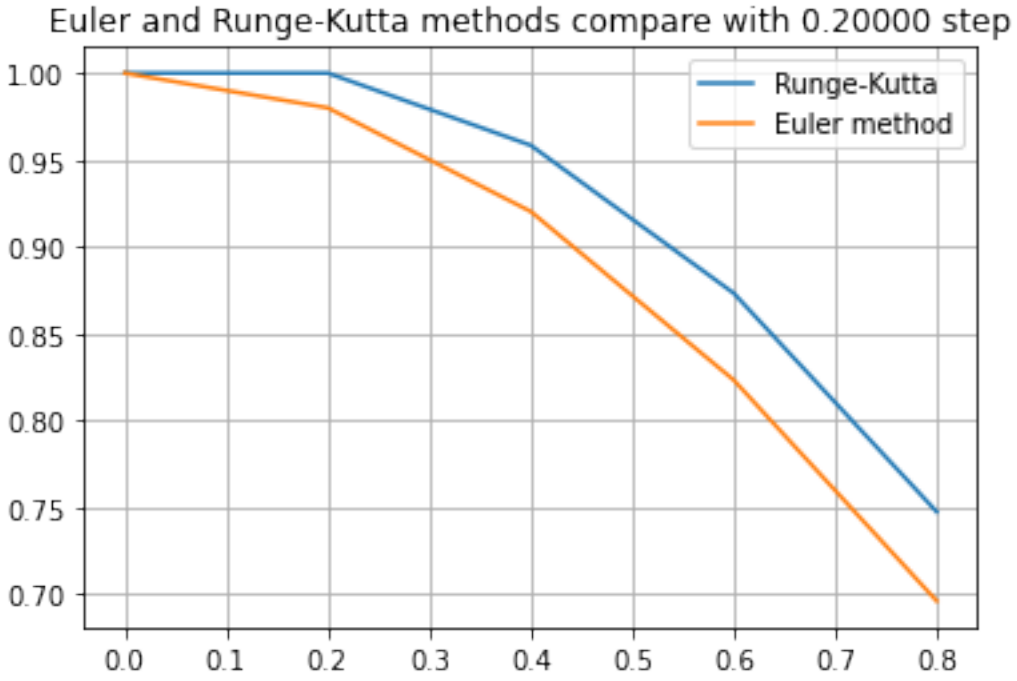

```
Euler method:            h = 0.300 y = 0.70302
Runge-Kutta method:      h = 0.300 y = 0.62496
```



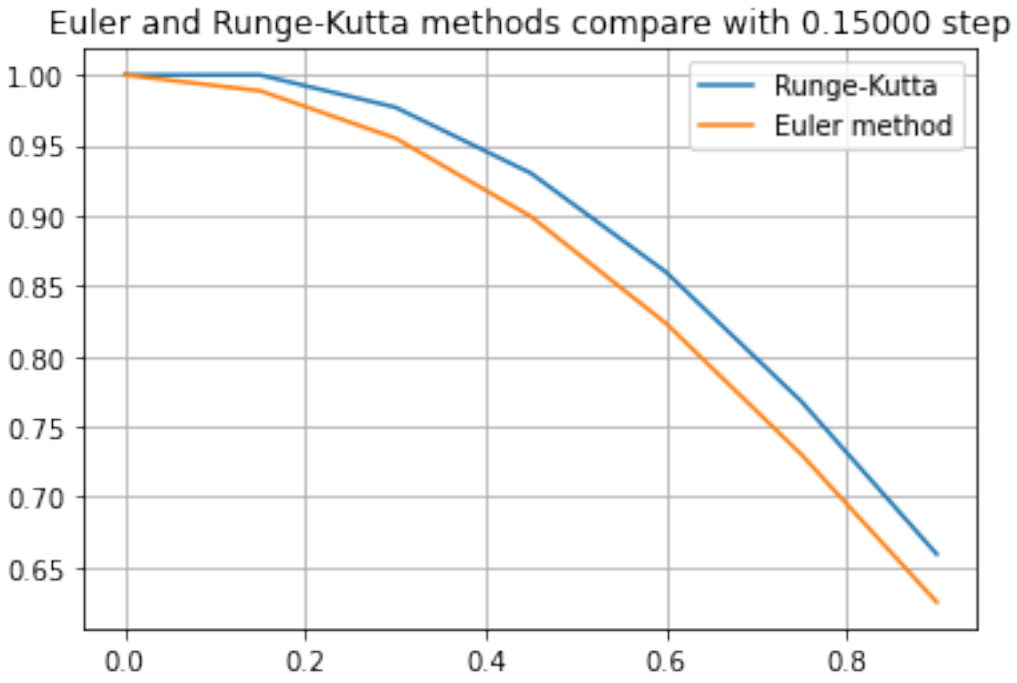
```
Euler method:            h = 0.250 y = 0.79764
Runge-Kutta method:      h = 0.250 y = 0.73001
```



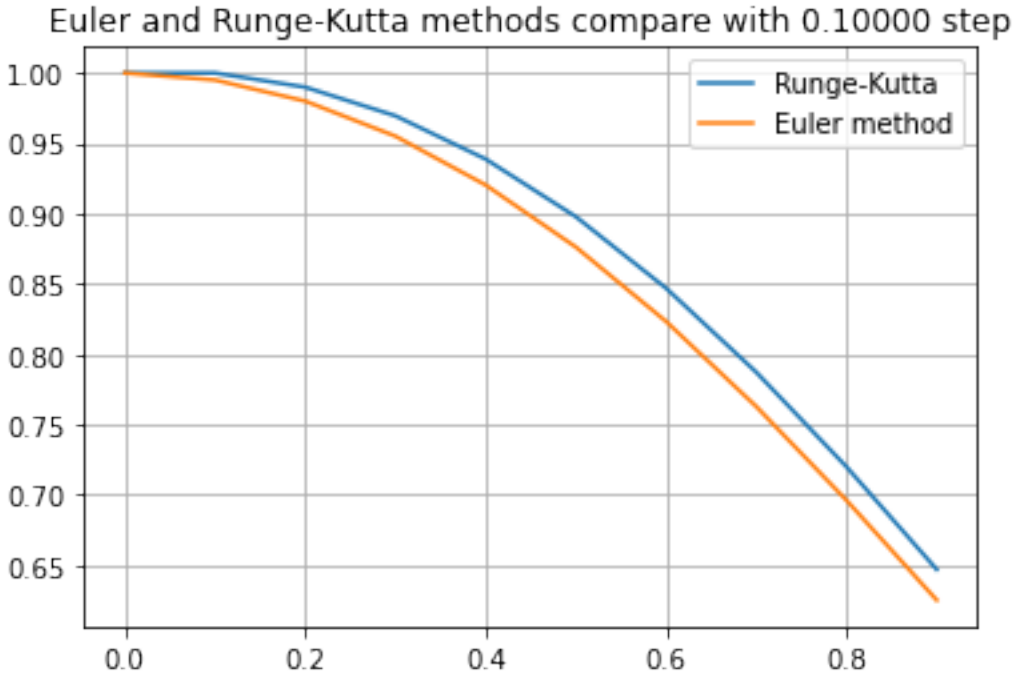

```
Euler method:            h = 0.200 y = 0.74739
Runge-Kutta method:      h = 0.200 y = 0.69602
```



```
Euler method:            h = 0.150 y = 0.65913
Runge-Kutta method:      h = 0.150 y = 0.62502
```




```
Euler method:            h = 0.100 y = 0.64684
Runge-Kutta method:      h = 0.100 y = 0.62503
```



```
Euler method:            h = 0.050 y = 0.59833
Runge-Kutta method:      h = 0.050 y = 0.58856
```