Aufgabe30

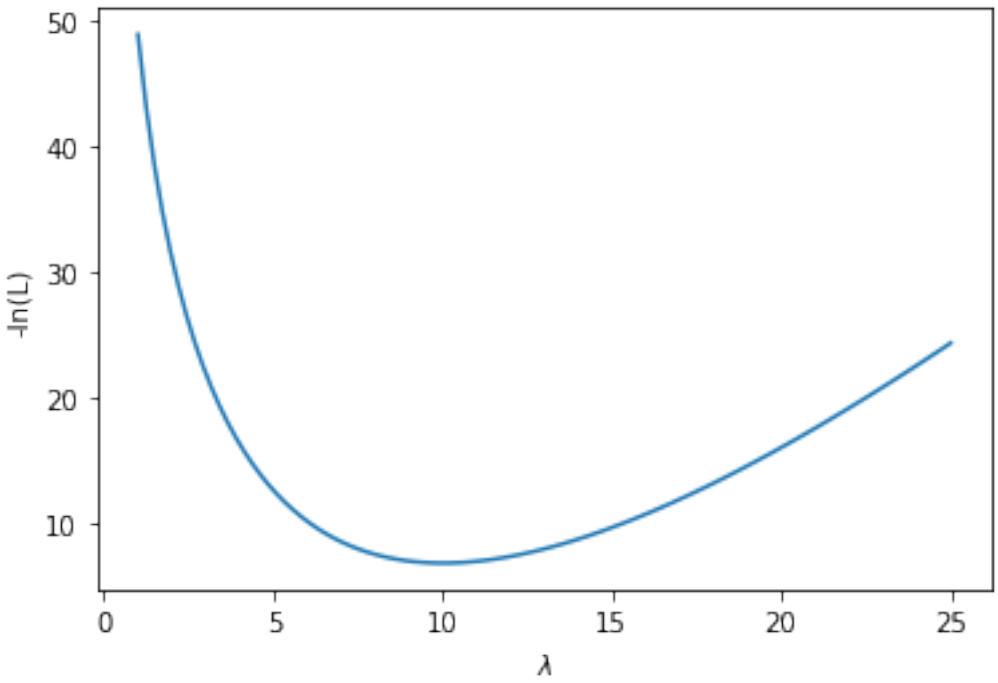
December 17, 2020

1 Aufgabe 30

a) Berechnen Sie die negative Log-Likelihood-Funktion als Funktion des einzigen Parameters und stellen Sie sie graphisch dar

$$
\begin{aligned}
P_\lambda &= \frac{\lambda^x}{x!} e^{-\lambda} \\
L(\lambda|x_1) &= \frac{\lambda_1^x}{x_1!} e^{-\lambda} \\
L(\lambda|x_1 \wedge x_2 \wedge x_3) &= L(\lambda|x_1) \cdot L(\lambda|x_2) \cdot L(\lambda|x_3) \\
&= \frac{\lambda^{30}}{x_1!} e^{-3\lambda} \frac{1}{13!9!8!}
\end{aligned}
$$

```
In [3]: import matplotlib.pyplot as plt
        import numpy as np
        import scipy
        from scipy.special import factorial
        x=[8,9,13]
        l = np.linspace(1,25,101) #man könnte den Bereich noch weiter eingrenten, weil nur Ber
        y=(l**13/factorial(13, exact=False)) * np.exp(-l) * (l**9/factorial(9, exact=False)) *
        F=-np.log(y)
        plt.plot(l, F)
        plt.xlabel(r"$\lambda$")
        plt.ylabel(r"-ln(L)")
        plt.show()
```



b) Bei welchem Wert von liegt das Minimum lnmax?

```
In [4]: #from scipy import optimize
        #minimum = optimize.fmin(y, 7)

        print(np.min(F))
        minL=l[np.argmin(F)]
        print('Minimum von -ln(F)=', minL)
```

```
6.8831843201705585
Minimum von -ln(F)= 10.12
```

Das Minimum liegt bei $\lambda = 10,12$

c) Für welche Werte von nimmt ln die Wertelnmax+12,lnmax+2undlnmax+92an und was sagen diese Werte aus?

```
In [11]: from scipy.optimize import fsolve
         from scipy.special import factorial
         def func(x):
             return -np.log(x**30/(factorial(13)*factorial(9)*factorial(8)) * np.exp(-3*x) + 1
         root = fsolve(func, 5)
```

```
        #np.isclose(func(root), [0.0, 0.0])  # func(root) should be almost 0.0.
        #array([ True,  True])
```

```
C:\Users\Lena\Anaconda3\lib\site-packages\ipykernel_launcher.py:4: RuntimeWarning: overflow en
  after removing the cwd from sys.path.
```

```
In [12]: import sympy as sy
         from sympy.solvers import solve
         from sympy import Symbol
         from sympy import *
         from sympy import log, exp, factorial,solve
         from sympy import LambertW
         from sympy import init_printing

         init_printing()

         x = Symbol('x')
         expr = (x**30/(factorial(13)*factorial(9)*factorial(8)) * exp(-3*x)) - 10.2 - 2
         sol=solve(-log(expr),x)
         print(sol)
         #print(latex(sol))
```

```
        ---------------------------------------------------------------------------

        RecursionError                            Traceback (most recent call last)

        <ipython-input-12-713db91abc08> in <module>()
         11 x = Symbol('x')
         12 expr = (x**30/(factorial(13)*factorial(9)*factorial(8)) * exp(-3*x)) - 10.2 - 2
    ---> 13 sol=solve(-log(expr),x)
         14 print(sol)
         15 #print(latex(sol))


        C:\Users\Lena\Anaconda3\lib\site-packages\sympy\solvers\solvers.py in solve(f, *symbols
       1033             if fi.has(Float):
       1034                 floats = True
    -> 1035                 f[i] = nsimplify(fi, rational=True)
       1036
       1037     # Any embedded piecewise functions need to be brought out to the


        C:\Users\Lena\Anaconda3\lib\site-packages\sympy\simplify\simplify.py in nsimplify(expr
       1130     """
       1131     try:
```

```
-> 1132         return sympify(as_int(expr))
   1133     except (TypeError, ValueError):
   1134         pass


    C:\Users\Lena\Anaconda3\lib\site-packages\sympy\core\compatibility.py in as_int(n)
    400     """
    401     try:
--> 402         result = int(n)
    403         if result != n:
    404             raise TypeError


    C:\Users\Lena\Anaconda3\lib\site-packages\sympy\core\expr.py in __int__(self)
    193         # places) we need to test whether we are off by one.
    194         from sympy import Dummy
--> 195         r = self.round(2)
    196         if not r.is_Number:
    197             raise TypeError("can't convert complex to int")


    C:\Users\Lena\Anaconda3\lib\site-packages\sympy\core\expr.py in round(self, p)
   3149         if not x.is_real:
   3150             i, r = x.as_real_imag()
-> 3151             return i.round(p) + S.ImaginaryUnit*r.round(p)
   3152         if not x:
   3153             return x


    C:\Users\Lena\Anaconda3\lib\site-packages\sympy\core\expr.py in round(self, p)
   3149         if not x.is_real:
   3150             i, r = x.as_real_imag()
-> 3151             return i.round(p) + S.ImaginaryUnit*r.round(p)
   3152         if not x:
   3153             return x


    ... last 2 frames repeated, from the frame below ...


    C:\Users\Lena\Anaconda3\lib\site-packages\sympy\core\expr.py in round(self, p)
   3149         if not x.is_real:
   3150             i, r = x.as_real_imag()
-> 3151             return i.round(p) + S.ImaginaryUnit*r.round(p)
   3152         if not x:
   3153             return x
```

```
RecursionError: maximum recursion depth exceeded
```

Ab der c) funktioniert das nicht mehr. Da sind beim Code irgendwelche Fehler, wissen aber leider nicht was da falsch ist und auch nicht wie man das sonst per Hand berechnen sollte.

In [ ]:

In [ ]:

In [ ]: