comp2

January 29, 2020

0.1 Computational Assignment 2

PHY224H1S | 2020 Winter

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[1]:
```
# imports
import numpy as np
from scipy import stats
from scipy.optimize import curve_fit
import matplotlib.pyplot as plt
%matplotlib inline
```

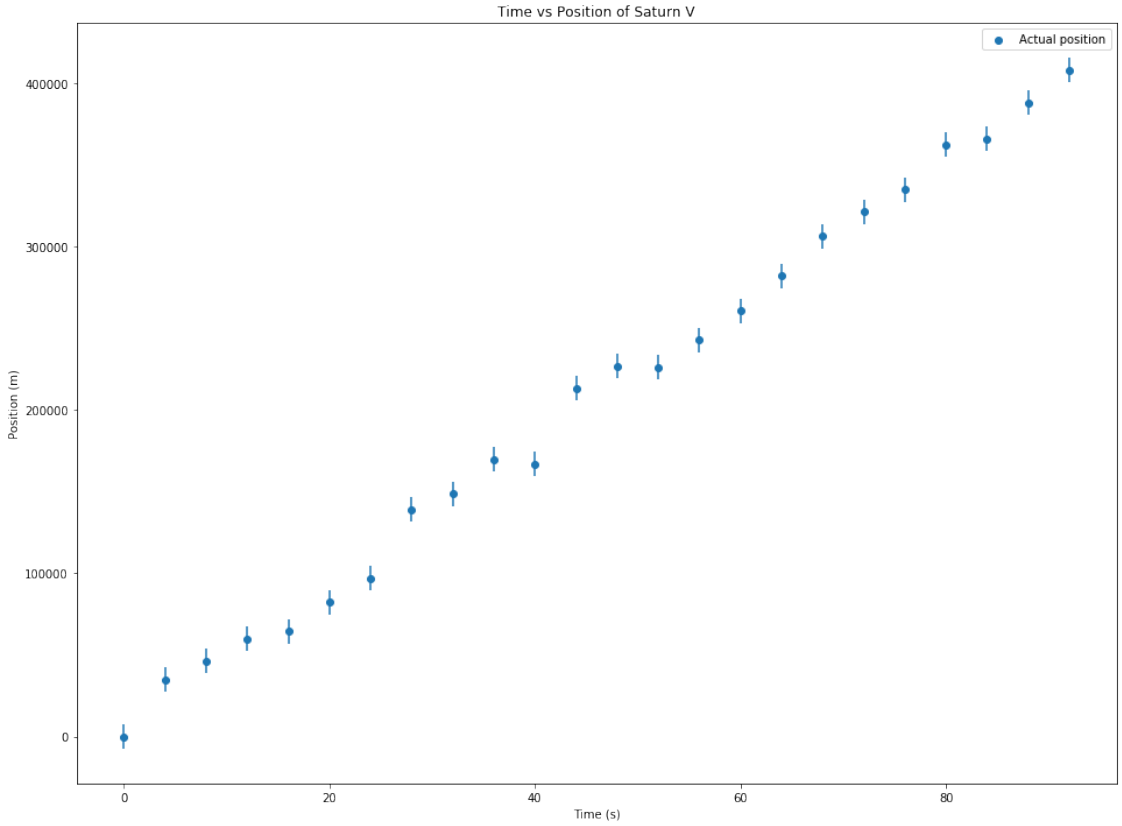
1 Question 1

[2]:
```
!head -n2 rocket.csv
```

```
# Time(s),Position(m),Uncertainty(m)
0.000000,0.000000,7500.000000
```

[3]:
```
time, position, position_uncertainty = np.loadtxt('rocket.csv', skiprows=1,␣
↪delimiter=',', unpack=True)
```

[4]:
```
plt.figure(figsize=(16, 12))
plt.scatter(time, position, label='Actual position')
plt.errorbar(time, position, yerr=position_uncertainty, marker='', ls='')
plt.xlabel('Time (s)')
plt.ylabel('Position (m)')
plt.title('Time vs Position of Saturn V')
plt.legend()
plt.savefig('rocket_plot1.png')
```



2 Question 2

[5]:
```
speeds = np.diff(position) / np.diff(time)
print(speeds.mean(), stats.sem(speeds))
```

```
4434.56260823913 629.3005178859614
```

3 Question 3

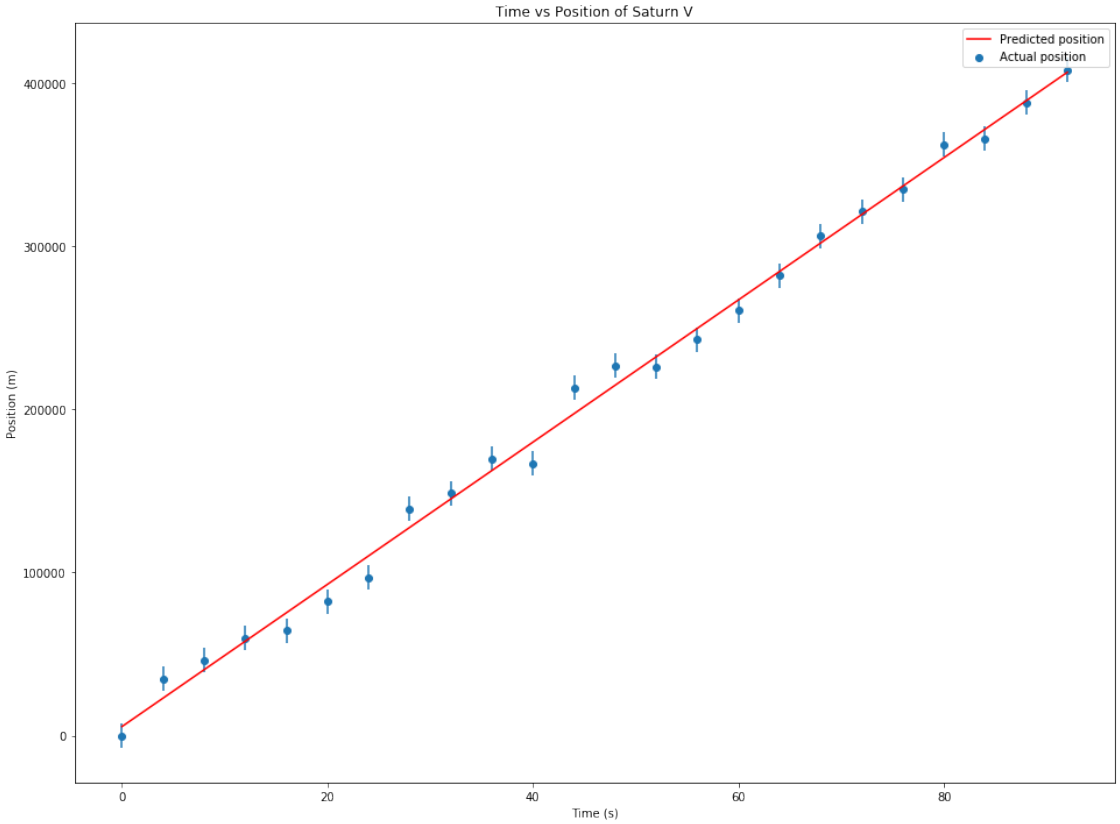
[6]:
```
def linreg(x, y):
    slope = ((x - x.mean()) * (y - y.mean())).sum() / np.square(x - x.mean()).
 ↪sum()
    intercept = y.mean() - slope * x.mean()
    return slope, intercept
```

[7]:
```
slope, intercept = linreg(time, position)
print(slope, intercept)

linregpos = slope * time + intercept
```

```
4357.412595548586 5640.244920890051
```

[8]:
```
plt.figure(figsize=(16, 12))
plt.scatter(time, position, label='Actual position')
plt.errorbar(time, position, yerr=position_uncertainty, marker='', ls='')
plt.xlabel('Time (s)')
plt.ylabel('Position (m)')
plt.title('Time vs Position of Saturn V')
plt.plot(time, linregpos, c='r', label='Predicted position')
plt.legend()
```

[8]:
```
<matplotlib.legend.Legend at 0x127d84990>
```



4 Question 5

[9]:
```
def rcs(pred, target, uncertainty, n_params):
    return np.square((pred - target) / uncertainty).sum() / (pred.size -␣
 ↪n_params)
```

[10]:
```
print(rcs(linregpos, position, position_uncertainty, 2))
```

1.325014463556978

5 Question 6

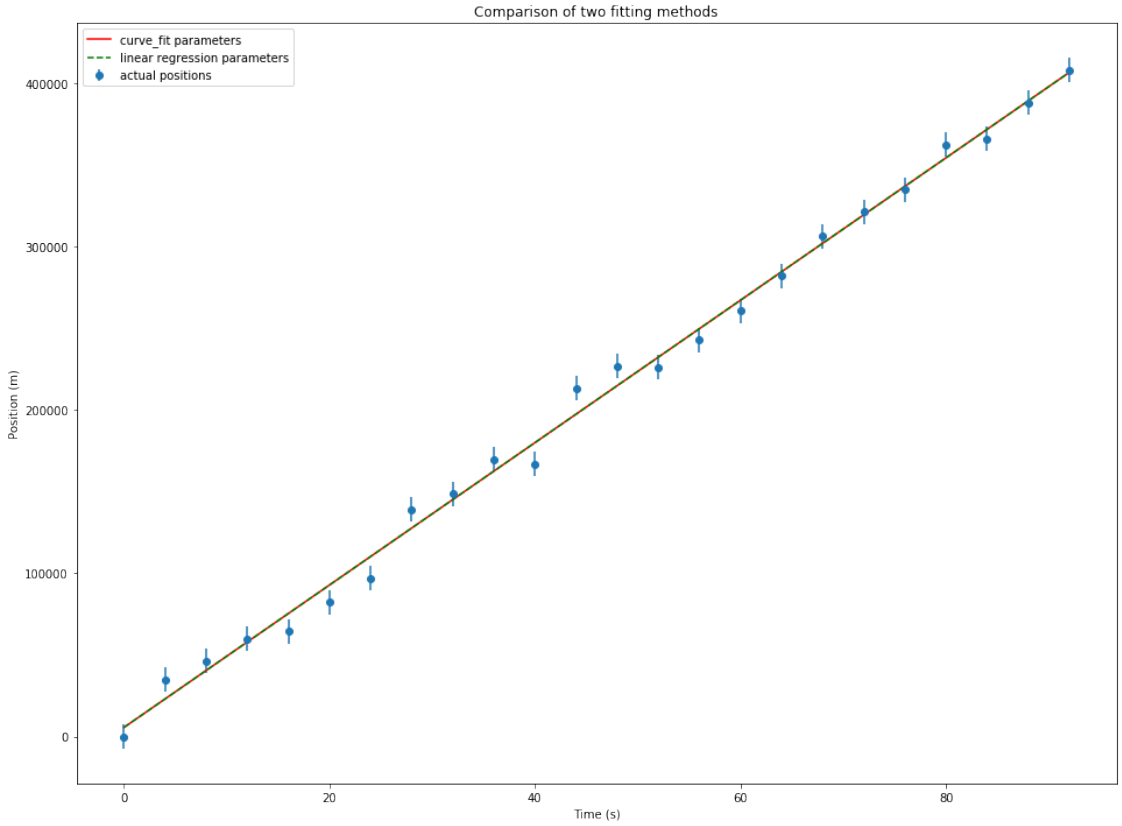
[11]:
```
def fit_func(indep_data, slope, intercept):
    return slope * indep_data + intercept

popt, pcov = curve_fit(f=fit_func, xdata=time, ydata=position,␣
↪sigma=position_uncertainty, absolute_sigma=True, p0=(4300, 5600))
```

[12]:
```
print(popt, np.sqrt(np.diag(pcov)))
print(rcs(fit_func(time, popt[0], popt[1]), position, position_uncertainty, 2))
```

```
[4357.4125952  5640.24494273] [  55.29074106 2968.58582183]
1.3250144635569776
```

[13]:
```
plt.figure(figsize=(16, 12))
plt.errorbar(time, position, yerr=position_uncertainty, marker='o', ls='',␣
↪label='actual positions')
plt.plot(time, fit_func(time, *popt), c='red', label='curve_fit parameters')
plt.plot(time, fit_func(time, *linreg(time, position)), c='green',␣
↪linestyle='dashed', label='linear regression parameters')
plt.legend()
plt.title('Comparison of two fitting methods')
plt.xlabel('Time (s)')
plt.ylabel('Position (m)')
```

[13]:
```
Text(0, 0.5, 'Position (m)')
```



6 Question 7

[14]:
```
!head -n5 feather.csv
```

```
# Time(s),Position(m),Uncertainty(m)
0.000000,1.926565,0.100000
0.100000,1.774297,0.100000
0.200000,1.804253,0.100000
0.300000,1.639400,0.100000
```

[15]:
```
ftime, fposition, funcertainty = np.loadtxt('feather.csv', delimiter=',',␣
↪skiprows=1, unpack=True)
```

[16]:
```
def pred_feather_pos(time, initpos, initspeed, accel):
    return initpos + initspeed * time + 1/2 * accel * np.square(time)
```

[17]:
```
popt2, pcov2 = curve_fit(f=pred_feather_pos, xdata=ftime, ydata=fposition,␣
↪sigma=funcertainty, absolute_sigma=True, p0=(1.7, 0, -1/7*9.81))
```

[18]:
```
print(popt2, np.sqrt(np.diag(pcov2)))
```

```
[ 1.78723393  0.21428325 -1.62483898] [0.06089164 0.14854806 0.15094446]
```

[19]:
```
plt.figure(figsize=(12, 8))
plt.errorbar(ftime, fposition, funcertainty, marker='o', ls='', label='actual␣
 ↪positions')
plt.plot(ftime, pred_feather_pos(ftime, *popt2), c='r', label='curve_fit␣
 ↪prediction')
plt.legend()
plt.xlabel('Time (s)')
plt.ylabel('Position (m)')
plt.title('Fitting position of feather dropped on Moon')
#plt.savefig('feather_plot1.png')
```

[19]:
```
Text(0.5, 1.0, 'Fitting position of feather dropped on Moon')
```