PH 1110 Lab 4 CX17

Carlos Medina

February 11, 2022

1 Propagation of Uncertainty

1) Python 3.6 code for propagation of uncertainty:

```python
### 1: velocity
v_Ai =0.3283 #initial velocity
dv_Ai =0.01595 #uncertainty of velocity
v_Af =0.2892 #final velocity
dv_Af =0.0028 #uncertainty of "
delta_vA =v_Af -v_Ai #change in velocity
dvA =dv_Ai +dv_Af #propogation of uncertainty for velocity
### 2: mass
m =0.4975 #measured mass of the cart in kg
dm =0.0001 #uncertainty in "
### 3: momentum
p_0 = (m *v_Ai) #initial momentum of the system
dp_0 =p_0 * ((dm/m)+((dv_Ai)/abs(v_Ai))) #uncertainty in "
#Some notes on the above equation
#Don't need to do absolute value of m
#because it's already positive
p_f = (m *v_Af) #final momentum of the system
#uncertainty in momentum
dp_f =p_f * ((dm/m)+((dv_Af)/abs(v_Af)))
delta_p =p_f -p_0 #change in momentum
dp =dp_f +dp_0 #uncertainty of "
print("change in momentum:",delta_p,"±",dp," kg * m/s")
#print the change in momentum and its uncertainty

#>> change in momentum: -0.019452249999999977 ± 0.009389874999999999  kg * m/
```
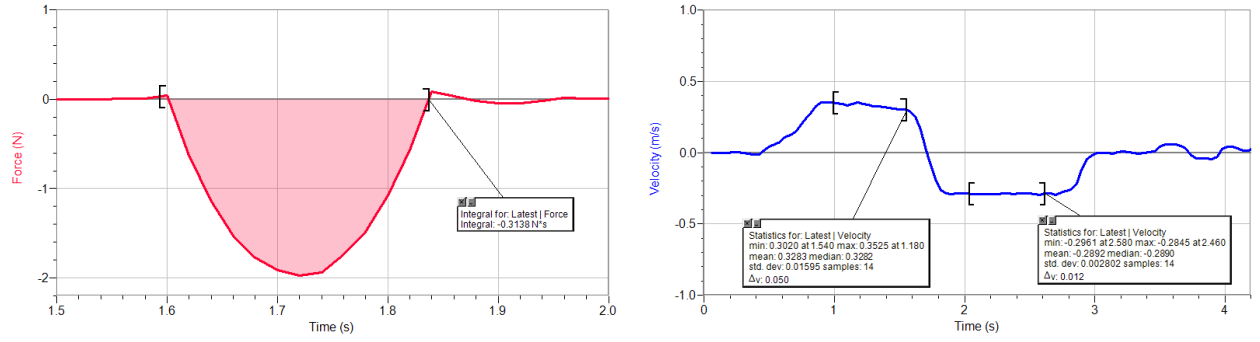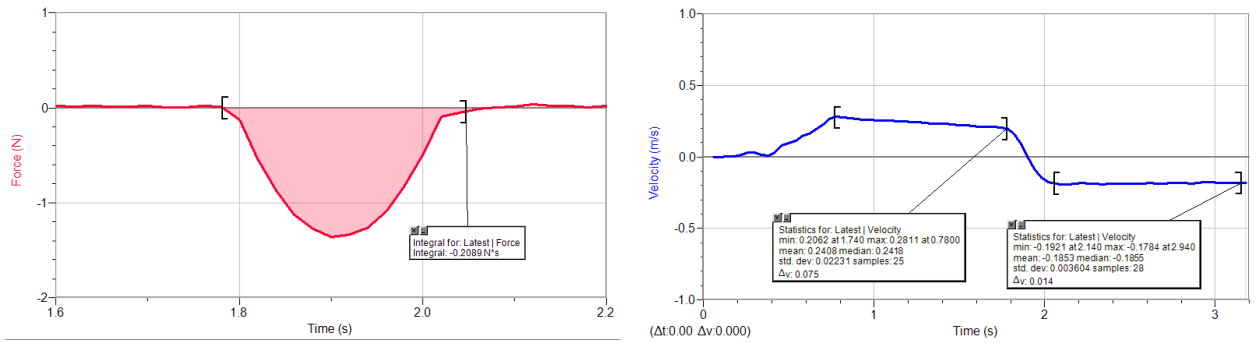
2 Writing

1) I made sure to not go too fast and to make sure everything was good

2)

(a) Slow force. The impulse measured is $-0.3138\,\mathrm{N\,s}$.

(b) Slow velocity. The initial velocity is $0.3283\,\mathrm{m\,s^{-1}}$ with $\sigma = 0.0159\,\mathrm{m\,s^{-1}}$, and the final velocity is $-0.2890\,\mathrm{m\,s^{-1}}$ with $\sigma = 0.0028\,\mathrm{m\,s^{-1}}$

Figure 1: Slow trial measurements.

(a) Slower force. The impulse measured is $-0.2089\,\mathrm{N\,s}$.

(b) Slower velocity. The initial velocity is $0.2408\,\mathrm{m\,s^{-1}}$ with $\sigma = 0.0223\,\mathrm{m\,s^{-1}}$, and the final velocity is $-0.1853\,\mathrm{m\,s^{-1}}$ with $\sigma = 0.0004\,\mathrm{m\,s^{-1}}$

Figure 2: Slower trial measurements.
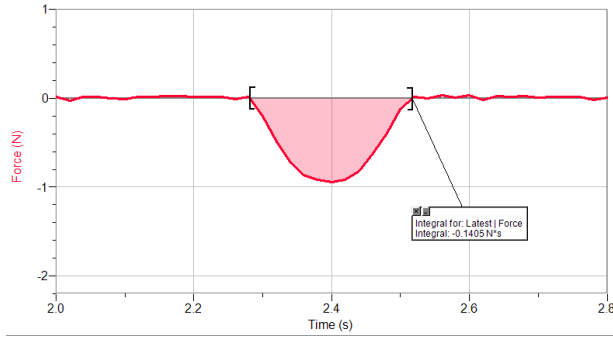
(a) Slowest force. The impulse measured is $-0.1405\,\mathrm{N\,s}$.
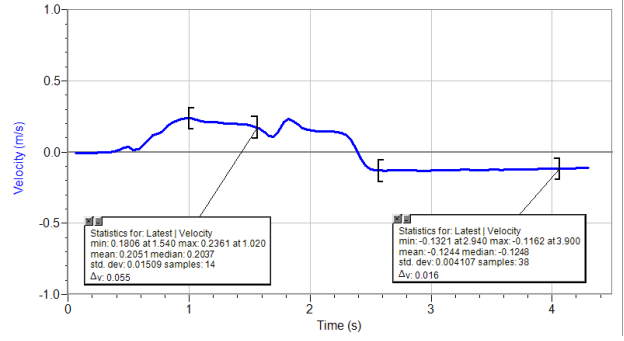
(b) Slowest velocity. The initial velocity is $0.2051\,\mathrm{m\,s^{-1}}$ with $\sigma = 0.0151\,\mathrm{m\,s^{-1}}$, and the final velocity is $-0.1244\,\mathrm{m\,s^{-1}}$ with $\sigma = 0.0041\,\mathrm{m\,s^{-1}}$

Figure 3: Slowest trial measurements.