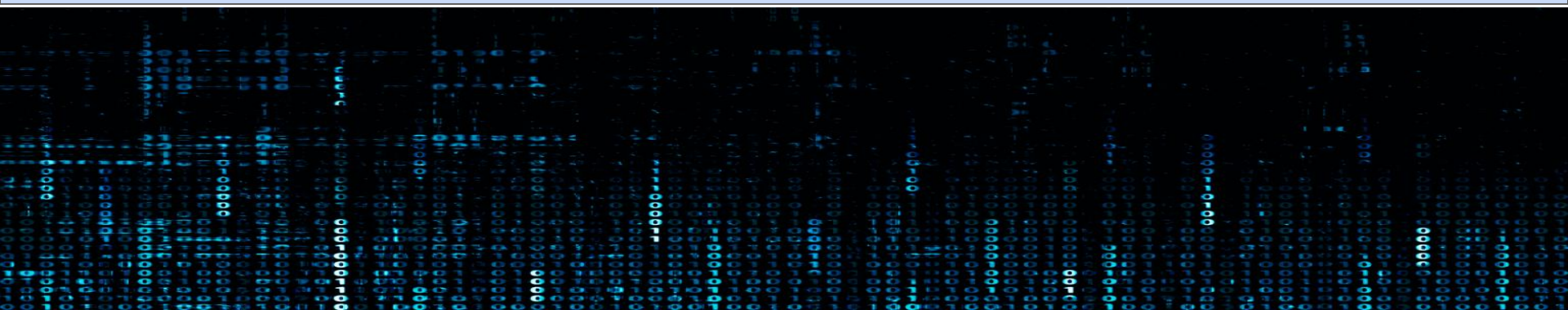


Computing & Data Analysis



Key ideas for data analysis in the classroom



Key ideas for data analysis in the classroom



© Andy Anderson

HE SPECIALIZES IN DRAWING CONCLUSIONS



The not so easy side of computing and data analysis

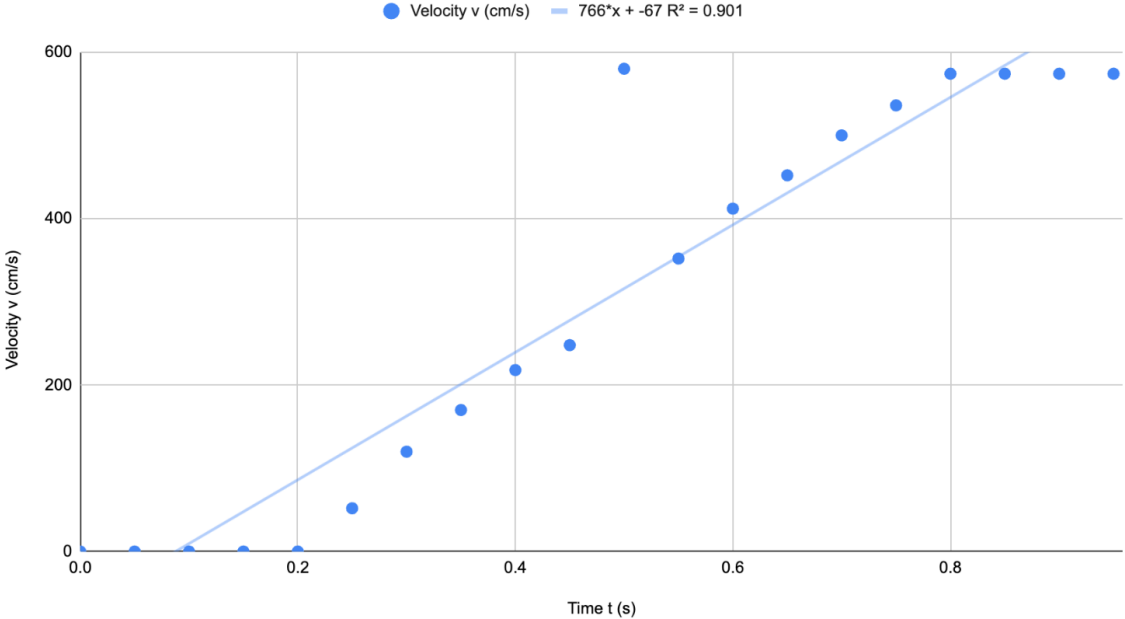
Here are a few challenges for our students:

- Identifying appropriate data analysis techniques
- Using software like Excel to help create data tables, graphs, slopes, etc.
- Noise reduction



Example from a past student of Eric's:

Velocity v (cm/s) vs. Time t (s) for a falling body.



(Don't worry, the student was severely punished!)

Useful resources to address some data analysis challenges



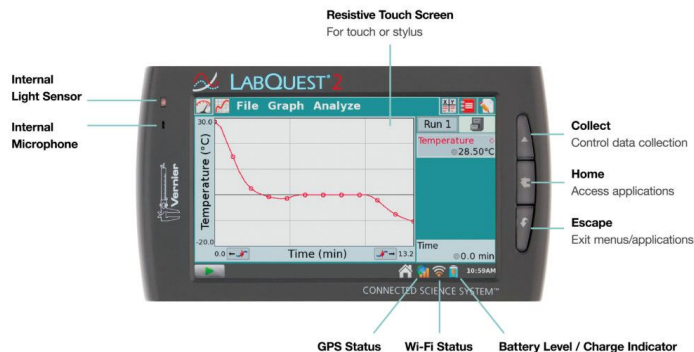
Physics Toolbox Sensor

Suite 4+

Chrystian Vieyra

★★★★☆ 4.0, 7 Ratings

Free



Google Sheets

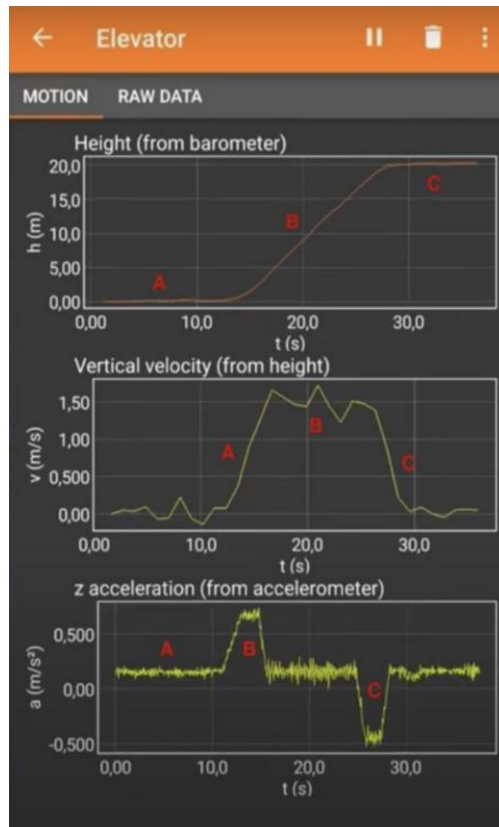
phyphox

Raw Sensors

- Acceleration (without g)**
Get raw data from the so called linear accelerometer, which g...
- Acceleration with g**
Get raw data from the accelerometer. This sensor will not su...
- Gyroscope (rotation rate)**
Get raw data from the gyroscope.
- Light**
Get raw data from the light sensor.
- Location (GPS)**
Get raw position data from satellite navigation.
- Magnetometer**
Get raw data from the magnetometer.
- Pressure**
Get raw data from the barometer.

Acoustics

- Audio Amplitude**
Get the amplitude of sounds.
- Audio Autocorrelation**
Measure the frequency of a single tone.
- Audio Scope**
Show recorded audio data.
- Audio Spectrum**
Display the frequency spectrum of an audio signal.
- Doppler effect**
Detect small frequency shifts of the Doppler effect.
- Frequency history**
Measure the frequency change over time for a single tone.
- Sonar**
Measures distances through echoes and the speed of sound.
- Tone generator**



phyphox Elevator

Motion Raw Data

Height (from barometer)

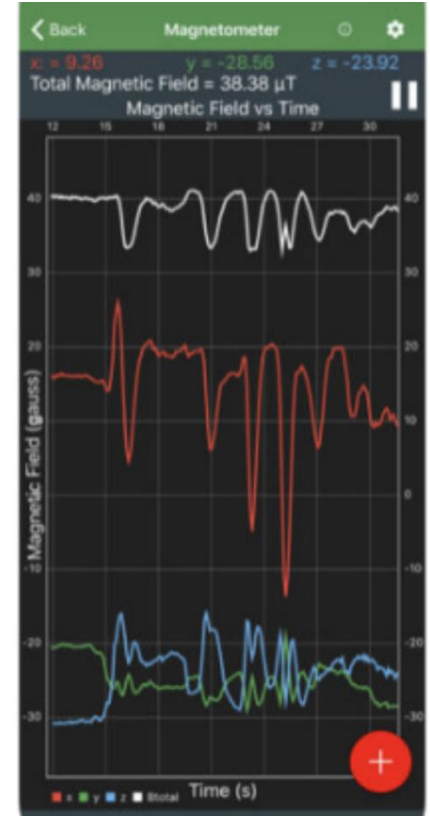
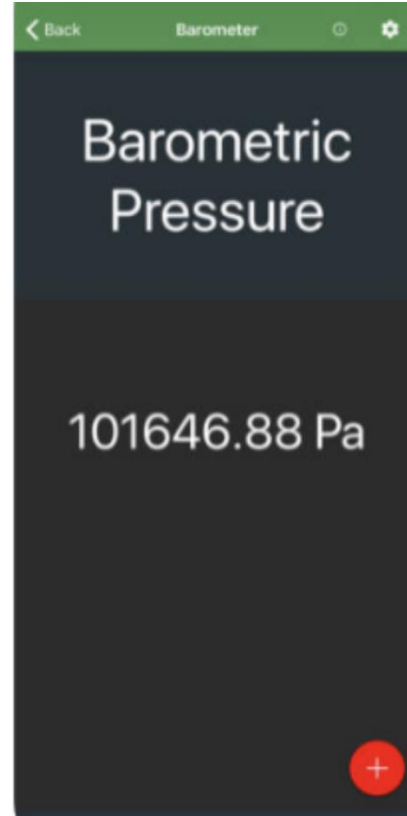
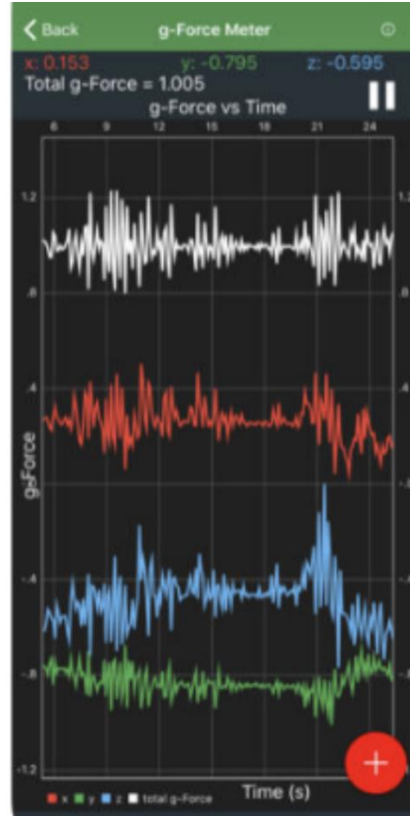
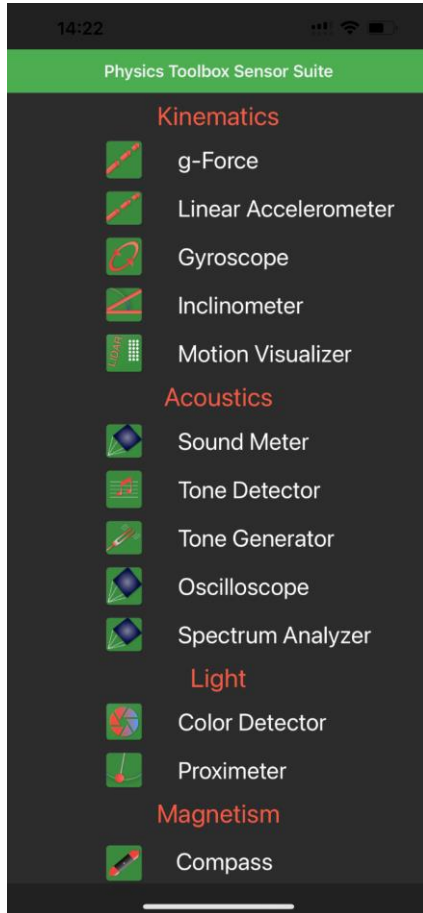
Export Data
Choose the data format.

- Excel
- CSV (Comma, decimal point)
- CSV (Tabulator, decimal point)
- CSV (Semicolon, decimal point)
- CSV (Tabulator, decimal comma)
- CSV (Semicolon, decimal comma)

Cancel Export Data



Physics Toolbox Sensor Suite 4+
Christian Vieyra
★★★★☆ 4.0, 7 Ratings
Free



Tracker

Video Analysis and Modeling Tool

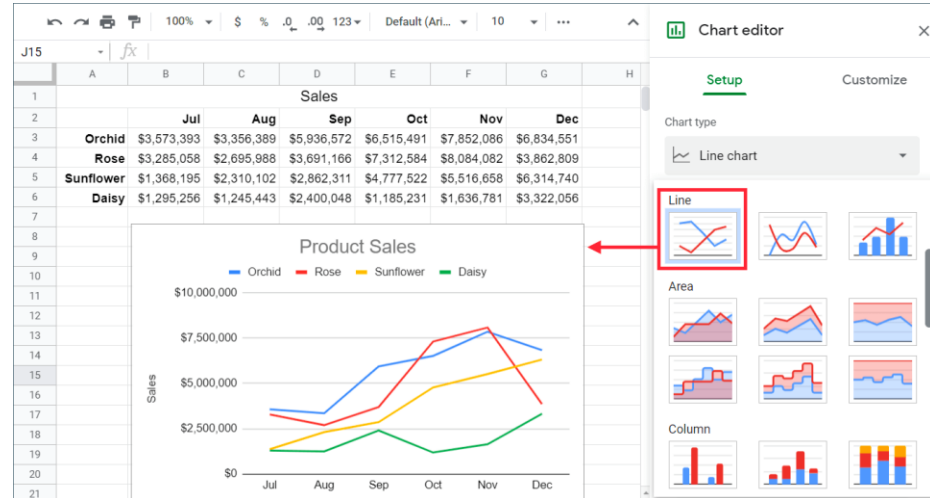
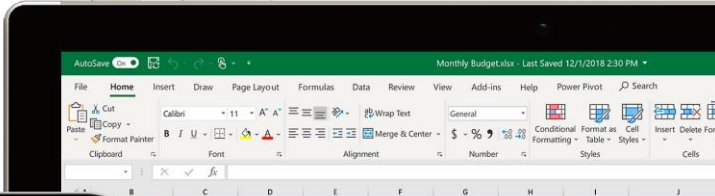
The screenshot shows the Tracker software interface with the following components:

- Main Window:** Displays a video of a pendulum experiment. A grid is overlaid on the video. A circular inset shows a close-up of a scale labeled "Newtons". The text "Pendulum on scale" is visible. Parameters listed are:
 - timestep: 1/30 s
 - length: 1 m
 - mass: 1 kg
- Right Panel:** Contains a plot titled "bob (t, θ)" showing a sinusoidal wave. Below the plot is a data table for "tension":

t (s)	mag (m)
0.297	11.60
0.495	14.00
0.693	12.00
0.990	7.900
- Top Panel:** Shows the software's menu bar (Arquivo, Editar, Vídeo, Trajetórias, Coordenadas, Janela, Ajuda) and toolbar. The "massa A" object is selected.
- Bottom Panel:** Shows the video playback controls and the file name "Pendulum.trk".

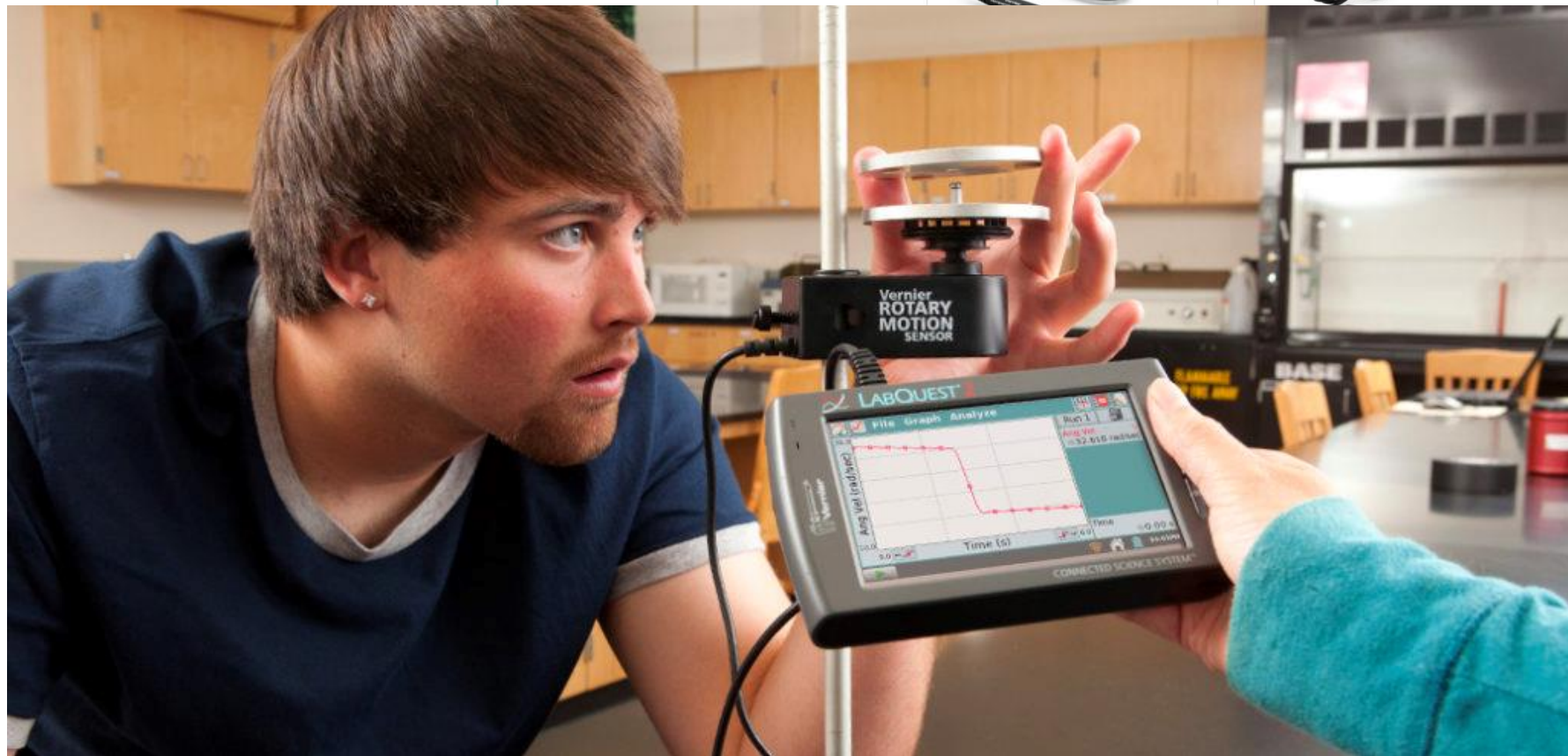


Google Sheets



Resistive Touch Screen

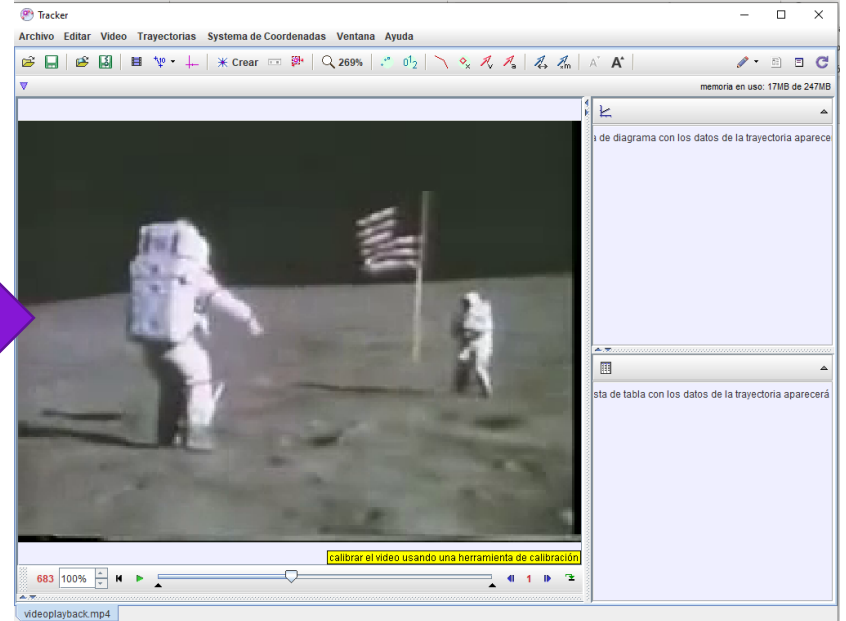
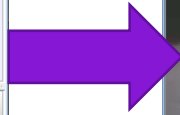
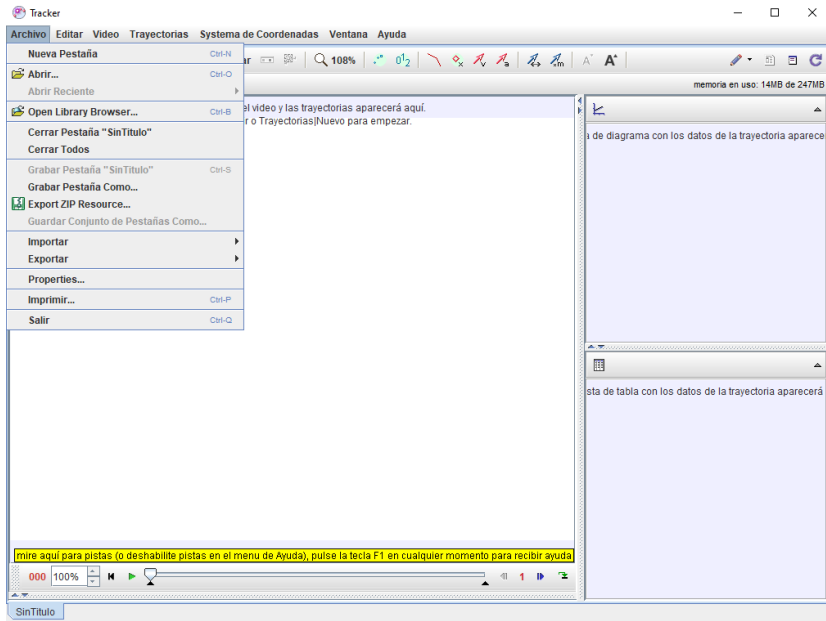
For touch or stylus



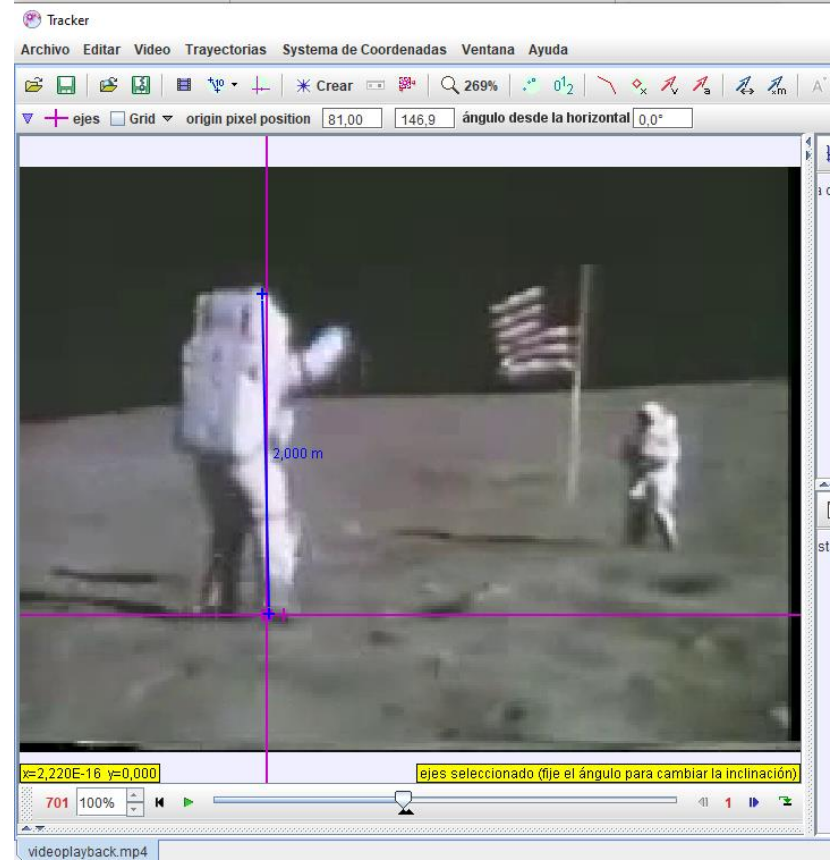
USING Tracker AT CLASS

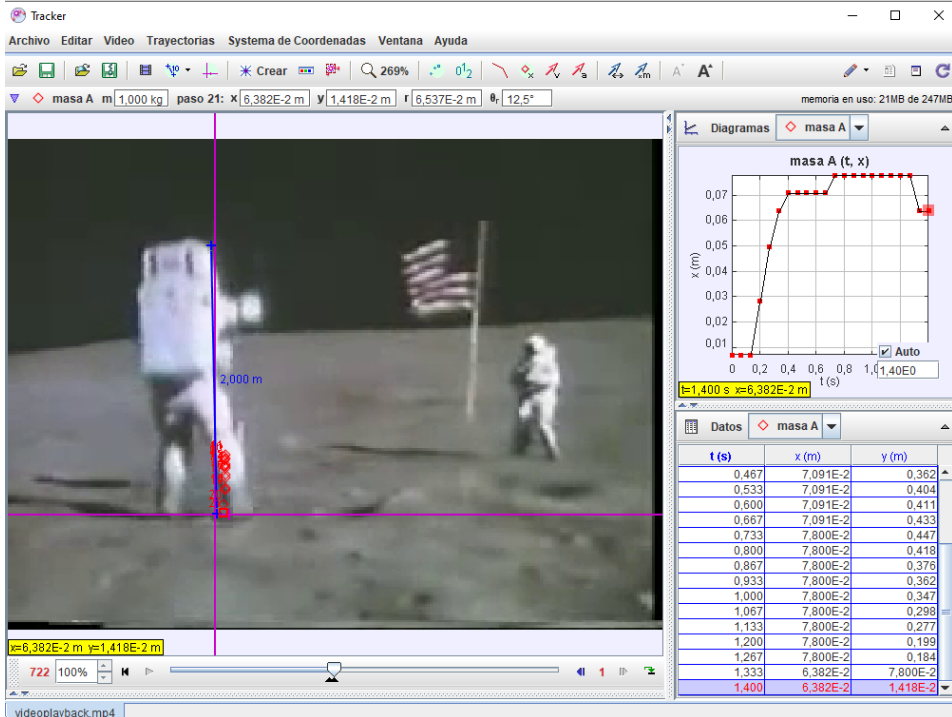
Video Analysis and Modeling Tool

1. Open and upload a video you want to track. Define frames.

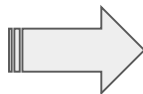


2. Add calibration bar. Define x and y axis

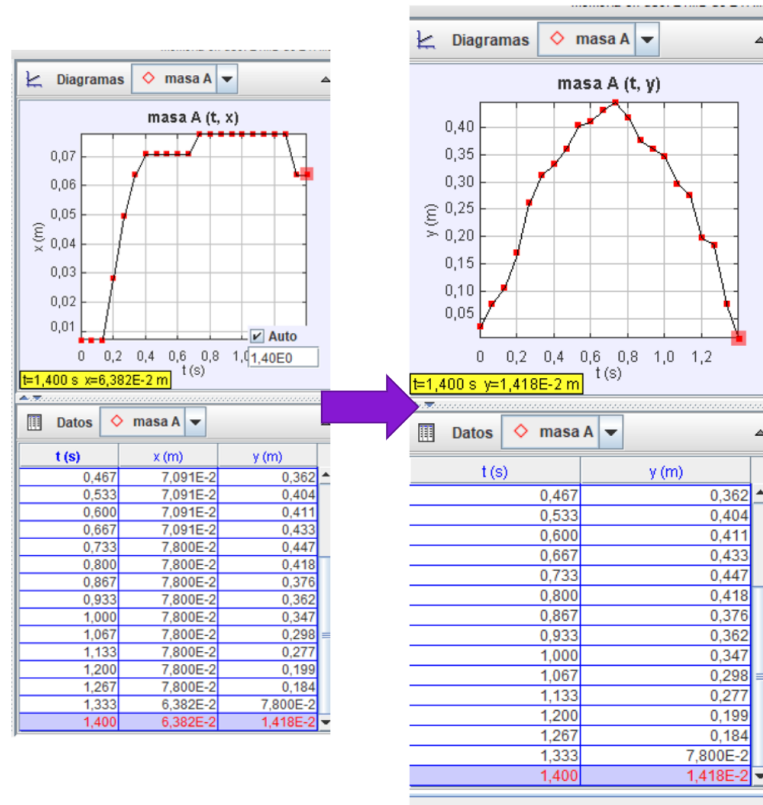


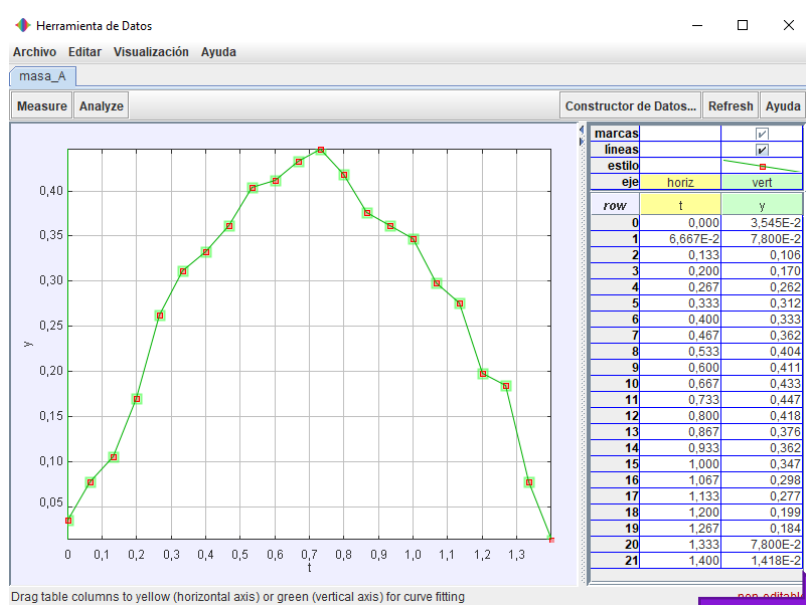


3. Track



4. Data processing





Drag table columns to yellow (horizontal axis) or green (vertical axis) for curve fitting

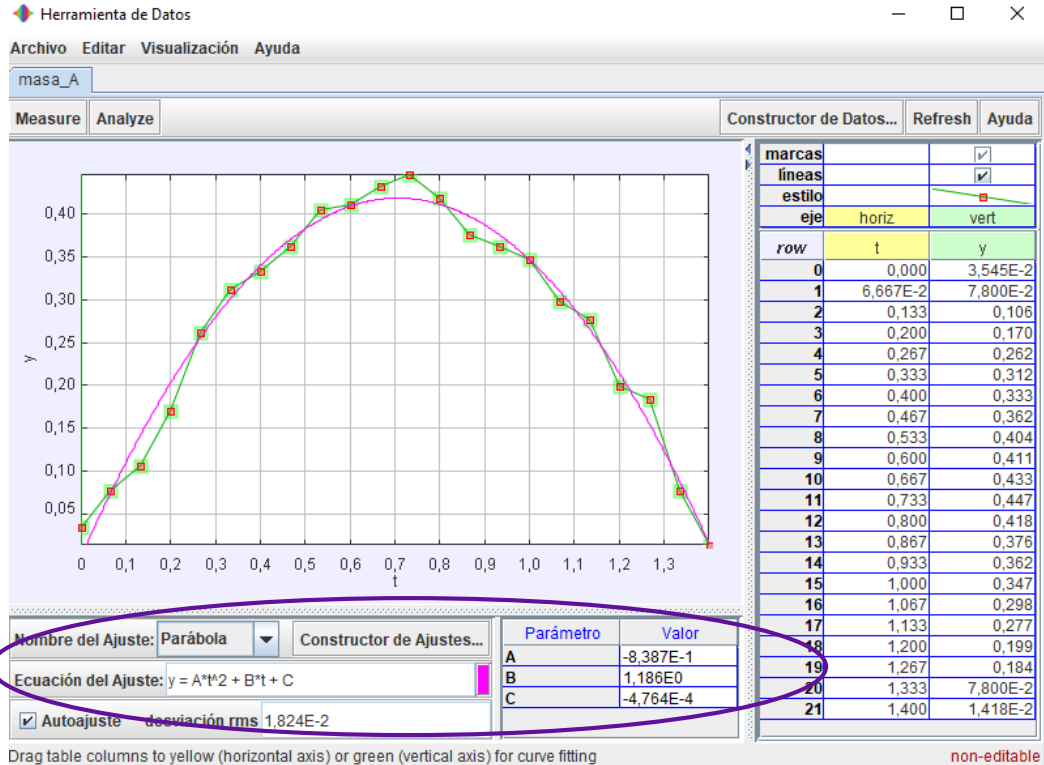


$$y = y_0 + v_0 t + \frac{1}{2} g t^2$$

**Moon's gravity (experimental value): 0,08387
*2 = 1.677 m/s²**

Moon's gravity (theoretical value): 1.625 m/s²

5. Analyse



Drag table columns to yellow (horizontal axis) or green (vertical axis) for curve fitting

non-editable

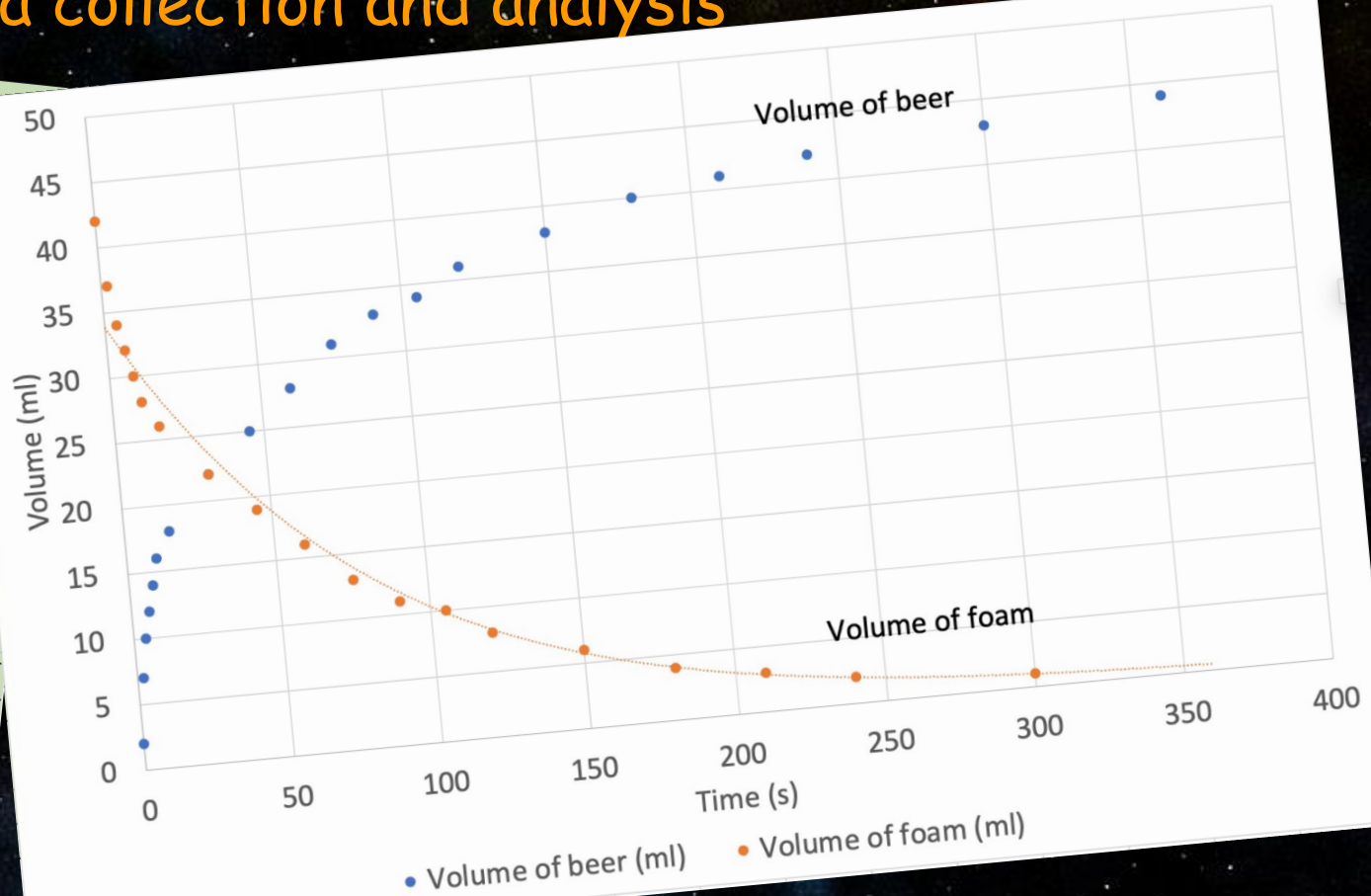
Best practice example - Law of Radioactive decay



Data collection and analysis

Raw data

Time (s)	Volume of beer (ml)	Volume of foam (ml)
0	2	42
2	7	37
4	10	34
6	12	32
8	14	30
10	16	28
15	18	26
30	22	22
45	25	19
60	28	16
75	31	13
90	33	11
105	34	10
120	36	8
150	38	6
180	40	4
210	41	3
240	42	2
300	43	1
360	44	

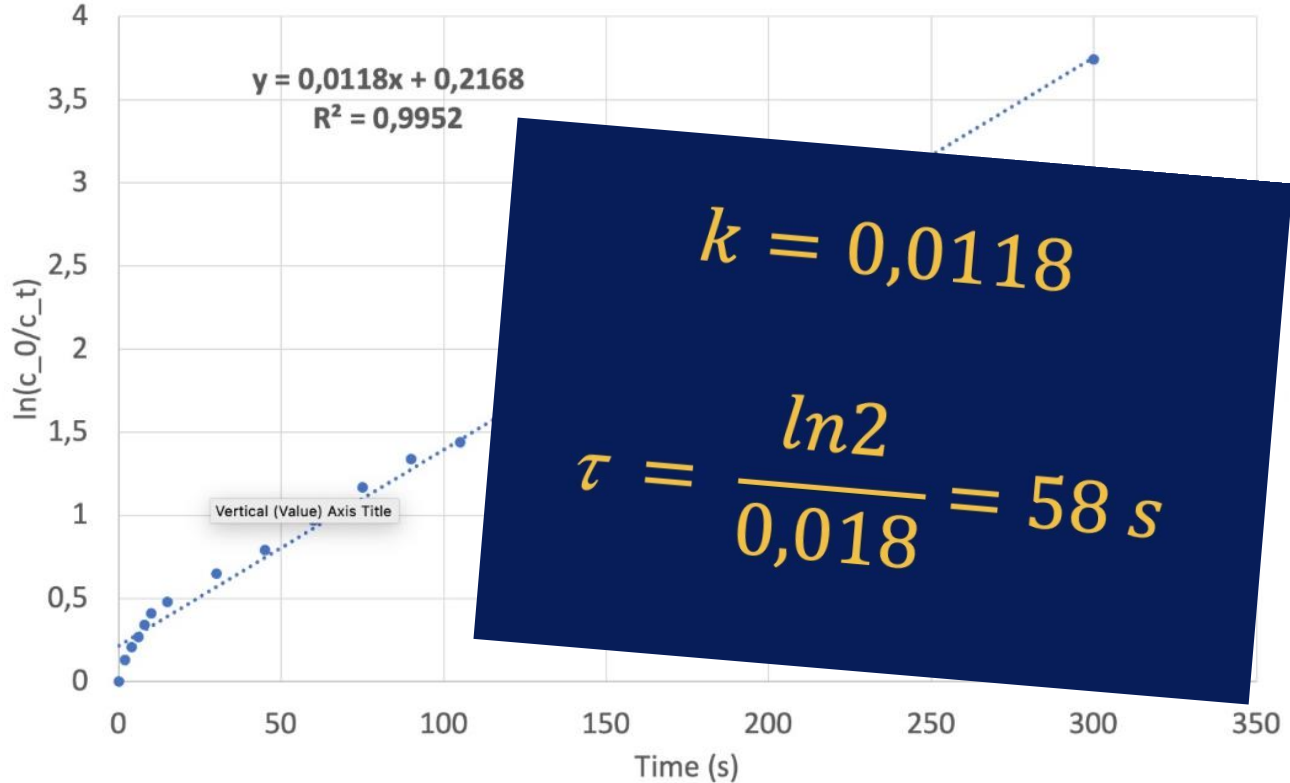


Advanced data analysis

$$\ln \frac{c_0}{c_t} = kt$$

$$\tau = \frac{\ln 2}{k}$$

Raw data	addata	(V_0/V_t)	
	0	0	
	0,13	0,13	
	0,21	0,21	
	0,27	0,27	
	0,34	0,34	
	0,41	0,41	
	0,48	0,48	
	0,65	0,65	
	0,79	0,79	
	0,97	0,97	
	,17	,17	
	,34	,34	
	1,44	1,44	
120	36	8	1,66
150	38	6	1,95
180	40	4	2,35
210	41	3	2,64
240	42	2	3,04
300	43	1	3,74
360	44		





Tech Triggers:

8
9
10
32
33
34
40
41
42
43

L1 Triggers:

L1_DoubleEG1
L1_EG10_Jet15
L1_EG5_TripleJet15
L1_MinBias_MTT10
L1_Mu3DE6_EG5
L1_SingleEG1

Thank you!