Participants are encouraged to ask questions and to engage with other participants in the Zoom Breakout Room. You will have 15–20 minutes to work with the model before the groups rejoin the main session.

1. Download the video and spreadsheet from the shared Dropbox folder using the links below.
   - Video: EXPO-22.mp4
   - Spreadsheet: EXPO-22.xlsx

   Note: You may be prompted to sign in to Dropbox, but you can close that dialog box without doing so to access the files.
2. Open the spreadsheet and find the sheet for the assigned model: Constant Torque or Linear Torque.
3. Open the video.
   - Windows Users: Windows Media Player is recommended. Right-click to get a dropdown menu. Select Enhancements $\longrightarrow$ Play Speed Settings to access navigation controls.
   - Mac Users: QuickTime is recommended. Navigate frames using the $\leftarrow$ and $\rightarrow$ keys.
4. Extract position data x_k for the first three frames and add the information in the blank cells $k = 0, 1, 2$ in the spreadsheet.
   - Try to read the meter stick (top) at the front edge of the car.
   - The starting position ($k = 0$) should be a little over 14 cm.
5. Adjust the parameters M_0 (cell K3) and k (cell K4) to improve the fit of the model to the velocity data by minimizing the sum of the squared error (cell K8).
   - The initial values are not intended to provide a good fit.
     - M_0 scales the velocity function vertically.
     - k affects the concavity of the velocity function.
   - You might try alternating between modifying M_0 and k by small amounts.
   - It will help to watch how changes affect the graph of the predicted velocities.
6. Note the following values for your final model.
   - M_0: Quantifies the torque produced by the pull-back motor.
   - k: Quantifies frictional losses.
   - v_{max}: Maximum velocity of the toy (cm/s).
   - Distance: Distance travelled by the toy over the given time interval.

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