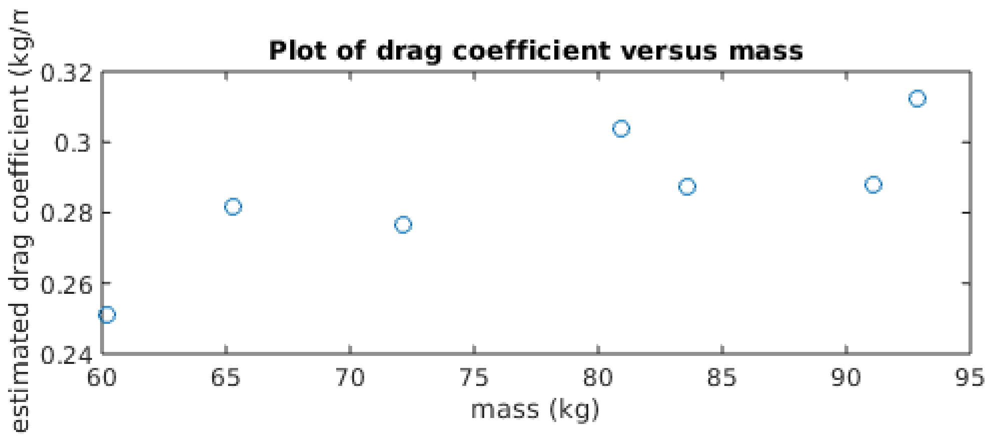
Solution

The data from Table 2.1 along with gravitational acceleration can be entered as

```
clear;clc
m = [83.6, 60.2, 72.1, 91.1, 92.9, 65.3, 80.9];
vt = [53.4, 48.5, 50.59, 55.7, 54, 47.7, 51.1];
g = 9.81;

% The drag coefficients can then be computed with Eq. (2.1). Because
 we are
% performing element-by-element operations on vectors, we must include
% periods prior to the operators:

cd = g * m ./ vt .^ 2

% We can now use some of MATLAB's built-in functions to generate some
% statistics for the results:

cdavg = mean(cd), cdmin = min(cd), cdmax = max(cd)

% Thus, the average value is
% $0.2854$
% with a range from
% $0.2511$
% to
% $0.3125$
% kg/m.
%
% Now, let's start to play with these data by using Eq. (2.1) to make
 a
% prediction of the terminal velocity based on the average drag:

vpred = sqrt(g * m / cdavg)

% Notices that we do not have to use periods prior to the operators in
 this
% formula? Do you understand why? (*Answer: g and cdavg are scalars,
 while
% m is a vector. Therefore element-by-element operation is implied*)

% We can plot these values versus the actual measured terminal
 velocities.
% We will also superimpose a line indicating exact predictions (the
 1:1
% line) to help assess the results. Because we are going to eventually
% generate a second plot, we employ the subplot command:

subplot(2,1,1);
plot(vt,vpred,'o',vt,vt);
xlabel('measured');
ylabel('predicted');
```

```
title('Plot of predicted versus measured velocities');

% AS in the top plot of Fig. 2.2, because the predictions generally
 follow
% the 1:1 line, you might initially conclude that the average drag
% coefficient yields decent results. However, notice how the model
 tends to
% underpredict the low velocities and overpredict the high. This
 suggests
% that rather than being constant, there might be a trend in the drag
% coefficients. This can be seen by plotting the estimated drag
% coefficients versus mass:

subplot(2,1,1);
plot(m,cd,'o');
xlabel('mass (kg)');
ylabel('estimated drag coefficient (kg/m)');
title('Plot of drag coefficient versus mass');

% The resulting plot, which is the bottom graph in Fig. 2.2, suggests
 that
% rather than being constant, the drag coefficient seems to be
 increasing
% as the mass of the jumper increases. Based on this result, you might
% coclude that your model needs to be improved. At the least, it might
% motivate you to conduct further experiments wit ha larger number of
% jumpers to confirm your preliminary finding. In addition, the result
% might also stimulate you to go to the fluid mechanics literature and
% learn more about the science of drag. As described previously in
 Sec.
% 1.4, you would discover that the parameter
% $c_{d}$
% is actually a lumped drag coefficient that along with the true drag
% includes other factors such as the jumper's frontal area and air
 density:
%
% $$ c_{d} = \frac{C_{D}\rho A}{2}$$
% where
% $ C_{D} =$
% a dimensionless drag coefficient,
%


cd =

  Columns 1 through 3

   0.287602575432395   0.251062599638644   0.276359827723317

  Columns 4 through 6

   0.288056045305545   0.312533950617284   0.281543451603971

  Column 7
```

```
   0.303931510678957

cdavg =

   0.285869994428588

cdmin =

   0.251062599638644

cdmax =

   0.312533950617284

vpred =

  Columns 1 through 3

  53.561577056316516  45.451525352327835  49.741382233145025

  Columns 4 through 6

  55.912563649945703  56.462236147934391  47.337662364284085

  Column 7

  52.689548597287427
```



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