# PRACTICAL COMPUTING USING MATLAB

## Solved Primary and Secondary School Exercises

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Title: PRACTICAL COMPUTING USING MATLAB: Solved Primary and Secondary School Exercises

# Contents

# Chapter 2

# Math Exercises

## 2.1 Introduction

We begin the practical applications of using MATLAB, starting with solving exercises in the primary and secondary school mathematics. The exercises have been adopted from the subjects offered by Flexible Open and Distance Education (FODE) and the electronic copies of their lessons are freely available in PDF files and can be viewed or downloaded from their website URL link: `https://fode.education.gov.pg/courses.html`.

Once again, the main focus of this text is on writing MATLAB code; only relevant information like equations or formulas related to the questions are covered. It is assumed that the reader will go through the concepts in the lesson documents and other sources and understand them before implementing the solutions in MATLAB as demonstrated in this text. In addition, the approach used in solving the questions may not strictly be the same as they have been presented in other documents. The questions were selected based primarily on their suitability to be implemented in MATLAB. Most of the exercises are implemented in the MATLAB Editor as*script* files along with a few *function* files.

## 2.2 Grade Eight Mathematics

The Grade 8 Mathematics course at FODE has 6 strands: *1: Numbers and Applications*, *2: Space and Shapes*, *3: Measurements (1)*, *4: Measurements (2)*, *5: Data and Change*, and *6: Patterns and Algebra.*. The course is based on the National Department of Education (NDOE) upper Primary Mathematics Syllabus and Curriculum Framework for Grade 8. It forms part of the continuum of Mathematics learning from Grade 6 to 8, providing a foundation for the grades 9 and 10 mathematics courses.

***Gr11 Gen.Math, U2, Act 11.2.3.4, Q3***

*The original price of a car is K40 000. If it depreciates at the rate of 2.5 per year, what is its value after 5 years?*

**Solution**

Eq 2.7 will be used here.

```
P = 40000; R = 2.5; n = 5;
A = P*(1-R/100)^n; %next year's value
```

***Gr11 Gen.Math, U2, Act 11.2.4.4, Q2***

*Jennifer wants to buy a brand-new car. She has really looked into models and prices and has decided to buy a hybrid. The vehicle costs K46,000 at a 3% interest rate over 6 years. Monthly payments are K699 per month.*

*a) How much will Jennifer pay overall for her hybrid?*

*b) How much will she pay in interest?*

**Solution**

```
% (a) Overall payment
P=46000; R=3; mthlypay=699; mthsperyr=12; yrs=6;
totalpay = mthlypay*mthsperyr*yrs; %total payment
% (b) Interest
interest=totalpay-P; %interest
```

### 2.4.2 Statistics (Unit 3)

***Gr11 Gen.Math, U3, Act 11.3.3.5, Q1***

*Compute the variance and standard deviation for the ungrouped data.*

Table 2.6: Ungrouped data.

| **Data** | **Frequency** | **Frequency $x$ data** | **Deviation** | **Squared deviation** | **Frequency $x$ squared deviation** |
|---|---|---|---|---|---|
| $x$ | $f$ | $fx$ | $x-\bar{x}$ | $(x-\bar{x})^2$ | $f(x-\bar{x})^2$ |
| 11 | 2 | – | – | – | – |
| 12 | 3 | – | – | – | – |
| 13 | 5 | – | – | – | – |
| 14 | 6 | – | – | – | – |
| 15 | 9 | – | – | – | – |
| 16 | 7 | – | – | – | – |
| 17 | 3 | – | – | – | – |
| 18 | 4 | – | – | – | – |
| 19 | 1 | – | – | – | – |
| Total | – | $\sum fx =$ | – | – | $\sum f(x-\bar{x})^2 =$ |

### 2.7.2 Trigonometry and Vectors (Unit 2)

*Gr12 Adv.Math, U2, Act 12.2.1.4.3, QA*

*Sketch the graph of each function (1)* $f(x) = 2 + cos(x)$ *and (2)* $g(x) = -cos(x)$*:*

**Solution**

```
x=-1.5*pi:0.1:3.2*pi; % choose domain -1.5pi to 3.2pi
fx=2*cos(x); gx=-cos(x);
plot(x,fx,'b-',x,gx,'r-')
legend('f(x)=2+cos(x)','g(x)=-cos(x)')
```

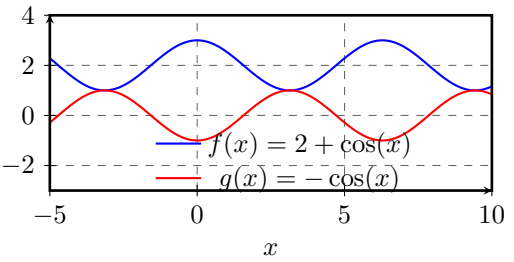



Figure 2.14: Plot of $f(x) = 2 + \cos(x)$, $g(x) = -\cos(x)$

*Gr12 Adv.Math, U2, Act 12.2.1.5, Q3*

*Sketch the graph of* $y = 2\sec(x)$ *in the domain* $0 \leq x \leq 2\pi$

**Solution**

To plot the function $y = 2\sec(x)$ in the domain $0 \leq x \leq 2\pi$ (radians) in MATLAB script, taking into consideration the asymptotes, we can write our script as follows. The asymptotes occur at $x = \frac{\pi}{2}$, $x = \frac{3\pi}{2}$, etc.

```
x = linspace(0, 2*pi, 1000); % Define the domain
% Calculate y values, avoiding asymptotes
y = zeros(size(x));
for i = 1:length(x)
    if abs(mod(x(i), pi) - pi/2) < 1e-4
        y(i) = NaN;  % Avoid division by zero at asymptotes
    else
        y(i) = 2 / cos(x(i));
    end
end
plot(x,y, 'b', 'LineWidth',2); xlabel('x'); ylabel('y');
title('Plot of y = 2sec(x)'); hold 'on';
asymptotes = pi/2:pi:3*pi/2;  % Locations of asymptotes
for i = 1:length(asymptotes)
    xline(asymptotes(i), '--r'); % Add vertical asymptote lines
    %xline(asymptotes(i), '--r', 'Asymptote'); %labeling
end
axis([0, 2*pi, -10, 10]); legend('y = 2sec(x)'); hold 'off';
```

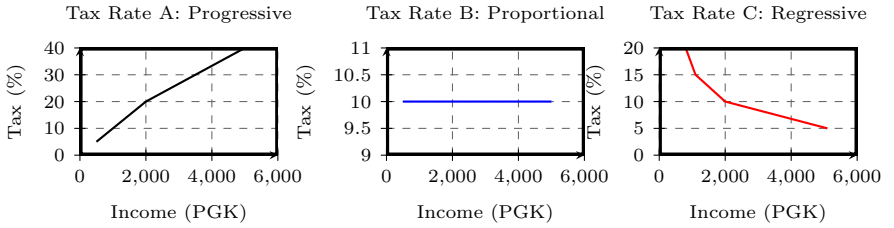
```
>> results
results =
         500          25           5          50          10         100          20
        1000         100          10         100          10         150          15
        2000         400          20         200          10         200          10
        5000        2000          40         500          10         200           4
```

### *Gr12 Econ, M2, Act 12.2.3, Q9*

*Sketch a graph illustrating each method of tax rate. Make sure to label all the axis and give a title to each graph.*

**Solution**

```
subplot(1,3,1);plot(AnnualIncome,TaxARate,'k','LineWidth',1.5);
title('Tax Rate A: Progressive')
xlabel('Income (PGK)'); ylabel('Tax (%)')
subplot(1,3,2);plot(AnnualIncome,TaxBRate,'b','LineWidth',1.5);
title('Tax Rate B: Proportional')
xlabel('Income (PGK)'); ylabel('Tax (%)')
subplot(1,3,3);plot(AnnualIncome,TaxCRate,'r','LineWidth',1.5);
title('Tax Rate C: Regressive')
xlabel('Income (PGK)'); ylabel('Tax (%)')
```




## 3.3.2 The Global Economy (Module 3)

### *Gr12 Econ, M3, Act 12.3.2, Q9*

*Given the following information in the table, calculate the answers in the fourth ($4^{th}$) in the table.*

*a) Compute the terms of trade for year 1 and 2.*

*b) What is the 'terms of trade' for year 2 and 3?*

| Year | Export Price Index | Import Price Index | Terms of Trade Index |
|---|---|---|---|
| 1 | 100 | 100 | 100 |
| 2 | 120 | 125 | - |
| 3 | 130 | 120 | - |

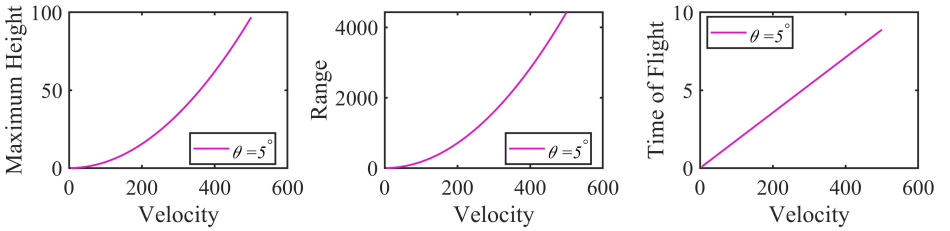



Figure 5.9: Maximum height, range, and time of flight for a projectile as a function of velocity (0-500 m/s) and angle of launch at 5 degrees.

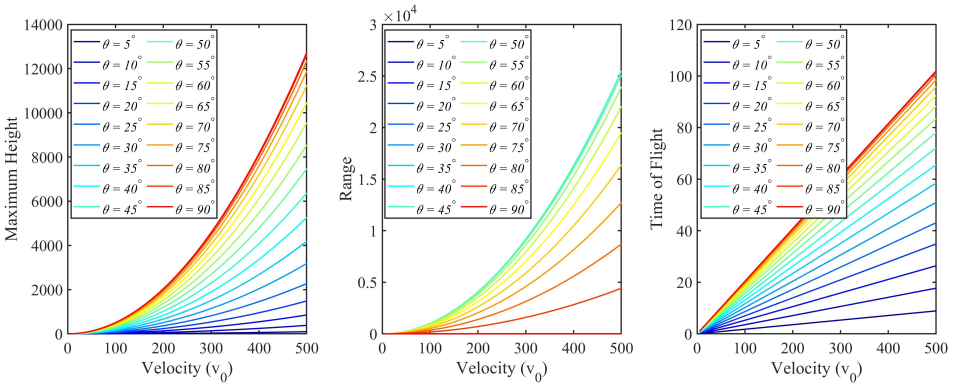



Figure 5.10: Maximum height, range, and time of flight for a projectile as a function of initial velocity and angle of launch.

### 3. Simple Harmonic Motion (SHM)

A mass-spring system undergoes simple harmonic motion. Its displacement, velocity, and acceleration of the mass as functions of time are given by:

$$\left.\begin{aligned} x(t) &= A\cos(\omega t + \phi) \\ v(t) &= -A\omega\sin(\omega t + \phi) \\ a(t) &= -A\omega^2\cos(\omega t + \phi) \end{aligned}\right\} \tag{5.51}$$

(where $A$ is the amplitude, $\omega$ is the angular frequency, and $\phi$ is the phase constant).

a) Write a MATLAB program (function) to calculate $x(t)$, $v(t)$, and $a(t)$.
b) Test your function in (a) using $t = 5$, $A = 1$, $\omega = 10$, and $\phi = \pi$.
c) Create a new script file. In it, create a vector of $t$ from 0 to 3 at an increment (step size) of 0.1. Call your function in (b) and provide all the inputs for calculation of the values of $x$, $v$, and $a$ for the different time points. You will need to write a loop for this. Plot the results on one graph against $t$.
d) Reduce the step size in (c) to 0.01 and repeat the calculation of $x$, $v$, and $a$. Plot the results again and describe/reason any difference. You will have a plot that looks like Figure 5.11.

# Index of Examples

# References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