LOTI.05.019 Data Analysis and Computational Methods with MATLAB
Third Practical Session

1. Question 1

For the function $y = \frac{2\sin x + \cos^2 x}{\sin^2 x}$, calculate the value of y for the following values of x using element-by-element operations: 20°, 30°, 40°, 50°, 60°, 70°.

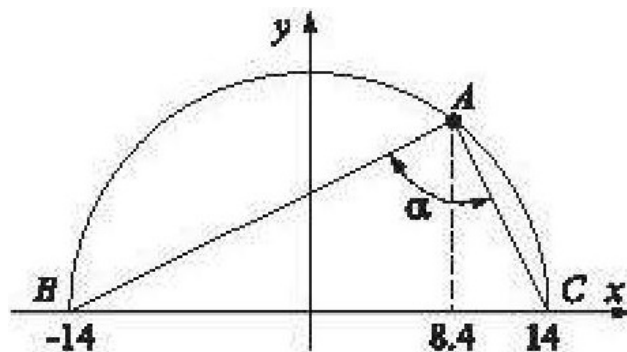## 2. Question 2

The following two vectors are defined in MATLAB:

$$\boldsymbol{v} = [15, 8, -6] \qquad \boldsymbol{u} = [3, -2, 6] \tag{1}$$

By hand (pencil and paper) write what will be displayed if the following commands are executed by MATLAB. Check your answers by executing the commands with MATLAB.

$$(a)\texttt{v./u} \qquad (b)\texttt{u'*v} \qquad (c)\texttt{u*v'} \tag{2}$$

3. Question 3

Use MAILAB to show that the angle inscribed in a semi-circle is a right angle. Use the following steps in a script file to calculate the angle. Define a variable with the value of the x coordinate of point A. Determine the y coordinate of point A using the equation $x^2 + y^2 = R^2$. Define vectors that correspond to the position of points A, B, and C and use them for determining position vectors $\boldsymbol{r}_{AB}$ and $\boldsymbol{r}_{AC}$. Calculate the angle α in two ways. First by using the equation $\alpha = \cos^{-1}\left(\frac{\boldsymbol{r}_{AB}.\boldsymbol{r}_{AC}}{|\boldsymbol{r}_{AB}||\boldsymbol{r}_{AC}|}\right)$, and then by using the equation $\alpha = \sin^{-1}\left(\frac{|\boldsymbol{r}_{AB}\times\boldsymbol{r}_{AC}|}{|\boldsymbol{r}_{AB}||\boldsymbol{r}_{AC}|}\right)$. Both should give 90°.

4. Question 4

Use MATLAB to show that the sum of the infinite series $\sum_{n=1}^{\infty} \frac{\left(\frac{9}{10}\right)^n}{n}$ converges to $\ln 10$. Do this by computing the sum for

$$(a)n = 10, \qquad (b)n = 50, \qquad (c)n = 100 \tag{3}$$

For each part, create a vector $\boldsymbol{n}$ in which the first element is 1, the increment is 1 and the last term is n. Then use element-by-element calculations to create a vector in which the elements are $\frac{\left(\frac{9}{10}\right)^n}{n}$. Finally, use MATLAB's built-in function `sum` to sum the series. Compare the values to $\ln 10$ (use `format long` to display the numbers).