Computing for Mathematics: Handout 6

This handout contains a summary of the topics covered and an activity to carry out prior or during your lab session.

At the end of the handout is a specific coursework like exercise.

For further practice you can do the exercises available at the matrices chapter of Python for Mathematics.

1 Summary

The purpose of this handout is to cover matrices which corresponds to the probability chapter of Python for Mathematics.

The topics covered are:

- Creating matrices.
- Manipulating matrices.
- Solving a system of linear equations using matrices.

2 Activity

We will be tackling the problem from the tutorial of the matrices chapter of Python for Mathematics.

The matrix A is given by $A = \begin{pmatrix} a & 1 & 1 \\ 1 & a & 1 \\ 1 & 1 & 2 \end{pmatrix}$.

1. Find the determinant of A 2. Hence find the values of a for which A is singular. 3. For the following values of a, when possible obtain A^{-1} and confirm the result by computing AA^{-1}: **1.** $a = 0$; **2.** $a = 1$; **3.** $a = 2$; **4.** $a = 3$.

There are instructions for how to do all of this is in the probability chapter of Python for Mathematics.

1. Create a variable `A` which has value the matrix A.
2. Create a variable `determinant` which has value the determinant of A.
3. Find the values of a for which the determinant of A is 0. This corresponds to the values for which A is singular.
4. Substitute the given values of a in to `A` and compute the inverse. Multiply the inverse by A to obtain the identity matrix $\begin{pmatrix} 1 & 0 & \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$ which confirms the result.

3 Summary examples

Create the matrix $B = \begin{pmatrix} 3 & 5 \\ 1 & -2 \end{pmatrix}$.

```
import sympy as sym
B = sym.Matrix(((3, 5), (1, -2)))
```

Obtain the determinant of $B = \begin{pmatrix} 3 & 5 \\ 1 & -2 \end{pmatrix}$.

```
import sympy as sym
B = sym.Matrix(((3, 5), (1, -2)))
B.det()
```

Obtain the inverse of $B = \begin{pmatrix} 3 & 5 \\ 1 & -2 \end{pmatrix}$

```
import sympy as sym
B = sym.Matrix(((3, 5), (1, -2)))
B.inv()
```

Calculate $\begin{pmatrix} 3 & 5 \\ 1 & -2 \end{pmatrix} \left(\begin{pmatrix} 3 & 1 \\ 4 & 1 \end{pmatrix} + 6 \begin{pmatrix} 2 & 3 \\ 1 & 1 \end{pmatrix} \right)$

```
import sympy as sym
B = sym.Matrix(((3, 5), (1, -2)))
C = sym.Matrix(((3, 1), (4, 1)))
D = sym.Matrix(((2, 3), (1, 1)))
B @ (C + 6 * D)
```

Solve the linear system:

$$x + 2y = 3$$
$$3x + y = 4$$

```
import sympy as sym
M = sym.Matrix(((1, 2), (3, 1)))
b = sym.Matrix(((3,), (4,)))
M.inv() @ b
```