ECON526: Problem Set 1 (Solutions)

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— INSTRUCTOR SOLUTIONS —

> SOLUTIONS
>
> We are mostly looking to ensure they have a working python setup, so expect grades for this to be nearly perfect for all students.

Instructions

- Ensure you modify the field above with your **name and student number above immediately**
- Modify directly and do not rename the file as Canvas will automatically append your name to it.
- Submit both the `.ipynb` and an exported `html` version of this file.
- See here for instructions.
- Do not change the filenames. Canvas automatically appends your name/student number to submitted files.

Setup

```
import numpy as np
import matplotlib.pyplot as plt
```

Install Python (with Jupyter and VS Code)

- See here for instructions and links.
- VS Code is optional but recommended.

Question 1

Modify the next cell with some math text with the Pythagorean theorem (e.g. $x^2 + y^2 = z^2$)

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Any markdown cell with LaTeX math, e.g. $x^2 + y^2 = z^2$.

Question 2

Modify the next cell to create a function which takes the sides of the rectangle and calculates the hypotenuse (i.e., code up $z(x, y) = \sqrt{x^2 + y^2}$) then calculate $z(3, 4)$

```
# modify here
```

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```
# SOLUTIONS
def hypotenuse(x, y):
    return np.sqrt(x**2 + y**2)


hypotenuse(3, 4)
```

```
np.float64(5.0)
```

Question 3

Take the following system of equations, build a matrix, and solve for the system of equations using numpy's `linalg.solve` function.

$$2x_1 + 3x_2 = 5$$
$$4x_1 + 9x_2 = 20$$

```
# modify here
```

SOLUTIONS

```
# SOLUTIONS
A = np.array([[2, 3], [4, 9]])
b = np.array([5, 20])
x = np.linalg.solve(A, b)
x
```

```
array([-2.5       ,  3.33333333])
```

Question 4

Now take the following system

$$x_1 + 2x_2 = 5$$
$$2x_1 + 4x_2 = 10$$

Try this with `linalg.solve`. Why doesn't it work? If this has a solution, find it and explain.

```
# modify here
```

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The second row is twice the first, so the matrix is singular and `np.linalg.solve([[1, 2], [2, 4]], [5, 10])` raises `LinAlgError: Singular matrix`. The system is still consistent because the right-hand side is also doubled, so there are infinitely many solutions: every (x_1, x_2) with $x_1 = 5 - 2x_2$.

Question 5

Plot $f(x) = x^2$ for a grid of 20 points of $x \in [0, 1]$. Hint: You can make a grid with `np.linspace(...)` and use matplotlib's `plt.plot(...)` function.

```
# modify here
```

SOLUTIONS

```
# SOLUTIONS
x = np.linspace(0, 1, num=20)
y = x**2
plt.plot(x, y)
```

