Python Lab 6 Solutions

Question 1.

`random.randint(a,b)` produces integers a<=x<=b (including b) and result is a single int

`numpy.random.randint(a,b,size)` produces integers a<=x<b (not including b) and result is a numpy array if size given otherwise a single int

For further details see:
https://www.w3schools.com/python/ref_random_randint.asp
https://numpy.org/doc/stable/reference/random/generated/numpy.random.randint.html

Question 2. Could be more possibilities for each, but must be one line for each part.

```
A[-2]
A[:5]   # or A[0:5]
len(np.unique(A))  # give half-marks for len(A)
(np.mean(A),np.std(A))
np.zeros(A.shape)
A[np.mod(A,10)==3]
```

Question 3.

(a) `np.nan` is used to record missing values ("not a number")
(b) Maximum value (excluding `np.nan`)

```
np.nanmax(B)
```

For further details see:
https://numpy.org/doc/stable/reference/constants.html
https://numpy.org/doc/stable/reference/generated/numpy.nanmax.html

Question 4. Many possible answers, for example:

```
np.arange(1,11,3)
np.arange(10,0,-3)
```

For further details see:
https://realpython.com/how-to-use-numpy-arange/

Question 5. np.diff() is the "discrete difference" function. Basically:

output[i] = input[i+1]-input[i]

Output:

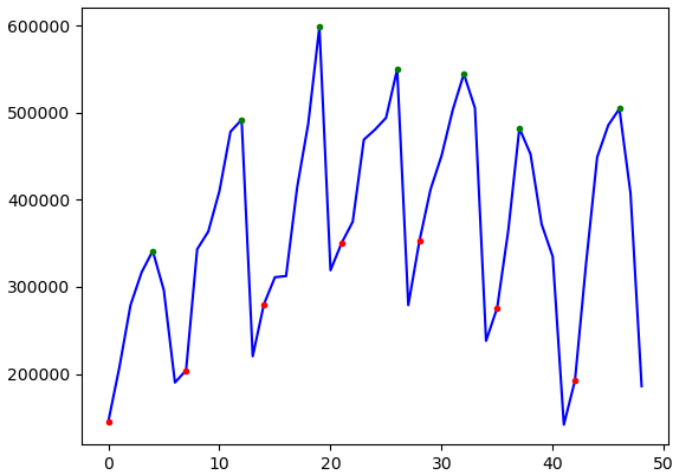
```
array([1, 2, 2, 4, 2, 4, 2, 4, 6])
```

3-2 = 1, 5-3=2, etc

Note the length of the output is one less than the length on the input as there is one less subtraction that there are elements.

For further details see:
https://www.geeksforgeeks.org/numpy-diff-in-python/
https://numpy.org/doc/stable/reference/generated/numpy.diff.html

Question 6.



(a) Overall goal/result is to identify the peaks (green dots) in the line plot of vaccination counts (these occur roughly weekly) and calculate the number of days between peaks.

(b) Line 1: Calculate differences between consecutive day vaccination counts (positive is increase, negative is decrease)

Line 2: Take the sign of the differences, i.e., positive gives 1, zero gives 0, and negative gives -1 (so 1 is increase in daily vaccinations, 0 is no change, and -1 is decrease in daily vaccinations). Then takes the differences of these signs, so we will often see a 0 (no change in the sign) and sometimes see a 2 (going from -1 to 1, i.e., decrease to increase so the valley) and sometimes see a -2 (going from 1 to -1, i.e., increase to decrease so the peak).

Line 3: Find the index of each peak (nonzero strangely returns a tuple of length 1) but because of the two uses of diff the indices are all out by one (so 1+).

Line 4: Plot the peaks with a green dot.

Line 5: Calculate the number of days between peaks, ranges from 5 days to 9 days, so roughly weekly but some variation.

For further details see:
https://numpy.org/doc/stable/reference/generated/numpy.diff.html
https://numpy.org/doc/stable/reference/generated/numpy.sign.html
https://numpy.org/doc/stable/reference/generated/numpy.nonzero.html

You just need to do a Google search for "numpy.diff" etc.