﻿"""

Created on Sun Mar 3 16:30:41 2019

@author: roryeggleston

"""

import numpy as np

import matplotlib.pyplot as plt

import matplotlib as mpl

mpl.rcParams['figure.figsize'] = [4.0, 3.0]

mpl.rcParams['figure.dpi'] = 100

mpl.rcParams['savefig.dpi'] = 100

mpl.rcParams['font.size'] = 12

mpl.rcParams['legend.fontsize'] = 'small'

mpl.rcParams['figure.titlesize'] = 'medium'

mpl.rcParams['lines.linewidth'] = 1.0

x = np.array([1,2,3,-99,5])

x.mean()

Out[5]: -17.6

mx = np.ma.masked\_array(x, mask=[0,0,0,1,0])

mx

Out[6]:

masked\_array(data=[1, 2, 3, --, 5],

mask=[False, False, False, True, False],

fill\_value=999999)

mx.mean()

Out[7]: 2.75

mx2 = np.ma.masked\_where(x<0,x)

mx2

Out[8]:

masked\_array(data=[1, 2, 3, --, 5],

mask=[False, False, False, True, False],

fill\_value=999999)

﻿np.mean(mx2)

Out[9]: 2.75

data = np.loadtxt('/Users/roryeggleston/Downloads/populations.txt')

data

Out[10]:

array([[ 1900., 30000., 4000., 48300.],

[ 1901., 47200., 6100., 48200.],

[ 1902., 70200., 9800., 41500.],

[ 1903., 77400., 35200., 38200.],

[ 1904., 36300., 59400., 40600.],

[ 1905., 20600., 41700., 39800.],

[ 1906., 18100., 19000., 38600.],

[ 1907., 21400., 13000., 42300.],

[ 1908., 22000., 8300., 44500.],

[ 1909., 25400., 9100., 42100.],

[ 1910., 27100., 7400., 46000.],

[ 1911., 40300., 8000., 46800.],

[ 1912., 57000., 12300., 43800.],

[ 1913., 76600., 19500., 40900.],

[ 1914., 52300., 45700., 39400.],

[ 1915., 19500., 51100., 39000.],

[ 1916., 11200., 29700., 36700.],

[ 1917., 7600., 15800., 41800.],

[ 1918., 14600., 9700., 43300.],

[ 1919., 16200., 10100., 41300.],

[ 1920., 24700., 8600., 47300.]])

data.shape

Out[11]: (21, 4)

data[:,0]

Out[12]:

array([1900., 1901., 1902., 1903., 1904., 1905., 1906., 1907., 1908.,

1909., 1910., 1911., 1912., 1913., 1914., 1915., 1916., 1917.,

1918., 1919., 1920.])

﻿plt.plot(data[:,0], data[:,1])

plt.plot(data[:,0], data[:,2])

plt.plot(data[:,0], data[:,3])

plt.xlabel('Year')

plt.ylabel('Population')

plt.legend(['Hares', 'Lynxes', 'Carrots'], loc = 'upper right')

Out[13]: <matplotlib.legend.Legend at 0x115e22358>



﻿data.T

Out[14]:

array([[ 1900., 1901., 1902., 1903., 1904., 1905., 1906., 1907.,

1908., 1909., 1910., 1911., 1912., 1913., 1914., 1915.,

1916., 1917., 1918., 1919., 1920.],

[30000., 47200., 70200., 77400., 36300., 20600., 18100., 21400.,

22000., 25400., 27100., 40300., 57000., 76600., 52300., 19500.,

11200., 7600., 14600., 16200., 24700.],

[ 4000., 6100., 9800., 35200., 59400., 41700., 19000., 13000.,

8300., 9100., 7400., 8000., 12300., 19500., 45700., 51100.,

29700., 15800., 9700., 10100., 8600.],

[48300., 48200., 41500., 38200., 40600., 39800., 38600., 42300.,

44500., 42100., 46000., 46800., 43800., 40900., 39400., 39000.,

36700., 41800., 43300., 41300., 47300.]])

year, hares, lynxes, carrots = data.T

year

Out[16]:

array([1900., 1901., 1902., 1903., 1904., 1905., 1906., 1907., 1908.,

1909., 1910., 1911., 1912., 1913., 1914., 1915., 1916., 1917.,

1918., 1919., 1920.])

hares

Out[17]:

array([30000., 47200., 70200., 77400., 36300., 20600., 18100., 21400.,

22000., 25400., 27100., 40300., 57000., 76600., 52300., 19500.,

11200., 7600., 14600., 16200., 24700.])

lynxes

Out[18]:

array([ 4000., 6100., 9800., 35200., 59400., 41700., 19000., 13000.,

8300., 9100., 7400., 8000., 12300., 19500., 45700., 51100.,

29700., 15800., 9700., 10100., 8600.])

carrots

Out[19]:

array([48300., 48200., 41500., 38200., 40600., 39800., 38600., 42300.,

44500., 42100., 46000., 46800., 43800., 40900., 39400., 39000.,

36700., 41800., 43300., 41300., 47300.])

﻿plt.plot(year, hares)

plt.plot(year, lynxes)

plt.plot(year, carrots)

plt.xlabel('Year')

plt.ylabel('Population')

plt.legend(['Hares', 'Lynxes', 'Carrots'], loc = 'upper right')

Out[20]: <matplotlib.legend.Legend at 0x115eb5a58>



﻿

plt.boxplot([hares, lynxes, carrots])

plt.xlabel('Hares, Lynxes, Carrots')

plt.ylabel('Populations (thousands)')

labels = ('Hares', 'Lynxes', 'Carrots')



﻿np.mean(data, axis = 0)

Out[22]: array([ 1910. , 34080.95238095, 20166.66666667, 42400. ])

data.mean(axis = 0)

Out[23]: array([ 1910. , 34080.95238095, 20166.66666667, 42400. ])

print(hares.mean())

print(lynxes.mean())

print(carrots.mean())

34080.95238095238

20166.666666666668

42400.0

year

Out[25]:

array([1900., 1901., 1902., 1903., 1904., 1905., 1906., 1907., 1908.,

1909., 1910., 1911., 1912., 1913., 1914., 1915., 1916., 1917.,

1918., 1919., 1920.])

(year > 1903)

#works

Out[26]:

array([False, False, False, False, True, True, True, True, True,

True, True, True, True, True, True, True, True, True,

True, True, True])

(year >= 1903)

#makes 1903 true

Out[27]:

array([False, False, False, True, True, True, True, True, True,

True, True, True, True, True, True, True, True, True,

True, True, True])

(year >= 1903 & (year <= 1910))

#"and doesn't work, has to be &

Out[28]:

array([ True, True, True, True, True, True, True, True, True,

True, True, True, True, True, True, True, True, True,

True, True, True])

﻿((year >= 1903) & (year <= 1910)) |((year >= 1917) & (year <= 1918))

Out[29]:

array([False, False, False, True, True, True, True, True, True,

True, True, False, False, False, False, False, False, True,

True, False, False])

mask = ((year >= 1903) & (year <= 1910)) |((year >= 1917) & (year <= 1918))

lynxes\_masked = np.ma.masked\_where(mask, lynxes)

lynxes\_masked

Out[31]:

masked\_array(data=[4000.0, 6100.0, 9800.0, --, --, --, --, --, --, --, --,

8000.0, 12300.0, 19500.0, 45700.0, 51100.0, 29700.0,

--, --, 10100.0, 8600.0],

mask=[False, False, False, True, True, True, True, True,

True, True, True, False, False, False, False, False,

False, True, True, False, False],

fill\_value=1e+20)

hares\_masked = np.ma.masked\_where(mask, hares)

#don't have to do carrots bc that data is fine

﻿plt.plot(year, hares\_masked)

plt.plot(year, lynxes\_masked)

plt.plot(year, carrots)

plt.xlabel('Year')

plt.ylabel('Population')

plt.legend(['Hares', 'Lynxes', 'Carrots'], loc = 'upper right')

Out[33]: <matplotlib.legend.Legend at 0x11604ce80>



﻿print(hares.mean())

print(hares\_masked.mean())

34080.95238095238

40472.72727272727

print(lynxes.mean())

print(lynxes\_masked.mean())

20166.666666666668

18627.272727272728

﻿plt.boxplot([hares, hares\_masked, lynxes, lynxes\_masked, carrots])

plt.xlabel('hares, hares\_masked, lynxes, lynxes\_masked, carrots')

plt.ylabel('Populations (thousands)')

Out[36]: Text(0, 0.5, 'Populations (thousands)')



﻿print(data)

[[ 1900. 30000. 4000. 48300.]

[ 1901. 47200. 6100. 48200.]

[ 1902. 70200. 9800. 41500.]

[ 1903. 77400. 35200. 38200.]

[ 1904. 36300. 59400. 40600.]

[ 1905. 20600. 41700. 39800.]

[ 1906. 18100. 19000. 38600.]

[ 1907. 21400. 13000. 42300.]

[ 1908. 22000. 8300. 44500.]

[ 1909. 25400. 9100. 42100.]

[ 1910. 27100. 7400. 46000.]

[ 1911. 40300. 8000. 46800.]

[ 1912. 57000. 12300. 43800.]

[ 1913. 76600. 19500. 40900.]

[ 1914. 52300. 45700. 39400.]

[ 1915. 19500. 51100. 39000.]

[ 1916. 11200. 29700. 36700.]

[ 1917. 7600. 15800. 41800.]

[ 1918. 14600. 9700. 43300.]

[ 1919. 16200. 10100. 41300.]

[ 1920. 24700. 8600. 47300.]]

hares

Out[38]:

array([30000., 47200., 70200., 77400., 36300., 20600., 18100., 21400.,

22000., 25400., 27100., 40300., 57000., 76600., 52300., 19500.,

11200., 7600., 14600., 16200., 24700.])

mask2 = ((year >= 1902) & (year <=1903)) |((year >= 1913) & (year <= 1913))

print(mask2)

[False False True True False False False False False False False False

False True False False False False False False False]

hares\_masked2 = np.ma.masked\_where(mask2, hares)

hares\_masked2

Out[41]:

masked\_array(data=[30000.0, 47200.0, --, --, 36300.0, 20600.0, 18100.0,

21400.0, 22000.0, 25400.0, 27100.0, 40300.0, 57000.0,

--, 52300.0, 19500.0, 11200.0, 7600.0, 14600.0,

16200.0, 24700.0],

mask=[False, False, True, True, False, False, False, False,

False, False, False, False, False, True, False, False,

False, False, False, False, False],

fill\_value=1e+20)

﻿plt.plot(year, hares\_masked2)

plt.plot(year, lynxes\_masked)

plt.plot(year, carrots)

plt.xlabel('Year')

plt.ylabel('Population')

plt.legend(['Hares', 'Lynxes', 'Carrots'], loc = 'upper right')

Out[42]: <matplotlib.legend.Legend at 0x116149438>



﻿print(hares\_masked2.mean())

27305.555555555555

plt.boxplot([hares, hares\_masked, hares\_masked2, lynxes, lynxes\_masked, carrots])

plt.xlabel('hares, hares\_masked, hares\_masked2, lynxes, lynxes\_masked, carrots')

plt.ylabel('Populations (thousands)')

Out[44]: Text(0, 0.5, 'Populations (thousands)')



﻿r = np.corrcoef(hares, lynxes)[0,1]

# r = 0.072

plt.scatter(hares, lynxes)

plt.title(('r=' + str(r)))

Out[46]: Text(0.5, 1.0, 'r=0.07189206073535571')

