

week12-scratch-work

April 8, 2024

```
[3]: import numpy as np
import numpy.linalg as la

rng = np.random.default_rng()
```

```
[84]: actual = { 'a': 10,
                'b': 15,
                'c': 13,
                'd': 20,
                'e': 25,
                'f': 30,
                'g': 5,
                'h': 15,
                'i': 17,
                'j': 20
                }

kl = actual.keys()

vv = np.array(list(actual.values()))

from itertools import chain, combinations

def nset(n, iterable):
    s = list(iterable)
    return list(combinations(s, n))

pairs = nset(2, kl)
```

```
[68]: p_est = { (x,y):round(actual[x] + actual[y] + rng.uniform(-5,5),2) for (x,y) in
    ↪ pairs }
p_est
```

```
[68]: {('a', 'b'): 21.21,
      ('a', 'c'): 24.35,
      ('a', 'd'): 34.57,
      ('a', 'e'): 32.72,
      ('a', 'f'): 36.14,
```

```

('a', 'g'): 17.21,
('a', 'h'): 26.41,
('a', 'i'): 29.92,
('a', 'j'): 32.84,
('b', 'c'): 29.09,
('b', 'd'): 33.78,
('b', 'e'): 40.63,
('b', 'f'): 44.46,
('b', 'g'): 17.03,
('b', 'h'): 30.58,
('b', 'i'): 32.7,
('b', 'j'): 31.19,
('c', 'd'): 30.08,
('c', 'e'): 37.3,
('c', 'f'): 39.4,
('c', 'g'): 20.44,
('c', 'h'): 28.34,
('c', 'i'): 31.07,
('c', 'j'): 36.78,
('d', 'e'): 41.44,
('d', 'f'): 47.97,
('d', 'g'): 28.51,
('d', 'h'): 38.0,
('d', 'i'): 38.71,
('d', 'j'): 39.24,
('e', 'f'): 59.61,
('e', 'g'): 29.19,
('e', 'h'): 35.09,
('e', 'i'): 42.18,
('e', 'j'): 46.8,
('f', 'g'): 34.14,
('f', 'h'): 46.71,
('f', 'i'): 48.07,
('f', 'j'): 49.53,
('g', 'h'): 23.46,
('g', 'i'): 22.13,
('g', 'j'): 24.21,
('h', 'i'): 29.03,
('h', 'j'): 32.51,
('i', 'j'): 38.17}

```

```

[90]: def sbv(i,n):
        # return the ith standard basis vector of length n
        return np.array([1 if j == i else 0 for j in range(n)])

def sbv_list(elem,ls):

```

```

    # return the standard basis vector determined by the position of `elem` in
    ↪ the list `ls`
    return sbv(list(ls).index(elem),len(ls))

```

```

M = np.array([sbv_list(x,k) + sbv_list(y,kl) for (x,y) in p_est.keys()])

b = np.array([p_est[x] for x in p_est.keys()])

(M,b)

```

```

[90]: (array([[1, 1, 0, 0, 0, 0, 0, 0, 0, 0],
              [1, 0, 1, 0, 0, 0, 0, 0, 0, 0],
              [1, 0, 0, 1, 0, 0, 0, 0, 0, 0],
              [1, 0, 0, 0, 1, 0, 0, 0, 0, 0],
              [1, 0, 0, 0, 0, 1, 0, 0, 0, 0],
              [1, 0, 0, 0, 0, 0, 1, 0, 0, 0],
              [1, 0, 0, 0, 0, 0, 0, 1, 0, 0],
              [1, 0, 0, 0, 0, 0, 0, 0, 1, 0],
              [1, 0, 0, 0, 0, 0, 0, 0, 0, 1],
              [0, 1, 1, 0, 0, 0, 0, 0, 0, 0],
              [0, 1, 0, 1, 0, 0, 0, 0, 0, 0],
              [0, 1, 0, 0, 1, 0, 0, 0, 0, 0],
              [0, 1, 0, 0, 0, 1, 0, 0, 0, 0],
              [0, 1, 0, 0, 0, 0, 1, 0, 0, 0],
              [0, 1, 0, 0, 0, 0, 0, 1, 0, 0],
              [0, 1, 0, 0, 0, 0, 0, 0, 1, 0],
              [0, 1, 0, 0, 0, 0, 0, 0, 0, 1],
              [0, 0, 1, 1, 0, 0, 0, 0, 0, 0],
              [0, 0, 1, 0, 1, 0, 0, 0, 0, 0],
              [0, 0, 1, 0, 0, 1, 0, 0, 0, 0],
              [0, 0, 1, 0, 0, 0, 1, 0, 0, 0],
              [0, 0, 1, 0, 0, 0, 0, 1, 0, 0],
              [0, 0, 1, 0, 0, 0, 0, 0, 1, 0],
              [0, 0, 1, 0, 0, 0, 0, 0, 0, 1],
              [0, 0, 0, 1, 1, 0, 0, 0, 0, 0],
              [0, 0, 0, 1, 0, 1, 0, 0, 0, 0],
              [0, 0, 0, 1, 0, 0, 1, 0, 0, 0],
              [0, 0, 0, 1, 0, 0, 0, 1, 0, 0],
              [0, 0, 0, 1, 0, 0, 0, 0, 1, 0],
              [0, 0, 0, 1, 0, 0, 0, 0, 0, 1],
              [0, 0, 0, 0, 1, 1, 0, 0, 0, 0],
              [0, 0, 0, 0, 1, 0, 1, 0, 0, 0],
              [0, 0, 0, 0, 1, 0, 0, 1, 0, 0],
              [0, 0, 0, 0, 1, 0, 0, 0, 1, 0],
              [0, 0, 0, 0, 1, 0, 0, 0, 0, 1],
              [0, 0, 0, 0, 0, 1, 1, 0, 0, 0]]))

```

```

[0, 0, 0, 0, 0, 1, 0, 1, 0, 0],
[0, 0, 0, 0, 0, 1, 0, 0, 1, 0],
[0, 0, 0, 0, 0, 1, 0, 0, 0, 1],
[0, 0, 0, 0, 0, 0, 1, 1, 0, 0],
[0, 0, 0, 0, 0, 0, 1, 0, 1, 0],
[0, 0, 0, 0, 0, 0, 1, 0, 0, 1],
[0, 0, 0, 0, 0, 0, 0, 1, 1, 0],
[0, 0, 0, 0, 0, 0, 0, 1, 0, 1],
[0, 0, 0, 0, 0, 0, 0, 0, 1, 1]],
array([21.21, 24.35, 34.57, 32.72, 36.14, 17.21, 26.41, 29.92, 32.84,
       29.09, 33.78, 40.63, 44.46, 17.03, 30.58, 32.7 , 31.19, 30.08,
       37.3 , 39.4 , 20.44, 28.34, 31.07, 36.78, 41.44, 47.97, 28.51,
       38. , 38.71, 39.24, 59.61, 29.19, 35.09, 42.18, 46.8 , 34.14,
       46.71, 48.07, 49.53, 23.46, 22.13, 24.21, 29.03, 32.51, 38.17]))

```

```

[91]: x = la.lstsq(M,b,rcond=None)
      x

```

```

[91]: (array([10.63041667, 13.79291667, 13.31541667, 20.24666667, 24.32916667,
       29.46291667,  5.74916667, 14.97541667, 17.70666667, 20.11791667]),
      array([245.843925]),
      10,
      array([4.24264069, 2.82842712, 2.82842712, 2.82842712, 2.82842712,
       2.82842712, 2.82842712, 2.82842712, 2.82842712, 2.82842712]))

```

```

[92]: (M @ x[0], b - M @ x[0])

```

```

[92]: (array([24.42333333, 23.94583333, 30.87708333, 34.95958333, 40.09333333,
       16.37958333, 25.60583333, 28.33708333, 30.74833333, 27.10833333,
       34.03958333, 38.12208333, 43.25583333, 19.54208333, 28.76833333,
       31.49958333, 33.91083333, 33.56208333, 37.64458333, 42.77833333,
       19.06458333, 28.29083333, 31.02208333, 33.43333333, 44.57583333,
       49.70958333, 25.99583333, 35.22208333, 37.95333333, 40.36458333,
       53.79208333, 30.07833333, 39.30458333, 42.03583333, 44.44708333,
       35.21208333, 44.43833333, 47.16958333, 49.58083333, 20.72458333,
       23.45583333, 25.86708333, 32.68208333, 35.09333333, 37.82458333]),
      array([-3.21333333,  0.40416667,  3.69291667, -2.23958333, -3.95333333,
       0.83041667,  0.80416667,  1.58291667,  2.09166667,  1.98166667,
      -0.25958333,  2.50791667,  1.20416667, -2.51208333,  1.81166667,
       1.20041667, -2.72083333, -3.48208333, -0.34458333, -3.37833333,
       1.37541667,  0.04916667,  0.04791667,  3.34666667, -3.13583333,
      -1.73958333,  2.51416667,  2.77791667,  0.75666667, -1.12458333,
       5.81791667, -0.88833333, -4.21458333,  0.14416667,  2.35291667,
      -1.07208333,  2.27166667,  0.90041667, -0.05083333,  2.73541667,
      -1.32583333, -1.65708333, -3.65208333, -2.58333333,  0.34541667]))

```

```

[76]: np.array(list(actual.values()))

```

```
[76]: array([10, 15, 13, 20, 25, 30,  5, 15, 17, 20])
```

```
[93]: len(x[0])
```

```
[93]: 10
```

```
[94]: x[0] - vv
```

```
[94]: array([ 0.63041667, -1.20708333,  0.31541667,  0.24666667, -0.67083333,  
          -0.53708333,  0.74916667, -0.02458333,  0.70666667,  0.11791667])
```

```
[95]: x[0],vv
```

```
[95]: (array([10.63041667, 13.79291667, 13.31541667, 20.24666667, 24.32916667,  
          29.46291667,  5.74916667, 14.97541667, 17.70666667, 20.11791667]),  
      array([10, 15, 13, 20, 25, 30,  5, 15, 17, 20]))
```

```
[ ]:
```