HW 6 Solution - ISE 754 Fall 2020

Contents

Question 1

LTL estimation formula

```
d = 532;
s = 70/20
q = 25*70/2000
ppiLTL = 144.3
rLTL = rateLTL(q,s,d,ppiLTL)
c_LTL = rLTL*q*d
```

```
s =

    3.5000
```

```
q =

    0.8750
```

```
ppiLTL =

  144.3000
```

```
rLTL =

    3.1039
```

```
c_LTL =

    1.4449e+03
```

LTL tariff

```
disc = 0; MC = 95.23;
cl = [500 400 300 250 200 175 150 125 110 100 92.5 85 77.5 70 65 60 55 50];
cl_avg = [0.52 1.49 2.49 3.49 4.49 5.49 6.49 7.49 8.49 9.72 11.22 12.72 ...
    14.22 18.01 25.5 32.16 39.68 56.18];
class = cl(argmin(dists(s,cl_avg')))
qB = [0 0.25 0.5 1 2.5 5 10 15 20 Inf];
i = find(qB(1:end-1) <= q & q < qB(2:end))
ODi = 124.23
ci = ODi*20*q
ODiplus1 = 101.83
qBi = qB(i+1)
ciplus1 = ODiplus1*20*qBi
c_tar = (1 - disc)*max(MC,min(ci,ciplus1))
```

```
class =

   250
```

```
i =

     3
```

```
ODi =
```

```
   124.2300


ci =

   2.1740e+03


ODiplus1 =

   101.8300


qBi =

     1


ciplus1 =

   2.0366e+03


c_tar =

   2.0366e+03
```

Difference

```
rat = c_tar/c_LTL;
fprintf('Tariff is %d%% %s than formula.\n',...
    round(100*(iff(rat>1,rat-1,1-rat))),iff(rat>1,'higher','lower'))
```

```
Tariff is 41% higher than formula.
```

Question 2

Create shipment

```
sh = vec2struct('f',75,'d',625,'s',12,'v',11200,'h',.4,'a',1);
sdisp(sh)
ppiTL = 123.4, ppiLTL = 141.4,
tr.r = 2*(ppiTL/102.7); tr.Kwt = 25; tr.Kcu = 2750;
```

```
sh:       1
--:-----------
 f:       75.00
 d:      625.00
 s:       12.00
```

```
  v:  11,200.00
  h:       0.40
  a:       1.00
```

```
ppiTL =

   123.4000
```

```
ppiLTL =

   141.4000
```

Current TLC

```
[TLC,q,isLTL] = minTLC(sh,tr,ppiLTL)
tdays = 365.25*q/sh.f
```

```
TLC =

   4.4929e+04
```

```
q =

    5.0144
```

```
isLTL =

  logical

   0
```

```
tdays =

   24.4201
```

Interval limited shipment

```
q1wk = 7*sh.f/365.25
[c,isLTL,cTL,cLTL] = transcharge(q1wk,sh,tr,ppiLTL)
[TLC1wk,TC,IC] = totlogcost(q1wk,c,sh)
```

```
q1wk =

    1.4374
```

```
c =

   861.6451


isLTL =

   logical

     1


cTL =

   1.5019e+03


cLTL =

   861.6451


TLC1wk =

   5.1399e+04


TC =

   4.4959e+04


IC =

   6.4394e+03
```

Impact on TLC

```
increase_in_TLC = TLC1wk - TLC
```

```
increase_in_TLC =

   6.4698e+03
```

Question 3

Create shipments 1 (A) and 2 (B)

```
uwt = [24 40];          % unit weight (lb)
ucu = [10 4];           % unit cube (ft^3)
```

```
udem = [1000 1200];      % unit annual demand
uval = [35 40];          % unit value ($)
a = 0.5;                 % alpha batch prod, constant consumption
th = [2 3];              % years when product loses xh% of original value
clear sh
sh = vec2struct('d',500,'f',udem.*uwt/2000,'s',uwt./ucu,...
    'a',a,'v',uval./(uwt/2000),'h',0.04+0.06+0.7./th);
tr = struct('r',2,'Kwt',25,'Kcu',2750);
sdisp(sh)
```

```
sh:    d    f     s      a       v          h
--:------------------------------------------
 1:   500   12   2.40   0.5   2,916.67   0.4500
 2:   500   24  10.00   0.5   2,000.00   0.3333
```

Determine optimal TL

```
[TLC,q] = minTLC(sh,tr);
vdisp('TLC,q')
```

```
 :      TLC       q
-:----------------
1:   5,801.99   3.30
2:   5,656.85   8.49
```

Create aggregate shipment AB

```
ash = aggshmt(sh);
sdisp(ash)
[TLCa,qa] = minTLC(ash,tr);
vdisp('TLCa,qa')
```

```
ash:        1
---:----------
   d:     500.00
   f:      36.00
   s:       4.86
   a:       0.50
   v:   2,305.56
   h:       0.37
```

```
 :     TLCa      qa
-:----------------
1:   8,252.08   6.69
```

Percentage change in TLC from A + B to AB

```
pctchg = 100*(TLCa - sum(TLC))/sum(TLC)
```

```
pctchg =

   -27.9851
```

Question 4

```
city = {'Asheville','Statesville','Winston-Salem','Greensboro',...
    'Durham','Raleigh','Wilmington'};  % City name cell array
P = [50 150 190 220 270 295 420]'; % I-40 mile marker
shS = vec2struct('f',[400 120],'s',[100 50]./[25 5]);
shC = aggshmt(shS);
shC = vec2struct(shC,'f',shC.f*[20 25 30 15 10]/100);
sh = [shS shC];
sdisp(sh)
qmax = maxpayld(sh,struct('Kcu',2750,'Kwt',25));
n = [sh.f]./qmax;
vdisp('qmax,n')
x = minisumloc(P([2 7 1 3 4 5 6]),n,1)
fprintf('Locate DC in %s\n',city{argmin(dists(x,P))})
```

```
sh:    f       s
--:------------
  1:   400    4.00
  2:   120   10.00
  3:   104    4.64
  4:   130    4.64
  5:   156    4.64
  6:    78    4.64
  7:    52    4.64

   :    qmax      n
 -:--------------
 1:    5.50   72.73
 2:   13.75    8.73
 3:    6.38   16.29
 4:    6.38   20.36
 5:    6.38   24.44
 6:    6.38   12.22
 7:    6.38    8.15

x =

   150.0000

Locate DC in Statesville
```

Question 5

Create Data

```matlab
clear all
city = {'Richmond','Canton','Malden','Tyler'};
st = {'CA','OH','MA','TX'};
zip = [72118 55472 15010 88102 87301 73099];
ud = [1200 3200 2200 1100 1600 1500];
cu = [2.7 1.3 2.7 3.6];
wt = [8 14 4 29];
BOM = [4 3 1 4];
cuFG = 38.2; wtFG = 175;
```

Geolocate

```matlab
city2lonlat = @(city,st) ...
    uscity('XY',mand(city,uscity('Name'),st,uscity('ST')));
for i = 1:length(city)
    XYP(i,:) = city2lonlat(city{i},st{i});
end
XYC = uszip5('XY',mand(zip,uszip5('Code5')));
```

Determine Location

```matlab
tr.Kcu = 2750; tr.Kwt = 25;
fout = ud*wtFG/2000
qmaxFG = maxpayld(wtFG/cuFG,tr)
wout = fout/qmaxFG
fin = (BOM*sum(ud)).*wt/2000
qmax = maxpayld(wt./cu,tr)
win = fin./qmax
xy = minisumloc([XYP; XYC],[win wout],'mi')
cityst = uscity50k;
idx = lonlat2city(xy,cityst);
fprintf('Locate NF in %s, %s.\n',cityst.Name{idx},cityst.ST{idx})
```

```
fout =

  105.0000   280.0000   192.5000    96.2500   140.0000   131.2500


qmaxFG =

    6.2991


wout =

   16.6691    44.4509    30.5600    15.2800    22.2255    20.8364
```

```
fin =

  172.8000  226.8000  21.6000  626.4000


qmax =

   4.0741   14.8077   2.0370   11.0764


win =

  42.4145   15.3164   10.6036   56.5527


xy =

  -96.6883   36.1712

Locate NF in Tulsa, OK.
```

Question 6

Read data

```
fn = 'HW6data.xlsx';
inS = table2struct(readtable(fn,'Sheet','Supplier'));
inC = table2struct(readtable(fn,'Sheet','Customer'));
UD = xlsread(fn,'Demand');
sdisp(inS),sdisp(inC),mdisp(UD)
```

```
inS:    zip     cu      wt      uc      sv
---:----------------------------------------
  1:  43,229   0.89    7.84    63.28    47.75
  2:  27,302   1.00    6.60     4.00     2.85
  3:  29,501   0.67    2.59     6.69     3.78
  4:  30,253   0.67    0.89    31.50    29.07
  5:  28,607   1.33   15.65    78.77    65.22
  6:  25,901   2.67   35.61   291.91   129.59
  7:   2,492   1.00    7.51    30.84    21.77
  8:  23,222   3.56   52.46   477.48   411.97
  9:  57,006   0.67   14.07    78.40    31.17
 10:  28,277   2.67    5.54    12.97    10.03
 11:  40,204   2.67   33.61    89.67    52.89
 12:   8,901   2.67   16.40    23.78    20.42
 13:   2,131   0.67    2.74    24.68    13.73
 14:  31,705   2.67   29.59   131.79   100.92
 15:  37,042   0.89   17.20    49.44    14.35
 16:  30,329   2.67    3.86     2.40     2.14
 17:  21,532   0.89   14.37    60.80    59.74
 18:  23,229   1.00   16.60    40.44    37.05
 19:  23,237   1.00    7.92     7.84     6.90
 20:  39,209   0.67   11.31    31.35    23.37
```

```
21:  17,603  3.56  86.63   65.77   51.22
22:  20,852  1.33  33.76   71.98   70.78
23:   2,114  0.89   0.56   27.74   25.19
24:   6,076  3.56  48.20  376.61  339.78
25:  29,418  0.67  15.80   55.06   40.53
26:  55,108  0.67   5.16   51.38   25.55
27:  64,772  0.67   2.35   18.37   15.83
28:  89,102  1.33   9.34   10.84    6.06
29:   7,011  2.67  20.57   12.27    7.63
30:  33,147  3.56  43.36  159.20  144.62
31:  60,505  0.67   1.85   11.68    8.61
32:  45,342  1.33   9.15    5.81    2.19
33:  45,344  3.56  14.06    7.44    7.35
34:  55,119  1.33  19.53  194.74  121.10
35:  27,106  1.33  54.61   83.83   51.75
36:  44,118  2.67  22.78  262.23  246.58
37:  25,705  1.00   4.84   65.11   54.82
38:  53,215  2.67  34.09   50.84   46.60
39:  28,304  2.67  37.57   27.62   23.99
40:  80,503  1.00  20.67   41.28   38.79
41:   2,364  0.89   3.11    4.76    2.02
42:  64,056  1.00  11.39  145.42  128.97
43:  48,227  0.89  11.31   66.89   31.52
44:  53,711  1.00  11.39   35.04   30.66
45:  28,792  1.33  11.12    9.16    7.19
46:  97,361  2.67  20.25  250.34  133.77
47:  21,853  1.00   4.54   18.62    3.19
48:  98,033  0.67   5.11   50.96   29.77
49:  47,265  0.67   5.00   50.02   47.98
50:  70,560  0.89   4.80   22.91   14.69
51:   8,876  1.00   2.17   55.60   24.17
52:  99,203  2.67  11.66  113.03   93.17
53:  53,403  1.33   3.79   78.55   46.45
54:  60,649  1.00   2.00   39.44   31.32
55:  80,504  0.89  32.24   18.49    8.77
56:  27,587  1.00  15.77   12.83    9.42
57:  52,804  1.33  10.93   54.21   39.53
58:  87,114  1.00  12.39   30.21   29.38
59:  48,152  1.33   3.53    7.58    7.34
60:  28,206  2.67  27.70  396.16  286.90
61:  19,966  1.00   9.37   36.63   21.79
62:  22,310  1.00   0.98    1.42    0.85
63:  46,013  2.67  43.08  253.42  234.76
64:  30,344  0.89  18.84   10.84    8.13

inC:     zip
---:--------
  1:  23,113
  2:  23,666
  3:  23,454
  4:  28,097
  5:  20,120
  6:  27,560
  7:  27,606
  8:  27,215
  9:  27,332
 10:  28,451
```

```
11:    24,018
12:    24,060
13:    23,185
14:    24,019
15:    27,265
16:    29,730
17:    29,708
18:    22,015
19:    27,330
20:    28,401
21:    27,409
22:    28,216
23:    28,144
24:    23,220
25:    29,928
26:    27,217
27:    29,431
28:    27,524
```

UD:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1:	251	497	319	255	66	425	185	254	38	281	467	208	569	356	485	501	328	128	138	498	238	293	513	261	415	397	353	474
2:	126	32	150	42	156	118	116	93	50	46	127	85	89	41	133	91	153	134	162	11	60	128	158	33	168	114	103	79
3:	386	1,591	1,572	1,534	776	1,595	1,439	751	1,159	563	802	572	827	1,665	1,396	838	1,690	72	1,150	956	1,036	911	747	1,757	1,719	1,111	1,003	757
4:	1,192	1,071	406	307	1,694	782	1,618	768	1,742	131	750	1,715	1,617	762	144	455	364	1,430	1,003	1,574	600	234	1,226	347	1,575	1,271	230	1,399
5:	14	3	63	126	136	7	148	32	108	31	161	16	162	148	162	180	65	17	141	134	133	2	47	141	54	50	170	134
6:	10	159	119	169	185	53	148	110	182	162	61	74	136	70	128	100	60	171	28	137	129	156	75	40	98	138	100	42
7:	2	10	38	46	1	37	21	32	36	2	27	46	44	46	19	10	42	37	38	24	28	23	23	35	12	39	42	32
8:	316	196	301	122	255	231	166	34	57	219	316	35	55	230	39	1	371	353	172	220	295	50	346	250	282	222	228	183
9:	36	1	80	115	85	55	30	62	40	112	74	52	59	119	61	2	86	89	110	125	65	108	50	50	108	8	19	81
10:	45	49	91	88	37	79	31	90	1	39	55	52	90	31	55	64	82	20	113	40	108	14	78	132	119	114	45	87
11:	18	3	37	22	23	40	30	41	10	11	25	10	35	38	10	37	30	40	39	30	34	23	3	23	10	12		

```
39      32
12:     50      87     163      94     103     179     168      38      63      79      76     229       2
    13      41       1     187     209     200     165     194     118     206     141      87      49       1
17     111
13:    250     122     445     627      44     180     580     196     325      73     281     253     384
   379     494     671      61     480     476     490     216     546     468     282     597     311       2
84     191
14:     14      58      24      34      15      62      10      35      60      46      65      11       9
    32      27      59      35      37      73      14      48      56      31      75       9      47
63      53
15:    252     173      23     240     183      19     182     268      21      23      19      58     108
   103     256     114     180     131     194      61      15     103     181      74     210     173       2
11      48
16:    140     233     147     104      28     233      76     167     210     257     266     168       7
    91     156     214     201     145     236     144      73     149     128     163     285     208
19     196
17:     41      43      32      21      30      31      45      27      41      28      34      15      44
    37      35       6      33      27      15       3      42      19       9      48      44      30
8      22
18:    511     400     311     466      20      53     561     467      97     594     515     186      36
   502     218     395     291     210     250     203     506     125     458     764     500     363       3
35     165
19:     70      42     158     110      41     162      45      51      55     114     164      72      20
   169      83     106      63      72      75     164      50     135     157     155      38     154
80     101
20:     67   1,850     102     158     523   1,194   1,537     194   1,744     613      94   1,189   1,737
  1,550     151     384   1,063   1,760     222   1,159     280     745     405     234     728     171       4
94       3
21:     22       9      26      21      36      29      32      19      25       0      15      22      21
     8      28      14      18      10      32       0      34      21      14      21       8      17
19      32
22:     44     112      24      12     118     154      28       1      80      99      40     111     140
     3      70      79      79     118       3      83      28      81      79      54     114     159
46      63
23:    231     232      87      79     185      31     226     196     162      43      87     225     219
   242      23      44     232     180      88     149     153     211     239     211     122      96       1
57     137
24:     19       9      10      52      62       6      31      14      38      17      50       9      24
    47      28      48      59      55      31      23       9       3      32      61      23      43
30      14
25:     57      37      87      51      57      86      63      36      44      72      22      11      61
    23      10       1      24      63      36      88      33      44       2      27      69      12
25      86
26:     49     191     803     131     834     352     451     549     290     380     132     754     550
   302     175       1     388     623     106       1     345     610     167     100     104     266       7
65     532
27:     93     115      86      19      24      49     113      75     125      32      73       4      31
   108      39      10      85      67     128      51      69      47      57      64      78       6
88      91
28:    328     123     185     477     222     363     478     469      49     233     110     413     107
   383     310     400     266     131     114      65      14      23      57     119      31     387       2
22     260
29:    117      78     101      14      79     111      84      57      85       1      88      89     103
    61      71      80      97     100      39      26     116      86      67      72     125      74       1
11      57
30:     12       0      21      15      17       6      24      14      27      32       3      13      18
     7      13      26      20      21      21      14      32      10      23       5      30      21
```

```
23      14
31:     220   1,120      71  1,106   1,660   1,048       926   1,105       376       743   216       705   1,827
   1,156   1,732   1,054       820         3   1,906       223   1,340   920   1,149   1,876       546   1,234
38   1,062
32:     209      98      24      79       100       225      95       139      19      97   127       164       144
      3      94       5      65       224       106       101      74   119      61       105       260       151      1
30      80
33:      29      13      22      46       42       3      21      16      17       3      16      28      45
     44      9      36      19      16      24      12      15   27      10      24       6      22
15      12
34:     130       529       484       482       185       215      77       418       458       125   117       332       352
     188       497       378       439       164       369       129       454   124      88      12       165      16      2
93      124
35:       8       8       8      41       60      41      36      57      29      25      44      23      55
     11      43      40      50      40       6      16       6   42      23      61      26      62
 3      12
36:      12       0      15      16      11      11      14       1      12      12   18       7       1
      2       7       3       4      13      17      15      12   4       4       3       6      16
10       7
37:      84       8      79      83       117      22      75      76      51      14   59       120      52
     41      51      96      41      26       0      43      15   31      47       107      79      39
79      18
38:      20      56       170      56       152       172      53       209       138       182   57       154       147
     118       100       5      36       159       176       131      12   118      18       155      25       184
 2      78
39:      67      38       104      42       139      15      47      24       116      42   137      50      65
     94      78      95      45      86       153      92       7   88      78       122       131       3      1
09      90
40:     137       128      58       137      99      57      90       123       128       117   56       136      76
     18       121       132       101      44       104       113       127      87      96       164      70      59
49      87
41:      95       168       386      34      21      62       207       204      38       347   18       264       158
     29       119       354       344       332       5      86       6   70       345       327       367       262       2
10      291
42:      34      53      63      20      54      43       9      58      48      64   91      16      12
     92      44      91      34      40      81       4      97   37      38      46       4      52
23      99
43:      85       137       129       177       188      15       186       157      69       193   10       126      25
     198       148       5       112      17      33       8      16   111      68      82      53       164      1
09      130
44:      27      68      61       121       100      75      62      76       5       1   55      13      97
     30       107      54      57      67      45       124      74   99      70      95      35      15
42      99
45:      23      25      32      37      18      19      32      37      10      31   33      31      13
     33      46      27      33      21      48       9      28   19      42      49      38      13
43      19
46:      58      21      42      33      60      28      23      61      33      69   74      58      13
      0      37      40       7      14      23      11       9   42      12      72      39      49
46      52
47:     657       769       552       682      83       172       526       165       380       362   520       420      56
     284       824       288       349       314       700       265       648   420       616       270       733       261       7
33      220
48:     295       265       352       232       311       347      49      93       174       271   170      87       126
     198       223       115      39      10       182       108      37   236       196      38       8      61
53      215
49:     447       411       794       539       369       838       200       588       503       163   708       376       786
     84       101       589       446       140       451       700       138   777       834       242      38       208      6
```

```
  73     255
50:    112    51    19    47    59    63    84    58   150    81   12    150    143
    75    24   123   125   121    28   125     5    74    45   110   143    85
   3     57
51:     17   881   870  1,174   903   907  1,426   143  1,554  1,453  131  1,137    12
   878   388   492  1,259   478   350   176  1,359   134  1,561   925    36  1,399  1,4
78  1,042
52:    568   712   865   949   825   305   389   789    23   127  122   872    71
  1,001   224    51   231   261   749   942   569   464  1,002   337   785   311
24    201
53:    298    43   145   249   139   101    34    17   231   114  159   257   189
   151   252   128    47   146   125   116   286    25   183    19   231   291
14    311
54:      5     7   166   202   152    78    49     4    40    64   11   194    49
    74   113   183    23    18   189   186   199   126   140   202   218   128
 1    230
55:    191    66   174   226   133   202   165    29   152    71   83   123    89
   152    40   212   110   121    37   104    41   143   213   138    97    49
83    180
56:    237   268   163   370   192    17    24   221   316    97   48    33   140
   323    54    69   235   233     9   352    76   359    39   112    48   239    3
55    354
57:     59    11   133   132    97    36    70    68   102     4  148    81     1
   150   131    60   132   138    76     4    78    19    20   115     0   121    1
43     72
58:     37   210   190     1   191   218   218    20   176   220   36   198   219
    67    64   191   202   150   220   166   192    50   164   206    49   215
78    221
59:    382   435   125   422   125   105   160   378    82   447  302   227    47
   274   339   325   259   154   171    72   358   375   192   212    97    86
70    125
60:     13    29    31    33    10     2    23    16    36     0    7    15    16
    32    21     5    20    33    26    11    19    27    28     2     0    31
 4     32
61:     79    25    63   141    48    14    89    77   113   144   23     3    50
   112   147   133    50    32    98    74   136    35   108    40   119   134    1
10     71
62:    154   350   107   103   171   293   215   278   109   139  367   171    48
   389    36   111   112   196   208   195   404    24   386   284   354   328    3
00    184
63:     14     3    10    11    16    13    17     2     7     7   15    11    15
     1    17     2     6    12     4     4    12    13     1     7     1     0
14      0
64:     11    78    47    72    28    78    83    35    22    93   67    34    43
    87    22    55    60    27     9    79    29    18    40    16    21    29
25      2
```
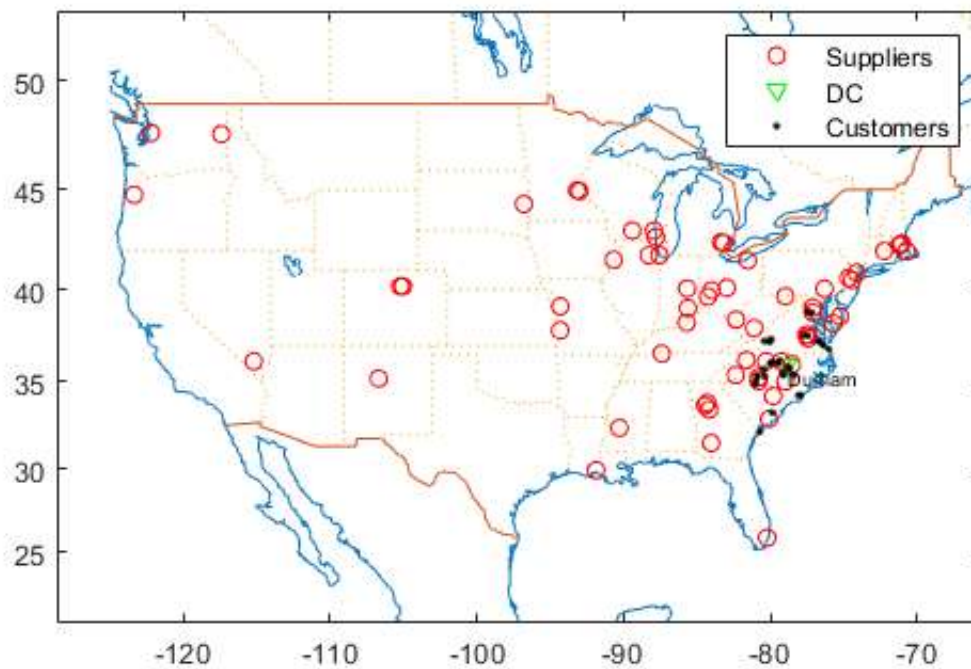
Geocode locations

```
city2lonlat = @(city,st) ...
    uscity('XY',mand(city,uscity('Name'),st,uscity('ST')));
DCstr = {'Durham','NC'};
DC = city2lonlat(DCstr{:});
SXY = uszip5('XY',mand([inS.zip],uszip5('Code5')));
CXY = uszip5('XY',mand([inC.zip],uszip5('Code5')));
```

Plot

```
XY = [SXY; DC; CXY];
makemap(XY)
hS = pplot(SXY,'ro');
hDC = pplot(DC,'gv');
hC = pplot(CXY,'k.');
pplot(DC,DCstr(1))
legend([hS hDC hC],{'Suppliers','DC','Customers'})
```


Create shipments

```
ppiTL = 135.1; % Sep 2019 (P)
tr = struct('r',2*(ppiTL/102.7),'Kwt',25,'Kcu',2750);
F = [inS.wt]'.*UD/2000;
s = [inS.wt]./[inS.cu];
v = 2000*[inS.uc]./[inS.wt];
h_ob = ([inS.uc] - [inS.sv])./[inS.uc];   % Obsolescence rate
h = 0.05 + 0.06 + h_ob;
in.aO = 0; in.aD = 0.5;
shS = vec2struct('f',sum(F,2),'s',s,'v',v,'h',h,...
    'd',dists(SXY,DC,'mi')*1.2);
shC = vec2struct(aggshmt(shS),'f',sum(F,1),'a',0+in.aD,...
    'd',dists(DC,CXY,'mi')*1.2);
in.ppiLTL = 188.3; % Jan 2019 (P)
```

No cooridination

```
sh = [vec2struct(shS,'a',in.aO+0.5) shC];
[NC.TLC,NC.q,NC.isLTL] = minTLC(sh,tr,in.ppiLTL);
NC.t = 365.25*[NC.q]./[sh.f];
vdisp('NC.TLC,NC.q,NC.t,NC.isLTL',true,true)
```

:	NC.TLC	NC.q	NC.t	NC.isLTL
1:	21,664.96	3.78	38.27	0.00
2:	803.58	1.67	65.97	0.00
3:	9,648.28	3.42	31.82	0.00
4:	18,461.17	1.39	43.32	0.00
5:	7,474.59	2.63	47.54	0.00
6:	26,109.47	2.39	16.13	0.00
7:	4,998.48	0.43	52.28	1.00
8:	23,863.13	5.30	13.32	0.00
9:	15,532.57	0.53	14.69	1.00
10:	2,525.31	1.60	114.24	0.00
11:	9,183.93	3.31	102.01	0.00
12:	6,903.05	8.45	118.82	0.00
13:	22,449.98	2.25	61.82	0.00
14:	11,602.62	3.78	84.77	0.00
15:	20,991.10	4.46	52.22	0.00
16:	4,906.82	1.99	84.76	0.00
17:	3,167.36	2.94	184.34	0.00
18:	7,910.82	8.38	38.79	0.00
19:	1,977.06	4.34	148.06	0.00
20:	31,955.45	15.81	50.18	0.00
21:	4,876.76	9.70	147.86	0.00
22:	5,212.45	9.65	103.27	0.00
23:	9,009.64	0.13	39.63	1.00
24:	15,119.84	4.66	83.32	0.00
25:	5,754.61	0.67	25.37	1.00
26:	43,820.03	3.59	51.09	0.00
27:	6,727.42	1.74	294.90	0.00
28:	25,689.14	9.63	118.84	0.00
29:	5,930.28	10.18	165.20	0.00
30:	8,291.71	5.60	195.79	0.00
31:	21,861.68	3.81	57.54	0.00
32:	5,672.09	6.10	157.01	0.00
33:	1,294.08	5.44	477.19	0.00
34:	65,128.57	6.69	34.07	0.00
35:	4,272.45	2.82	43.13	0.00
36:	4,008.62	0.30	38.16	1.00
37:	6,581.47	0.91	88.69	0.00
38:	11,090.92	17.58	130.65	0.00
39:	2,450.71	6.90	62.23	0.00
40:	13,230.07	19.45	253.24	0.00
41:	7,996.16	3.81	173.80	0.00
42:	10,701.41	0.52	24.63	1.00
43:	15,876.74	0.60	14.03	1.00
44:	8,260.75	5.71	206.55	0.00
45:	1,737.81	3.25	263.50	0.00

```
  46:     29,771.09    0.55     19.44      1.00
  47:     17,761.49    2.30     30.25      0.00
  48:     30,712.92    0.77     24.59      1.00
  49:     15,812.71    5.24     61.77      0.00
  50:     11,249.25    2.51    176.14      0.00
  51:     45,772.17    1.32     19.73      0.00
  52:    105,637.35    6.01     27.36      0.00
  53:     27,081.90    1.26     56.45      0.00
  54:     12,125.12    0.98    116.51      0.00
  55:     19,174.08   25.00    165.43      0.00
  56:      1,731.81    2.83     26.33      0.00
  57:     14,567.62    3.86    117.11      0.00
  58:     13,154.75   17.03    240.93      0.00
  59:      6,010.60    3.64    118.71      0.00
  60:      6,569.91    0.21     10.66      1.00
  61:      8,511.49    2.11     72.64      0.00
  62:      2,495.89    1.35    166.96      0.00
  63:      4,486.12    0.59     42.83      1.00
  64:      3,242.67    7.83    250.83      0.00
  65:     12,965.59    3.02     22.61      0.00
  66:     16,413.42    3.83     22.11      0.00
  67:     16,869.28    3.93     23.22      0.00
  68:     12,722.55    2.97     17.38      0.00
  69:     18,749.45    4.37     26.25      0.00
  70:      5,657.19    0.89      5.76      0.00
  71:      5,641.02    1.31      8.02      0.00
  72:      6,645.98    1.55     11.42      0.00
  73:      8,031.03    1.87     12.39      0.00
  74:     13,289.22    3.10     22.45      0.00
  75:     11,629.00    2.71     20.98      0.00
  76:     13,273.96    3.09     21.14      0.00
  77:     14,629.12    3.41     23.48      0.00
  78:     13,693.92    3.19     18.64      0.00
  79:      8,999.94    2.10     16.12      0.00
  80:     13,229.19    3.08     24.52      0.00
  81:     14,897.13    3.47     20.67      0.00
  82:     18,798.79    4.38     26.17      0.00
  83:      7,102.50    1.66     11.73      0.00
  84:     13,927.83    3.25     21.43      0.00
  85:      9,048.39    2.11     14.87      0.00
  86:     12,519.10    2.92     22.19      0.00
  87:     11,859.71    2.76     17.36      0.00
  88:     14,208.95    3.31     21.84      0.00
  89:     20,562.30    4.79     31.86      0.00
  90:      6,509.83    1.52     10.69      0.00
  91:     16,463.57    3.84     27.32      0.00
  92:      7,967.32    1.86     14.42      0.00
Total:  1,284,899.41  383.99  6,894.77     11.00
  Avg:     13,966.30    4.17     74.94      0.12
```

All cross-docked

```
sh = [vec2struct(shS,'a',in.aO+0) shC];
qmax = maxpayld(sh,tr);
TLC0h = @(t) ...
    totlogcost([sh.f]*t,transcharge([sh.f]*t,sh,tr,in.ppiLTL),sh);
```

```
TLCh = @(t) iff(t >= 1/365.25 & [sh.f]*t <= qmax, TLC0h(t), Inf);
tx0 = min(qmax./[sh.f]);
X.t = fminsearch(@(t) sum(TLCh(t)),tx0);
X.q = [sh.f]*X.t;
[~,X.isLTL] = transcharge(X.q,sh,tr,in.ppiLTL);
X.TLC = TLCh(X.t);
vdisp('X.TLC,X.q,X.isLTL',true,true)
fprintf('Cross-docking occurs every %.2f days\n',365.25*X.t)
```

:	X.TLC	X.q	X.isLTL
1:	15,155.41	2.70	0.00
2:	969.01	0.69	0.00
3:	5,611.68	2.94	0.00
4:	14,616.03	0.88	0.00
5:	6,495.13	1.51	0.00
6:	7,699.68	4.05	0.00
7:	4,778.56	0.22	1.00
8:	5,808.50	10.89	0.00
9:	12,172.09	0.99	1.00
10:	5,272.95	0.38	0.00
11:	9,002.48	0.89	1.00
12:	16,600.17	1.95	0.00
13:	25,368.93	0.99	0.00
14:	12,927.27	1.22	1.00
15:	17,927.89	2.33	1.00
16:	14,365.84	0.64	0.00
17:	3,717.75	0.44	1.00
18:	5,609.38	5.91	0.00
19:	5,350.23	0.80	0.00
20:	29,310.88	8.62	0.00
21:	11,472.13	1.79	1.00
22:	9,838.44	2.56	0.00
23:	8,207.83	0.09	1.00
24:	15,385.59	1.53	1.00
25:	4,811.77	0.73	1.00
26:	34,872.96	1.92	1.00
27:	7,950.04	0.16	1.00
28:	59,122.30	2.22	1.00
29:	17,906.59	1.69	0.00
30:	10,331.63	0.78	1.00
31:	27,093.88	1.81	0.00
32:	15,929.76	1.06	1.00
33:	9,243.34	0.31	1.00
34:	40,562.07	5.37	0.00
35:	3,368.21	1.79	0.00
36:	3,623.03	0.22	1.00
37:	6,156.38	0.28	1.00
38:	28,756.61	3.68	0.00
39:	2,787.65	3.03	0.00
40:	26,090.09	2.10	1.00
41:	20,788.83	0.60	1.00
42:	9,074.56	0.57	1.00
43:	12,202.34	1.17	1.00

```
44:      10,683.68      0.76      1.00
45:       4,145.54      0.34      1.00
46:      24,528.53      0.78      1.00
47:       9,821.25      2.08      0.00
48:      26,233.96      0.86      1.00
49:      17,851.59      2.32      0.00
50:      11,760.06      0.39      1.00
51:      16,510.35      1.83      0.00
52:      88,986.32      6.01      0.00
53:      25,391.25      0.61      1.00
54:      13,197.60      0.23      1.00
55:      42,063.31      4.13      1.00
56:         833.42      2.94      0.00
57:      15,643.59      0.90      1.00
58:      30,987.70      1.93      1.00
59:      21,277.95      0.84      0.00
60:       4,441.13      0.54      1.00
61:       8,507.18      0.80      1.00
62:       9,138.95      0.22      0.00
63:       4,145.16      0.38      1.00
64:       6,694.88      0.85      1.00
65:      13,201.14      3.66      0.00
66:      16,787.49      4.73      0.00
67:      17,095.95      4.63      0.00
68:      14,052.83      4.67      0.00
69:      18,765.44      4.55      0.00
70:       9,827.45      4.21      0.00
71:      10,449.30      4.49      0.00
72:       9,349.25      3.71      0.00
73:      10,681.70      4.13      0.00
74:      13,550.06      3.78      0.00
75:      12,040.67      3.53      0.00
76:      13,717.06      4.00      0.00
77:      14,800.06      3.97      0.00
78:      14,712.92      4.68      0.00
79:      10,289.47      3.56      0.00
80:      13,308.25      3.44      0.00
81:      15,486.34      4.60      0.00
82:      18,817.27      4.58      0.00
83:       9,802.93      3.86      0.00
84:      14,344.83      4.14      0.00
85:      10,781.38      3.88      0.00
86:      12,794.68      3.60      0.00
87:      13,106.49      4.36      0.00
88:      14,570.44      4.15      0.00
89:      20,801.23      4.12      0.00
90:       9,598.98      3.88      0.00
91:      16,463.59      3.84      0.00
92:       9,655.87      3.52      0.00
Total:  1,376,032.34    228.56     36.00
 Avg:      14,956.87      2.48      0.39
Cross-docking occurs every 27.36 days
```