

数学模型参考答案及代码

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第五章

5.1 题目解答

5.1.1 第一题：

```
1  clc;clear all;close all;
2  f=-[50 100];
3  A=[1 1
4      2 1
5      0 1];
6  b=[300 400 250];
7  lb=[0 0];
8  ub=[inf inf];
9  a=linprog(f,A,b,[],[],lb,ub)
10 %answer:
11 Optimization terminated.
12 a =
13 50.0000
14 250.0000
```

5.1.2 第二题答案：

```
1  (1)
2  f=[1 2 3];
3  A=[-2 1 -1
4      1 1 2
5      0 -1 1];
6  b=[-4 8 -2];
7  lb=[0 0 0];
8  ub=[inf inf inf];
```

```
9   a=linprog(f,A,b,[],[],lb,ub)
10  %answer:
11  Optimization terminated.
12
13  a =
14
15  3.0000
16  2.0000
17  0.0000
18  (2)
19  f=-[5 2 4];
20  A=[-3 -1 -2
21     -6 -3 -5];
22  b=[-2 -10];
23  lb=[0 0 0];
24  ub=[inf inf inf];
25  a=linprog(f,A,b,[],[],lb,ub)
26  answer:
27  NO ANSWER
```

5.1.3 第三题答案:

解:

可建立 0-1 规划模型, 假设对于每个井位的钻与不钻两个状态设为变量 x_i , 其中变量的值为 1 时代表钻, 值为 0 时代表不钻, 由题意可得以下模型:

$$\begin{aligned} \min z &= \sum_{i=1}^{10} c_i x_i \\ s.t. &\begin{cases} x_1 = x_7 \\ 0.5 * (x_1 + x_7) + x_5 = 1 \\ x_3 + x_5 = 1 \\ x_4 + x_5 = 1 \\ 0 \leq x_i \leq 1, \text{且 } x_1, x_2, \dots, x_{10}, \text{全部为整数} \end{cases} \end{aligned} \quad (5.1)$$

5.1.4 第四题答案:

```
1 clear all; clc;close all;
2 f=-[15 10 12 10 12 11 12 9 9 9 10 20 ...
3 15 17 13 18 17 9 9 13 7 13 10 13 12];
4 intcon=1:25;
5 A=[];
6 b=[];
7 Aeq=[ones(1,5),zeros(1,20);
8 zeros(1,5),ones(1,5),zeros(1,15);
9 zeros(1,10),ones(1,5),zeros(1,10);
10 zeros(1,15),ones(1,5),zeros(1,5);
11 zeros(1,20),ones(1,5);
12 full(sparse(ones(1,5),[1,6,11,16,21],ones(1,5))),zeros(1,4);
13 full(sparse(ones(1,5),[2,7,12,17,22],ones(1,5))),zeros(1,3);
14 full(sparse(ones(1,5),[3,8,13,18,23],ones(1,5))),zeros(1,2);
15 full(sparse(ones(1,5),[4,9,14,19,24],ones(1,5))),zeros(1,1);
16 full(sparse(ones(1,5),[5,10,15,20,25],ones(1,5)))];
17 beq=ones(10,1);
18 lb=zeros(25,1);
19 ub=ones(25,1);
20 [a,z]=intlinprog(f,intcon,A,b,Aeq,beq,lb,ub);
21 reshape(a,[5,5])
22 z
```

5.1.5 第五题答案:

```
1 fun = @(x)50*x(1)+0.2*x(1)^2+50*x(2)+0.2*x(2)^2+...
2 50*x(3)+0.2*x(3)^2+(x(1)-40)*4+(x(1)+x(2)-100)*4;
3 x0=[1,1,1];
4 A=[-1 0 0
5     1 0 0
6     -1 -1 0];
7 b=[-40
8     100
9     -100];
10 Aeq=[1,1,1];
11 beq=[180];
12 ub=[0 0 0];
13 lb=[100 100 100];
14 [x,fval]=fmincon(fun,x0,A,b,Aeq,beq,ub,lb)
15 %answer:
16 x =
```

17 50.0000 60.0000 70.0001

5.1.6 第六题答案:

```
1 (1)
2 %build a m file:
3 function [c,ceq]=answer61(x)
4 c=-(1-x(1))^3+x(2);
5 ceq=[];
6 %code:
7 fun =@(x)-x(1);
8 A = [];
9 b = [];
10 Aeq = [];
11 beq = [];
12 lb = [0,0];
13 ub = [inf,inf];
14 nonlcon = @answer61;
15 x0 = [0,0];
16 x = fmincon(fun,x0,A,b,Aeq,beq,lb,ub,nonlcon)
17 %answer:
18 x =
19 0.9988 0.0000
20 (2)
21 same as (1)
22 (3)
23 fun= @(x)(x(1)-3)^2+(x(2)-3)^2;
24 x0=[0,0];
25 A=[1,1];
26 b=4;
27 Aeq=[];
28 beq=[];
29 ub=[0,0];
30 lb=[inf,inf];
31 [x,fval]=fmincon(fun,x0,A,b,Aeq,beq,ub,lb)
32 %answer:
33 x =
34 2.0000 2.0000
```

5.1.7 第七题答案:

```
1  f=-[15,18,21,24;  
2  19,23,22,18;  
3  26,18,16,19;  
4  19,21,23,17;];  
5  intcon=1:16;  
6  A=[];  
7  b=[];  
8  Aeq=[ones(1,4),zeros(1,12);  
9  zeros(1,4),ones(1,4),zeros(1,8);  
10 zeros(1,8),ones(1,4),zeros(1,4);  
11 zeros(1,12),ones(1,4),  
12 full(sparse(ones(1,4),[1,5,9,13],ones(1,4))),zeros(1,3);  
13 full(sparse(ones(1,4),[2,6,10,14],ones(1,4))),zeros(1,2);  
14 full(sparse(ones(1,4),[3,7,11,15],ones(1,4))),zeros(1,1);  
15 full(sparse(ones(1,4),[4,8,12,16],ones(1,4)))];  
16 beq=ones(8,1);  
17 lb=zeros(16,1);  
18 ub=ones(16,1);  
19 [a,z]=intlinprog(f,intcon,A,b,Aeq,beq,lb,ub);  
20 reshape(a,[4,4])  
21 z  
22 %answer:  
23 ans =  
24 0 0 0 1  
25 0 1 0 0  
26 1 0 0 0  
27 0 0 1 0  
28 z =  
29 -96
```

5.1.8 第八题:

暂时空着

5.1.9 第九题:

解:

设播放音乐节目的时间为 x_1 , 播放新闻所用的时间为 x_2 , 商业节目的时间为 x_3 , 依据题意建立线性规划模型:

$$\begin{aligned} \max z &= -17.5 * x_1 - 40 * x_2 + 250 * x_3, \\ s.t. \quad &\begin{cases} x_1 + x_2 + x_3 = 12 \\ 0 \leq x_3 \leq 2.4 \\ 1 \leq x_2 \leq 12 \\ 0 \leq x_1 \leq 12 \end{cases} \end{aligned} \quad (5.2)$$

然后发现这是一个很简单的线性规划模型, 代码如下:

```
1  f=[-17.5 -40 250];
2  A=[];
3  b=[];
4  Aeq=[1 1 1];
5  beq=12;
6  lb=[0 1 0];
7  ub=[12 12 2.4];
8  [a,z]=linprog(f,A,b,Aeq,beq,lb,ub)
9  %answer:
10 Optimization terminated.
11 a =
12 8.6000
13 1.0000
14 2.4000
15 z =
16 -409.5000
```

第七章

7.1 代码部分

由于本节代码较多，现将所有代码以函数方式给出，待到解题的时候直接调用函数就可以了：

7.1.1 图论代码

Dijkstra 算法的 Matlab 函数：

```
1 function [d Q] = shorta(T)
2 pp(1:length(T)) = 0; pp(1) = 1; Q = 1;
3 M = max(T(:)); d(1:length(T)) = M; d(1) = 0; K = 1;
4 while sum(pp)<length(T)
5     tt = find(pp==0); % 找出未标记的点
6     d(tt) = min(d(tt), d(K)+T(K,tt));
7     ttt = find(d(tt)==min(d(tt)));
8     K = tt(ttt(1)); pp(K) = 1; Q = [Q, K];
9 end
```

Floyd 算法的 Matlab 函数：

```
1 function [P, u] = f_path(W)
2 % W 表示权值矩阵; P 表示最短路; % u 表示最短路的权和
3 n = length(W); U = W; k = 1; % Step1 初始化
4 % Step2
5 while k<=n
6     for i=1:n
7         for j=1:n
8             if U(i, j) > U(i, k) + U(k, j)
9                 U(i, j) = U(i, k) + U(k, j);
10            end;
11        end;
12    end
13    k = k+1;
14 end
15 u = U(1, n);
16 % 输出最短路的顶点
17 P1 = zeros(1,n); k = 1; P1(k) = n; V = ones(1,n)*inf; kk = n;
18 while kk~=1
19     for i=1:n
20         V(1, i) = U(1, kk) - W(i, kk);
21         if V(1, i)==U(1, i)
```

```
22     P1(k+1) = i; kk = i; k = k+1;
23     end;
24 end;
25 end
26 k = 1; wrow = find(P1~=0);
27 for j=length(wrow) : (-1) : 1
28     P(k) = P1(wrow(j)); k = k+1;
29 end
```

0-1 规划模型算法:

```
1 function y=op01(W)
2 %0-1 规划模型的MATLAB 程序
3 n = length(W);
4 A = zeros(n, n*n);
5 intcon=1:n*n;
6 for i = 1:n
7     e1 = zeros(1, n);
8     e1(i) = 1;
9     e2 = -1*ones(1, n);
10    e2(i) = 0;
11    A(i, :) = repmat(e1, 1, n);
12    A(i, (i-1)*n+1:i*n) = e2;
13 end
14 b = zeros(n, 1);
15 b(1) = 1;
16 b(end) = -1;
17 lb=zeros(n*n,1);
18 ub=ones(n*n,1);
19 x = intlinprog(W,intcon,[],[],A,b,lb,ub);
20 y = reshape(x, n, n);
```

7.1.2 网络流模型代码

最大流模型代码

Ford—Fulkerson 算法代码:

```
1 function f=ford(u,f)
2 %Ford—Fulkerson 算法的Matlab
3 n = length(u); list = [ ]; maxf = zeros(1:n); maxf(n) = 1;
4 M=1000;
5 while maxf(n)>0
```

```

6     maxf = zeros(1, n); pred=zeros(1, n);
7     list = 1; record = list; maxf(1) = M;
8     while (~isempty(list)) & (maxf(n)==0)
9         flag = list(1); list(1) = []; index1 = (find(u(flag, :)~=0));
10        label1 = index1(find(u(flag, index1) - f(flag, index1)~=0));
11        label1 = setdiff(label1, record); list = union(list, label1);
12        pred(label1(find(pred(label1)==0))) = flag;
13        maxf(label1) = min(maxf(flag), u(flag, label1) - f(flag, label1)
14            );
15        record = union(record, label1); label2 = find(f(:, flag)~=0);
16        label2 = label2'; label2 = setdiff(label2, record);
17        list = union(list, label2);
18        pred(label2(find(pred(label2)==0))) = -flag;
19        maxf(label2) = min(maxf(flag), f(label2, flag));
20        record = union(record, label2);
21    end
22    if maxf(n)>0
23        v2 = n; v1 = pred(v2);
24        while v2~=1
25            if v1>0
26                f(v1,v2) = f(v1, v2)+maxf(n);
27            else
28                v1 = abs(v1); f(v2, v1) = f(v2, v1)-maxf(n);
29            end
30            v2 = v1; v1 = pred(v2);
31        end;
32    end
33    f; % 最后的f为最大流量矩阵

```

规划模型的代码:

```

1     function x=op02(u)
2     n=length(u);
3     e = [1, zeros(1, n-1)]; c = repmat(-e, 1, n);
4     A = repmat(e, 1, n); A(end-n+1:end) = A(end-n+1:end) - 1;
5     for i = 2:n-1
6         e1 = zeros(1, n); e1(i) = 1; e2 = -1*ones(1, n); e2(i) = 0;
7         A(i,:) = repmat(e1, 1, n); A(i,(i-1)*n+1:i*n) = e2;
8     end
9     b = zeros(n-1,1);
10    intcon=1:36;
11    [x, f] = intlinprog(c,intcon, [], [], A, b, zeros(n*n, 1), u(:))

```

```
    ;  
12  x = reshape(x, n, n); % 最后的f
```

最小费用最大流模型

最小费用最大流模型 Ford 算法代码:

```
1  function [f,wf,zwf]=ford02(C,b)  
2  %最小费用最大流问题的Matlab 代码  
3  %C是弧容量  
4  %b是费用  
5  n = length(C);  
6  wf = 0; wf0 = Inf; % wf 表示最大流量, wf0 表示预定的流量值  
7  f = zeros(n,n); % 取初始可行流f 为零流  
8  while 1  
9      for i=1:n  
10         for j=1:n  
11             if (j~=i)  
12                 a(i,j) = inf;  
13             end;  
14         end;  
15     end % 构造有向赋权图  
16     for i=1:n  
17         for j=1:n  
18             if (C(i,j)>0 & f(i,j)==0)  
19                 a(i,j) = b(i,j);  
20             elseif (C(i,j)>0 & f(i,j)==C(i,j))  
21                 a(j,i) = -b(i,j);  
22             elseif (C(i,j)>0)  
23                 a(i,j) = b(i,j); a(j,i) = -b(i,j);  
24             end  
25         end  
26     end  
27     for i=2:n  
28         p(i) = inf; s(i) = i;  
29     end % 用Ford 算法求最短路, 赋初值  
30     for (k=1:n)  
31         pd = 1; % 求有向赋权图中vs 到vt 的最短路  
32         for (i=2:n)  
33             for (j=1:n)  
34                 if (p(i)>p(j)+a(j,i))  
35                     p(i) = p(j)+a(j,i); s(i) = j; pd = 0;
```

```
36         end;
37     end;
38 end
39 if (pd)
40     break;
41 end;
42 end % 求最短路的Ford 算法结束
43 if (p(n)==inf)
44     break;
45 end % 不存在vs 到vt 的最短路, 算法终止. 注意在求最小费
46 % 用最大流时构造有向赋权图中不含负权回路, 故不出现k=n
47 dvt = inf; t=n; % 进入调整过程, dvt 表示调整量
48 while (1) % 计算调整量
49     if (a(s(t), t)>0)
50         dvtt = C(s(t), t)-f(s(t), t); % 前向弧调整量
51     elseif (a(s(t), t)<0)
52         dvtt = f(t, s(t)); % 后向弧调整量
53     end
54     if (dvt>dvtt)
55         dvt = dvtt;
56     end
57     if (s(t)==1)
58         break;
59     end % 当t 的标号为vs 时, 终止计算调整量
60     t = s(t);
61     end % 继续调整前一段弧上的流f
62     pd = 0;
63     if (wf+dvt>wf0)
64         dvt = wf0-wf; pd = 1;
65     end % 如果最大流量大于或等于预定的流量值
66     t = n;
67 while (1) % 调整过程
68     if (a(s(t), t)>0)
69         f(s(t), t) = f(s(t), t)+dvt; % 前向弧调整
70     elseif (a(s(t), t)<0)
71         f(t,s(t)) = f(t,s(t))-dvt; % 后向弧调整
72     end
73     if (s(t)==1)
74         break;
75     end % 当t 的标号为vs 时, 终止调整过程
76     t = s(t);
77 end
```

```

78     if (pd)
79         break;
80     end % 如果最大流量达到预定的流量值
81     wf = 0;
82     for (j=1:n)
83         wf = wf+f(1, j);
84     end;
85 end % 计算最大流量
86 zwf = 0;
87 for (i=1:n)
88     for (j=1:n)
89         zwf = zwf+b(i, j)*f(i, j);
90     end
91 end % 计算最小费用

```

最小费用最大流规划算法代码：

```

1  function [f,wf]=op03(C,w)
2  n = length(C);
3  e = [1, zeros(1, n-1)]; c = repmat(-e, 1, n);
4  A = repmat(e, 1, n); A(end-n+1:end) = A(end-n+1:end) - 1;
5  for i = 2:n-1
6      e1 = zeros(1, n); e1(i) = 1; e2 = -1*ones(1, n); e2(i) = 0;
7      A(i,:) = repmat(e1, 1, n); A(i,(i-1)*n+1:i*n) = e2;
8  end
9  b = zeros(n-1,1);
10 intcon=1:n*n;
11 [x, fv ] = intlinprog(c, intcon,[ ], [ ], A, b, zeros(n*n, 1), C(:)
    );
12 f = reshape(x, n, n);
13 A = repmat(e, 1, n);
14 for i = 2:n
15     e1 = zeros(1, n); e1(i) = 1; e2 = -1*ones(1, n); e2(i) = 0;
16     A(i,:) = repmat(e1, 1, n); A(i,(i-1)*n+1:i*n) = e2;
17 end
18 b = [-fv; zeros(n-2,1); fv ];
19 [x, gv ] = linprog(w, [ ], [ ], A, b, zeros(n*n, 1), C(:));
20 wf = reshape(x, n, n); % 最小费用最大流量矩阵

```

7.1.3 最优连线模型与最优环游模型代码

最小生成树代码

避圈法代码:

```
1  function A = avoidcircle(W)
2  [m, n] = size(W);
3  e = 0;
4  for i = 1 : n
5      for j = i : n
6          if W(i, j) ~= 0
7              e = e + 1;
8              E(e, :) = [i, j, W(i, j)];
9          end
10     end
11 end
12 % 按权值大小排列边的顺序
13 for i = 1 : e - 1
14     for j = i + 1 : e
15         if E(i, 3) > E(j, 3)
16             temp = E(j, :);
17             E(j, :) = E(i, :);
18             E(i, :) = temp;
19         end
20     end
21 end
22 A = zeros(1, 3); S = 1 : n;
23 for i = 1 : e
24     if S(E(i, 1)) ~= S(E(i, 2))
25         A = cat(1, A, E(i, :));
26         indicator = S(E(i, 1));
27         for j = 1 : n
28             if S(j) == indicator
29                 S(j) = S(E(i, 2));
30             end
31         end
32     end
33 end
34 A(1, :) = [];
```

破圈法代码:

暂时空着:

最优环游模型:

改良圈算法代码:

```
1  function [circle,sum]=circle1(a)
2  a = a+a';
3  c1 = [5 1:4 6];
4  L = length(c1);
5  flag = 1;
6  while flag>0
7      flag = 0;
8      for m=1:L-3
9          for n=m+2:L-1
10             if a(c1(m),c1(n))+a(c1(m+1),c1(n+1))< a(c1(m),c1(m+1))+a(c1(n),
11                 c1(n+1))
12                 flag = 1;
13                 c1(m+1:n) = c1(n:-1:m+1);
14             end;
15         end;
16     end
17     sum1 = 0;
18     for i=1:L-1
19         sum1 = sum1+a(c1(i),c1(i+1));
20     end
21     circle = c1;
22     sum = sum1;
23     c1 = [5 6 1:4]; % 改变初始圈, 最后一个顶点不动
24     sum1 = 0; flag = 1;
25     while flag>0
26         flag=0;
27         for m=1:L-3
28             for n=m+2:L-1
29                 if a(c1(m),c1(n))+a(c1(m+1),c1(n+1)) < ...
30                     a(c1(m),c1(m+1))+a(c1(n),c1(n+1))
31                     flag=1; c1(m+1:n)=c1(n:-1:m+1);
32                 end;
33             end;
34         end;
35     end
36     sum1 = 0;
37     for i=1:L-1
38         sum1 = sum1+a(c1(i),c1(i+1));
```



```

39 end
40 if sum1<sum
41     sum = sum1;
42     circle = c1;
43 end

```

规划算法代码:

```

1 %此为错误代码, 待修正
2 function x=op04(a)
3     n = length(a); a = a+a';
4     A = kron(eye(n), ones(1, n));
5     A(n+1:2*n, :) = repmat(eye(n), 1, n);
6     b = ones(2*n, 1);
7     intcon=1:36;
8     [x, f] = intlinprog(a(:),intcon, [], [], A, b,zeros(36,1),ones
        (36,1));
9     x = reshape(x, n, n);

```

7.2 题目解答:

7.2.1 第一题答案:

建立图论矩阵:

$$A = \begin{bmatrix} 0 & 1 & 4 & 0 & 0 & 0 & 0 \\ 0 & 0 & 5 & 3 & 5 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 0 & 5 & 7 & 3 \\ 0 & 0 & 0 & 0 & 0 & 0 & 7 \\ 0 & 0 & 0 & 0 & 0 & 0 & 2 \end{bmatrix}$$

然后直接作为矩阵带入函数即可, 但是需要注意的是带入时将零换成极大值即可, 求解代码:

```

1 %(1)Dijkstra算法:
2 m=10000;
3 W=[0,1,4,m,m,m,m;
4     m,0,5,3,5,m,m;
5     m,m,0,m,m,2,m;
6     m,m,m,0,5,7,3;

```

```

7      m,m,m,m,0,m,7;
8      m,m,m,m,m,0,2;
9      m,m,m,m,m,m,0;];
10     [d,Q]=shorta(w)
11     %answer
12     d =
13         0 1 4 4 6 6 7
14     Q =
15         1 2 3 4 5 6 7
16 % (2) Floyd算法:
17 [d,Q]=f_path(w)
18 %answer
19 d =
20     1 2 4 7
21 Q =
22     7
23 % (3) 规划算法:
24 d=op01(w)
25 %answer
26 LP:Optimal objective value is 7.000000.
27 d =
28     0 1 0 0 0 0 0
29     0 0 0 1 0 0 0
30     0 0 0 0 0 0 0
31     0 0 0 0 0 0 1
32     0 0 0 0 0 0 0
33     0 0 0 0 0 0 0
34     0 0 0 0 0 0 0

```

7.2.2 第二题答案:

解法同上，求解代码：

```

1 % (1) Dijkstra算法:
2 m=10000;
3 W=[0,9,8,m,m,m,m;
4     m,0,5,2,1,m,m;
5     m,m,0,8,m,7,m;
6     m,m,m,0,2,3,m;
7     m,m,m,m,0,m,3;
8     m,m,m,m,m,0,4;
9     m,m,m,m,m,m,0;];

```

```

10     [d,Q]=shorta(W)
11     %answer
12     d =
13         0 9 8 11 10 14 13
14     Q =
15         1 3 2 5 4 7 6
16     %(2)Floyd算法:
17     [d,Q]=f_path(W)
18     %answer
19     d =
20         1 2 5 7
21     Q =
22         7
23     %(3)规划算法:
24     d=op01(W)
25     %answer
26     LP:Optimal objective value is 13.000000.
27     d =
28         0 1 0 0 0 0 0
29         0 0 0 1 0 0 0
30         0 0 0 0 0 0 0
31         0 0 0 0 0 0 0
32         0 0 0 0 0 0 1
33         0 0 0 0 0 0 0
34         0 0 0 0 0 0 0

```

7.2.3 第三题答案:

求解代码:

```

1     f=zeros(6,6);
2     u=[0,16,20,0,0,0,;
3         0,0,0,10,0,10;
4         0,0,0,6,6,0;
5         0,0,0,0,0,10;
6         0,0,0,0,0,16;
7         0,0,0,0,0,0;];
8     f=ford(u,f)
9     %answer:
10    f =
11        0 16 10 0 0 0
12        0 0 0 6 0 10

```

```
13      0 0 0 4 6 0
14      0 0 0 0 0 10
15      0 0 0 0 0 6
16      0 0 0 0 0 0
```

7.2.4 第四题答案:

求解代码:

```
1  f=zeros(7,7);
2  u=[0,7,8,6,0,0,0;
3      0,0,0,0,5,0,0;
4      0,3,0,2,5,3,0;
5      0,0,0,0,0,10;
6      0,0,0,0,3,0,9;
7      0,0,0,0,0,0;];
8  f=ford(u,f)
9  %answer:
10 f =
11      0 5 8 5 0 0 0
12      0 0 0 0 5 0 0
13      0 0 0 0 5 3 0
14      0 0 0 0 0 5 0
15      0 0 0 0 0 0 10
16      0 0 0 0 0 0 8
17      0 0 0 0 0 0 0
```

7.2.5 第五题答案:

求解代码:

```
1  f=-[2,3,4,1,7;
2      3,4,2,5,6;
3      2,5,3,4,1;
4      5,2,3,2,5;
5      3,7,6,2,4];
6  intcon=1:25;
7  A=[];
8  b=[];
9  Aeq=[ones(1,5),zeros(1,20);
10      zeros(1,5),ones(1,5),zeros(1,15);
11      zeros(1,10),ones(1,5),zeros(1,10);
```

```

12 zeros(1,15),ones(1,5),zeros(1,5);
13 zeros(1,20),ones(1,5);
14 full(sparse(ones(1,5),[1,6,11,16,21],ones(1,5))),zeros(1,4);
15 full(sparse(ones(1,5),[2,7,12,17,22],ones(1,5))),zeros(1,3);
16 full(sparse(ones(1,5),[3,8,13,18,23],ones(1,5))),zeros(1,2);
17 full(sparse(ones(1,5),[4,9,14,19,24],ones(1,5))),zeros(1,1);
18 full(sparse(ones(1,5),[5,10,15,20,25],ones(1,5)))]];
19 beq=ones(10,1);
20 lb=zeros(25,1);
21 ub=ones(25,1);
22 [a,z]=intlinprog(f,intcon,A,b,Aeq,beq,lb,ub);
23 a=reshape(a,[5,5])
24 %answer:
25 a=
26     0  0  0  0  1
27     0  0  0  1  0
28     0  1  0  0  0
29     1  0  0  0  0
30     0  0  1  0  0

```

7.2.6 第六题答案:

求解代码:

```

1 C = [0,6,2,1,0;0,0,0,0,0;0,2,0,10,3;0,4,0,0,0;0,0,0,0,0]; % 弧容量
2 b = [0,5,9,4,0;0,0,0,0,0;0,3,0,4,2;0,3,0,0,0;0,0,0,0,0];
3 [f,wf,zwf]=ford02(C,b)
4 %answer:
5 f =
6     0  0  2  0  0
7     0  0  0  0  0
8     0  0  0  0  2
9     0  0  0  0  0
10    0  0  0  0  0
11 wf =
12     2
13 zwf =
14    22

```

7.2.7 第七题答案:

求解代码:

```
1 C = [0,2,8,0,0,0;  
2       0,0,5,2,0,0;  
3       0,0,0,0,3,0;  
4       0,0,1,0,0,6;  
5       0,0,0,4,0,7;  
6       0,0,0,0,0,0]; % 弧容量  
7 b = [0,8,7,0,0,0;  
8       0,0,5,9,0,0;  
9       0,0,0,0,9,0;  
10      0,0,2,0,0,5;  
11      0,0,0,6,0,10;  
12      0,0,0,0,0,0];  
13 [f,wf,zwf]=ford02(C,b)  
14 %answer:  
15 f =  
16     0 2 3 0 0 0  
17     0 0 0 2 0 0  
18     0 0 0 0 3 0  
19     0 0 0 0 0 2  
20     0 0 0 0 0 3  
21     0 0 0 0 0 0  
22 wf =  
23     5  
24 zwf =  
25    122
```

7.2.8 第八题答案:

求解代码:

```
1 a(1, 1:6) = [0,3, 7, 4, 0, 0];  
2 a(2, 1:6) = [3, 0, 2,0,9,0];  
3 a(3, 1:6) = [7,2,0,1,6,3];  
4 a(4, 1:6) = [4,0,1,0,0,4];  
5 a(5, 1:6) = [0,9,6,0,0,3]; a(6, :)=0;  
6 aviodcircle(a)  
7 %answer:  
8 ans =  
9     3 4 1  
10    2 3 2  
11    1 2 3  
12    3 6 3
```

13 5 6 3

7.2.9 第九题答案:

求解代码:

```
1  a(1,1:9)=[0,2,1,3,0,0,0,0,0];
2  a(2,1:9)=[2,0,4,0,5,6,0,0,0];
3  a(3,1:9)=[1,4,0,3,5,0,0,0,0];
4  a(4,1:9)=[3,0,5,0,6,0,0,8,0];
5  a(5,1:9)=[0,5,3,6,0,4,0,0,0];
6  a(6,1:9)=[0,2,0,0,4,0,5,0,3];
7  a(7,1:9)=[0,0,0,0,3,5,0,4,1];
8  a(8,1:9)=[0,0,0,8,7,0,4,0,2];
9  a(9,1:9)=[0,0,0,0,0,0,0,0,0];
10 avoidcircle(W)
11 %answer:
12 ans =
13
14      2 5 1
15      2 4 2
16      4 6 3
17      5 7 3
18      2 3 5
19      1 3 8
```

7.2.10 第十题答案:

求解代码:

```
1  a(1,2)=10;a(1,3)=20;a(1,4)=30;a(1,5)=40;a(1,6)=50;
2  a(2,3)=18;a(2,4)=30;a(2,5)=25;a(2,6)=21;
3  a(3,4)=5;a(3,5)=10;a(3,6)=15;
4  a(4,5)=8;a(4,6)=16;
5  a(5,6)=18;
6  a(6,:)=0;
7  [circle,sum]=circle1(a)
8  %answer:
9  circle =
10  5 4 3 1 2 6
11  sum =
12  64
```