Contents

1 Integration

1.1 Simpson's rule

Numerical approximation of definite integrals, given by:

$$\int_a^b f(x)dx \approx \frac{b-a}{6}\left[f(a) + 4f\left(\frac{a+b}{2}\right) + f(b)\right]$$

1.1.1 Field test: Environmental Protection

Source:*Latin America Regional Contest - 2012*

```
#include<iostream>
#include<iomanip>


using namespace std;

double W,D,A,K;
double p1[10],q1[10],p2[10],q2[10];
double EPS = 1e-4;

double f(double x, double cut){
    double n1,n2,d1,d2; //Horner's rule.
    n1 = n2 = d1 = d2 = 0.0;
    for(int i=K;i>=0;i--){
        n1 = n1 * x + p1[i];
        d1 = d1 * x + q1[i];
        n2 = n2 * x + p2[i];
        d2 = d2 * x + q2[i];
    }
    double f1 = n1/d1 , f2 = n2/d2;

    if(f1 <= cut)
        return 0;
    else if(cut < f2)
        return f1 - f2;
    else return f1 - cut;
}

double simpson(double a, double b, double x){
```

```
30      double fa,fab,fb;
31      fa = f(a,x);
32      fab = f((a+b)/2.0, x);
33      fb = f(b,x);
34      double r = ((b-a)/6.0) * (f(a,x) + (4*f((a+b)/2.0,x)) + f(b,x));
35      return r;
36  }
37
38  int main(){
39      freopen("E.in" , "r" , stdin);
40
41      while(cin>> W >> D >> A >> K){
42          for(int i=0;i<=K;i++)
43              cin>>p1[i];
44          for(int i=0;i<=K;i++)
45              cin>>q1[i];
46          for(int i=0;i<=K;i++)
47              cin>>p2[i];
48          for(int i=0;i<=K;i++)
49              cin>>q2[i];
50          double lo = -D, hi = 0.0;
51          for(int i=0;i<25;i++){
52              double m = (lo + hi)/2.0;
53              double act_area = 0.0;
54              for(double a=0.0; a+EPS-1e-5<W ; a+=EPS){
55                  act_area += simpson(a, a+EPS,m);
56              }
57              if(act_area < A)
58                   hi = m;
59              else lo = m;
60
61          }
62          cout <<fixed <<  setprecision(5) << -lo << endl;
63      }
64      return 0;
65  }
```