Exercises 4.5

2. The nodal coordinates of a 3-node bar element are(x1,y1) = (−1,−1),(x2,y2) = (1,1)and(x3,y3) = (0,1). Determine the element length analyti-cally; then use the Gauss quadrature testing different numbers of integration points. How many integration points are required to find the element length accurately?

```
clear all
clc
```

```
syms xi
```

```
C = [-1 -1; 0 1; 1 1];
J = C'* lin_deriv (xi);
eqs = norm(J);
L = int(eqs, -1, 1);
valor_analitico = vpa(L, 4)
```

valor_analitico = 4.126

```
quadrature_1_pts = [0.0 2.0];

quadrature_2_pts = [
    -0.5773502692 1.0
     0.5773502692 1.0];

quadrature_4_pts = [
    -0.8611363116 0.3478548451
    -0.3399810436 0.6521451549
     0.3399810436 0.6521451549
     0.8611363116 0.3478548451];

quadrature_8_pts = [
    -0.9602898565 0.1012285363
    -0.7966664774 0.2223810345
    -0.5255324099 0.3137066459
    -0.1834346425 0.3626837834
     0.1834346425 0.3626837834
     0.5255324099 0.3137066459
     0.7966664774 0.2223810345
     0.9602898565 0.1012285363];

N = quadrature_8_pts;
L = 0.00;
[s, w] = quadrature(N);
for i = 1:size(N, 1)
    L = (subs(eqs, xi, s(i))) * w(i) + L;
end
valor_numerico = vpa(L, 4)
```

valor_numerico = 4.124

```
function dn = lin_deriv (xi)
dn = [xi - 1/2
```

```
      xi + 1/2
      -2*xi];
end

function [xi, w] = quadrature (quadrature)
Npst = size(quadrature, 1);
for i = 1:Npst
    xi(i,1) = quadrature (i, 1);
    w(i,1)  = quadrature (i, 2);
end
end
```