Applied Numerical Analysis | (7th Edition)

Problem

Repeat Exercise 1, but now for a Bezier surface.

Exercise 1

Using the data from Exercise 2, construct the B-spline surface from the rectangular array of 16 points nearest to (2.8. 0.54) and find *z*(2.8. 0.54). Compare to the result of Exercise.

Exercise 2

From this table, estimate *z*(*x*, *y*) for *x* = 2.8 and *y* = 0.54 using an array of nine points nearest to the point of interpolation to construct interpolating polynomials. (There may be several ways to choose these points; try them all.) The function whose values are tabulated is *z* = *x* + *ey*.

x|*y*	0.2	0.4	0.5	0.7	0.9
1.3 |	2.521	2.792	2.949	3.314	3.760
2.5 |	3.721	3.992	4.149	4.514	4.960
3.1 |	4.321	4.592	4.749	5.1 14	5.560
4.7 |	5.921	6.192	6.349	6.714	7. 160
5.5 |	6.721	6.992	7.149	7.514	7.960

Step-by-step solution

Step 1 of 6

The text does not describe the exact method of how to construct a Bezier surface (it refers the reader to another text by the author), so the reader will be walked through on how to construct such a surface using Mathematica. The interpolation at $z(2.8,0.54)$ is dependent upon two parameters *u*,*v*, which were obtained by trial and error as approximately $u=.4835$, and $v=.356$

Comment

Step 2 of 6

To pick the 16 points nearest $(2.8,.54)$, try to center this point in the given table of data values. Since the *x* coordinates are 1.3, 2.5, 3.1, 4.7, and 5.5, 2.8 is between 2.5 and 3.1, and the four possible *x* coordinate nodes for the rectangle are 1.3, 2.5, 3.1, and 4.7. Since the *y* coordinates are 0.2, 0.4, 0.5, 0.7, and 0.9, 0.54 is between 0.5 and 0.7, and the four possible *y* coordinates are 0.4, 0.5, 0.7, and 0.9.

Comment

Step 3 of 6

From this, the *xy*-coordinates are

Comment

Step 4 of 6

$$\begin{array}{llll}(1.3,0.4) & (1.3,0.5) & (1.3,0.7) & (1.3,0.9)\\ (2.5,0.4) & (2.5,0.5) & (2.5,0.7) & (2.5,0.9)\\ (3.1,0.4) & (3.1,0.5) & (3.1,0.7) & (3.1,0.9)\\ (4.7,0.4) & (4.7,0.5) & (4.7,0.7) & (4.7,0.9)\end{array}$$

Comment

Step 5 of 6

To draw the graph that includes the control points (red), the lines (gray) connecting the control points, and the Bezier curve (blue), make use of the following Mathematica commands

INPUT:

```
pts={{{1.3,.4,2.792},{1.3,.5,2.949},{1.3,.7,3.314},{1.3,.9,3.76}},{{2.5,.4,3.992},
{2.5,.5,4.149},{2.5,.7,4.514},{2.5,.9,4.96}},{{3.1,.4,4.592},{3.1,.5,4.749},
{3.1,.7,5.114},{3.1,.9,5.56}},{{4.7,.4,6.192},{4.7,.5,6.349},{4.7,.7,6.714},
{4.7,.9,7.16}}};
```

INPUT:

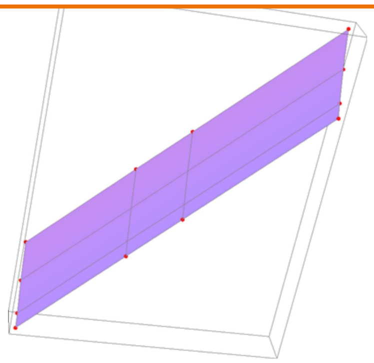
```
f=BezierFunction[pts]
```

OUTPUT:

```
BezierFunction[{{0.,1.}},"<>"]
```

INPUT:

```
Show[Graphics3D[{PointSize[Medium],Red,Map[Point,pts]}],
Graphics3D[{Gray,Line[pts],Line[Transpose[pts]]}],
ParametricPlot3D[f[u,v],{u,0,1},{v,0,1},Mesh → None]]
```



Comment

Step 6 of 6

Normally, to approximate $z(2.8, 0.54)$, the equations generating the Bezier surface must be solved for to find the *uv*-coordinate corresponding to $(2.8, 0.54)$. Since the text does not give the equations, one must try by trial and error to find this coordinate. After trial and error, the *u* and *v* parameters were found to be approximately $u = .4835$, and $v = .356$

INPUT:

f[.4835,.356]

OUTPUT:

{2.80066,0.540309,4.53369}

which shows that the parameters get close to the interpolation point with $z(2.8, 0.54) \approx 4.53369$.

Comment

Was this solution helpful? 0 0

Recommended solutions for you in Chapter 3

Chapter 3, Problem 3E

Multiply out the Lagrangian polynomials in Exercises 1 and 2 to get the quadratics in the form ax2 + bx + c. How different are the values for a, b, and c?Exercise 1Write out the Lagrangian polynomial from this table:...

View this solution

Chapter 3, Problem 48E

Compute the connected Bezier curve from this set of points: Point # 0123456789x10507590105150180190160130y10156C Draw the graph determined by the ten points.b. Why is the graph smoothly connected at points 3 and 6?c....

View this solution