

Applied Numerical Analysis | (7th Edition)

Chapter 3, Problem 64E

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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	5.114	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 $v = .356$

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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.

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Step 3 of 6

From this, the xy -coordinates are

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Step 4 of 6

$(1.3, 0.4)$ $(1.3, 0.5)$ $(1.3, 0.7)$ $(1.3, 0.9)$
 $(2.5, 0.4)$ $(2.5, 0.5)$ $(2.5, 0.7)$ $(2.5, 0.9)$
 $(3.1, 0.4)$ $(3.1, 0.5)$ $(3.1, 0.7)$ $(3.1, 0.9)$
 $(4.7, 0.4)$ $(4.7, 0.5)$ $(4.7, 0.7)$ $(4.7, 0.9)$

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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]]
```

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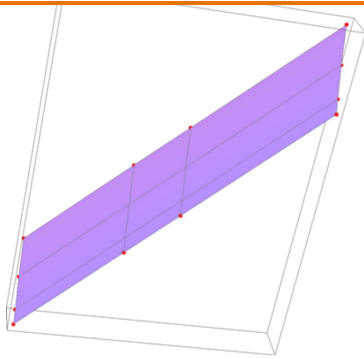


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Step 6 of 6

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 $z(2.8, 0.54) \approx 4.53369$.

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Was this solution helpful?

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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 $ax^2 + bx + c$. How different are the values for a , b , and c ? Exercise 1 Write 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....

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