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Course / Unit 1: Functions of two variables / Problem Set 1A



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Problem Set A due Aug 4, 2021 20:30 IST Completed

1A-9

5/5 points (graded)

Let 
$$f(x,y) = \sin(xy^2 + y) + 2e^x$$
.

Compute the linear approximation of f around (0,0). Express your answer in terms of x and y.

$$f(x,y)pprox egin{array}{c} 2+2*x+y \ \hline 2+2\cdot x+y \ \hline \end{array}$$
 Answer:  $2+2*x+y$ 

Use your approximation from above to approximate f(0.1, 0.2).

$$f(0.1,0.2) \approx \boxed{$$
 2.4  $\checkmark$  Answer: 2.4

We want to find a value of  $m{y}$  near to zero so that  $m{f}(0, m{y}) = 1.99$ . Approximate this value of  $m{y}$ .

We want to find a point (x,y) near (0,0) where f(x,y)=2 and x-y=0.01. Approximate this point (x,y). (Enter your answer to 5 decimal places.)

**Answer:** -0.02/3

### Solution:

To compute the linear approximation, we need the values

$$f\left(0,0\right)=\sin\left(0\right)+2e^{0}=2$$

$$f_{x}\left(0,0
ight)=y^{2}\cos\left(xy^{2}+y
ight)+2e^{x}ig|_{\left(x,y
ight)=\left(0,0
ight)}=2$$

$$f_y\left(0,0
ight)=\cos\left(xy^2+y
ight)\left(2xy+1
ight)ig|_{(x,y)=(0,0)}=1.$$

Then we obtain

$$f\left(x,y
ight)pprox f\left(0,0
ight)+f_{x}\left(0,0
ight)x+f_{y}\left(0,0
ight)y=2+2x+y$$

for (x, y) near (0, 0).

To approximate f(0.1, 0.2), we substitute these values into our linear approximation to obtain

$$f(0.1, 0.2) \approx 2 + 2(0.1) + 0.2 = 2.4.$$

To find an approximate value of y near zero so that  $f\left(0,y
ight)=1.99$ , we use our linea

$$1.99 \approx 2 + 2(0) + 1(y)$$
.

Solving for y yields y pprox -0.01. Therefore, f(0,-0.01) pprox 1.99.

Finally, to find the point (x,y) such that f(x,y)=2 and x-y=0.01, we can substitute x=0.01+y into the linear approximation:

$$2 = 2 + 2(0.01 + y) + 1(y)$$
.

Solving for y yields y=-0.02/3. Then from x-y=0.01 we have x=0.01-0.02/3=0.01/3.

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You have used 1 of 5 attempts

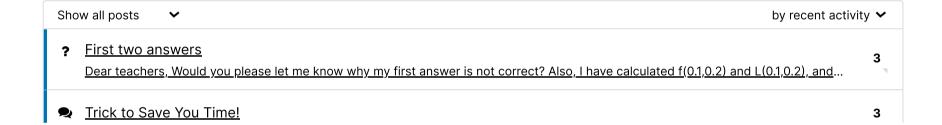
**1** Answers are displayed within the problem

## 6. Linear approximation

Topic: Unit 1: Functions of two variables / 6. Linear approximation

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2 min + 6 activities

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