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6. Cases to consider for a quadratic function

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Lecture due Sep 13, 2021 20:30 IST Completed

Given a quadratic function

$$w(x,y) = ax^2 + bxy + cy^2$$

(4.63)

for $a \neq 0$, the three cases presented in the video on the previous page are as follows:

Case 1: If $4ac - b^2 < 0$, then $w(x,y)$ is a difference of squares. This implies that the origin is a **saddle point** .

Case 2: If $4ac - b^2 = 0$, then $w(x,y)$ is constant in one direction, which means the origin is a degenerate critical point. We will not focus on this case in this course.

Case 3: If $4ac - b^2 > 0$, then $w(x,y)$ is a sum of two squares. This means that the sign of w depends entirely on the term $1/(4a)$.

- If $a > 0$, then $w \geq 0$ and the origin is a **local minimum** .
- If $a < 0$, then $w \leq 0$ and the origin is a **local maximum** .

Identify the critical point of the quadratic function, 1

1/1 point (graded)

Use the criterion above to determine what type of critical point $(0,0)$ is for the quadratic function

$$-2x^2 + 3xy - 4y^2$$

☐ Saddle

☐ Degenerate

☐ Minimum

☒ Maximum



Solution:

We look at the quantity $4ac - b^2 = 4(-2)(-4) - 3^2 = 32 - 9 > 0$, thus we are in case 3. Since $a < 0$, the origin is a maximum.

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You have used 1 of 2 attempts

Answers are displayed within the problem

Identify the critical point of the quadratic function, 2

1/1 point (graded)

Use the criterion above to determine if the what type of critical point $(0,0)$ is for the quadratic function

$$2x^2 + 3xy - 2y^2$$



Calculator



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☒ Saddle

☐ Degenerate

☐ Minimum

☐ Maximum

Solution:

We look at the quantity $4ac - b^2 = 4(2)(-2) - 3^2 = -16 - 9 < 0$, thus we are in case 1. The origin is a saddle.

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You have used 1 of 2 attempts

Answers are displayed within the problem

Identify the critical point of the quadratic function, 3

1/1 point (graded)
Use the criterion above to determine if the what type of critical point $(0, 0)$ is for the quadratic function

$$x^2 + 2xy + y^2$$

☐ Saddle

☒ Degenerate

☐ Minimum

☐ Maximum

Solution:

We look at the quantity $4ac - b^2 = 4(1)(1) - 2^2 = 0$, thus we are in case 2. The origin is a degenerate critical point.

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You have used 1 of 2 attempts






Answers are displayed within the problem

6. Cases to consider for a quadratic function

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Topic: Unit 3: Optimization / 6. Cases to consider for a quadratic function

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 [Staff] Case 2: We will not focus on this case in this course Hi, dear staff. This is really a great course! The content are so well prepared and the TAs and the forum are so helpful. As a full-time... I feel a bit sad when I see that an interesting case will not be developed further in class. Maybe some optional material can be adde...	14
 caption typo Hello. You used "Identify the critical point of the quadratic function, 1" twice. Best wishes.	2
 Typo in lecture 3, case 3  Community TA	2



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