

Calculus Quiz 2: Prof. Kaplan

January 30, 2025

Student name: _____. Do what you can in 15 minutes.

Question 1: Figure 1 shows a function $Af(a(x - x_0)) + B$ that uses input scaling and output scaling on a pattern-book function.

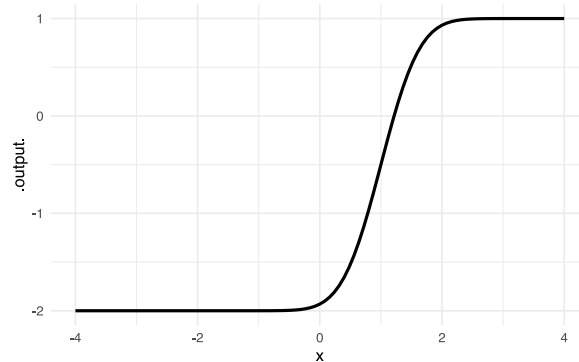


Figure 1: $Af(a(x - x_0)) + B$

- Which pattern-book function is involved?
 - Give numerical values for each of the four parameters.
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Question 2: Figure 2 shows an exponential function with input and output scaling.

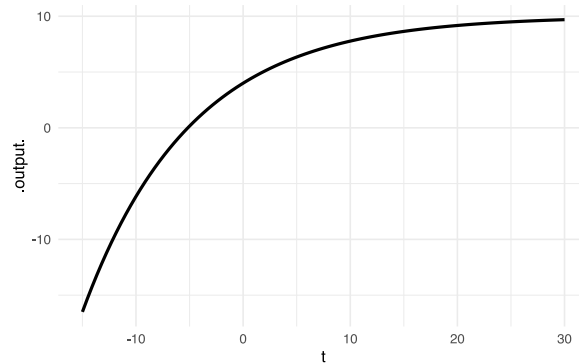


Figure 2: For Question 2.

- Is this exponential decay or exponential growth?
 - What is the baseline parameter B ?
 - Find either the half-life or the doubling-time depending on your answer to (i).
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Question 3: Draw a graph of $g(t) \equiv 3 \sin\left(\frac{2\pi}{4}t\right) - 5$ over a domain of your choice but which clearly shows the period. Place reasonably accurate labelled tick marks along the two axes.

Question 4: Figure 3 shows a handful of data points and a candidate function not them.

- Draw in the residual for each data point, quantify it, and calculate the “sum of squared residuals.” (You can round off reasonably in quantifying the residuals.)
- Draw in a better fitting function of the same shape.

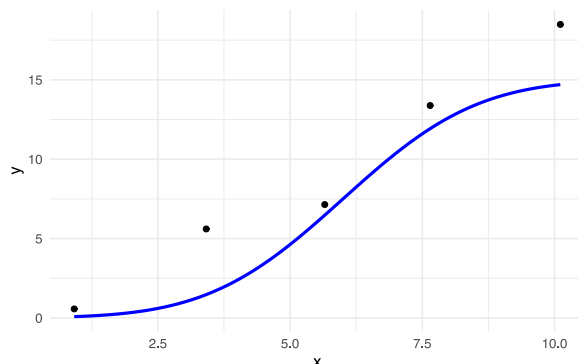
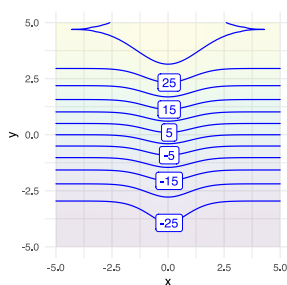
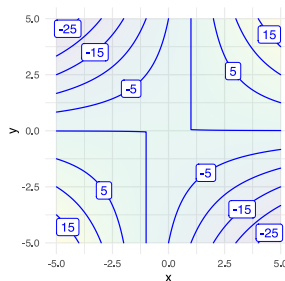


Figure 3: Data and a fitted function

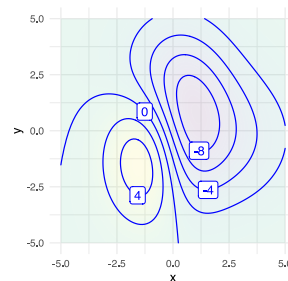
Question 5:



(a) $f(x, y)$



(b) $g(x, y)$



(c) $h(x, 7)$

Figure 4: Plots for Question 5

Above are contour plots for three unrelated functions: $f(x, y)$, $g(x, y)$, and $h(x, y)$. One of the three involves a linear combination of two functions $u_1(x)$ and $u_2(y)$. Another is defined piecewise. The third is a nonlinear combination (e.g. function multiplication).

- We haven't talked about the features of a function of two variables that would let you answer this question precisely, but which contour plot corresponds to which kind of function?
 - $f(x, y)$: linear-comb or piecewise or nonlinear-comb
 - $g(x, y)$: linear-comb or piecewise or nonlinear-comb
 - $h(x, y)$: linear-comb or piecewise or nonlinear-comb
- Briefly explain what feature(s) in the contour plots informed your answer to (a).