

Discussion Questions – Week #5b

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Please do the following questions as a group. Make sure that everyone in your group understands how each questions works. These questions are open ended and admit several approaches each. If you need help, please ask.

Question 1. *Taylor expand:*

- $f(x, y) = \frac{1}{1-x-y}$ about $(x, y) = (0, 0)$
- $H(p, q) = p \ln(p) + q \ln(q)$ about $(p, q) = (\frac{1}{2}, \frac{1}{2})$.
- $t(\rho, \theta) = \rho \cos(\theta)$ about $(\rho, \theta) = (1, \frac{\pi}{2})$.

Question 2. *This exercise is intended to show the difference between “Taylor expand and substitute” (1-2) and “Taylor expand about a point” (3).*

Consider the function $f(x, y) = e^{x+y}$. Define $s(t) = e^t$ and $r(x, y) = x+y$. Note that $f(x, y) = s(r(x, y))$.

1. Compute the Taylor series of $f(x, y)$ about $(x, y) = (0, 0)$.
2. Show the result above is equal to substituting $t = x + y$ in to the Taylor series of $s(t)$ about $t = 0$.
3. Now consider the Taylor expansion of $f(x, y)$ about $(1, 1)$.
 - (a) Show that the Taylor polynomial of $r(x, y)$ about $(x, y) = (1, 1)$ is $r(x, y) = 2 + (x - 1) + (y - 1)$.
 - (b) Using (3a) what is the coefficient of $(x - 1)(y - 1)$ in the Taylor series of $f(x, y)$ about the point $(x, y) = (1, 1)$ obtained by substituting your answer for Question 2.3a in to your Taylor series for $s(t)$ from Question 2.2? Compare this with $\frac{\partial^{(1,1)}f}{(1,1)!}(1, 1)$.