Math 1211 Learning Journal 7

Choose one interesting problem from the text of medium difficulty that was not assigned.

* Describe why you find it interesting.
* either solve it or find a solution online
* work through it using your understanding to critique that solution and improve it.

I found this question in the after-text exercise.

According to (*4.8 L’Hôpital’s Rule - Calculus Volume 1 | OpenStax*, n.d.), the traditional method of evaluating the limits like using numerical evidence. L’Hopital’s rule will be able to reveal the limit that exists and determine the exact value.

When the limit x->a, f(x), and g(x), the limit shall exist if there is such a real number for the rational function. But there are cases when indeterminate forms. This form means that we can not directly derive the functional ratio to a real number. The numerator and denominator might be approaching 0 or infinite. Thus, we are not able to directly get the real number as the real solution. And instead of using direct comparison, we can compare the derivative of the two functions if they are matching the cases that apply to the indeterminate forms.

The infer process is also quite straightforward, we can use the linear approximation

For x near a f(x) ≈f(a) +f’(a)(x-a), and f(a) is close to 0 so we can ignore this case.

And (x-a) can be canceled out as both terms of f(x) and g(x), so the limit can be obtained to derivatives. Similarly, the ∞/∞ can be obtained similarly.

The reason being is that the question involves the analysis of indeterminate item n.

The question is below,

I found it difficult when I first approach this question. I do not know what to do with the function of the exponent of n. It's not able to refactor or either able to rearrange this formula.

The way I tackle this issue is really to stick with the definition of the function itself.

As we want to examine if can use the L’Hopitals rule, then we found that

= 0 as 1^n-1=0

And the denominator x also approached 0. Thus, it matches the indeterminate form 0/0, then we can get the limit by using the limit of the ratio of their derivatives.

So d(1+x)n-1/dx = n(1+x)n-1 and derivative of x = 1

then the =n\*(1)-1=n.

We got the result and the lesson I learned here is not to be afraid of the extra variable in the function, and just proceed with the usual calculation step. I also learned that when coming to the question of limit, we need to see the actual value of the limit ratio.

Then if the limit function is matching the indeterminate form. Then we can quickly use the L’hopotals rule. This will use the derivative as the result of the limit.

This process will give us a method to get the result easier.

This can also be solved differently. The limit function can be refactored into the product form 1/x \* ((1+x)n-1). It's equivalent to ∞-∞, this is also one of the indeterminate forms from the list 0⋅∞, ∞−∞,1∞, ∞0, and 00

Reference

*4.8 L’Hôpital’s Rule - Calculus Volume 1 | OpenStax*. (n.d.). Retrieved October 18, 2022, from https://openstax.org/books/calculus-volume-1/pages/4-8-lhopitals-rule