

Math 242 Lab 9

Power Series

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Lab Assignment

- Complete ALL Lab Assignment Questions (with codes, computation results, and brief response questions from page 3~4)
- Submit “lastnameLab09.nb” and “lastnameLab09.pdf” (**File->Save As → pdf**) on Canvas
- Deadline: **Tomorrow 11:59pm**
- Correct computation results (without codes) are available on Canvas
→ Files → Lab → Lab_09_Power Series → lab09_examples_hints

SumConvergence

- Syntax: `SumConvergence[(summand), (index)]`
- Example:
- In: `SumConvergence[x^n, n]`
- Out: $\text{Abs}[x] < 1$
- This means that the series $\text{Sum}[x^n, \{n, 0, \text{Infinity}\}]$ converges if $\text{Abs}[x] < 1$

NumberLinePlot

- Syntax: `NumberLinePlot[(an interval), (variable)]`
- Recall that `SumConvergence` will give us some inequalities, which implicitly gives an interval of x that satisfies these inequalities.
- Example:
- `NumberLinePlot[SumConvergence[x^n, n], x]`

Series

- Previous we've been thinking what a series converge to. Now work backward. Given a function f , we can express f as a series
- Syntax: $\text{Series}[f[x], \{x, a, N\}]$
- Gives expansion of $f[x]$ in terms of $c_k(x-a)^k$ and output up to $c_N(x-a)^N$

Series

```
In[14]:= Series[Log[5 - x], {x, 0, 5}]
```

```
Out[14]= Log[5] -  $\frac{x}{5}$  -  $\frac{x^2}{50}$  -  $\frac{x^3}{375}$  -  $\frac{x^4}{2500}$  -  $\frac{x^5}{15625}$  + O[x]6
```

```
In[87]:= Series[Log[5 - x], {x, 1, 5}]
```

```
Out[87]= 2 Log[2] -  $\frac{x-1}{4}$  -  $\frac{1}{32} (x-1)^2$  -  $\frac{1}{192} (x-1)^3$  -  $\frac{(x-1)^4}{1024}$  -  $\frac{(x-1)^5}{5120}$  + O[x-1]6
```

Plot

- Syntax: `Plot[f[x], {x, a, b}]`

Plot the function $f[x]$ from a to b

- Syntax: `Plot[{f1[x],f2[x],f3[x]}, {x, a, b}]`
- Plot multiple functions $f1[x], f2[x], f3[x]$ from a to b , all on the same graph.
- `Plot[{f1[x],f2[x],f3[x]}, {x, a, b}, PlotLegends -> "Expressions"]`
Add `PlotLegends -> "Expressions"` so that we know which plot corresponds to which function.

Plot the “Series” – Remove $O[x]^k$

- The output of the function “Series” will include an error term at the end. We should remove it (by only copy the other terms) when plotting.

- Wrong example 1:

“Series” will give an expression includes $O[x]^6$ which causes error (see previous pages for more about “Series”)

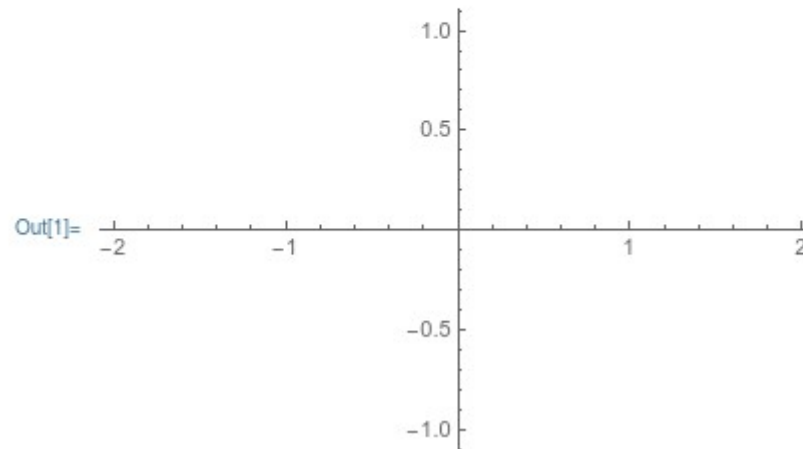
```
In[1]:= Plot[Series[Log[5 - x], {x, 0, 5}], {x, -2, 2}]
```

General: -1.99992 is not a valid variable.

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General: Further output of General::ivar will be suppressed during this calculation.



Plot the “Series” – Remove $O[x]^k$

- The output of the function “Series” will include an error term at the end. We should remove it (by only copy the other terms) when plotting.

- Wrong example 2:

$+O[x]^6$ will cause error

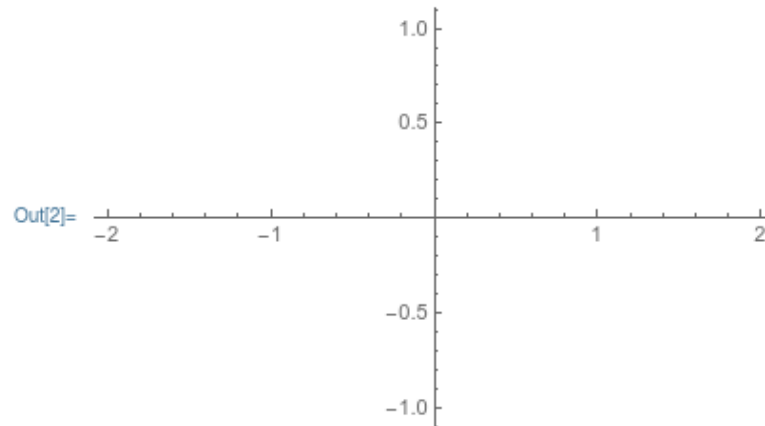
```
In[2]:= Plot[Log[5] -  $\frac{x}{5}$  -  $\frac{x^2}{50}$  -  $\frac{x^3}{375}$  -  $\frac{x^4}{2500}$  -  $\frac{x^5}{15625}$  +  $O[x]^6$ , {x, -2, 2}]
```

... SeriesData: Attempt to evaluate a series at the number -1.99992. Returning Indeterminate.

... SeriesData: Attempt to evaluate a series at the number -1.91829. Returning Indeterminate.

... SeriesData: Attempt to evaluate a series at the number -1.83665. Returning Indeterminate.

... General: Further output of SeriesData::ssdn will be suppressed during this calculation.



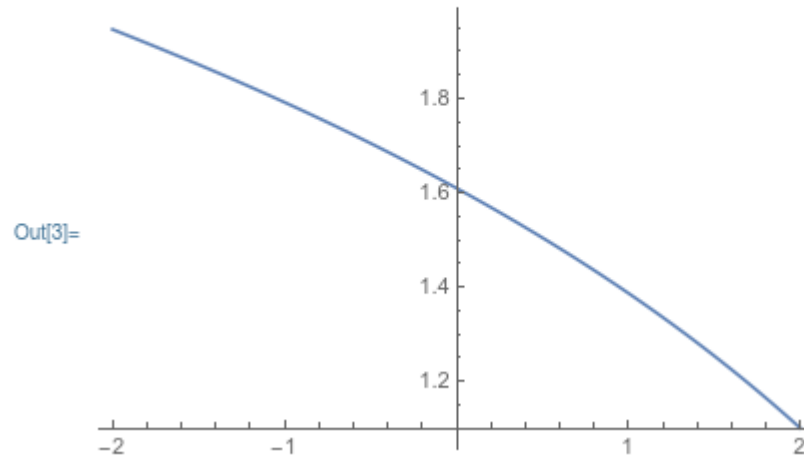
Plot the “Series” – Remove $O[x]^k$

- The output of the function “Series” will include an error term at the end. We should remove it (by only copy the other terms) when plotting.

- Correct example:

Remove the $O[x]^6$ term.

```
In[3]:= Plot[Log[5] -  $\frac{x}{5}$  -  $\frac{x^2}{50}$  -  $\frac{x^3}{375}$  -  $\frac{x^4}{2500}$  -  $\frac{x^5}{15625}$ , {x, -2, 2}]
```



Wrong

- ClearAll
- $\ln(k)$, $\log[k]$
- Sumconvergence[x^n , n]
- Numberlineplot[\dots, x]
- SumConvergence[x^n , k]
- SumConvergence[x^k , n]

Correct

- ClearAll[s], Clear[s]
- Log[k]
- SumConvergence[x^n , n]
- NumberLinePlot[\dots, x]