Calculus II

Power series expansions related to exponents, part 2

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2019

•
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•
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.

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• To find the radius of convergence, let $a_n = \frac{e^3}{n!}(x-3)^n$.

$$\lim_{n \to \infty} \left| \frac{a_{n+1}}{a_n} \right| = \lim_{n \to \infty} \left| \frac{e^3 (x-3)^{n+1}}{(n+1)!} \cdot \frac{n!}{e^3 (x-3)^n} \right| = \lim_{n \to \infty} \frac{|x-3|}{n+1} = 0$$

• Therefore by the Ratio Test the series converges for all x.

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- Therefore $R = \infty$.

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- Therefore by the Ratio Test the series converges for all x.
- Therefore $R = \infty$.
- Just like the Maclaurin series, this series also represents e^x .

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 Recall that $e^y = \sum_{n=0}^{\infty} \frac{y^n}{n!}$

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 $= e^{3} \sum_{n=0}^{\infty} \frac{(x-3)^{n}}{n!}$

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Set $y = x - 3$

$$e^{x} = e^{x-3+3} = e^{3}e^{x-3}$$

$$= e^{3}\sum_{n=0}^{\infty} \frac{(x-3)^{n}}{n!}$$

$$= \sum_{n=0}^{\infty} \frac{e^{3}}{n!} (x-3)^{n}$$

$$e^{x} = e^{x-3+3} = e^{3}e^{x-3}$$
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 Recall that $e^{y} = \sum_{n=0}^{\infty} \frac{y^{n}}{n!}$
 $= e^{3} \sum_{n=0}^{\infty} \frac{(x-3)^{n}}{n!}$
 $= \sum_{n=0}^{\infty} \frac{e^{3}}{n!} (x-3)^{n}$

The radius of convergence was already computed to be $R = \infty$.