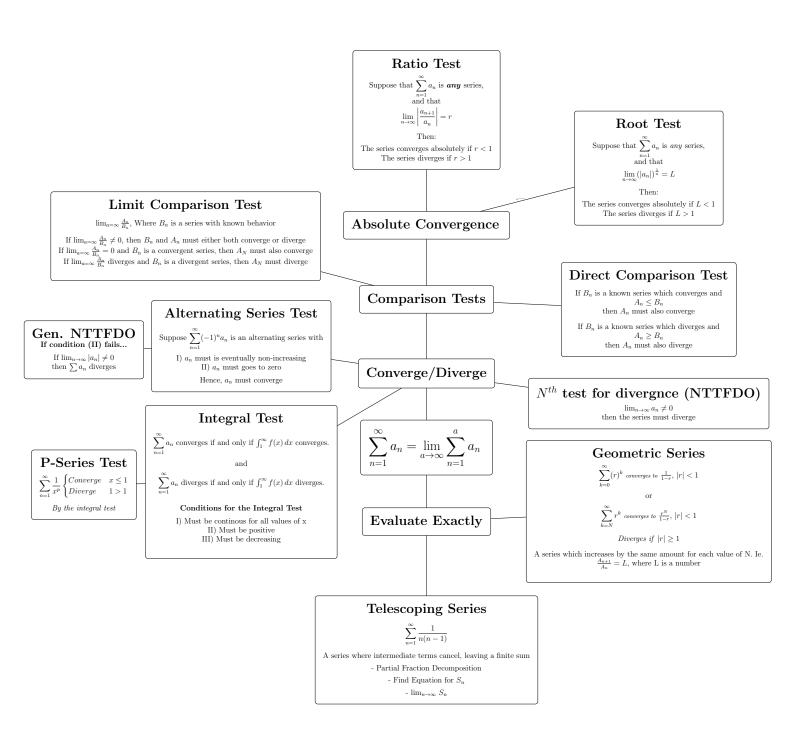
# Calc II Notes Pierson L



# 1 Absolute Convergence

10.5

## 1.1 Good Practice Problems

57

## 1.2 Ratio Test

The Ratio Test<sup>1</sup> states that

Suppose that 
$$\sum_{n=1}^{\infty} a_n$$
 is  $any$  series, and that 
$$\lim_{n\to\infty} \left| \frac{a_{n+1}}{a_n} \right| = r$$

Then:

The series converges absolutely if r < 1The series diverges if r > 1

#### 1.2.1 Examples

## example 1

Simplify 
$$\frac{(n+2)!}{(n-1)!}$$

 $Ratio\ of\ factorials$ 

$$= \frac{(n+2)!}{(n-1)!}$$

$$= \frac{(n+1)(n+1)(n)(n-1)\cdots(1)}{(n-1)(n-2)(n-3)\cdots(1)}$$

$$= \frac{(n+1)(n+1)(n)(n-1)}{(n-1)}$$

$$= (n+1)(n+1)(n)$$

<sup>&</sup>lt;sup>1</sup>Very important regarding factorials

## example 2

Problem 57 from book

$$\sum_{n=1}^{\infty} \frac{2^n (n!)^2}{2n!}$$

We apply the Ratio test

$$\lim_{n \to \infty} \frac{\frac{(2^{n+1})(n+1)!^2}{2(n+1)!}}{\frac{2^n n!^2}{2n!}}$$

$$\lim_{n \to \infty} \frac{2^{n+1}(n+1)^2}{2(n+1)} \times \frac{2n!}{2n(n!)^2}$$

$$\lim_{n \to \infty} \frac{2^{n+1}(n+1)^2}{2\mathbf{n}+2} \times \frac{2n!}{2n(n!)^2}, \text{ note the } +2$$

$$\lim_{n \to \infty} \frac{2(n+1)^2}{(2\mathbf{n}+2)(2\mathbf{n}+1)}$$

$$= \frac{1}{2} < 1$$

Hence, the series  $\sum_{n=1}^{\infty} \frac{2^n (n!)^2}{2n!}$  converges

## 1.3 Misc

# 1.3.1 Factorials

ex.1

$$4! = 4 \times 3! = 4x3x2! = 4x3x2x1! = 4x3x2x1x0!$$

$$0! = 1$$

$$0 + 4! = 24$$

ex. 2

Simplify 
$$\frac{(n+2)!}{(n-1)!}$$

 $Ratio\ of\ factorials$ 

$$=\frac{(n+2)!}{(n-1)!}$$

$$=\frac{(n+1)(n+1)(n)(n-1)\cdots(1)}{(n-1)(n-2)(n-3)\cdots(1)}$$

$$= \frac{(n+1)(n+1)(n)(n-1)}{(n-1)}$$

$$= (n+1)(n+1)(n)$$