MA1521 Cheatsheet

AY20/21 Sem 1 | Chapter 1-3

Estimation

first order estimate: $y' \approx y + \Delta x \times \frac{dy}{dx}\Big|_{x=2}$

second order estimate:

$y' \approx$ 1st estimate $+ (\frac{(\triangle x)^2}{2} \times \frac{d^2y}{dx^2}\Big|_{x=2})$

Stats

pop. variance: $\sigma^2 = \frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n}$

pop. covariance: $\text{cov}(x, y) = \frac{\sum xy^2 - \frac{\sum x \sum y}{n}}{n}$

pop. correlation: $\frac{\text{cov}(x,y)}{\sigma_x \times \sigma_y}$

Differentiation

extreme values:

- $f'(x) = 0$
- $f'(x)$ does not exist
- end points of the domain of f

parametric differentiaton: $\frac{d^2y}{dx^2} = \frac{d}{dx}(\frac{dy}{dx}) = \frac{\frac{d}{dt}(\frac{dy}{dx})}{\frac{dx}{dt}}$

L'Hospital's Rule

- for indeterminate forms ($\frac{0}{0}$ or $\frac{\infty}{\infty}$), cannot directly substitute $x = a$.
- for other forms: convert to ($\frac{0}{0}$ or $\frac{\infty}{\infty}$) then apply L'Hospital's rule
- for exponents: use $\ln$, then sub into $e^{f(x)}$

$\lim_{x \to x_0} \frac{f(x)}{g(x)} = \lim_{x \to x_0} \frac{f'(x)}{g'(x)}$

Rules of Limits

1. $\lim_{x \to a} (f \pm g)(x) = L \pm L'$
2. $\lim_{x \to a} (fg)(x) = LL'$
3. $\lim_{x \to a} \frac{f}{g}(x) = \frac{L}{L'}$, provided $L' \neq 0$
4. $\lim_{x \to a} kf(x) = kL$ for any real number k.

Integration

$\frac{d}{dx} \int_a^x f(t)dt = f(x)$

- **indefinite integral** — the integral of the function without any limits
- **antiderivative** — any function whose derivative will be the same as the original function

substitution: $\int_a^b f(g(x))g'(x)dx = \int_{g(a)}^{g(b)} f(u)du$

by parts: $\int uv' \, dx = uv - \int u'v \, dx$

revolution (x-axis), $V = \pi \int_a^b [f(x)]^2 - [g(x)]^2 dx$