
HOMEWORK DAY 15 – *Linear Approximations §2.9*

1. §2.9: 1

2. §2.9: 5

3. **Linear approximations of functions.** Show that for any real number k , $(1 + x)^k \approx 1 + kx$ for small x . Use that result to approximate $(1.02)^{0.7}$ and $(0.9)^{-0.3}$.

4. **Linear Extrapolation.** The Table in §2.7: # 27, shows the world population every 10 years since 1900.

(a) Use the last two entries to estimate the slope of the function $P(t)$ at $t = 110$ (year 2010).

(b) Use your result in (a) to find the linear approximation of $P(t)$ at $t = 110$ (year 2010).

(c) Use the linear approximation to estimate the population at $t = 120$ (year 2020).

(d) Go online and find the actual population in 2020 and compare with your estimate in (c). Is your estimate an underestimate or overestimate?

5. **Approximating measurement errors.** The circumference c of a sphere was measured to be 84 cm with a possible error of at most 0.5 cm (in absolute value). Approximate the maximum error using this measurement of c to compute

(a) the surface area of the sphere

(b) the volume of the sphere

6. **Approximating changes.** Approximate the amount of paint needed to apply a coat of paint 0.05cm thick to a hemispherical dome with diameter 50 m. Use linear approximations. Also compute the exact amount of paint needed and compare to the linear approximation.

7. **Approximating changes.** Approximate the volume of a thin cylindrical shell with height h , inner radius r , and thickness Δr . Use linear approximations. Also find the exact volume and compare.

HOMEWORK DAY 16 – *Maximum and Minimum Values §3.1*

8. §3.1: 5

9. (a) Give an example of a function that is bounded below on its domain but has no absolute minimum. Explain.

(b) Give an example of a function that is bounded above on its domain but has no absolute maximum. Explain.

10. Sketch the graph of the following functions and use your sketch to find absolute and local max/min values of f , if they exist.

(a) §3.1: 15

(b) §3.1: 17

(c) $f(t) = \cos(3\pi t)/2 + 1$

(d) §3.1: 27 (piecewise)

(e) $f(x) = \sqrt{r^2 - x^2}$

Hint: to graph it, first find the domain of f , then note that

$$y = \sqrt{r^2 - x^2} \iff y^2 = r^2 - x^2, y \geq 0 \iff x^2 + y^2 = r^2, y \geq 0.$$

11. Find the absolute maxima and minima of the following functions, clearly explaining your reasoning.
(Use the Closed Interval Method)

(a) $f(x) = 2x^3 - 3x^2 - 12x + 1$, $-2 \leq x \leq 3$

(b) $f(x) = x - 2 \cos x$, $0 \leq x \leq 2$

(c) $f(x) = x^2(x^2 - 1)$, $x \in [-1, 2]$

(d) $f(t) = \sqrt[3]{t}(8 - t)$, $t \in [0, 8]$.

HOMEWORK DAY 17 – *Mean Value Theorem (for derivatives) §3.2*

12. §3.2: 3

13. §3.2: 4

14. §3.2: 15

15. §3.2: 35