MATH140: Limits and Continuity

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Name: ______________________________ Date: _______________ Score: / 30

Learning Objectives

- Calculate the mean, median, mode, and range of a data set
- Compute sample variance and standard deviation
- Construct quartiles, the IQR, and identify outliers
- Describe the shape, center, and spread of a distribution

Simplify each expression completely. Show all steps and circle your final answer.

Limits by factoring

1. Evaluate: limit as x approaches 1 of [1(x^2 - 1^2) / (x - 1)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 1} \frac{1(x^2 - 1^2)}{x - 1}$$

Answer: ____

2. Evaluate: limit as x approaches 4 of [1(x^2 - 4^2) / (x - 4)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 4} \frac{1(x^2 - 4^2)}{x - 4}$$

Answer: ____

3. Evaluate: limit as x approaches 3 of [4(x^2 - 3^2) / (x - 3)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 3} \frac{4(x^2 - 3^2)}{x - 3}$$

Answer: ____

4. Evaluate: limit as x approaches 4 of [2(x^2 - 4^2) / (x - 4)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 4} \frac{2(x^2 - 4^2)}{x - 4}$$

Answer: ____

5. Evaluate: limit as x approaches 2 of [5(x^2 - 2^2) / (x - 2)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 2} \frac{5(x^2 - 2^2)}{x - 2}$$

Answer: ____

6. Evaluate: limit as x approaches 2 of [5(x^2 - 2^2) / (x - 2)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 2} \frac{5(x^2 - 2^2)}{x - 2}$$

Answer: ____

7. Evaluate: limit as x approaches 3 of [1(x^2 - 3^2) / (x - 3)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 3} \frac{1(x^2 - 3^2)}{x - 3}$$

Answer: ____

8. Evaluate: limit as x approaches 3 of [1(x^2 - 3^2) / (x - 3)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 3} \frac{1(x^2 - 3^2)}{x - 3}$$

Answer: ____

Limits by substitution

9. Evaluate the limit: limit as x approaches 1 of (1x^2 + -1x + -4).

$$\lim_{x \to 1} (1x^2 - 1x - 4)$$

Answer: ____

10. The demand function for a product is D(p) = -1p^2 + 11p + 99. Find the limit of demand as price approaches $1.

$$\lim_{x \to 1} (-1x^2 + 11x + 99)$$

Answer: ____

11. Evaluate: limit as x approaches -1 of (3x^2 + 0x + 5).

$$\lim_{x \to -1} (3x^2 + 0x + 5)$$

Answer: ____

12. Evaluate the limit: limit as x approaches 2 of (3x^2 + -4x + 5).

$$\lim_{x \to 2} (3x^2 - 4x + 5)$$

Answer: ____

13. The demand function for a product is D(p) = -1p^2 + 5p + 101. Find the limit of demand as price approaches $3.

$$\lim_{x \to 3} (-1x^2 + 5x + 101)$$

Answer: ____

14. Evaluate: limit as x approaches -3 of (1x^2 + -1x + 3).

$$\lim_{x \to -3} (1x^2 - 1x + 3)$$

Answer: ____

15. Evaluate the limit: limit as x approaches -1 of (2x^2 + 3x + -3).

$$\lim_{x \to -1} (2x^2 + 3x - 3)$$

Answer: ____

16. The demand function for a product is D(p) = -1p^2 + 3p + 95. Find the limit of demand as price approaches $4.

$$\lim_{x \to 4} (-1x^2 + 3x + 95)$$

Answer: ____

17. Evaluate: limit as x approaches 1 of (5x^2 + -3x + 4).

$$\lim_{x \to 1} (5x^2 - 3x + 4)$$

Answer: ____

18. Evaluate the limit: limit as x approaches 3 of (1x^2 + -2x + -4).

$$\lim_{x \to 3} (1x^2 - 2x - 4)$$

Answer: ____

19. The demand function for a product is D(p) = -2p^2 + 10p + 113. Find the limit of demand as price approaches $3.

$$\lim_{x \to 3} (-2x^2 + 10x + 113)$$

Answer: ____

20. Evaluate: limit as x approaches 1 of (1x^2 + -1x + 8).

$$\lim_{x \to 1} (1x^2 - 1x + 8)$$

Answer: ____

21. Evaluate the limit: limit as x approaches -2 of (2x^2 + -4x + 6).

$$\lim_{x \to -2} (2x^2 - 4x + 6)$$

Answer: ____

22. The demand function for a product is D(p) = -1p^2 + 7p + 103. Find the limit of demand as price approaches $2.

$$\lim_{x \to 2} (-1x^2 + 7x + 103)$$

Answer: ____

23. Evaluate: limit as x approaches -2 of (4x^2 + -4x + 7).

$$\lim_{x \to -2} (4x^2 - 4x + 7)$$

Answer: ____

24. Evaluate the limit: limit as x approaches 0 of (4x^2 + 2x + 1).

$$\lim_{x \to 0} (4x^2 + 2x + 1)$$

Answer: ____

25. The demand function for a product is D(p) = -1p^2 + 4p + 110. Find the limit of demand as price approaches $4.

$$\lim_{x \to 4} (-1x^2 + 4x + 110)$$

Answer: ____

26. Evaluate: limit as x approaches 1 of (4x^2 + -2x + -1).

$$\lim_{x \to 1} (4x^2 - 2x - 1)$$

Answer: ____

27. Evaluate the limit: limit as x approaches 1 of (1x^2 + -4x + 5).

$$\lim_{x \to 1} (1x^2 - 4x + 5)$$

Answer: ____

28. The demand function for a product is D(p) = -1p^2 + 11p + 44. Find the limit of demand as price approaches $2.

$$\lim_{x \to 2} (-1x^2 + 11x + 44)$$

Answer: ____

29. Evaluate: limit as x approaches -3 of (1x^2 + -5x + -5).

$$\lim_{x \to -3} (1x^2 - 5x - 5)$$

Answer: ____

30. Evaluate the limit: limit as x approaches 0 of (3x^2 + 3x + -8).

$$\lim_{x \to 0} (3x^2 + 3x - 8)$$

Answer: ____

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ANSWER KEY & SOLUTIONS

Topics: Limits by factoring, Limits by substitution. All answers verified by independent computation.

Solutions

Limits by factoring

1. Evaluate: limit as x approaches 1 of [1(x^2 - 1^2) / (x - 1)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 1} \frac{1(x^2 - 1^2)}{x - 1}$$

→ *Factor: 1(x-1)(x+1) / (x-1).*

→ *Cancel (x-1) and substitute x = 1: 1(2·1) = 2.*

Answer: $= (1)(x + 1)|_{x = 1} = 2$

2. Evaluate: limit as x approaches 4 of [1(x^2 - 4^2) / (x - 4)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 4} \frac{1(x^2 - 4^2)}{x - 4}$$

→ *Factor: 1(x-4)(x+4) / (x-4).*

→ *Cancel (x-4) and substitute x = 4: 1(2·4) = 8.*

Answer: $= (1)(x + 4)|_{x = 4} = 8$

3. Evaluate: limit as x approaches 3 of [4(x^2 - 3^2) / (x - 3)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 3} \frac{4(x^2 - 3^2)}{x - 3}$$

→ *Factor: 4(x-3)(x+3) / (x-3).*

→ *Cancel (x-3) and substitute x = 3: 4(2·3) = 24.*

Answer: $= (4)(x + 3)|_{x = 3} = 24$

4. Evaluate: limit as x approaches 4 of [2(x^2 - 4^2) / (x - 4)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 4} \frac{2(x^2 - 4^2)}{x - 4}$$

→ *Factor: 2(x-4)(x+4) / (x-4).*

→ *Cancel (x-4) and substitute x = 4: 2(2·4) = 16.*

Answer: $= (2)(x + 4)|_{x = 4} = 16$

5. Evaluate: limit as x approaches 2 of [5(x^2 - 2^2) / (x - 2)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 2} \frac{5(x^2 - 2^2)}{x - 2}$$

→ *Factor: 5(x-2)(x+2) / (x-2).*

→ *Cancel (x-2) and substitute x = 2: 5(2·2) = 20.*

Answer: $= (5)(x + 2)|_{x = 2} = 20$

6. Evaluate: limit as x approaches 2 of [5(x^2 - 2^2) / (x - 2)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 2} \frac{5(x^2 - 2^2)}{x - 2}$$

→ *Factor: 5(x-2)(x+2) / (x-2).*
→ *Cancel (x-2) and substitute x = 2: 5(2·2) = 20.*

Answer: $= (5)(x + 2)|_{x = 2} = 20$

7. Evaluate: limit as x approaches 3 of [1(x^2 - 3^2) / (x - 3)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 3} \frac{1(x^2 - 3^2)}{x - 3}$$

→ *Factor: 1(x-3)(x+3) / (x-3).*
→ *Cancel (x-3) and substitute x = 3: 1(2·3) = 6.*

Answer: $= (1)(x + 3)|_{x = 3} = 6$

8. Evaluate: limit as x approaches 3 of [1(x^2 - 3^2) / (x - 3)]. (0/0 indeterminate form — factor to resolve.)

$$\lim_{x \to 3} \frac{1(x^2 - 3^2)}{x - 3}$$

→ *Factor: 1(x-3)(x+3) / (x-3).*
→ *Cancel (x-3) and substitute x = 3: 1(2·3) = 6.*

Answer: $= (1)(x + 3)|_{x = 3} = 6$

Limits by substitution

9. Evaluate the limit: limit as x approaches 1 of (1x^2 + -1x + -4).

$$\lim_{x\to 1}(1x^2 - 1x - 4)$$

→ *Polynomial — direct substitution: plug in x = 1.*

→ *= 1(1)^2 + -1(1) + -4 = -4.*

Answer: $\lim_{x\to 1} = 1 + -1 + -4 = -4$

10. The demand function for a product is D(p) = -1p^2 + 11p + 99. Find the limit of demand as price approaches $1.

$$\lim_{x\to 1}(-1x^2 + 11x + 99)$$

→ *Substitute p = 1: -1(1)^2 + 11(1) + 99 = 109.*

→ *When price is $1, demand approaches 109 units.*

Answer: $\lim_{x\to 1} = -1 + 11 + 99 = 109$

11. Evaluate: limit as x approaches -1 of (3x^2 + 0x + 5).

$$\lim_{x\to -1}(3x^2 + 0x + 5)$$

→ *Direct substitution: x = -1.*

→ *= 3(-1)^2 + 0(-1) + 5 = 8.*

Answer: $\lim_{x\to -1} = 3 + 0 + 5 = 8$

12. Evaluate the limit: limit as x approaches 2 of (3x^2 + -4x + 5).

$$\lim_{x\to 2}(3x^2 - 4x + 5)$$

→ *Polynomial — direct substitution: plug in x = 2.*

→ *= 3(2)^2 + -4(2) + 5 = 9.*

Answer: $\lim_{x\to 2} = 12 + -8 + 5 = 9$

13. The demand function for a product is D(p) = -1p^2 + 5p + 101. Find the limit of demand as price approaches $3.

$$\lim_{x\to 3}(-1x^2 + 5x + 101)$$

→ *Substitute p = 3: -1(3)^2 + 5(3) + 101 = 107.*

→ *When price is $3, demand approaches 107 units.*

Answer: $\lim_{x\to 3} = -9 + 15 + 101 = 107$

14. Evaluate: limit as x approaches -3 of (1x^2 + -1x + 3).

$$\lim_{x \to -3} (1x^2 - 1x + 3)$$

→ *Direct substitution: x = -3.*
→ *= 1(-3)^2 + -1(-3) + 3 = 15.*

Answer: $\lim_{x \to -3} = 9 + 3 + 3 = 15$

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15. Evaluate the limit: limit as x approaches -1 of (2x^2 + 3x + -3).

$$\lim_{x \to -1} (2x^2 + 3x - 3)$$

→ *Polynomial — direct substitution: plug in x = -1.*
→ *= 2(-1)^2 + 3(-1) + -3 = -4.*

Answer: $\lim_{x \to -1} = 2 + -3 + -3 = -4$

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16. The demand function for a product is D(p) = -1p^2 + 3p + 95. Find the limit of demand as price approaches $4.

$$\lim_{x \to 4} (-1x^2 + 3x + 95)$$

→ *Substitute p = 4: -1(4)^2 + 3(4) + 95 = 91.*
→ *When price is $4, demand approaches 91 units.*

Answer: $\lim_{x \to 4} = -16 + 12 + 95 = 91$

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17. Evaluate: limit as x approaches 1 of (5x^2 + -3x + 4).

$$\lim_{x \to 1} (5x^2 - 3x + 4)$$

→ *Direct substitution: x = 1.*
→ *= 5(1)^2 + -3(1) + 4 = 6.*

Answer: $\lim_{x \to 1} = 5 + -3 + 4 = 6$

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18. Evaluate the limit: limit as x approaches 3 of (1x^2 + -2x + -4).

$$\lim_{x \to 3} (1x^2 - 2x - 4)$$

→ *Polynomial — direct substitution: plug in x = 3.*
→ *= 1(3)^2 + -2(3) + -4 = -1.*

Answer: $\lim_{x \to 3} = 9 + -6 + -4 = -1$

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19. The demand function for a product is D(p) = -2p^2 + 10p + 113. Find the limit of demand as price approaches $3.

$$\lim_{x \to 3} (-2x^2 + 10x + 113)$$

→ *Substitute p = 3: -2(3)^2 + 10(3) + 113 = 125.*
→ *When price is $3, demand approaches 125 units.*

Answer: $\lim_{x \to 3} = -18 + 30 + 113 = 125$

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20. Evaluate: limit as x approaches 1 of (1x^2 + -1x + 8).

$$\lim_{x \to 1} (1x^2 - 1x + 8)$$

→ *Direct substitution: x = 1.*

→ *= 1(1)^2 + -1(1) + 8 = 8.*

Answer: $\lim_{x \to 1} = 1 + -1 + 8 = 8$

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21. Evaluate the limit: limit as x approaches -2 of (2x^2 + -4x + 6).

$$\lim_{x \to -2} (2x^2 - 4x + 6)$$

→ *Polynomial — direct substitution: plug in x = -2.*

→ *= 2(-2)^2 + -4(-2) + 6 = 22.*

Answer: $\lim_{x \to -2} = 8 + 8 + 6 = 22$

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22. The demand function for a product is D(p) = -1p^2 + 7p + 103. Find the limit of demand as price approaches $2.

$$\lim_{x \to 2} (-1x^2 + 7x + 103)$$

→ *Substitute p = 2: -1(2)^2 + 7(2) + 103 = 113.*

→ *When price is $2, demand approaches 113 units.*

Answer: $\lim_{x \to 2} = -4 + 14 + 103 = 113$

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23. Evaluate: limit as x approaches -2 of (4x^2 + -4x + 7).

$$\lim_{x \to -2} (4x^2 - 4x + 7)$$

→ *Direct substitution: x = -2.*

→ *= 4(-2)^2 + -4(-2) + 7 = 31.*

Answer: $\lim_{x \to -2} = 16 + 8 + 7 = 31$

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24. Evaluate the limit: limit as x approaches 0 of (4x^2 + 2x + 1).

$$\lim_{x \to 0} (4x^2 + 2x + 1)$$

→ *Polynomial — direct substitution: plug in x = 0.*

→ *= 4(0)^2 + 2(0) + 1 = 1.*

Answer: $\lim_{x \to 0} = 0 + 0 + 1 = 1$

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25. The demand function for a product is D(p) = -1p^2 + 4p + 110. Find the limit of demand as price approaches $4.

$$\lim_{x \to 4} (-1x^2 + 4x + 110)$$

→ *Substitute p = 4: -1(4)^2 + 4(4) + 110 = 110.*
→ *When price is $4, demand approaches 110 units.*

Answer: $\lim_{x \to 4} = -16 + 16 + 110 = 110$

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26. Evaluate: limit as x approaches 1 of (4x^2 + -2x + -1).

$$\lim_{x \to 1} (4x^2 - 2x - 1)$$

→ *Direct substitution: x = 1.*
→ *= 4(1)^2 + -2(1) + -1 = 1.*

Answer: $\lim_{x \to 1} = 4 + -2 + -1 = 1$

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27. Evaluate the limit: limit as x approaches 1 of (1x^2 + -4x + 5).

$$\lim_{x \to 1} (1x^2 - 4x + 5)$$

→ *Polynomial — direct substitution: plug in x = 1.*
→ *= 1(1)^2 + -4(1) + 5 = 2.*

Answer: $\lim_{x \to 1} = 1 + -4 + 5 = 2$

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28. The demand function for a product is D(p) = -1p^2 + 11p + 44. Find the limit of demand as price approaches $2.

$$\lim_{x \to 2} (-1x^2 + 11x + 44)$$

→ *Substitute p = 2: -1(2)^2 + 11(2) + 44 = 62.*
→ *When price is $2, demand approaches 62 units.*

Answer: $\lim_{x \to 2} = -4 + 22 + 44 = 62$

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29. Evaluate: limit as x approaches -3 of (1x^2 + -5x + -5).

$$\lim_{x \to -3} (1x^2 - 5x - 5)$$

→ *Direct substitution: x = -3.*
→ *= 1(-3)^2 + -5(-3) + -5 = 19.*

Answer: $\lim_{x \to -3} = 9 + 15 + -5 = 19$

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30. Evaluate the limit: limit as x approaches 0 of (3x^2 + 3x + -8).

$$\lim_{x \to 0} (3x^2 + 3x - 8)$$

→ *Polynomial — direct substitution: plug in x = 0.*
→ *= 3(0)^2 + 3(0) + -8 = -8.*

Answer: $\lim_{x \to 0} = 0 + 0 + -8 = -8$