MATH230: Vectors in 3D

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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.

Dot product

1. Find the dot product u · v, where u = (-3, -4, 0) and v = (-1, -1, -2).

$$(-3, -4, 0) \cdot (-1, -1, -2)$$

Answer: _____

2. Force vector F = (1, 3, 6) N acts on a displacement d = (2, 4, 3) m. Compute the work W = F · d.

$$(1, 3, 6) \cdot (2, 4, 3)$$

Answer: _____

3. Compute the dot product: (0, 1, 1) · (2, 3, -3). Are these vectors orthogonal?

$$(0, 1, 1) \cdot (2, 3, -3)$$

Answer: _____

4. Find the dot product u · v, where u = (-3, 2, -4) and v = (-1, 4, -2).

$$(-3, 2, -4) \cdot (-1, 4, -2)$$

Answer: _____

5. Force vector F = (3, 1, 4) N acts on a displacement d = (5, 4, 5) m. Compute the work W = F · d.

$$(3, 1, 4) \cdot (5, 4, 5)$$

Answer: _____

6. Compute the dot product: (1, -1, -2) · (1, 2, 1). Are these vectors orthogonal?

$$(1, -1, -2) \cdot (1, 2, 1)$$

Answer: _____

7. Find the dot product u · v, where u = (3, 0, 1) and v = (-1, 3, 1).

$$(3, 0, 1) \cdot (-1, 3, 1)$$

Answer: _____

8. Force vector F = (2, 5, 5) N acts on a displacement d = (2, 2, 2) m. Compute the work W = F · d.

$$(2, 5, 5) \cdot (2, 2, 2)$$

Answer: _____

9. Compute the dot product: (-1, -3, 2) · (1, 0, 3). Are these vectors orthogonal?

$$(-1, -3, 2) \cdot (1, 0, 3)$$

Answer: _____

10. Find the dot product u · v, where u = (-2, 3, 4) and v = (0, 3, 3).

$$(-2, 3, 4) \cdot (0, 3, 3)$$

Answer: _____

11. Force vector F = (1, 2, 2) N acts on a displacement d = (3, 1, 2) m. Compute the work W = F · d.

$$(1, 2, 2) \cdot (3, 1, 2)$$

Answer: _____

12. Compute the dot product: (3, 1, -3) · (0, 2, 1). Are these vectors orthogonal?

$$(3, 1, -3) \cdot (0, 2, 1)$$

Answer: _____

13. Find the dot product u · v, where u = (-1, -1, -1) and v = (-4, -1, 3).

$$(-1, -1, -1) \cdot (-4, -1, 3)$$

Answer: _____

14. Force vector F = (2, 1, 6) N acts on a displacement d = (4, 1, 2) m. Compute the work W = F · d.

$$(2, 1, 6) \cdot (4, 1, 2)$$

Answer: _____

15. Compute the dot product: (-1, -1, 1) · (-2, -1, -2). Are these vectors orthogonal?

$$(-1, -1, 1) \cdot (-2, -1, -2)$$

Answer: _____

16. Find the dot product u · v, where u = (-2, -3, -1) and v = (3, 0, 1).

$$(-2, -3, -1) \cdot (3, 0, 1)$$

Answer: _____

17. Force vector F = (4, 4, 3) N acts on a displacement d = (3, 4, 1) m. Compute the work W = F · d.

$$(4, 4, 3) \cdot (3, 4, 1)$$

Answer: _____

18. Compute the dot product: (0, -3, 2) · (1, 0, 1). Are these vectors orthogonal?

$$(0, -3, 2) \cdot (1, 0, 1)$$

Answer: _____

19. Find the dot product u · v, where u = (-3, 0, 2) and v = (-1, 3, 0).

$$(-3, 0, 2) \cdot (-1, 3, 0)$$

Answer: _____

20. Force vector F = (1, 1, 4) N acts on a displacement d = (4, 4, 3) m. Compute the work W = F · d.

$$(1, 1, 4) \cdot (4, 4, 3)$$

Answer: _____

21. Compute the dot product: (2, 0, 2) · (2, 3, 1). Are these vectors orthogonal?

$$(2, 0, 2) \cdot (2, 3, 1)$$

Answer: _____

22. Find the dot product u · v, where u = (-3, 0, 3) and v = (3, -2, 1).

$$(-3, 0, 3) \cdot (3, -2, 1)$$

Answer: _____

23. Force vector F = (3, 5, 5) N acts on a displacement d = (1, 3, 2) m. Compute the work W = F · d.

$$(3, 5, 5) \cdot (1, 3, 2)$$

Answer: _____

Vector magnitude

24. Find the magnitude of vector v = (2, 3, 3).

$$|(2, 3, 3)|$$

Answer: _____

25. Find the magnitude of vector v = (0, 2, 3).

$$|(0, 2, 3)|$$

Answer: _____

26. Find the magnitude of vector v = (4, 1, 3).

$$|(4, 1, 3)|$$

Answer: _____

27. Find the magnitude of vector v = (0, 2, 0).

$$|(0, 2, 0)|$$

Answer: _____

28. Find the magnitude of vector v = (3, 1, 1).

$$|(3, 1, 1)|$$

Answer: _____

29. Find the magnitude of vector v = (3, 2, 2).

$$|(3, 2, 2)|$$

Answer: _____

30. Find the magnitude of vector v = (0, 0, 1).

$$|(0, 0, 1)|$$

Answer: _____

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ANSWER KEY & SOLUTIONS

Topics: Vector magnitude, Dot product. All answers verified by independent computation.

Solutions

Dot product

1. Find the dot product u · v, where u = (-3, -4, 0) and v = (-1, -1, -2).

$$(-3,\ -4, 0) \cdot (-1,\ -1,\ -2)$$

→ *u·v = a1b1 + a2b2 + a3b3.*
→ *= (-3)(-1) + (-4)(-1) + (0)(-2) = 7.*

Answer: $= 7$

2. Force vector F = (1, 3, 6) N acts on a displacement d = (2, 4, 3) m. Compute the work W = F · d.

$$(1, 3, 6) \cdot (2, 4, 3)$$

→ *W = F · d = (1)(2) + (3)(4) + (6)(3) = 32 J.*

Answer: $= 32$

3. Compute the dot product: (0, 1, 1) · (2, 3, -3). Are these vectors orthogonal?

$$(0, 1, 1) \cdot (2, 3,\ -3)$$

→ *Dot product = (0)(2) + (1)(3) + (1)(-3) = 0.*
→ *If dot product = 0 the vectors are orthogonal; otherwise they are not.*

Answer: $= 0$

4. Find the dot product u · v, where u = (-3, 2, -4) and v = (-1, 4, -2).

$$(-3, 2,\ -4) \cdot (-1, 4,\ -2)$$

→ *u·v = a1b1 + a2b2 + a3b3.*
→ *= (-3)(-1) + (2)(4) + (-4)(-2) = 19.*

Answer: $= 19$

5. Force vector F = (3, 1, 4) N acts on a displacement d = (5, 4, 5) m. Compute the work W = F · d.

$$(3, 1, 4) \cdot (5, 4, 5)$$

→ *W = F · d = (3)(5) + (1)(4) + (4)(5) = 39 J.*

Answer: $= 39$

6. Compute the dot product: (1, -1, -2) · (1, 2, 1). Are these vectors orthogonal?

$$(1,\ -1,\ -2) \cdot (1, 2, 1)$$

→ *Dot product = (1)(1) + (-1)(2) + (-2)(1) = -3.*
→ *If dot product = 0 the vectors are orthogonal; otherwise they are not.*

Answer: $= -3$

7. Find the dot product u · v, where u = (3, 0, 1) and v = (-1, 3, 1).

$$(3, 0, 1) \cdot (-1, 3, 1)$$

→ *u·v = a1b1 + a2b2 + a3b3.*
→ *= (3)(-1) + (0)(3) + (1)(1) = -2.*

Answer: $= -2$

8. Force vector F = (2, 5, 5) N acts on a displacement d = (2, 2, 2) m. Compute the work W = F · d.

$$(2, 5, 5) \cdot (2, 2, 2)$$

→ *W = F · d = (2)(2) + (5)(2) + (5)(2) = 24 J.*

Answer: $= 24$

---

9. Compute the dot product: (-1, -3, 2) · (1, 0, 3). Are these vectors orthogonal?

$$(-1, -3, 2) \cdot (1, 0, 3)$$

→ *Dot product = (-1)(1) + (-3)(0) + (2)(3) = 5.*
→ *If dot product = 0 the vectors are orthogonal; otherwise they are not.*

Answer: $= 5$

---

10. Find the dot product u · v, where u = (-2, 3, 4) and v = (0, 3, 3).

$$(-2, 3, 4) \cdot (0, 3, 3)$$

→ *u·v = a1b1 + a2b2 + a3b3.*
→ *= (-2)(0) + (3)(3) + (4)(3) = 21.*

Answer: $= 21$

---

11. Force vector F = (1, 2, 2) N acts on a displacement d = (3, 1, 2) m. Compute the work W = F · d.

$$(1, 2, 2) \cdot (3, 1, 2)$$

→ *W = F · d = (1)(3) + (2)(1) + (2)(2) = 9 J.*

Answer: $= 9$

---

12. Compute the dot product: (3, 1, -3) · (0, 2, 1). Are these vectors orthogonal?

$$(3, 1, -3) \cdot (0, 2, 1)$$

→ *Dot product = (3)(0) + (1)(2) + (-3)(1) = -1.*
→ *If dot product = 0 the vectors are orthogonal; otherwise they are not.*

Answer: $= -1$

---

13. Find the dot product u · v, where u = (-1, -1, -1) and v = (-4, -1, 3).

$$(-1, -1, -1) \cdot (-4, -1, 3)$$

→ *u·v = a1b1 + a2b2 + a3b3.*
→ *= (-1)(-4) + (-1)(-1) + (-1)(3) = 2.*

Answer: $= 2$

---

14. Force vector F = (2, 1, 6) N acts on a displacement d = (4, 1, 2) m. Compute the work W = F · d.

$$(2, 1, 6) \cdot (4, 1, 2)$$

→ *W = F · d = (2)(4) + (1)(1) + (6)(2) = 21 J.*

Answer: $= 21$

---

15. Compute the dot product: (-1, -1, 1) · (-2, -1, -2). Are these vectors orthogonal?

$$(-1,\ -1, 1)\cdot(-2,\ -1,\ -2)$$

→ *Dot product = (-1)(-2) + (-1)(-1) + (1)(-2) = 1.*
→ *If dot product = 0 the vectors are orthogonal; otherwise they are not.*

Answer: $= 1$

16. Find the dot product u · v, where u = (-2, -3, -1) and v = (3, 0, 1).

$$(-2,\ -3,\ -1)\cdot(3, 0, 1)$$

→ *u·v = a1b1 + a2b2 + a3b3.*
→ *= (-2)(3) + (-3)(0) + (-1)(1) = -7.*

Answer: $= -7$

17. Force vector F = (4, 4, 3) N acts on a displacement d = (3, 4, 1) m. Compute the work W = F · d.

$$(4, 4, 3)\cdot(3, 4, 1)$$

→ *W = F · d = (4)(3) + (4)(4) + (3)(1) = 31 J.*

Answer: $= 31$

18. Compute the dot product: (0, -3, 2) · (1, 0, 1). Are these vectors orthogonal?

$$(0,\ -3, 2)\cdot(1, 0, 1)$$

→ *Dot product = (0)(1) + (-3)(0) + (2)(1) = 2.*
→ *If dot product = 0 the vectors are orthogonal; otherwise they are not.*

Answer: $= 2$

19. Find the dot product u · v, where u = (-3, 0, 2) and v = (-1, 3, 0).

$$(-3, 0, 2)\cdot(-1, 3, 0)$$

→ *u·v = a1b1 + a2b2 + a3b3.*
→ *= (-3)(-1) + (0)(3) + (2)(0) = 3.*

Answer: $= 3$

20. Force vector F = (1, 1, 4) N acts on a displacement d = (4, 4, 3) m. Compute the work W = F · d.

$$(1, 1, 4)\cdot(4, 4, 3)$$

→ *W = F · d = (1)(4) + (1)(4) + (4)(3) = 20 J.*

Answer: $= 20$

21. Compute the dot product: (2, 0, 2) · (2, 3, 1). Are these vectors orthogonal?

$$(2, 0, 2)\cdot(2, 3, 1)$$

→ *Dot product = (2)(2) + (0)(3) + (2)(1) = 6.*
→ *If dot product = 0 the vectors are orthogonal; otherwise they are not.*

Answer: $= 6$

22. Find the dot product u · v, where u = (-3, 0, 3) and v = (3, -2, 1).

$$(-3, 0, 3) \cdot (3, -2, 1)$$

→ *u·v = a1b1 + a2b2 + a3b3.*
→ *= (-3)(3) + (0)(-2) + (3)(1) = -6.*

Answer: $= -6$

---

23. Force vector F = (3, 5, 5) N acts on a displacement d = (1, 3, 2) m. Compute the work W = F · d.

$$(3, 5, 5) \cdot (1, 3, 2)$$

→ *W = F · d = (3)(1) + (5)(3) + (5)(2) = 28 J.*

Answer: $= 28$

Vector magnitude

24. Find the magnitude of vector v = (2, 3, 3).

$|(2, 3, 3)|$

→ *Formula: |v| = sqrt(a^2 + b^2 + c^2).*
→ *= sqrt(2^2 + 3^2 + 3^2) = sqrt(22) = None.*

Answer: $= \sqrt{22} = None$

25. Find the magnitude of vector v = (0, 2, 3).

$|(0, 2, 3)|$

→ *Formula: |v| = sqrt(a^2 + b^2 + c^2).*
→ *= sqrt(0^2 + 2^2 + 3^2) = sqrt(13) = None.*

Answer: $= \sqrt{13} = None$

26. Find the magnitude of vector v = (4, 1, 3).

$|(4, 1, 3)|$

→ *Formula: |v| = sqrt(a^2 + b^2 + c^2).*
→ *= sqrt(4^2 + 1^2 + 3^2) = sqrt(26) = None.*

Answer: $= \sqrt{26} = None$

27. Find the magnitude of vector v = (0, 2, 0).

$|(0, 2, 0)|$

→ *Formula: |v| = sqrt(a^2 + b^2 + c^2).*
→ *= sqrt(0^2 + 2^2 + 0^2) = sqrt(4) = 2.*

Answer: $= \sqrt{4} = 2$

28. Find the magnitude of vector v = (3, 1, 1).

$|(3, 1, 1)|$

→ *Formula: |v| = sqrt(a^2 + b^2 + c^2).*
→ *= sqrt(3^2 + 1^2 + 1^2) = sqrt(11) = None.*

Answer: $= \sqrt{11} = None$

29. Find the magnitude of vector v = (3, 2, 2).

$|(3, 2, 2)|$

→ *Formula: |v| = sqrt(a^2 + b^2 + c^2).*
→ *= sqrt(3^2 + 2^2 + 2^2) = sqrt(17) = None.*

Answer: $= \sqrt{17} = None$

30. Find the magnitude of vector v = (0, 0, 1).

$|(0, 0, 1)|$

→ *Formula: |v| = sqrt(a^2 + b^2 + c^2).*
→ *= sqrt(0^2 + 0^2 + 1^2) = sqrt(1) = 1.*

Answer: $= \sqrt{1} = 1$