Probability & Conditional Probability

AP Statistics Worksheet · Grade 11–12

Name: _____ Date: _____

Learning Objectives

- Calculate simple (marginal) probabilities from two-way frequency tables
- Calculate conditional probabilities using the definition P(A|B) = P(A∩B) / P(B)
- Determine whether two events are independent by comparing P(A) and P(A|B)

Problems

1. A survey of 300 students asked about their grade level and whether they own a pet. Use the table below to find the probability that a randomly selected student is in 10th grade.

Grade	Has Pet	No Pet	Total
9th	42	58	100
10th	54	66	120
11th	32	48	80
Total	128	172	300

2. Using the same student survey table from Problem 1, find the probability that a randomly selected student owns a pet.

Grade	Has Pet	No Pet	Total
9th	42	58	100
10th	54	66	120
11th	32	48	80
Total	128	172	300

3. A company surveyed 500 employees about their department and whether they exercise regularly. Use the table to find the probability that a randomly selected employee works in the Marketing department.

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Department	Exercises	Does Not Exercise	Total
Marketing	78	72	150
Engineering	110	90	200
Sales	55	95	150
Total	243	257	500

4. Using the employee survey table from Problem 3, find the conditional probability that a randomly selected employee exercises regularly, given that the employee works in the Engineering department.

Department	Exercises	Does Not Exercise	Total
Marketing	78	72	150
Engineering	110	90	200
Sales	55	95	150
Total	243	257	500

5. Using the employee table from Problem 3, find the conditional probability that a randomly selected employee works in Sales, given that the employee does NOT exercise regularly.

Department	Exercises	Does Not Exercise	Total
Marketing	78	72	150
Engineering	110	90	200
Sales	55	95	150
Total	243	257	500

6. A survey of 400 adults recorded their age group and preferred social media platform. Use the table to find both P(Instagram) and P(Instagram | Age 18-29). Then decide whether age group and platform preference are independent.

Age Group	Instagram	Facebook	Neither	Total
18–29	90	30	20	140

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Age Group	Instagram	Facebook	Neither	Total
30–49	50	80	30	160
50+	10	70	20	100
Total	150	180	70	400

7. The two-way table below shows data for 250 high school athletes. Some values are missing. Fill in the missing values, then find the probability that a randomly selected athlete plays football given that the athlete is male.

Sport	Male	Female	Total
Football	70	0	70
Basketball	45	35	80
Soccer	30	70	100
Total			250

8. A researcher surveys 320 adults about sleep habits and health rating. Use the table to (a) find P(Good Health), (b) find P(Good Health | Sleeps 8+ hours), and (c) determine whether sleeping 8 or more hours and being in good health are independent events. Justify your answer.

Sleep	Good Health	Poor Health	Total
Less than 8 hrs	60	100	160
8 or more hrs	96	64	160
Total	156	164	320

9. A college records the major and scholarship status of 480 students. Using the table, find (a) P(Scholarship), (b) P(Science Major | Scholarship), and (c) P(Science Major). Then use your answers to determine whether having a scholarship and majoring in Science are independent events.

Major	Scholarship	No Scholarship	Total
Science	72	48	120

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Major	Scholarship	No Scholarship	Total
Humanities	60	100	160
Business	48	152	200
Total	180	300	480

10. A study tracks 600 adults by exercise frequency and whether they developed cardiovascular disease (CVD) over 10 years. Using the table, (a) find P(CVD), (b) find P(CVD | Exercises Regularly), (c) find P(CVD | Never Exercises), and (d) write a complete statistical conclusion about whether exercise frequency and CVD risk are independent, citing all probability values calculated.

Exercise Frequency	Developed CVD	No CVD	Total
Exercises Regularly	18	162	180
Exercises Sometimes	36	144	180
Never Exercises	66	174	240
Total	120	480	600

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Probability & Conditional Probability — Answer Key

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Answer Key

1. Answer: P(10th grade) = 120/300 = 0.40

- Identify the total number of 10th grade students: 120
- Identify the overall sample size: 300
- P(10th grade) = 120 / 300 = 0.40 (or 40%)

2. Answer: P(Has Pet) = 128/300 ≈ 0.4267

- Identify the total number of students who own a pet: 128
- Identify the overall sample size: 300
- P(Has Pet) = 128 / 300 ≈ 0.4267 (about 42.67%)

3. Answer: P(Marketing) = 150/500 = 0.30

- Identify the total number of Marketing employees: 150
- Identify the overall sample size: 500
- P(Marketing) = 150 / 500 = 0.30 (or 30%)

4. Answer: P(Exercises | Engineering) = 110/200 = 0.55

- The condition restricts us to Engineering employees only: 200 total
- Among Engineering employees, 110 exercise regularly
- P(Exercises | Engineering) = 110 / 200 = 0.55 (or 55%)

5. Answer: P(Sales | Does Not Exercise) = 95/257 ≈ 0.3697

- The condition restricts us to employees who do NOT exercise: 257 total
- Among non-exercisers, 95 work in Sales
- P(Sales | Does Not Exercise) = 95 / 257 ≈ 0.3697 (about 37%)

6. Answer: P(Instagram) = 150/400 = 0.375; P(Instagram | 18–29) = 90/140 ≈ 0.6429. Not independent because 0.375 ≠ 0.6429.

- P(Instagram) = 150 / 400 = 0.375
- P(Instagram | Age 18–29): restrict to 140 adults aged 18–29; 90 prefer Instagram
- P(Instagram | Age 18–29) = 90 / 140 ≈ 0.6429
- Since P(Instagram) ≠ P(Instagram | Age 18–29), the events are NOT independent
- Conclusion: Age group and platform preference are dependent

7. Answer: Male Total = 145, Female Total = 105; P(Football | Male) = 70/145 ≈ 0.4828

- Male total = 70 + 45 + 30 = 145
- Female total = 0 + 35 + 70 = 105

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- Verify: 145 + 105 = 250 ✓
- P(Football | Male) = 70 / 145 ≈ 0.4828 (about 48.28%)

8. Answer: P(Good Health) = 156/320 = 0.4875; P(Good Health | 8+ hrs) = 96/160 = 0.60. Not independent since 0.4875 ≠ 0.60.

- (a) P(Good Health) = 156 / 320 = 0.4875
- (b) P(Good Health | Sleeps 8+ hrs): restrict to 160 adults sleeping 8+ hrs; 96 are in good health
- P(Good Health | 8+ hrs) = 96 / 160 = 0.60
- (c) Since P(Good Health) = 0.4875 ≠ P(Good Health | 8+ hrs) = 0.60, the events are NOT independent
- Conclusion: Sleeping 8 or more hours and being in good health are dependent — getting more sleep is associated with better health

9. Answer: P(Scholarship) = 180/480 = 0.375; P(Science | Scholarship) = 72/180 = 0.40; P(Science) = 120/480 = 0.25. Not independent since 0.40 ≠ 0.25.

- (a) P(Scholarship) = 180 / 480 = 0.375
- (b) P(Science | Scholarship): restrict to 180 scholarship students; 72 are Science majors
- P(Science | Scholarship) = 72 / 180 = 0.40
- (c) P(Science) = 120 / 480 = 0.25
- Since P(Science) = 0.25 ≠ P(Science | Scholarship) = 0.40, the events are NOT independent
- Conclusion: Having a scholarship and majoring in Science are dependent events

10. Answer: P(CVD) = 120/600 = 0.20; P(CVD | Regular) = 18/180 = 0.10; P(CVD | Never) = 66/240 = 0.275. Events are NOT independent — exercise frequency is associated with CVD risk.

- (a) P(CVD) = 120 / 600 = 0.20
- (b) P(CVD | Exercises Regularly): restrict to 180 regular exercisers; 18 developed CVD
- P(CVD | Regular) = 18 / 180 = 0.10
- (c) P(CVD | Never Exercises): restrict to 240 non-exercisers; 66 developed CVD
- P(CVD | Never Exercises) = 66 / 240 = 0.275
- (d) For independence we would need P(CVD) = P(CVD | Regular) = P(CVD | Never Exercises)
- 0.20 ≠ 0.10 ≠ 0.275, so the events are NOT independent
- Conclusion: Exercise frequency and CVD risk are statistically dependent. Regular exercisers show a much lower CVD rate (10%) compared to the overall rate (20%) and non-exercisers (27.5%), suggesting that exercise is associated with reduced cardiovascular disease risk.

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