Probability Tables

- While it is unlikely to work with invalid probability tables, it is important to know what makes them valid. Thus, the rules for a valid probability table are:
  1. ○ Each of the probabilities are between 0 and 1
  2. ○ The sum of all probabilities is equal to 1

Practice

1. For each of the following tables, determine whether or not it is a valid probability distribution table and what rules it breaks if it is invalid. (Hint: remember the rules for probability distribution tables.)

Table A:

X	2	4	6	8	10	12
Prob.	0.09	0.45	0.2	0.06	0.11	0.21

① ✓
② ✗

$\sum \text{Prob.} = 0.09 + 0.45 + \ldots + 0.21 = 1.12$

Invalid

Table B:

X	0.25	0.5	0.75	1
Prob.	0.07	.51	0.32	0.1

① ✓
② ✓

$\sum \text{Prob.} = 0.07 + 0.51 + 0.32 + 0.1 = 1$

Valid

Table C:

X	0.5	1	1.5	2	2.5	3	3.5	4
Prob.	1.09	2.3	0.9	0.71	1.5	0.89	1.35	1.26

① ✗
~~②~~

Invalid

Table D:

X	5	10	15
Prob.	0.35	0.61	0.04

① ✓
② ✓

$\sum \text{Prob.} = 0.35 + 0.61 + 0.04 = 1$

Valid

2. A group of friends are playing a betting game based off of the sum of rolling three-sided dice with a two-sided dice. Barabra wants to know the probabilities of each sum so she can bet with less risk. Create a probability table, then answer the questions below.

X	1	2	3
1	2	3	4
2	3	4	5

$\rightarrow X = 2, 3, 4, 5 \rightarrow$

X	2	3	4	5
P	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{2}{6}$	$\frac{1}{6}$

(A) What is the probability of more than 2 but at most 4?

$$\underbrace{P(2 < X \leq 4)}_{\text{wants } 3 \,\&\, 4} = P(3) + P(4) = \frac{2}{6} + \frac{2}{6} = \frac{4}{6} = \frac{2}{3}$$

(B) What is the probability of at least 3?

$$\underbrace{P(X \geq 3)}_{\text{wants } 3,4,\,\&\, 5} = 1 - P(X=2) = 1 - \frac{1}{6} \rightarrow \frac{6}{6} - \frac{1}{6} = \frac{5}{6}$$

→ could also add P(3), P(4), & P(5)

(C) What is the probability of less than 5?

$$\underbrace{P(X < 5)}_{\text{wants } 2,3,\,\&\, 4} = P(2) + P(3) + P(4) = \frac{1}{6} + \frac{2}{6} + \frac{2}{6} = \frac{5}{6}$$

→ could also $1 - P(X=5)$

(D) Find the mean, variance, and standard deviation of the probability table.

$$\mu = \sum(x_i \cdot p_i) = \left(2 \cdot \frac{1}{6}\right) + \left(3 \cdot \frac{2}{6}\right) + \left(4 \cdot \frac{2}{6}\right) + \left(5 + \frac{1}{6}\right) = 3.5$$

$$\sigma^2 = \sum(x_i^2 \cdot p_i) - \mu^2 = \left[\left(2^2 \cdot \frac{1}{6}\right) + \ldots + \left(5^2 \cdot \frac{1}{6}\right)\right] - 3.5^2 = 0.92$$

$$\sigma = \sqrt{\sigma^2} = \sqrt{0.92} = 0.96$$

3. Find the missing value of the table below, then answer the questions below.

X	1	2	3	4	5	6	7
Prob.	0.21	0.08	0.05	0.33	?	0.03	0.16

$$P(5) = 1 = (P_{1-4} + P_{6-7}) = 1 - [(0.21 + 0.08 + 0.05 + 0.33) + (0.03 + 0.16)] = 0.14$$

(A) What is the probability of at most 2 or more than 5?

$\underbrace{P(X \le 2 \overset{+}{\text{or}} X > 5)}_{\text{wants } 1,2,6,\&7} = \underset{0.21}{\cancel{P(1)}} + \underset{0.08}{\cancel{P(2)}} + \underset{0.03}{\cancel{P(6)}} + \underset{0.16}{\cancel{P(7)}} = 0.48$

(B) What is the probability of more than 3?

$\underbrace{P(X > 3)}_{\text{wants } 4-7} = 1 - (X \le 3) = 1 - (\underset{0.21}{\cancel{P(1)}} + \underset{0.08}{\cancel{P(2)}} + \underset{0.05}{\cancel{P(3)}}) = 0.66$

wants 4–7 → could also add 4, 5, 6, & 7

(C) What is the probability of 7?

$P(X=7) = 0.16$

(D) Find the mean, variance, and standard deviation of the probability table.

Enter X into L_1 & Prob. into L_2

↓

1-Var Stat on L_1 with frequency at L_2

↓

$\mu = \Sigma x = 3.84$ & $\sigma = \sigma x = 1.98$

$\sigma^2 = (\sigma)^2 = (1.98)^2 = 3.92$