Relative Frequency Approach in Probability

Data Science and A.I. Lecture Series

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Relative Frequencies and Probabilities

So, in general, if X is a variable having the values $x_1, x_2, \ldots, x_n$ with frequencies $f_1, f_2, \ldots, f_n$, respectively, then:

$$\frac{f_1}{\sum f_i}, \frac{f_2}{\sum f_i}, \ldots, \frac{f_n}{\sum f_i}$$

are the relative frequencies of $x_1, x_2, \ldots, x_n$, respectively, and hence the probabilities of X taking the values $x_1, x_2, \ldots, x_n$.

Example 1: Age of Couples

Table: Age Distribution of 100 Couples

Age of Husband	**15-25**	**25-35**	**35-45**	**45-55**
Age of Wife				
10-20	6	3	0	0
20-30	3	16	10	0
30-40	0	10	15	7
40-50	0	0	7	10
50-60	0	0	4	5

- Probability of wife's age $20 - 50$:

$$P = \frac{3 + 16 + 10 + 0 + 0 + 0 + 10 + 15 + 7 + 0}{100} = 0.82$$

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Age of Wife				
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30-40	0	10	15	7
40-50	0	0	7	10
50-60	0	0	4	5

- Probability of wife's age $20 - 50$:

$$P = \frac{3 + 16 + 10 + 0 + 0 + 0 + 10 + 15 + 7 + 0}{100} = 0.82$$

- Probability of wife's age $20 - 40$ and husband's age $35 - 45$:

$$P = \frac{10 + 15}{100} = 0.25$$

Example 2: Student Ages

Table: Age Distribution of 15 Students

Age (Years)	**Frequency (f)**	**Relative Frequency ($\frac{f}{15}$)**
14	2	$\frac{2}{15}$
15	1	$\frac{1}{15}$
16	2	$\frac{2}{15}$
17	3	$\frac{3}{15}$
18	1	$\frac{1}{15}$
19	2	$\frac{2}{15}$
20	3	$\frac{3}{15}$
21	1	$\frac{1}{15}$

- Probability of age divisible by 3 $(15, 18, 21)$:

$$P = \frac{1+1+1}{15} = 0.2$$

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- Probability of age divisible by 3 $(15, 18, 21)$:

$$P = \frac{1+1+1}{15} = 0.2$$

- Probability of age > 16 $(17, 18, 19, 20, 21)$:

$$P = \frac{3+1+2+3+1}{15} = 0.6667$$

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14	2	$\frac{2}{15}$
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- Probability of age divisible by 3 $(15, 18, 21)$:
$$P = \frac{1+1+1}{15} = 0.2$$
- Probability of age > 16 $(17, 18, 19, 20, 21)$:
$$P = \frac{3+1+2+3+1}{15} = 0.6667$$
- Probability of age ≥ 18:
$$P = \frac{1+2+3+1}{15} = 0.4667$$

Example 3: Tyre Durability

Table: Distance Covered by Tyres (2000 Cases)

Distance (km)	**Frequency (f)**	**Relative Frequency ($\frac{f}{2000}$)**
Less than 4000	20	$\frac{20}{2000}$
4001-10000	100	$\frac{100}{2000}$
10001-20000	200	$\frac{200}{2000}$
20001-40000	1500	$\frac{1500}{2000}$
More than 40000	180	$\frac{180}{2000}$

- Probability of ≥ 4001 km:

$$P = \frac{100 + 200 + 1500 + 180}{2000} = 0.99$$

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More than 40000	180	$\frac{180}{2000}$

- Probability of ≥ 4001 km:

$$P = \frac{100 + 200 + 1500 + 180}{2000} = 0.99$$

- Probability of ≤ 20000 km:

$$P = \frac{20 + 100 + 200}{2000} = 0.16$$

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- Probability of ≥ 4001 km:

$$P = \frac{100 + 200 + 1500 + 180}{2000} = 0.99$$

- Probability of ≤ 20000 km:

$$P = \frac{20 + 100 + 200}{2000} = 0.16$$

- Probability of > 20000 km:

$$P = \frac{1500 + 180}{2000} = 0.84$$

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More than 40000	180	$\frac{180}{2000}$

- Probability of ≥ 4001 km:

$$P = \frac{100 + 200 + 1500 + 180}{2000} = 0.99$$

- Probability of ≤ 20000 km:

$$P = \frac{20 + 100 + 200}{2000} = 0.16$$

- Probability of > 20000 km:

$$P = \frac{1500 + 180}{2000} = 0.84$$

- Probability of $10000 - 40000$ km:

$$P = \frac{200 + 1500}{2000} = 0.85$$

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