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# COMP3055 Machine Learning

## Probability Exercises

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# *Probability Exercises*

# Exercise-1: **Nightlights and Myopia**

Assuming these data are representative of a larger population, what is the **approximate probability** that someone from that population who **sleeps with a nightlight** in early childhood **will develop some degree of myopia**?

| Slept with: | No Myopia | Myopia | High Myopia | Total |
|---|---|---|---|---|
| Darkness | 155 (90%) | 15 (9%) | 2 (1%) | 172 |
| Nightlight | 153 (66%) | 72 (31%) | 7 (3%) | 232 |
| Full Light | 34 (45%) | 36 (48%) | 5 (7%) | 75 |
| Total | 342 (71%) | 123 (26%) | 14 (3%) | 479 |

- 总共有 232 名孩子 **睡觉时使用小夜灯**。
- 在这 232 名孩子中，有 72 人患有 **普通近视（Myopia）**，有 7 人患有 **高度近视（High Myopia）**。

因此，**总共有 79 人**（72 人 Myopia 和 7 人 High Myopia）患有某种程度的近视。

所以，条件概率 $P(\text{Myopia}|\text{Nightlight})$ 计算为：

$$P(\text{Myopia}|\text{Nightlight}) = \frac{79}{232} \approx 0.34$$

# Exercise-2: Tuberculous meningitis

**If tuberculous meningitis had a case fatality of 20%,**

**(a) Find the probability that this disease would be fatal in two randomly selected patients (the two events are independent)**

**(b) If two patients are selected randomly what is the probability that at least one of them will die?**

a. 0.2*0.2 = 0.04

b. 1 - 0.8*0.8 = 0.36

Exercise-3: We have a population of potential workers. We know that
40% are vocational school graduates (V),
50% are high school grads (H),
10% are college grads (C).
In addition,
10% of the vocational school grads are unemployed (U),
5% of the high school grads are unemployed (U),
2% of the college grads are unemployed (U).

Determine the probability that a randomly selected unemployed person is a college graduate, that is, Pr(C|U)

- 40% 是职业学校毕业生 $P(V) = 0.40$
- 50% 是高中毕业生 $P(H) = 0.50$
- 10% 是大学毕业生 $P(C) = 0.10$
- 10% 的职业学校毕业生失业 $P(U|V) = 0.10$
- 5% 的高中毕业生失业 $P(U|H) = 0.05$
- 2% 的大学毕业生失业 $P(U|C) = 0.02$

根据贝叶斯定理，$P(C|U)$ 可以写成：

$$P(C|U) = \frac{P(U|C) \cdot P(C)}{P(U)}$$

其中，$P(U)$ 是总失业率，可以用全概率公式计算：

$$P(U) = P(U|V) \cdot P(V) + P(U|H) \cdot P(H) + P(U|C) \cdot P(C)$$