**Email Spam Classification Using Bayes’ Decision Rule**

### 1. Given Information

* **Classes**
  + ω₁ : Spam
  + ω₂ : Not Spam
* **Prior probabilities**
  + P(ω₁) = 0.30 (30 % of all e‑mails are spam)
  + P(ω₂) = 0.70 (70 % of all e‑mails are not spam)
* **Likelihoods for the feature “winner”**
  + P(x | ω₁) = 0.60 (the word “winner” appears in 60 % of spam e‑mails)
  + P(x | ω₂) = 0.05 (the word “winner” appears in 5 % of non‑spam e‑mails)

The observation is “the e‑mail contains the word *winner*”.

### 2. Bayes Decision Rule

For two possible classes the rule says:

(The denominator is the same for both sides, so it can be omitted when we only need to compare.)

### 3. Compute “likelihood × prior” for each class

**Spam ( ω₁ ):**

**Not Spam ( ω₂ ):**

### 4. Compare the two values

The product for the Spam class is larger.

### 5. Decision

According to the Bayes decision rule we select the class with the larger product, therefore:

### 6. (Optional) Posterior probabilities for verification

The overall probability of seeing the word “winner” is

Hence

## The posterior for Spam is far higher, confirming the classification.