TASK-4 (HP):

a) When you decide to accept the person, two scenarios can occur:

1.) The person is the correct person

↓

This happens when probability $g(x)$ & costs you 0.

2.) The person is an intruder.

↓

occurs with P: $1-g(x)$ & costs C_a.

Thus, expected cost of accepting a person is:

$$\text{cost(accept)} = g(x) \times 0 + (1-g(x)) \times C_a$$

$$= (1-g(x))\, C_a$$

lly, if we decide to reject the person

1.) person is correct ⇒ $g(x) \times C_r$

2.) person is intruder ⇒ $(1-g(x)) \times 0$

So, expected cost of rejecting = $g(x) \cdot C_r$

b.) we would accept the person if the expected cost of accepting

($\leq$)

expected cost of rejecting.

i.e., $(1-g(x))\, C_a \leq g(x) \cdot C_r$

$\Rightarrow \quad C_a - (C_a + C_r)\, g(x) \leq 0$

$\Rightarrow \quad g(x) \geq \dfrac{C_a}{C_a + C_r}$

$\therefore$ Threshhold $k = \dfrac{C_a}{C_a + C_r}$

(c) Supermarket

$C_a = 1$ (cost of letting in an intruder)

$C_r = 10$ (cost of rejecting a legit customer)

Using the formulae:

$$k = \frac{C_a}{C_a + C_r} = \frac{1}{1+10}$$

$$\approx 0.0909$$

From this,

if Probability of a person being legitimate $\geq 9.09\%$

↳ they are accepted

CIA:

$C_a = 1000$ (cost of letting in an intruder)

$C_r = 1$ (cost of rejecting a legit agent)

$$k = \frac{1000}{1+1000} = \approx 0.9990$$

For the CIA, with the new costs, threshold

$\approx 99.9\%$

$\Downarrow$

System needs to be 99.9% sure that someone is legitimate before they are allowed access.

Intuition:

- Supermarket has a slightly higher threshold than previously (9.09%) because cost of mistakenly rejecting a legitimate customer is now slightly higher than cost of mistakenly accepting an intruder.
- p(CIA) ~ 99.9%

↳ System needs to be almost entirely certain of someone's legitimacy before granting access. This highlights the importance of security in such high-stakes environment.