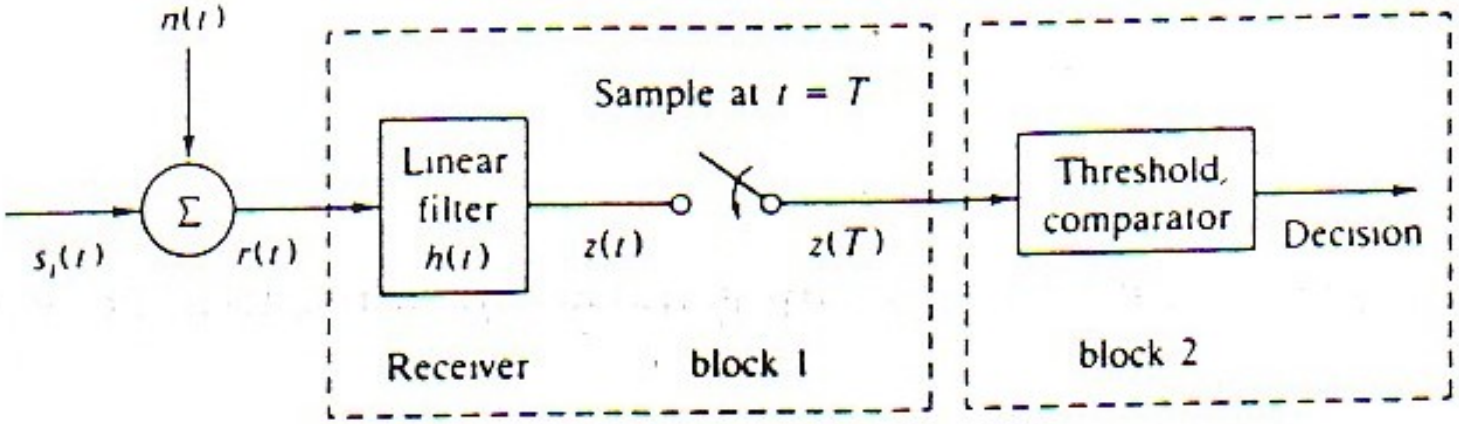
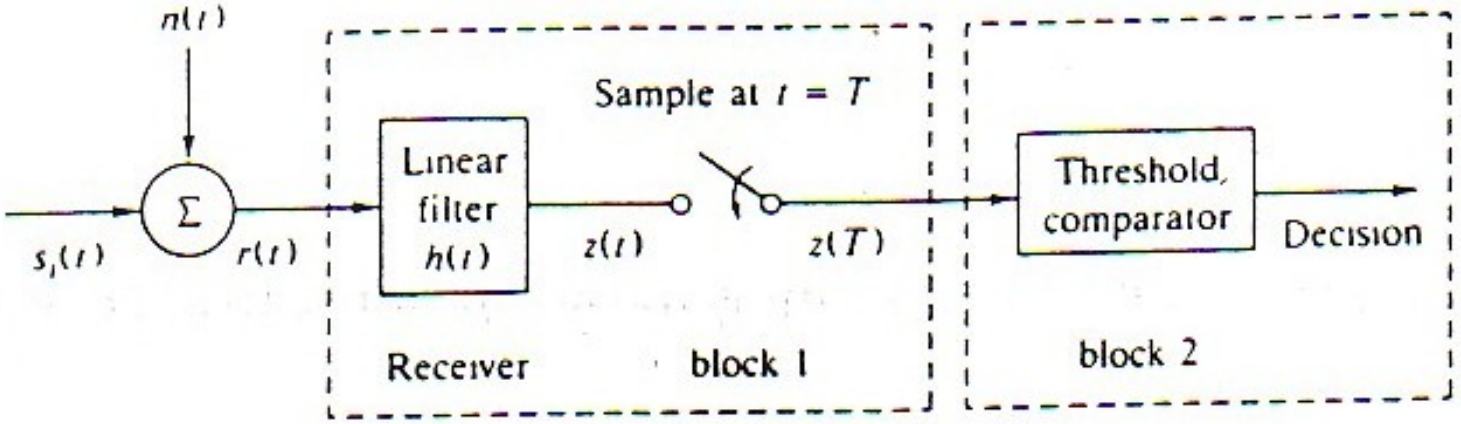
Binary Signal Detection

In MATLAB we've worked some with AWGN noise and the concept of bit error probability. Let's describe how this is measured.

Binary Signal Detection

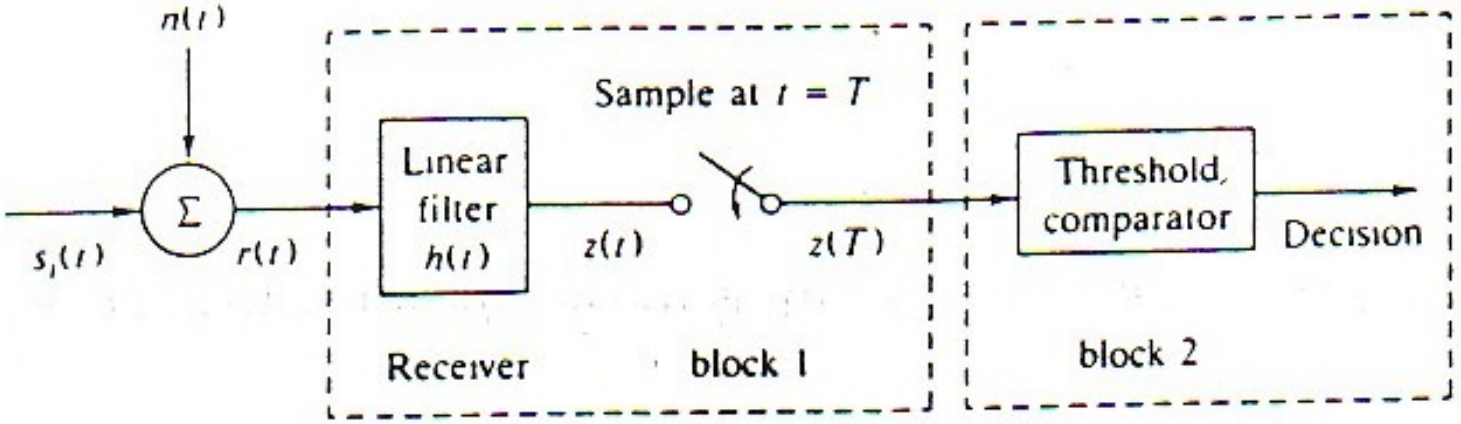


Binary Signal Detection



$$s_i(t) = \begin{cases} s_1(t) & 0 \le t \le T \quad \text{for logic 1} \\ s_2(t) & 0 \le t \le T \quad \text{for logic 0} \end{cases}$$

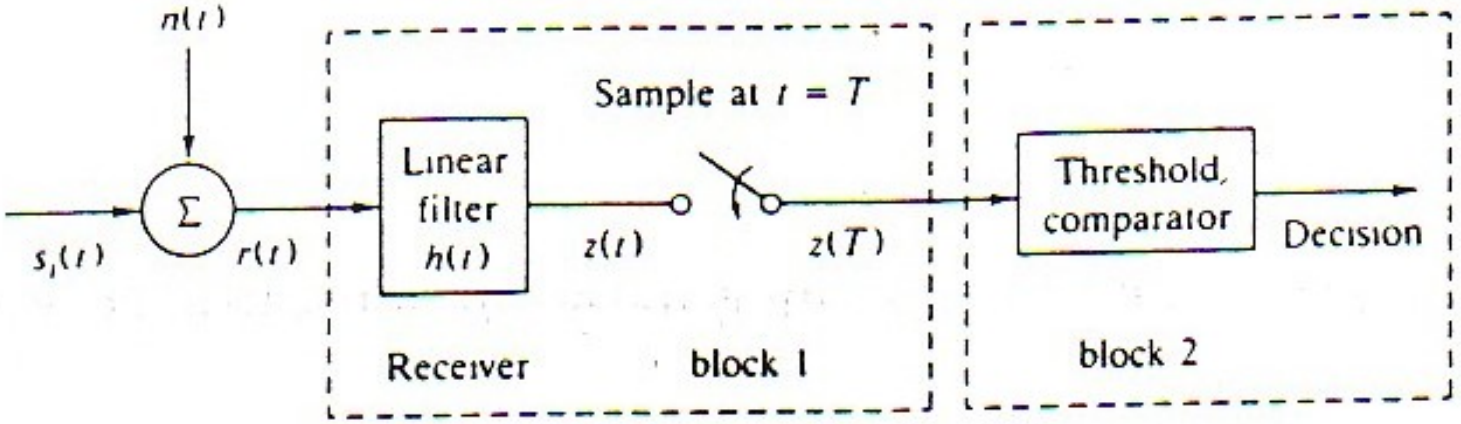
Binary Signal Detection



$$s_i(t) = \begin{cases} s_1(t) & 0 \le t \le T \quad \text{for logic 1} \\ s_2(t) & 0 \le t \le T \quad \text{for logic 0} \end{cases}$$

$$r(t) = s_i(t) + n(t) \qquad i = 1, 2 \qquad 0 \le t \le T$$

Binary Signal Detection

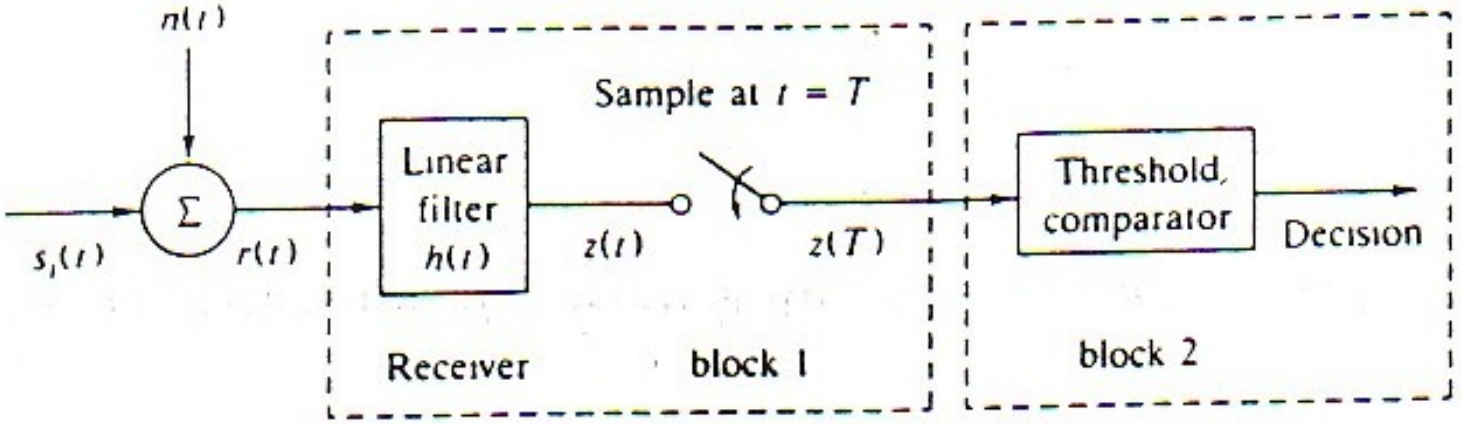


$$s_i(t) = \begin{cases} s_1(t) & 0 \le t \le T \quad \text{for logic 1} \\ s_2(t) & 0 \le t \le T \quad \text{for logic 0} \end{cases}$$

$$r(t) = s_i(t) + n(t) \qquad i = 1, 2 \qquad 0 \le t \le T$$

$$z(T) = a_i(T) + n_0(T) \qquad i = 1, 2$$

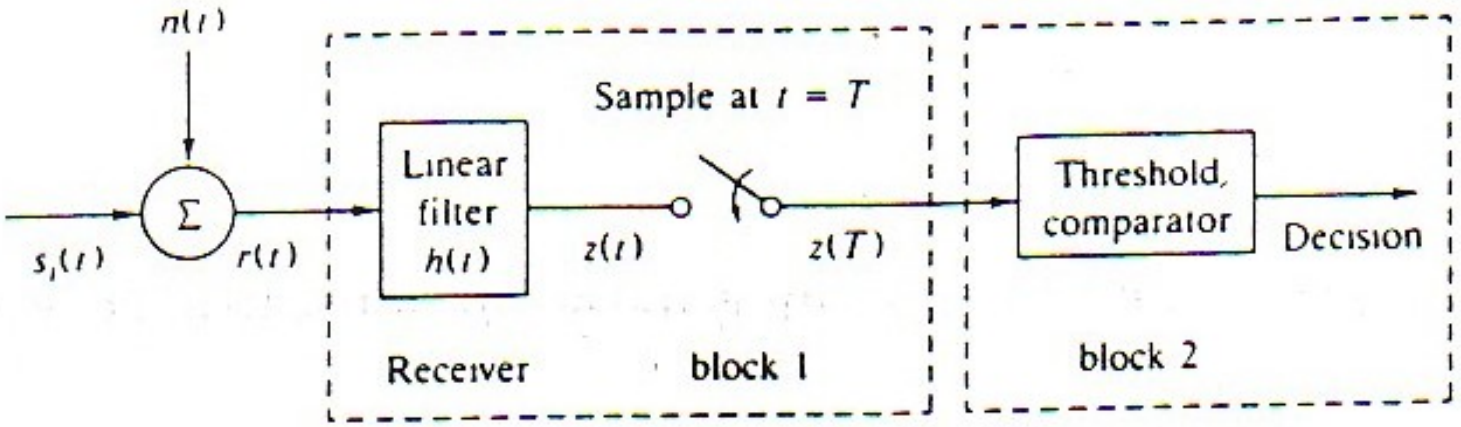
Binary Signal Detection



$$z(T) = a_i(T) + n_0(T) \qquad i = 1, 2$$

$$z = a_i + n_0 \qquad i = 1, 2$$

Binary Signal Detection



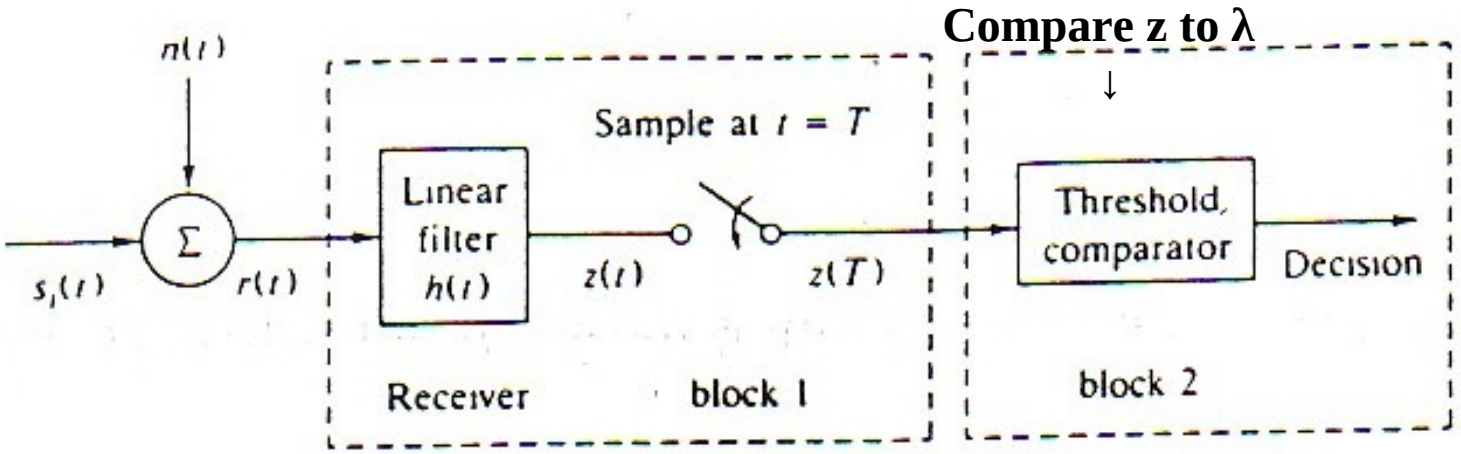
$$z(T) = a_i(T) + n_0(T) \qquad i = 1, 2$$

$$z = a_i + n_0 \qquad i = 1, 2$$

***z* has two meanings (either a_1 or a_2), depending on whether $s_1(t)$ or $s_2(t)$ was sent.**

***z* is sometimes called the *test statistic*.**

Binary Signal Detection

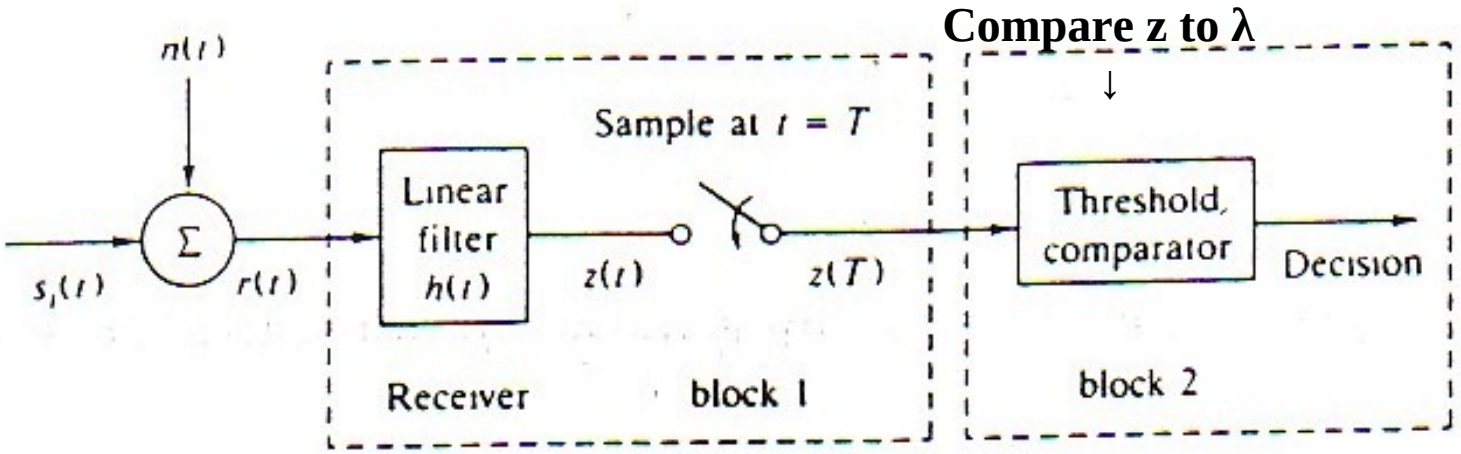


λ is the threshold level of the threshold comparator

***z* has two meanings (either a_1 or a_2), depending on whether $s_1(t)$ or $s_2(t)$ was sent.**

***z* is sometimes called the *test statistic*.**

Binary Signal Detection

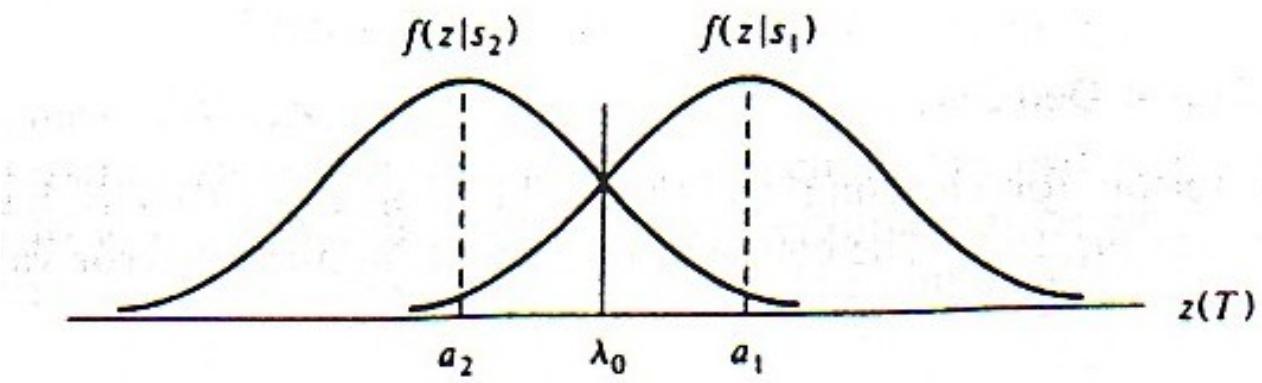


λ is the threshold level of the threshold comparator

H_1 → $z > \lambda$ **H_2 → $z < \lambda$**

***z* has two meanings (either a_1 or a_2), depending on whether $s_1(t)$ or $s_2(t)$ was sent.**

Binary Signal Detection



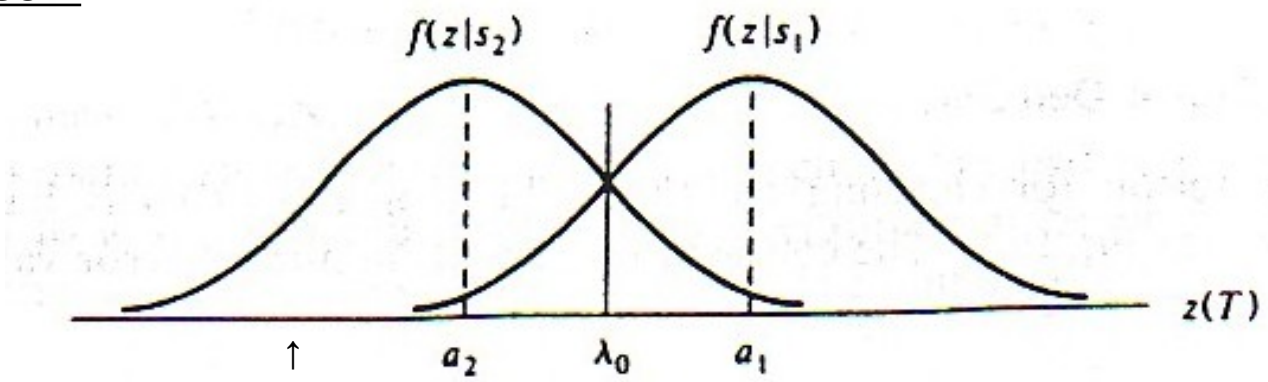
λ is the threshold level of the threshold comparator

H_1 → $z > \lambda$ **H_2 → $z < \lambda$**

***z* has two meanings (either a_1 or a_2), depending on whether $s_1(t)$ or $s_2(t)$ was sent.**

Binary Signal Detection

Case 1



z is here

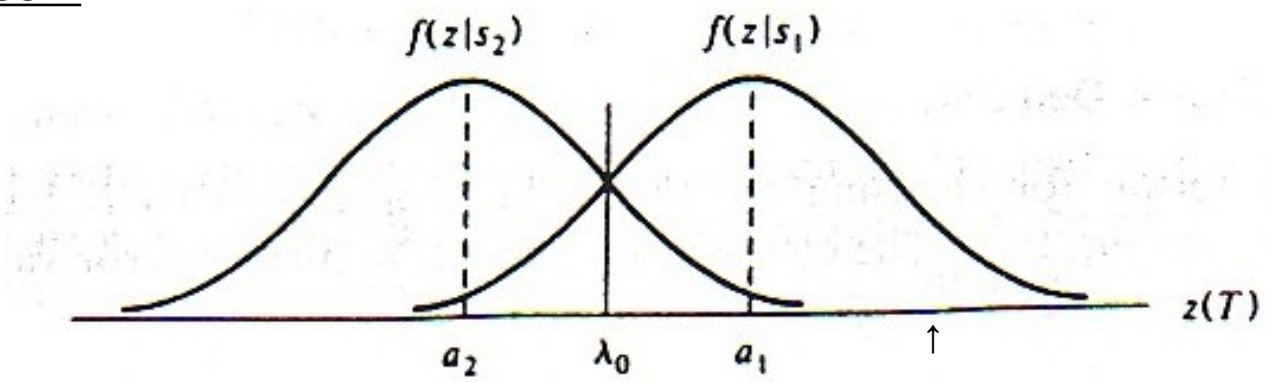
λ is the threshold level of the threshold comparator

H_1 → $z > \lambda$ **H_2 → $z < \lambda$**

***z* has two meanings (either a_1 or a_2), depending on whether $s_1(t)$ or $s_2(t)$ was sent.**

Binary Signal Detection

Case 2



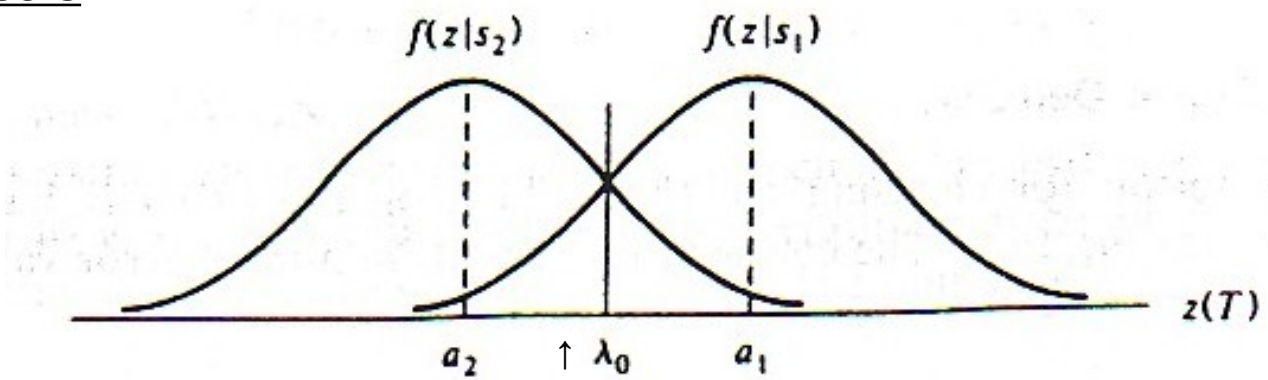
λ is the threshold level of the threshold comparator

H_1 → $z > \lambda$ **H_2 → $z < \lambda$**

***z* has two meanings (either a_1 or a_2), depending on whether $s_1(t)$ or $s_2(t)$ was sent.**

Binary Signal Detection

Case 3



z is here

λ is the threshold level of the threshold comparator

H_1 → $z > \lambda$ **H_2 → $z < \lambda$**

***z* has two meanings (either a_1 or a_2), depending on whether $s_1(t)$ or $s_2(t)$ was sent.**