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I. Binary Symmetric Channel

1. (Manual Computation) Consider a random transmission of 100 bits on a BSC with a 1-p=0.05 and p=0.95, determine the probabiities of the ff. Let T = Transmitted and R = Received.

```
N_100 = 100; % number of bits to be generated
tx_100 = rand(1,N_100) > 0.5; % generate 100 random bits
tx0_100 = (sum(tx_100(:)==0))/100; % number of transmitted 0's
tx1_100 = (sum(tx_100(:)==1))/100; % number of transmitted 1's
txe_100 = 0.05; % transmission error probability rate
txs_100 = 0.95; % transmission success probability rate
```

1. Manual Computation of P()

To determine error and success P(Rx) and P(Tx) through MANUAL computations, the ff. equations must be considered:

a.1 P(R'1') receive P() success rate

$$P(R'1') = P(T'1') \times P(R'1' \mid T'1') + P(T'0') \times P(R'1' \mid T'0')$$

```
rx1_100 = tx1_100*txs_100+tx0_100*txe_100; % computes the P(R'1')
fprintf('P(R1) is equal to %.4f',rx1_100); % display P(R'1')

% a.1. To determine P(R'1') and P(R'0') through MANUAL computations,
 the ff.
% equations must be considered:
```

```
P(R1) is equal to 0.5450
```

a.2 P(R'0') receive P() error rate

$$P(R'0') = P(T'0') \times P(R'0' \mid T'0') + P(T'1') \times P(R'0' \mid T'1')$$

```
rx0_100 = tx0_100*txs_100+tx1_100*txe_100; % computes the P(R'0')
fprintf('P(R0) is equal to %.4f',rx0_100); % display P(R'0')
```

P(R0) is equal to 0.4550

b.1 P(R'1'|T'1') - conditional P() aka priti

$$P(R'1'|T'1') = \frac{P(T'1'|R'1') \times P(R'1')}{P(T'1')}$$

```
PR1T1_100 = (txs_100*rx1_100)/tx1_100; % computes P(R'1'|T'1')
fprintf('P(R1|T1) is equal to %.4f', PR1T1_100); %display P(R'1'|T'1')
```

P(R1|T1) is equal to 0.9414

b.2 P(R'0'|T'1') - conditional P() aka proti

$$P(R'0'|T'1') = \frac{P(T'1'|R'0') \times P(R'0')}{P(T'1')}$$

```
PR0T1_100 = (txe_100*rx0_100)/tx1_100; % computes P(R'0'|T'1')
fprintf('P(R0|T1) is equal to %.4f', PR0T1_100); %display P(R'0'|T'1')
```

P(R0|T1) is equal to 0.0414

b.3 P(R'1'|T'0') - conditional P() aka prito

$$P(R'1'|T'0') = \frac{P(T'0'|R'1') \times P(R'1')}{P(T'0')}$$

```
PR1T0_100 = (txe_100*rx1_100)/tx0_100; % computes P(R'1'|T'0')
fprintf('P(R1|T0) is equal to %.4f', PR1T0_100); %display P(R'1'|T'0')
```

P(R1|T0) is equal to 0.0606

b.4 P(R'0'|T'0') - conditional P() aka proto

$$P(R'0'|T'0') = \frac{P(T'0'|R'0') \times P(R'0')}{P(T'0')}$$

```
PR0T0_100 = (txs_100*rx0_100)/tx0_100; % computes P(R'0'|T'0')
fprintf('P(R0|T0) is equal to %.4f', PR0T0_100); %display P(R'0'|T'0')
```

P(R0|T0) is equal to 0.9606

c.1 P(T'1'|R'1') - bayesian P() aka tiri

$$P(T'1'|R'1') = \frac{P(R'1'|T'1') \times P(T'1')}{P(R'1'|T'1') \times P(T'1') + P(R'1'|T'0') \times P(T'0')}$$

```
PT1R1_100 = (txs_100*tx1_100)/((txs_100*tx1_100)+(txe_100*tx0_100)); %
 computes P(T'1'|R'1')
fprintf('P(T1|R1) is equal to %.4f', PT1R1_100); %display P(T'1'|R'1')
```

```
P(T1|R1) is equal to 0.9587
```

c.2 P(T'0'|R'1') - bayesian P() aka tori

$$P(T'0'|R'1') = \frac{P(R'1'|T'0') \times P(T'0')}{P(R'1'|T'0') \times P(T'0') + P(R'1'|T'1') \times P(T'1')}$$

```
PT0R1_100 = (txe_100*tx0_100)/((txe_100*tx0_100)+(txs_100*tx1_100)); %
 computes P(T'0'|R'1')
fprintf('P(T0|R1) is equal to %.4f', PT0R1_100); %display P(T'0'|R'1')
```

```
P(T0|R1) is equal to 0.0413
```

c.3 P(T'1'|R'0') - bayesian P() aka tiro

$$P(T'1'|R'0') = \frac{P(R'0'|T'1') \times P(T'1')}{P(R'0'|T'1') \times P(T'1') + P(R'0'|T'0') \times P(T'0')}$$

```
PT1R0_100 = (txe_100*tx1_100)/((txe_100*tx1_100)+(txs_100*tx0_100)); %
 computes P(T'1'|R'0')
fprintf('P(T1|R0) is equal to %.4f', PT1R0_100); %display P(T'1'|R'0')
```

```
P(T1|R0) is equal to 0.0604
```

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