Tanishq Chauhan
21C3184
CS-B

Chauhan

Rajshree
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Applied Mathematics - III (BACR3C1)

Mid Semester Test - 3

* Answer of Q. No. 3

Given process

$$x(t) = 4\cos(3t + \theta)$$

x is distributed in ∈ interval $(-\pi, \pi)$

~~It is~~ If x is uniformaly distributed, then density function is given by :-

$$f(\theta) = \frac{1}{\pi - (-\pi)}, \quad -\pi < x < \pi$$

$$f(\theta) = \frac{1}{2\pi}$$

To prove that the value above random process is WSS we need two conditions :-

1. Expectation of $x(t)$ $E\{x(t)\}$ should be independent of time
2. Expectation of $(x(t)\, x(t-1))$ should be dependent on time

1)

$$\therefore E(x(t)) = E(4\cos(3t + \theta))$$

$$= \int_{-\pi}^{\pi} f(\theta)\, 4\cos(3t + \theta) \cdot d\theta$$

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$$= \frac{4}{2\pi} \int_{-\pi}^{\pi} \cos(3t + x)\,dx$$

$$= \frac{4}{2\pi} \left[\sin(3t + x)\right]_{-\pi}^{\pi}$$

$$= \frac{2}{\pi} \left[\sin(3t + \pi) - \sin(3t - \pi)\right]$$

$$= \frac{2}{\pi} \left[2\cos\frac{(3t + \pi + 3t - \pi)}{2} \sin\frac{(3t + \pi - 3t + \pi)}{2}\right]$$

$$= \frac{4}{\pi} \left[\cos\left(\frac{6t}{2}\right) \sin(\pi)\right]$$

$$= 0$$

2) $E\{x(t)x(t-\tau)\} = 16E\{\cos(3t + x)\cos(3(t + \tau) - 3) + x\}$

$$\Rightarrow \frac{16}{2} E\left[\cos((3(2t - \tau + 2x) + \cos 3\tau\right] dx$$

$$\Rightarrow \frac{16}{4\pi} \int_{-\pi}^{\pi} \left[\cos(3(2t - 3) + 2x) + \cos\tau\right] dx$$

$$= \frac{4}{\pi} \left[\sin\frac{(6t - 3\tau) + 2x)}{2} + \sin 3\tau x\right]_{-\pi}^{\pi}$$

$$= \frac{4}{\pi} \left[\sin((6t - 3\tau) + 2\pi) + (\sin 3\tau)(2\pi) - \sin((6t - 3\tau) - 2\pi)\right]$$

$$= \frac{4}{\pi} \left[\sin(3\tau)\right]\pi = 4\sin 3\tau$$

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It is the function of time τ.

Hence, above given Random process is WSS process.

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* Answer of Q. No 1

Let p_m = Proportion of male iphone users.

from sample

$$p_m = \frac{337}{1343} = 0.25$$

p_f = proportion of female iphone users

$$p_f = \frac{52}{232} = 0.22$$

H_0 : $p_m > p_f$; proportion of male iphone users is greater than of female

H_1 : $p_m \leq f.f$; proportion of male iphone users is less than or equal to that of

i.e. $|z| < |z|_{0.05}$ $(1.111 < 1.699)$

The proportion of male iphone users is greater than that of female

now, for 95% confidance limit

$$z \leq |z|_{0.05}$$

$$\frac{p_m - p_f}{\sqrt{\frac{p_f q_f}{n_f}}} \leq 1.645$$

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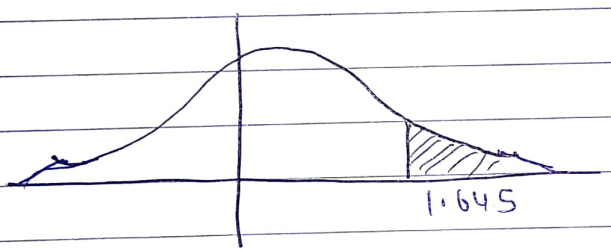
$$pm - pf \leq 1.645 \times 0.027$$
$$\leq 0.009$$

$$\Rightarrow (0 - \infty, 0.004)$$

female, i.e

The Los, α is 5%

$$|Z_{0.05}| = 1.645$$



$$Z = \frac{Pm - Pf}{\sqrt{\frac{PfQf}{nf}}}$$

$$Z = \frac{0.25 - 0.22}{\sqrt{\frac{0.22 \times 0.78}{232}}}$$

$$Z = \frac{0.03}{\sqrt{0.00074}} = \frac{0.03}{0.027}$$

$$= 1.111$$

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* Answer of Q. No-2

$n_1 = 274$, $\bar{X}_1 = 3.95$, $\bar{X}_2 = 4.10$
$n_2 = 320$, $S_1 = 0.63$, $S_2 = 0.47$

$$SE(\bar{X}_1 - \bar{X}_2) = \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}$$

$$= \sqrt{\frac{(0.63)^2}{274} + \frac{(0.47)^2}{320}}$$

$$= \sqrt{0.0021}$$

$$= 0.045$$

Let; $H_0 : \bar{X}_1 = \bar{X}_2$, Both are equally satisfied

$H_1 : \bar{X}_1 < \bar{X}_2$, B's customer are more satisfied from A's customer (left tailed)

LOS : = 1% = 0.01
$Z_{0.01} = -2.33$

Now; $$Z = \frac{\bar{X}_1 - \bar{X}_2}{SE(\bar{X}_1 - \bar{X}_2)}$$

$$Z = \frac{3.95 - 4.10}{0.045} = -3.33$$

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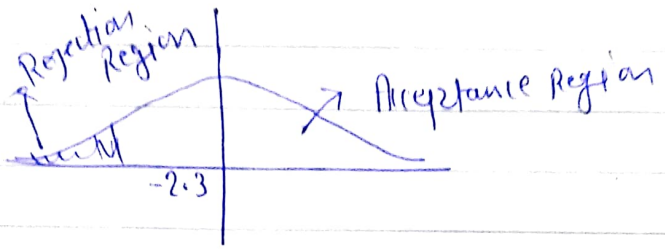

Since;

$$Z = -3.33 < -2.33 = Z_{0.01}$$

Hence it falls in rejection region area, H_0 is rejected & H_1 is Accepted.
i.e. B's customer are more satisfied than A's customer.

=> 98% confidance interval :-

$$Z = \frac{\bar{X}_1 - \bar{X}_2}{SE(\bar{X}_1 - \bar{X}_2)} \geq Z_{0.02}$$

$$\frac{\bar{X}_1 - \bar{X}_2}{0.045} \geq -2.055$$

$$\bar{X}_1 - \bar{X}_2 \geq -2.055 \times 0.045$$

$$\boxed{\bar{X}_1 - \bar{X}_2 \geq 0.0924}$$

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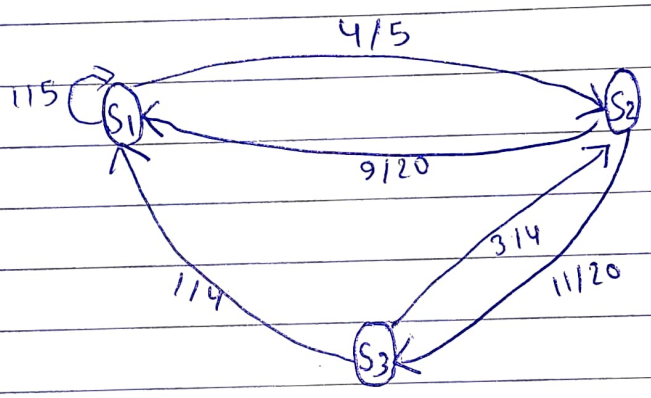
* Answer of Q. No. 4

$$P = \begin{bmatrix} 1/5 & 4/5 & 0 \\ 9/20 & 0 & 11/20 \\ 1/4 & 3/4 & 0 \end{bmatrix}$$



⇒ State S_2 is recurrent because from whereever we can go, there is a way of returning to S_2