IYSE 6420 Fall 2020 Homework1

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**1. Circuit**

1. *Find the probability that the circuit is operational during time interval T.*

S: circuit is operational

H1: E6 is working

H2: E6 is not working

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Element | E1 | E2 | E3 | E4 | E5 | E6 | E7 |
| Works (p) | 0.5 | 0.7 | 0.3 | 0.4 | 0.9 | 0.5 | 0.7 |
| Fails (q) | 0.5 | 0.3 | 0.7 | 0.6 | 0.1 | 0.5 | 0.3 |

Hypotheses H1:

A person looking towards the camera

Description automatically generated

P(S|H1) = (1 – q1q5) (1 - q2q3q4q7)

= (1 – 0.5 x 0.1) x (1 – 0.3 x 0.7 x 0.6 x 0.3)

= 0.91409

Hypotheses H2:

A picture containing photo, sitting

Description automatically generated

P(S|H2) = 1 – (1 – p1 x (1 – q2q3q4)) x (1 – p5 x p7)

= 1 – (1 – 0.5 x (1 – 0.3 x 0.7 x 0.6)) x (1 – 0.5 x 0.7)

= 0.63405

By total probability,

P(S) = P(S|H1) x P(H1) + P(S|H2) x P(H2)

= 0.91409 x 0.5 + 0.63405 x 0.5

= 0.77407

1. *If the circuit was found operational at the time T, what is the probability that the element E6 was operational.*

P(H1|S) = P(S|H1) x P(H1) / P(S)

= 0.91409 x 0.5 / 0.77407

= 0.59

**2. Two Batches**

*What is the probability that the second product, randomly selected from the same batch, is found non-conforming?*

H1: product is selected from 1st batch

H2: product is selected from 2nd batch

|  |  |  |
| --- | --- | --- |
| Batches | Prob. Item Conforming | Prob. Selected |
| 1st batch | 1.0 | 0.5 |
| 2nd batch | 0.9 | 0.5 |

A: product is conforming

P(A) = P(A|H1) P(H1) + P(A|H2) P(H2)

= 1.0 x 0.5 + 0.9 x 0.5

= 0.95

P(H1|A) = P(A|H1) x P(H1) / P(A)

= 1.0 x 0.5 / 0.95

= 0.526

The probability that the product is from 1st batch: 0.526

P(H2|A) = P(A|H2) x P(H2) / P(A)

= 0.9 x 0.5 / 0.95

= 0.474

The probability that the product is from 2nd batch: 0.474

Probability of the next product from same batch is non-conforming:

P(~A) = P(H1|A) x P(A|H1) + P(H2|A) x P(A|H2)

= 0.526 x 1.0 + 0.474 x 0.9

= 0.9526

**3. Machine**

*a) What is the probability that the machine will fail? Evaluate this probability for p = 0.4.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Machine | M1 | M2 | M3 | M4 |
| Work | p | p | p | ½ |
| Fail | q = (1-p) | q = (1-p) | q = (1-p) | ½ |

H1: No machine works

P(H1) = q x q x q / 2 = q3 / 2

= 0.63 / 2

= 0.108

H2: Only one machine works

Mi: Only Mi works

P(H2) = P(M1) + P(M2) + P(M3) + P(M4)

= p x q2 / 2 x 3 + q3 / 2

= 0.4 x 0.62 / 2 x 3 + 0.63 / 2

= 0.324

H0: the machine will fail

P(H0) = P(H1) + P(H2) = 0.432

b) If the machine failed, what is the probability that the component which fails with probability 1/2 actually failed.

P(M4 failed|H0) = 1 – P(M4|H0)

= 1 – P(H0|M4) x P(M4) / P(H0)

= 1 – 1 x q3 / 2 / 0.432

If q = 1-p = 0.6, then

P(M4 failed|H0) = 1 – (0.63 / 2 / 0.432)

= 0.75