MIDTERM

**Q1**

Is the following function a proper distance function? Why? Explain your answer. Measure the distance between (0, 0, 0) and (0, 1, 0)

𝒅(𝒙,𝒚) = Ʃ ((𝒙𝒊― 𝒀𝒊)𝟐)

**A1**

The properties of a distance functions are:

1. The distance between two points x and y are always non negative, d(x, y) >= 0. Also the only way d(x, y) = 0 is if x = y.
2. The distance is symmetric. This means the distance d(x, y) = d(y, x)
3. The triangle inequality. For points x, y, z, we find that d(x, y) <= d(x, z) + d(z, y)

Looking at the given equation 𝒅(𝒙,𝒚) = Ʃ ((𝒙𝒊― 𝒀𝒊)𝟐), we can see that, for any values of xi and yi, (xi – yi)2 will not be a negative and (xi – yi)2 will be equal to (yi – xi)2

The distance between x = (0, 0, 0) and y = (0, 1, 0) using formula 𝒅(𝒙,𝒚) = Ʃ ((𝒙𝒊― 𝒀𝒊)𝟐)

𝒅(𝒙,𝒚) = Ʃ ((𝒙𝒊― 𝒀𝒊)𝟐)

𝒅(𝒙,𝒚) = ((0 – 0) + (0 – 1) + (0 – 0))2

𝒅(𝒙,𝒚) = (0 – 1 + 0)2

𝒅(𝒙,𝒚) = (- 1)2

𝒅(𝒙,𝒚) = 1

The distance between (0, 0, 0) and (0, 1, 0) is 1 and proves that the function satisfies all properties.

**Q2**

An employee of a company is traveling to either England, Italy, or Spain. The employee can travel to only one country. There is a 50% chance the employee will go to England and a 20% chance to Italy. Assume the chances of contracting COVID to be proportional to the prevalence of the disease in each country, given in the table below. For example, the chances of contracting COVID in England is 1200/1,000,000.

What are the chances that the employee will contract COVID while travelling?

Assume that the employee has traveled to Europe and contracted COVID, what is the probability that he/she traveled to England?

Chart, treemap chart

Description automatically generated

**A2**

Probability employee will go to England = P(E) = 0.5

Probability employee will go to Italy = P(I) = 0.2

Probability employee will go to Spain = P(S) = 0.3

Probability of covid infection in England = P(C|E) = 1200/1000000 = 0.0012

Probability of covid infection in in Italy = P(C|I) = 1400/1000000 = 0.0014

Probability of covid infection in Spain = P(C|S) = 1800/1000000 = 0.0018

1. What are the chances that the employee will contract COVID while travelling?

Let the probability that the employee catches covid at all be P(C).

P(C) = P(C|E) P(E) + P(C|I) P(I) + P(C|S) P(S)

= 0.0012 \* 0.5 + 0.0014 \* 0.2 + 0.0018 \*0.3

= 0.0006 + 0.00028 + 0.00054

= 0.00142

1. Assume that the employee has traveled to Europe and contracted COVID, what is the probability that he/she traveled to England?

P(E|C) = P(C|E)P(E) = 0.0012\*0.5 = 0.0006 = 0.42253

P(C) 0.00142 0.00142