CS101 (Fall 2012): Problem Set #3 Bayesian Networks

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1 Problem 1

a. (c)
b. (a)
c. (a)
d. The CPT for the G_{child}:

G_{mother}	G_{father}	$P(G_{child} = l)$	$P(G_{child} = r)$
l	l	$1 - m$	m
l	r	0.5	0.5
r	l	0.5	0.5
r	r	m	$1 - m$

e.

$$
\begin{aligned}
P(G_{child} = l) = & \sum_{G_{mother}, G_{father}} P(G_{child} = l, G_{father}, G_{mother}) \\
= & P(G_{child} = l, G_{father} = l, G_{mother} = l) + P(G_{child} = l, G_{father} = l, G_{mother} = r) + \\
& P(G_{child} = l, G_{father} = r, G_{mother} = l) + P(G_{child} = l, G_{father} = r, G_{mother} = r) \\
= & P(G_{child} = l \mid G_{father} = l, G_{mother} = l) P(G_{father} = l, G_{mother} = l) + \\
& P(G_{child} = l \mid G_{father} = l, G_{mother} = r) P(G_{father} = l, G_{mother} = r) + \\
& P(G_{child} = l \mid G_{father} = r, G_{mother} = l) P(G_{father} = r, G_{mother} = l) + \\
& P(G_{child} = l \mid G_{father} = r, G_{mother} = r) P(G_{father} = r, G_{mother} = r) \\
= & (1 - m) q^2 + 0.5 q (1 - q) + 0.5 (1 - q) q + m (1 - q)^2 \\
= & (1 - m) q^2 + q (1 - q) + m (1 - q)^2
\end{aligned}
$$

f. According to e., we get:

$$\begin{aligned} P(G_{child} = l) = P(G_{father}) = P(G_{mother}) = q \\ (1-m)q^2 + q(1-q) + m(1-q)^2 = q \\ q = 0.5 \end{aligned}$$

As we know about the handedness in humans, a variety of studies suggest that 70-90% of the world population is right-handed(1). But according to the hypothesis, the distribution of handedness is same as the gene, which means 50% of the world population is right-handed. This is not true. So the hypothesis is wrong.

References

[1] *Handedness. From Wikipedia, the free encyclopedia.*