Ira A. Fulton Schools of Engineering
Arizona State University
Engineering | School of Computing, Informatics, and Decision Systems Engineering

CSE 571: Artificial Intelligence

Inference in Bayesian Networks

Purpose

Apply inference to Bayesian Networks to reason about uncertainty. This technique is useful for real-world problems that can be modeled as an inference problem, such as for determining an insurance premium.

Objectives

Students will be able to:

- Familiarize with the representation of Bayesian Networks
- Apply inference techniques to Bayesian Network to reason about uncertainty.
- Solve complex inference problems with Bayesian Network

Technology Requirements

- NA

Project Description

It is an election year and in a parallel universe, the Pencil Party is running for the presidency. The Pencil Party is more likely to pass a law on car ownership other than other parties, but any party can perform the legalization. Knowing the probability, the analysts on the parallel universe model the situation with the Bayes Network as shown below:

Part 1

You will be calculating and typing in your numeric results to a specific place value. Refer to the assignment submission area in the course to input and submit your answers.

	+p	-p
P(Pencil)	0.2	0.8

	P(+c|P)	P(-c|P)
+p	0.85	0.15
-p	0.333	0.667

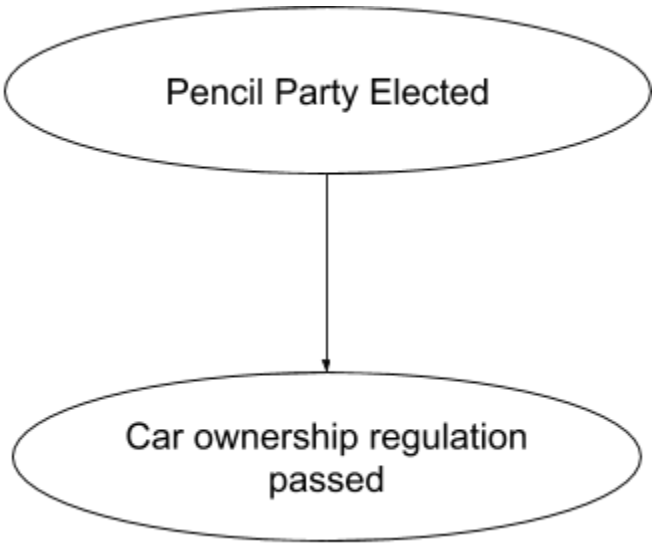

Figure 3.0: Bayesian Network

It is an election year and in a parallel universe, the Pencil party is running for the presidency. The Pencil party is more likely to pass a law on car ownership than other parties, but any party can perform the legalization. Knowing the probability, the analysts on the parallel universe model the situation in Figure 3.0: Bayesian Network.

P	C	P(P, C)
+p	+c	1.a
+p	-c	1.b
-p	+c	1.c
-p	-c	1.d

Figure 3.1: Joint Probability Table

Review Figure 3.0: Bayesian Network and Figure 3.1: Joint Probability Table. What is the joint probability for 1.a, 1.b, 1.c, and 1.d?

Part 2

You will be calculating and typing in your numeric results to a specific place value. Refer to the assignment submission area in the course to input and submit your answers.

Although there is news coverage of the election, we cannot be sure who won the election. What is the conditional probability P(+p|+c) that the Pencil Party was elected given that the car ownership is legalized?

Part 3

You will be calculating and typing in your numeric results to a specific place value. Refer to the assignment submission area in the course to input and submit your answers.

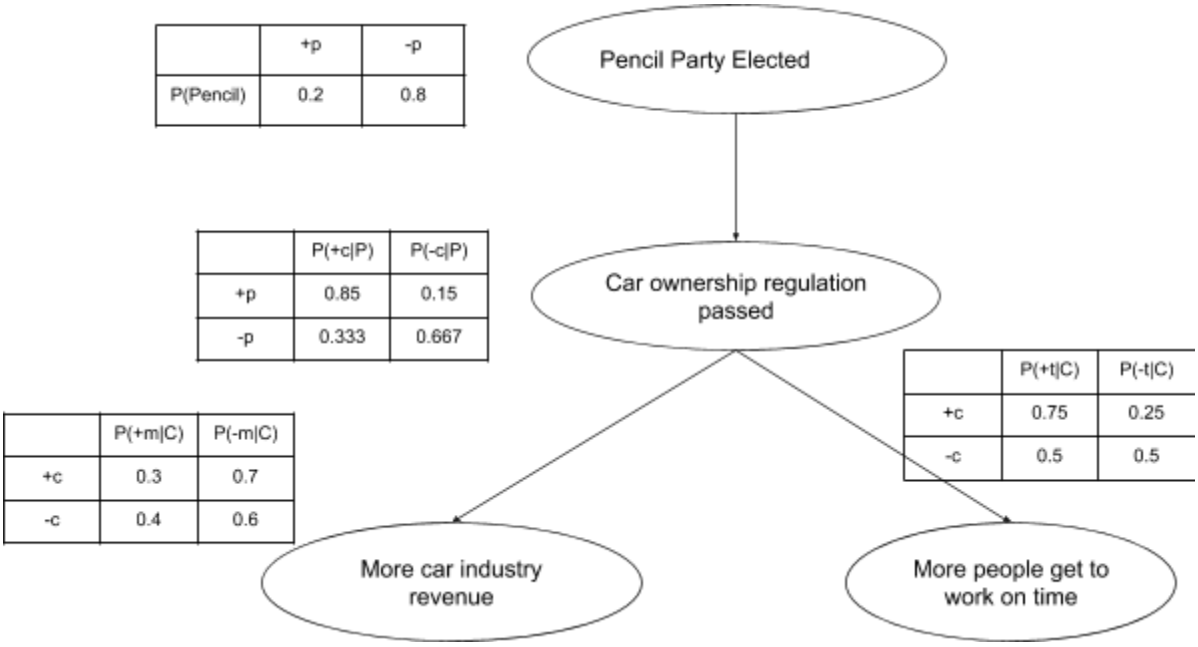

Figure 3.2

Review Figure 3.2. Now, assume we have observed more evidence, therefore we can make better inferences. The analysts on the parallel universe introduced two new random variables:

1. Whether there is more car industry revenue (M)
2. Whether more people get to work on time (T).

P	C	M	T	P(P, C, M, T)	P	C	M	T	P(P, C, M, T)
+	+	+	+	0.0383	-	+	+	+	4.h

+	+	+	-	4.a	-	+	+	-	4.i
+	+	-	+	4.b	-	+	-	+	4.j
+	+	-	-	4.c	-	+	-	-	4.k
+	-	+	+	4.d	-	-	+	+	4.l
+	-	+	-	4.e	-	-	+	-	4.m
+	-	-	+	4.f	-	-	-	+	4.n
+	-	-	-	4.g	-	-	-	-	4.o

Table 3.3

Review Table 3.3, which shows the full joint distribution. What are the values of 4.a - 4.o?

Part 4

You will be calculating and typing in your numeric results to a specific place value. Refer to the assignment submission area in the course to input and submit your answers.

Using either full joint distribution or conditional tables, what is the probability of P(+m|+c)?

Using either full joint distribution or conditional tables, what is the probability of P(+m|+c,+p)?

Using either full joint distribution or conditional tables, what is the probability of P(+m)?

Using either full joint distribution or conditional tables, what is the probability of P(+t |+m)?