

## Risk and Decision-Making for Data Science and AI

### Week 6 Lab 5 Answers

#### **Question 1: Absolute Vs Relative Risk**

a) Probability of non-bacon eaters who died from Disease A:  $\frac{24}{60} = 0.4$  or 40%

Probability of bacon eaters who died from Disease A:  $\frac{10}{40} = 0.25$  or 25%

Relative risk  $\frac{0.4}{0.25} = 1.6$

Relative risk increase =  $(1 - 1.6) * 100 = 60\%$

b) Probability of non-bacon eaters who died from Disease A:  $\frac{24}{60} = 0.4$  or 40%

Probability of bacon eaters who died from Disease A:  $\frac{10}{40} = 0.25$  or 25%

Absolute risk increase =  $0.4 - 0.25 = 0.15$  or 15%

#### **Question 2: Utility, Expected Utility and Optimal decision**

a) First, we calculate win and lose utilities.

*Win utility* =  $10000 - 100 = 9900$

*Lose utility* =  $-100$

Then we calculate the expected utility to determine the total expected utility:

*Expected utility of win* =  $9900 * \frac{1}{36} = 275$

*Expected utility of lose* =  $-100 * \frac{35}{36} = -97.22$

*Total expected utility of playing* =  $275 - 97.22 = 177.78$

b) Total utility of playing = 177.78

Total utility of not playing = 0

The optimal decision is for Mr. West to play the game since this maximises total expected utility.

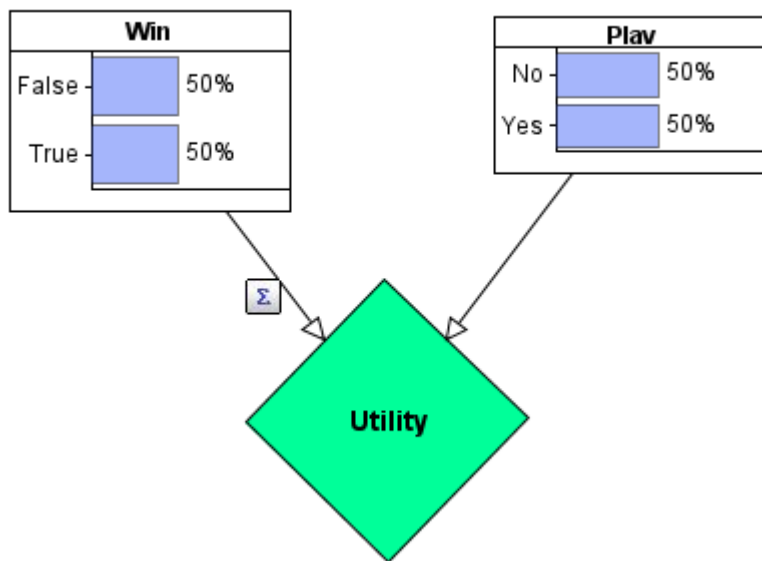
#### **Question 3: Influence Diagram and Decision Tree**

a)

Using Agena

## Risk and Decision-Making for Data Science and AI

### Week 6 Lab 5 Answers



#### Node Probability Table

NPT Editing Mode

Partitioned Expression ▼

Select the required parents from the list on the left and add them to the list on the right. The list on the right will contain the parents involved in the partitioned table. The order of the parents determines the configuration of states in the table below.

	<div>Add &gt;</div> <div>Add all &gt;&gt;</div> <div>&lt;&lt; Remove all</div> <div>&lt; Remove</div>	<div>Play</div> <div>Win</div> <div><div>↑</div><div>↓</div></div>
--	---	--

Enter a formula for each partition by double-clicking the cell.

Play	No		Yes	
Win	False	True	False	True
Expressions	Arithmetic(0.0)	Arithmetic(0.0)	Arithmetic(-50.0)	Arithmetic(350.0)

## Risk and Decision-Making for Data Science and AI

### Week 6 Lab 5 Answers

**Assign Decision, Chance, and Utility Nodes** ?

Win [Win]

> Decision nodes:  
Play [Play]

<

> Observable chance nodes:

<

> Utility node:  
Utility [Utility]

<

**Calculation** ?

Utility calculated as: ? ss\_mean Continuous simulation: ? Full

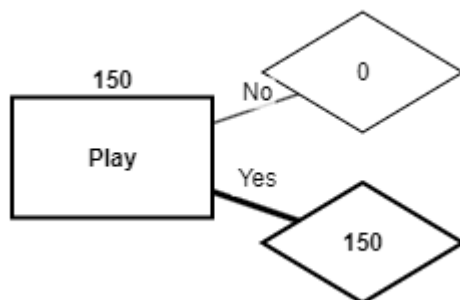
Skip re-calculation: ? ☐

**Evaluation** ?

Utility selection policy: Maximise Rounding precision: ? 2

Simplify DT: ? ☒ Highlight optimal decisions: ☒

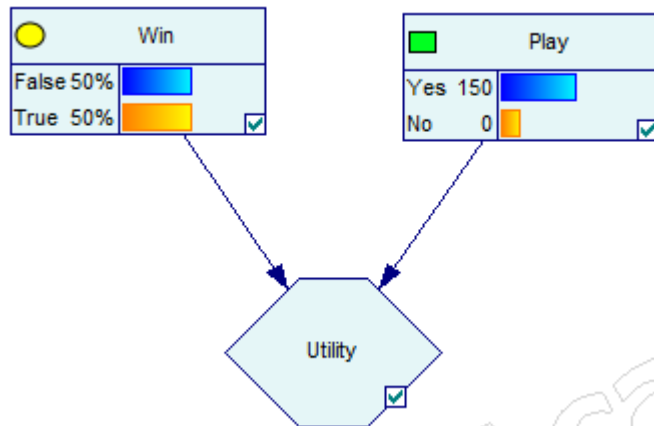
Report file location: c:\London\Teaching\ECS7005P 23.24\DT New Bayesian Network0.html Choose...



Using Genie:

# Risk and Decision-Making for Data Science and AI

## Week 6 Lab 5 Answers



Using Python:

```
import os

%matplotlib inline
from pylab import *
import matplotlib.pyplot as plt
from IPython.display import display,HTML

import math

import pyAgrum as gum
import pyAgrum.lib.notebook as gnb

[1] ✓ 0.8s

infdiag = gum.InfluenceDiagram()

win = infdiag.addChanceNode(gum.LabelizedVariable("Win","Win",["False","True"]))
play = infdiag.addDecisionNode(gum.LabelizedVariable("Play","Play",["Yes","No"]))
utility = infdiag.addUtilityNode(gum.LabelizedVariable("Utility","Utility",1))

infdiag.addArc("Win","Utility")
infdiag.addArc("Play","Utility")

infdiag

[2] ✓ 0.0s

...
Win Play
Utility
```

## Risk and Decision-Making for Data Science and AI

### Week 6 Lab 5 Answers

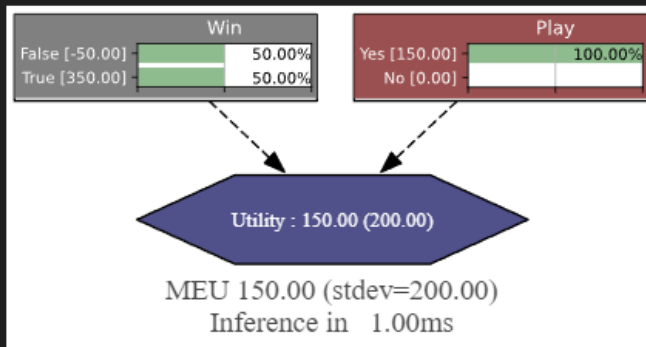
```
infdiag.cpt("Win").fillWith([0.5,0.5])

infdiag.utility("Utility") [{'Play': 'No', 'Win': 'False'}] = 0
infdiag.utility("Utility") [{'Play': 'No', 'Win': 'True'}] = 0
infdiag.utility("Utility") [{'Play': 'Yes', 'Win': 'False'}] = -50
infdiag.utility("Utility") [{'Play': 'Yes', 'Win': 'True'}] = 350
```

✓ 0.0s

```
gnb.showInference(infdiag)
```

✓ 0.1s



So the optimal decision is to play