Friday, December 6

Term Projects

**Digital Copy ≤ Midnight Friday
Turn in Printed Hard Copy Before
10 AM Saturday**

Monday
**Assignment 23
Course Response Forms
Take Home Exam Distributed**

Wednesday
**In Class Final Exam: 9 to Noon
Take Home Exam Due by Noon**

Game Theory, The Bible

And Opera

Game Theory

Game Theory is the branch of mathematics concerned with the analysis of strategies for dealing with competitive situations where the outcome of a participant's choice of action depends critically on the actions of other participants.

Game theory is the study of mathematical models of conflict and cooperation between intelligent rational decision-makers.

Some Applications of Game Theory

Economics

Political Science

Psychology

Biology

History

Literature

Religion

Games

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📈 **TRENDING**   See Metallica's Reality-Bending, War-Torn 'Confusion'...   Watch 'South Park' Parody Donald Trump's Election Win   How the Electoral College Rigged the Election for Donald...

What Game Theory Tells Us About Donald Trump
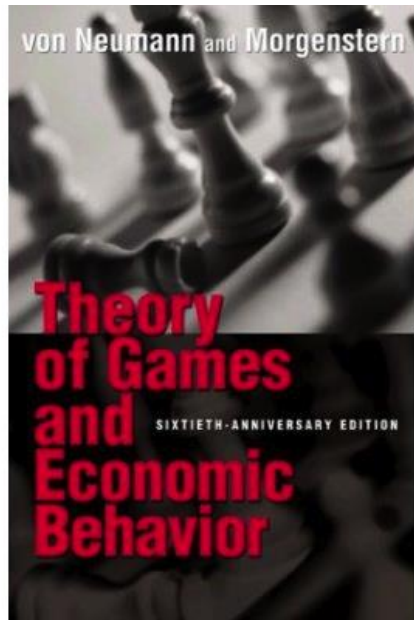
John Von Neumann
1903 - 1957

Game Theory

(A) (1)

Oskar Morgenstern
1902-1977

Monograph Efficiency	9.3
Marginal Rate of Reference	0.0
Public Perception Indicator	1.8
Productivity Potential Index	- 24.0
Expected Utility	1.5

Oscar Morgenstern
1902 - 1977

Oskar Morgenstern

Game theory is a new discipline that has aroused much interest because of its novel mathematical properties and its many applications to social, economic, and political problems. The theory is in a state of active development. It has begun to affect the social sciences over a broad spectrum. The reason that applications are becoming more numerous and are dealing with highly significant problems encountered by social scientists is due to the fact that the mathematical structure of the theory differs profoundly from previous attempts to provide mathematical foundations of social phenomena. These earlier efforts were oriented on the physical sciences and inspired by the tremendous success these have had over the centuries. Yet social phenomena are different: people are acting sometimes against each other, sometimes cooperatively with each other; they have different degrees of information about each other, their aspirations lead them to conflict or cooperation. Inanimate nature shows none of these traits. Atoms, molecules, stars may coagulate, collide, and explode but they do not fight each other; nor do they collaborate. Consequently, it was dubious that the methods and concepts developed for the physical sciences would succeed in being applied to social problems.

The foundations of game theory were laid by John von Neumann, who in 1928 proved the basic minimax theorem, and with the publication in 1944 of the *Theory of Games and Economic Behavior* the field was established. It was shown that social events can best be described by models taken from suitable games of strategy. These games in turn are amenable to thorough mathematical analysis.

CLASSIFICATION OF GAMES

1) **NUMBER OF PLAYERS**

   1-Person "Games Against Nature"
   Decision Analysis
   2-Person
   n-Person 3 or more decision makers
   Coalitions

2) **"ZERO-SUM" vs "NONZERO-SUM"**

3) **PRESENCE OR ABSENCE OF *CHANCE* MOVES**

4) **KIND AND AMOUNT OF INFORMATION AVAILABLE TO EACH PLAYER CONCERNING MOVES OF THE OTHER PLAYER.**

   Perfect Information: Chess, Tic-Tac-Toe, Go
   Imperfect Information: Gin Rummy

5) NUMBER OF AVAILABLE STRATEGIES

A **Strategy** is a complete set of principles which determine a player's moves for all situations which may arise in the course of a game.

MOVE *vs* STRATEGY

A	B	C
D	E	F
G	H	I

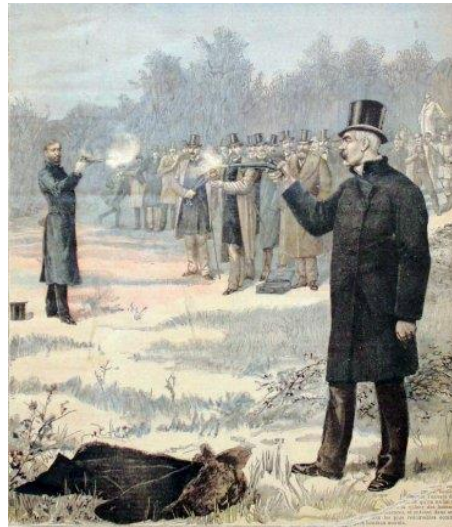**MOVE:** Place "X" in Box *F*

STRATEGY: Occupy alphabetically smallest open cell

Classification by Number of Strategies

Infinite: At last one player has infinitely many possible strategies

DUELS

Finite: Each player has a finite number of strategies from which to choose:

m by *n* Game

One player has *m* available
Other player has *n* available

Duels

Hamilton – Burr Duel

Truels: 3 – Person Duels

MATHEMATICS MAGAZINE

- The Truel
- A Pedestrian Approach to a Method of Convoy
- Formulaic, Algorithms, and Quartic Extrema
- Markov Chains and RISK
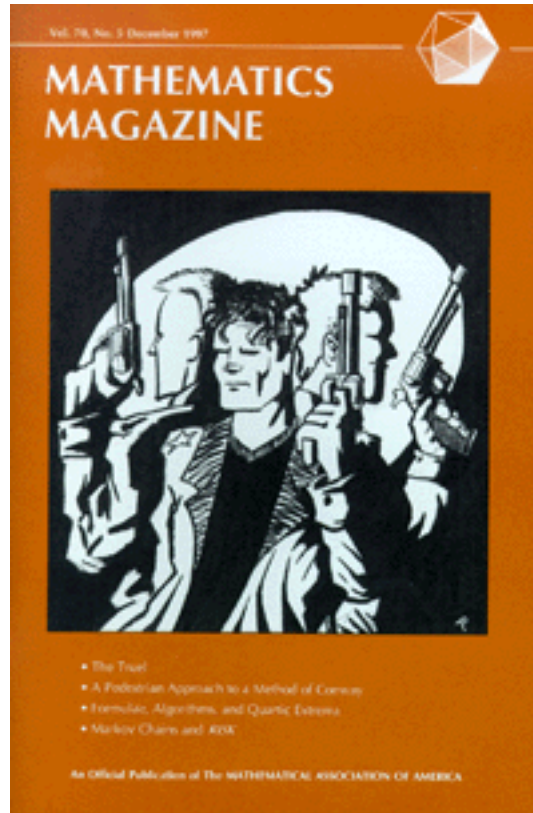
Mathematical Models, The Bible and Opera
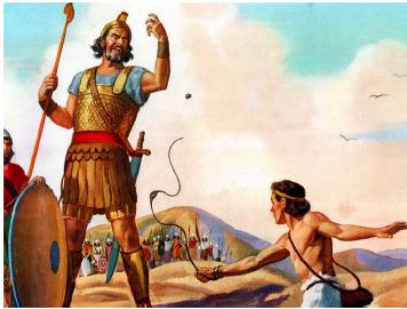
Case Studies

Should David Take Up The Challenge To Fight Goliath?

Should Abraham Sacrifice His Son Isaac As God Demands?

Should Tosca and Scarpia Double Cross Each Other?

BIBLICAL GAMES

Game Theory and the Hebrew Bible

Steven J. Brams

1940 –

Department of Politics
New York University

YouTube: Game Theory and the Humanities
https://www.youtube.com/watch?v=rFP7fZri4QQ

א וַיְהִ֗י אַחַר֙ הַדְּבָרִ֣ים הָאֵ֔לֶּה וְהָ֣אֱלֹהִ֔ים נִסָּ֖ה אֶת־אַבְרָהָ֑ם

ב וַיֹּ֣אמֶר אֵלָ֤יו אַבְרָהָם֙ וַיֹּ֣אמֶר הִנֵּ֔נִי: וַיֹּ֡אמֶר קַח־נָ֠א אֶת־
בִּנְךָ֨ אֶת־יְחִידְךָ֤ אֲשֶׁר־אָהַ֙בְתָּ֙ אֶת־יִצְחָ֔ק וְלֶךְ־לְךָ֔ אֶל־אֶ֖רֶץ
הַמֹּרִיָּ֑ה וְהַעֲלֵ֤הוּ שָׁם֙ לְעֹלָ֔ה עַ֚ל אַחַ֣ד הֶֽהָרִ֔ים אֲשֶׁ֖ר אֹמַ֥ר

ג אֵלֶֽיךָ: וַיַּשְׁכֵּ֨ם אַבְרָהָ֜ם בַּבֹּ֗קֶר וַֽיַּחֲבֹשׁ֙ אֶת־חֲמֹר֔וֹ וַיִּקַּ֞ח
אֶת־שְׁנֵ֤י נְעָרָיו֙ אִתּ֔וֹ וְאֵ֖ת יִצְחָ֣ק בְּנ֑וֹ וַיְבַקַּע֙ עֲצֵ֣י עֹלָ֔ה וַיָּ֣קׇם

ד וַיֵּ֔לֶךְ אֶל־הַמָּק֖וֹם אֲשֶׁר־אָמַר־ל֥וֹ הָאֱלֹהִֽים: בַּיּ֣וֹם הַשְּׁלִישִׁ֗י

ה וַיִּשָּׂ֨א אַבְרָהָ֧ם אֶת־עֵינָ֛יו וַיַּ֥רְא אֶת־הַמָּק֖וֹם מֵרָחֹֽק: וַיֹּ֣אמֶר
אַבְרָהָ֣ם אֶל־נְעָרָ֗יו שְׁבוּ־לָכֶ֥ם פֹּה֙ עִֽם־הַחֲמ֔וֹר וַאֲנִ֣י וְהַנַּ֔עַר

ו נֵלְכָ֖ה עַד־כֹּ֑ה וְנִֽשְׁתַּחֲוֶ֖ה וְנָשׁ֥וּבָה אֲלֵיכֶֽם: וַיִּקַּ֣ח אַבְרָהָ֡ם
אֶת־עֲצֵ֣י הָעֹלָ֗ה וַיָּ֙שֶׂם֙ עַל־יִצְחָ֣ק בְּנ֔וֹ וַיִּקַּ֣ח בְּיָד֔וֹ אֶת־הָאֵ֖שׁ

ז וְאֶת־הַֽמַּאֲכֶ֑לֶת וַיֵּלְכ֥וּ שְׁנֵיהֶ֖ם יַחְדָּֽו: וַיֹּ֨אמֶר יִצְחָ֜ק אֶל־
אַבְרָהָ֤ם אָבִיו֙ וַיֹּ֣אמֶר אָבִ֔י וַיֹּ֖אמֶר הִנֶּ֣נִּֽי בְנִ֑י וַיֹּ֗אמֶר הִנֵּ֤ה

ח הָאֵשׁ֙ וְהָ֣עֵצִ֔ים וְאַיֵּ֥ה הַשֶּׂ֖ה לְעֹלָֽה: וַיֹּ֙אמֶר֙ אַבְרָהָ֔ם אֱלֹהִ֞ים

ט יִרְאֶה־לּ֤וֹ הַשֶּׂה֙ לְעֹלָ֣ה בְּנִ֔י וַיֵּלְכ֥וּ שְׁנֵיהֶ֖ם יַחְדָּֽו: וַיָּבֹ֗אוּ
אֶֽל־הַמָּקוֹם֮ אֲשֶׁ֣ר אָֽמַר־ל֣וֹ הָאֱלֹהִים֒ וַיִּ֨בֶן שָׁ֤ם אַבְרָהָם֙
אֶת־הַמִּזְבֵּ֔חַ וַֽיַּעֲרֹ֖ךְ אֶת־הָעֵצִ֑ים וַֽיַּעֲקֹד֙ אֶת־יִצְחָ֣ק בְּנ֔וֹ וַיָּ֤שֶׂם

י אֹתוֹ֙ עַל־הַמִּזְבֵּ֔חַ מִמַּ֖עַל לָעֵצִֽים: וַיִּשְׁלַ֤ח אַבְרָהָם֙ אֶת־

יא יָד֔וֹ וַיִּקַּ֖ח אֶת־הַֽמַּאֲכֶ֑לֶת לִשְׁחֹ֖ט אֶת־בְּנֽוֹ: וַיִּקְרָ֨א אֵלָ֜יו
מַלְאַ֤ךְ יְהוָה֙ מִן־הַשָּׁמַ֔יִם וַיֹּ֖אמֶר אַבְרָהָ֣ם ׀ אַבְרָהָ֑ם וַיֹּ֖אמֶר

יב הִנֵּֽנִי: וַיֹּ֗אמֶר אַל־תִּשְׁלַ֤ח יָֽדְךָ֙ אֶל־הַנַּ֔עַר וְאַל־תַּ֥עַשׂ ל֖וֹ
מְא֑וּמָה כִּ֣י ׀ עַתָּ֣ה יָדַ֗עְתִּי כִּֽי־יְרֵ֤א אֱלֹהִים֙ אַ֔תָּה וְלֹ֥א חָשַׂ֛כְתָּ

יג אֶת־בִּנְךָ֥ אֶת־יְחִידְךָ֖ מִמֶּֽנִּי: וַיִּשָּׂ֨א אַבְרָהָ֜ם אֶת־עֵינָ֗יו וַיַּרְא֙
וְהִנֵּה־אַ֔יִל אַחַ֕ר נֶאֱחַ֥ז בַּסְּבַ֖ךְ בְּקַרְנָ֑יו וַיֵּ֤לֶךְ אַבְרָהָם֙ וַיִּקַּ֣ח

יד אֶת־הָאַ֔יִל וַיַּעֲלֵ֥הוּ לְעֹלָ֖ה תַּ֣חַת בְּנֽוֹ: וַיִּקְרָ֧א אַבְרָהָ֛ם שֵֽׁם־
הַמָּק֥וֹם הַה֖וּא יְהוָ֣ה ׀ יִרְאֶ֑ה אֲשֶׁר֙ יֵאָמֵ֣ר הַיּ֔וֹם בְּהַ֥ר יְהוָ֖ה

טו יֵרָאֶֽה: וַיִּקְרָ֛א מַלְאַ֥ךְ יְהוָ֖ה אֶל־אַבְרָהָ֑ם שֵׁנִ֖ית מִן־הַשָּׁמָֽיִם:

טז וַיֹּ֕אמֶר בִּ֥י נִשְׁבַּ֖עְתִּי נְאֻם־יְהוָ֑ה כִּ֗י יַ֚עַן אֲשֶׁ֤ר עָשִׂ֙יתָ֙ אֶת־
הַדָּבָ֣ר הַזֶּ֔ה וְלֹ֥א חָשַׂ֖כְתָּ אֶת־בִּנְךָ֥ אֶת־יְחִידֶֽךָ: כִּֽי־בָרֵ֣ךְ

יז אֲבָרֶכְךָ֗ וְהַרְבָּ֨ה אַרְבֶּ֤ה אֶֽת־זַרְעֲךָ֙ כְּכוֹכְבֵ֣י הַשָּׁמַ֔יִם וְכַח֕וֹל
אֲשֶׁ֖ר עַל־שְׂפַ֣ת הַיָּ֑ם וְיִרַ֣שׁ זַרְעֲךָ֔ אֵ֖ת שַׁ֥עַר אֹיְבָֽיו: וְהִתְבָּרֲכ֣וּ

יח בְזַרְעֲךָ֔ כֹּ֖ל גּוֹיֵ֣י הָאָ֑רֶץ עֵ֕קֶב אֲשֶׁ֥ר שָׁמַ֖עְתָּ בְּקֹלִֽי: וַיָּ֤שׇׁב

יט אַבְרָהָם֙ אֶל־נְעָרָ֔יו וַיָּקֻ֛מוּ וַיֵּלְכ֥וּ יַחְדָּ֖ו אֶל־בְּאֵ֣ר שָׁ֑בַע
וַיֵּ֥שֶׁב אַבְרָהָ֖ם בִּבְאֵ֥ר שָֽׁבַע: פ

כ וַיְהִ֗י אַחֲרֵי֙ הַדְּבָרִ֣ים הָאֵ֔לֶּה וַיֻּגַּ֥ד לְאַבְרָהָ֖ם לֵאמֹ֑ר הִ֠נֵּה
יָלְדָ֨ה מִלְכָּ֥ה גַם־הִ֛וא בָּנִ֖ים לְנָח֥וֹר אָחִֽיךָ: אֶת־ע֥וּץ בְּכֹר֖וֹ

כא וְאֶת־בּ֣וּז אָחִ֑יו וְאֶת־קְמוּאֵ֖ל אֲבִ֥י אֲרָֽם: וְאֶת־כֶּ֣שֶׂד וְאֶת־חֲז֔וֹ

כב וְאֶת־פִּלְדָּ֖שׁ וְאֶת־יִדְלָ֑ף וְאֵ֖ת בְּתוּאֵֽל: וּבְתוּאֵ֖ל יָלַ֣ד אֶת־

כג רִבְקָ֑ה שְׁמֹנָ֥ה אֵ֙לֶּה֙ יָלְדָ֣ה מִלְכָּ֔ה לְנָח֖וֹר אֲחִ֥י אַבְרָהָֽם:

Some time later God tested Abraham. He said to him, "Abraham!"

"Here I am," he replied.

² Then God said, "Take your son, your only son, whom you love—Isaac—and go to the region of Moriah. Sacrifice him there as a burnt offering on a mountain I will show you."

³ Early the next morning Abraham got up and loaded his donkey. He took with him two of his servants and his son Isaac. When he had cut enough wood for the burnt offering, he set out for the place God had told him about. ⁴ On the third day Abraham looked up and saw the place in the distance. ⁵ He said to his servants, "Stay here with the donkey while I and the boy go over there. We will worship and then we will come back to you."

⁶ Abraham took the wood for the burnt offering and placed it on his son Isaac, and he himself carried the fire and the knife. As the two of them went on together, ⁷ Isaac spoke up and said to his father Abraham, "Father?"

"Yes, my son?" Abraham replied.

"The fire and wood are here," Isaac said, "but where is the lamb for the burnt offering?"

⁸ Abraham answered, "God himself will provide the lamb for the burnt offering, my son." And the two of them went on together.

⁹ When they reached the place God had told him about, Abraham built an altar there and arranged the wood on it. He bound his son Isaac and laid him on the altar, on top of the wood. ¹⁰ Then he reached out his hand and took the knife to slay his son. ¹¹ But the angel of the LORD called out to him from heaven, "Abraham! Abraham!"

"Here I am," he replied.

¹² "Do not lay a hand on the boy," he said. "Do not do anything to him. Now I know that you fear God, because you have not withheld from me your son, your only son."

¹³ Abraham looked up and there in a thicket he saw a ram caught by its horns. He went over and took the ram and sacrificed it as a burnt offering instead of his son. ¹⁴ So Abraham called that place The LORD Will Provide. And to this day it is said, "On the mountain of the LORD it will be provided."

¹⁵ The angel of the LORD called to Abraham from heaven a second time ¹⁶ and said, "I swear by myself, declares the LORD, that because you have done this and have not withheld your son, your only son, ¹⁷ I will surely bless you and make your descendants as numerous as the stars in the sky and as the sand on the seashore. Your descendants will take possession of the cities of their enemies, ¹⁸ and through your offspring all nations on earth will be blessed because you have obeyed me."

Qur'ân verses 37:99 to verse 37:109

وَقَالَ إِنِّى ذَاهِبٌ إِلَىٰ رَبِّى سَيَهْدِينِ ۝ رَبِّ هَبْ لِى مِنَ

ٱلصَّـٰلِحِينَ ۝ فَبَشَّرْنَـٰهُ بِغُلَـٰمٍ حَلِيمٍ ۝ فَلَمَّا بَلَغَ مَعَهُ

ٱلسَّعْىَ قَالَ يَـٰبُنَىَّ إِنِّى أَرَىٰ فِى ٱلْمَنَامِ أَنِّى أَذْبَحُكَ فَٱنظُرْ

مَاذَا تَرَىٰ قَالَ يَـٰأَبَتِ ٱفْعَلْ مَا تُؤْمَرُ سَتَجِدُنِى إِن شَآءَ

ٱللَّهُ مِنَ ٱلصَّـٰبِرِينَ ۝ فَلَمَّا أَسْلَمَا وَتَلَّهُ لِلْجَبِينِ

۝ وَنَـٰدَيْنَـٰهُ أَن يَـٰإِبْرَٰهِيمُ ۝ قَدْ صَدَّقْتَ ٱلرُّءْيَآ

99. He said: "I will go to my Lord! He will surely guide me
100. "O my Lord! Grant me a righteous (son)!"
101. So We gave him the good news of a forbearing son.
102. Then, when (the son) reached (the age of) (serious) work with him, he said: "O my son! I have seen in a vision that I offer thee in sacrifice: now see what is thy view!" (The son) said: "O my father! Do as thou art commanded: thou will find me, if Allah so wills, one of the steadfast!"
103. So when they had both submitted (to Allah), and he had laid him prostrate on his forehead (for sacrifice),
104. We called out to him "O Abraham! ...
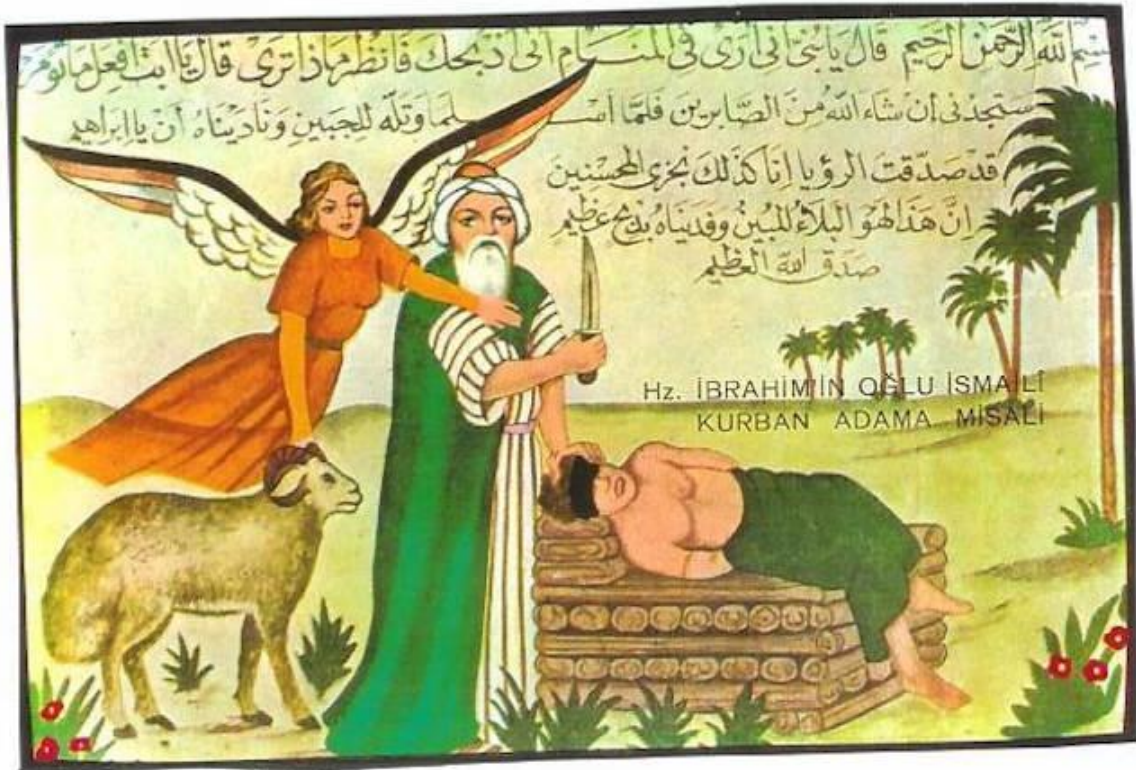105. "Thou hast already fulfilled the vision!" - thus indeed do We reward those who do right.

Hz. İBRAHİMİN OĞLU İSMAİLİ
KURBAN ADAMA MİSALİ

Father, look, here is the fire and the wood, but where is the lamb for the burnt sacrifice?
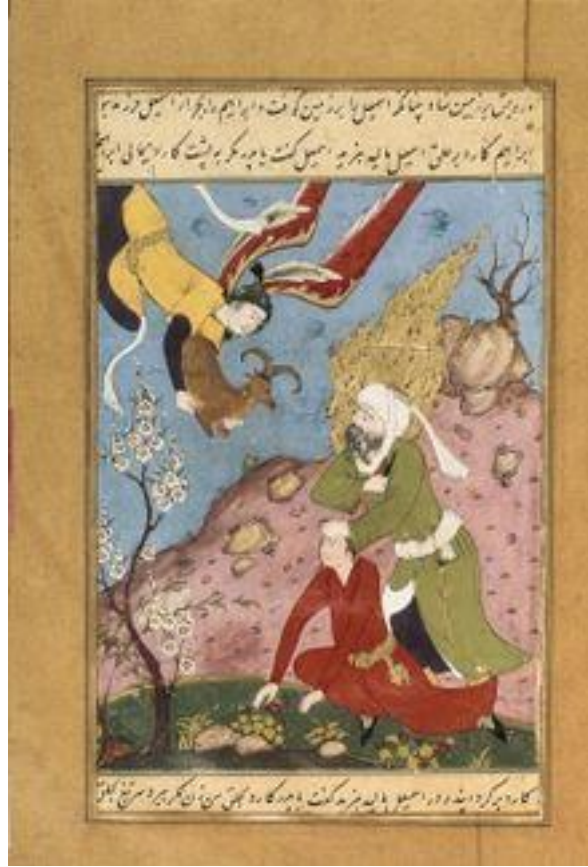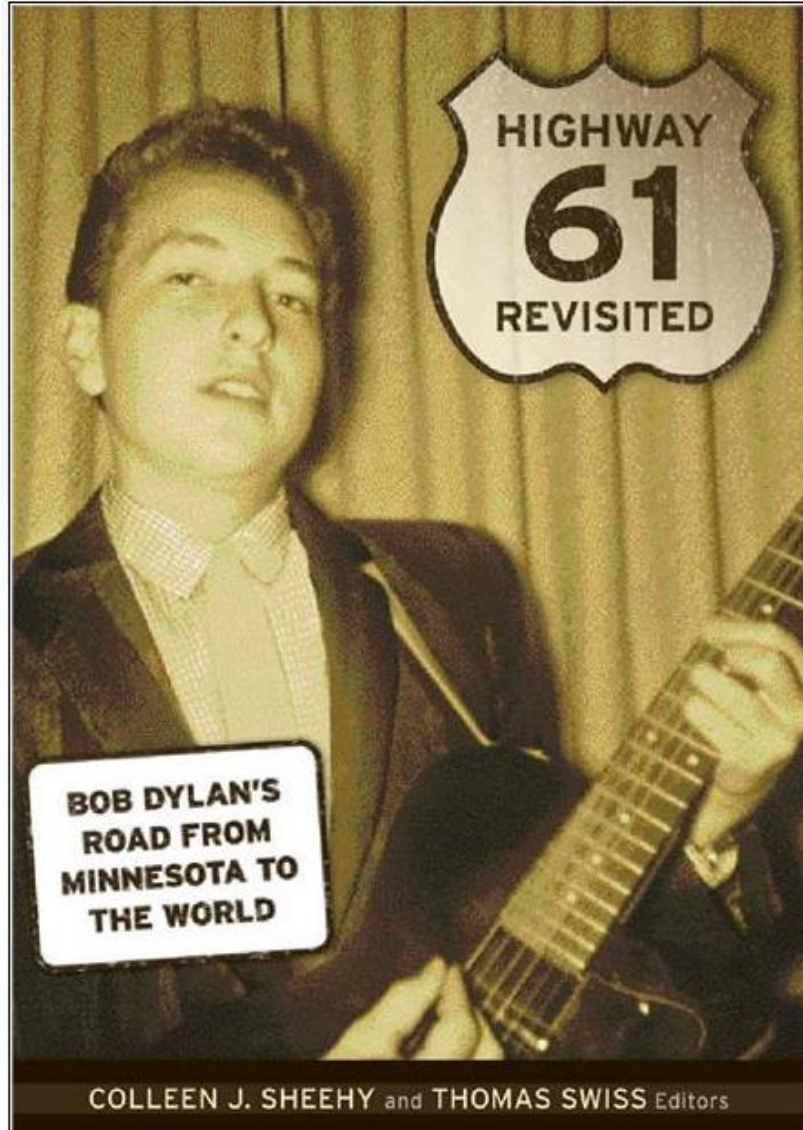
HIGHWAY 61 REVISITED

BOB DYLAN'S ROAD FROM MINNESOTA TO THE WORLD

COLLEEN J. SHEEHY and THOMAS SWISS Editors

Oh God said to Abraham, "Kill me a son"
Abe says, "Man, you must be puttin' me on"
God say, "No." Abe say, "What ?"
God say, "You can do what you want Abe, but
The next time you see me comin' you better run"
Well Abe says, "Where do you want this killin' done?"
God says. "Out on Highway 61".

https://www.youtube.com/watch?v=NDgefX2sZRU

Tom Ayres and Le Strange perform Highway 61, Bob Dylan '66. LIve at Planet Gemini
April 15, 2011

Game Theory and The Bible

Steven Brams, *Biblical Games: Strategic Analysis of Old Testament Stories,* Cambridge: MIT Press, 1980

*I.	Game Theory: What Is It?*

*II.	A Classification of Games*
	A, Number of Players
	B. Zero-sum vs Nonzero-sum
	C. Chance
	D. Information
	E. Number of Strategies

*III.	One Person Games = Games Against Nature*
	(Decision Making Under Uncertainty)
		Example: David's Decision To Fight Goliath

*IV.	Biblical Games*
	A. God as a Player
	B. The Binding of Isaac
	C. Abraham's Choices and God's Choices
	D. The Outcome Matrix
	E. God's Preferences
	F. Abraham's Preferences
		1. Abraham Faithful Regardless
		2. Abraham Wavers Somewhat
		3. Abraham Wavers Seriously
	G. The Strategies
	H. The Payoff Matrix
	I. The Concept of a Dominating Strategy
	J. Strategic Calculations

Abraham's Choices
    O :   Offer Isaac
    O*:   Don't Offer Isaac

God's Choices:
    R :   Renege if Isaac offered; relent if
            not   [*merciful*]
    R*:   Don't renege/relent   [*adamant*]

Outcome Matrix
GOD

		R	R*
A		Abraham faithful	Abraham faithful
B	O	God merciful	God Adamant
R		Isaac saved	Isaac sacrificed
A			
H		Abraham resistant	Abraham resistant
A	O*	God merciful	God Adamant
M		Isaac saved	Isaac's fate uncertain

<u>Outcome Matrix</u>

GOD

		R	**R***
A		Abraham faithful	Abraham faithful
B	**O**	God merciful	God Adamant
R		Isaac saved	Isaac sacrificed
A			
H		Abraham resistant	Abraham resistant
A	**O***	God merciful	God Adamant
M		Isaac saved	Isaac's fate uncertain

How Does God Rank The Outcomes?

GOD

		R	**R***
A			
B	**O**	4	3
R			
A			
H			
A	**O***	1	2
M			

What About Abraham's Preferences?

(a) Abraham faithful regardless

$$
\begin{array}{c c}
 & R \quad R* \\
\begin{array}{c} O \\ O* \end{array} &
\left(\begin{array}{cc} 4 & 3 \\ 2 & 1 \end{array} \right)
\end{array}
$$

What About Abraham's Preferences?

(a) Abraham faithful regardless

$$\begin{array}{cc} & R \quad R* \\ \begin{array}{c} O \\ O* \end{array} & \begin{pmatrix} 4 & 3 \\ 2 & 1 \end{pmatrix} \end{array}$$

(b) Abraham wavers somewhat

$$\begin{array}{cc} & R \quad R* \\ \begin{array}{c} O \\ O* \end{array} & \begin{pmatrix} 4 & 2 \\ 3 & 1 \end{pmatrix} \end{array}$$

What About Abraham's Preferences?

(a) Abraham faithful regardless

$$\begin{array}{cc} & \begin{array}{cc} R & R* \end{array} \\ \begin{array}{c} O \\ O* \end{array} & \begin{pmatrix} 4 & 3 \\ 2 & 1 \end{pmatrix} \end{array}$$

(b) Abraham wavers somewhat

$$\begin{array}{cc} & \begin{array}{cc} R & R* \end{array} \\ \begin{array}{c} O \\ O* \end{array} & \begin{pmatrix} 4 & 2 \\ 3 & 1 \end{pmatrix} \end{array}$$

(c) Abraham wavers seriously

$$\begin{array}{cc} & \begin{array}{cc} R & R* \end{array} \\ \begin{array}{c} O \\ O* \end{array} & \begin{pmatrix} 4 & 1 \\ 3 & 2 \end{pmatrix} \end{array}$$

$$
\begin{array}{cc}
& \begin{array}{cc} R & \quad R^* \end{array} \\
\begin{array}{c} O \\ O^* \end{array} &
\begin{pmatrix} (4,4) & (3,3) \\ (2,1) & (1,2) \end{pmatrix}
\end{array}
\qquad
\begin{array}{cc}
& \begin{array}{cc} R & \quad R^* \end{array} \\
\begin{array}{c} O \\ O^* \end{array} &
\begin{pmatrix} (4,4) & (2,3) \\ (3,1) & (1,2) \end{pmatrix}
\end{array}
\qquad
\begin{array}{cc}
& \begin{array}{cc} R & \quad R^* \end{array} \\
\begin{array}{c} O \\ O^* \end{array} &
\begin{pmatrix} (4,4) & (1,3) \\ (3,1) & (2,2) \end{pmatrix}
\end{array}
$$

<div align="center">(a)   (b)   (c)</div>

The Strategies

Abraham: O or O*

God:
  R /R be merciful regardless
  R*/R* be adamant regardless
  R /R* tit-for-tat
  R*/R tat-for-tit

The notation *A/B* for a strategy for God means:
do *A* if Abraham does *O*,
do *B* if Abraham does *O**

Abraham: O or O*

God:
 R /R be merciful regardless
 R*/R* be adamant regardless
 R /R* tit-for-tat
 R*/R tat-for-tit

The Payoff Matrix For
(a): Abraham Faithful Regardless

	R	R*	R/R	R*/R*	R/R*	R*/R
O	(4,4)	(3,3)	(4,4)	(3,3)	(4,4)	(3,3)
O*	(2,1)	(1,2)	(2,1)	(1,2)	(1,2)	(2,1)

What Should Abraham Do?

Abraham: O or O*

God:
R /R be merciful regardless
R*/R* be adamant regardless
R /R* tit-for-tat
R*/R tat-for-tit

The Payoff Matrix For
(a): Abraham Faithful Regardless

$$
\begin{array}{c c c c c c c}
 & R & R^* & R/R & R^*/R^* & R/R^* & R^*/R \\
O & (4,4) & (3,3) & (4,4) & (3,3) & (4,4) & (3,3) \\
O^* & (2,1) & (1,2) & (2,1) & (1,2) & (1,2) & (2,1) \\
\end{array}
$$

What Should Abraham Do?

Abraham Has A Dominant Strategy

Abraham: O or O*

God:
  R /R be merciful regardless
  R*/R* be adamant regardless
  R /R* tit-for-tat
  R*/R tat-for-tit

The Payoff Matrix For
(a): Abraham Faithful Regardless

	R	R*	R/R	R*/R*	R/R*	R*/R
O	(4,4)	(3,3)	(4,4)	(3,3)	(4,4)	(3,3)
O*	(2,1)	(1,2)	(2,1)	(1,2)	(1,2)	(2,1)

What Should Abraham Do?

Abraham Has A Dominant Strategy

Abraham Should Play O Strategy

What Will God Do?

Abraham: O or O*

God:
 R /R be merciful regardless
 R*/R* be adamant regardless
 R /R* tit-for-tat
 R*/R tat-for-tit

The Payoff Matrix For
(a): Abraham Faithful Regardless

	R	R*	R/R	R*/R*	R/R*	R*/R
O	(4,4)	(3,3)	(4,4)	(3,3)	(4,4)	(3,3)
O*	(2,1)	(1,2)	(2,1)	(1,2)	(1,2)	(2,1)

What Should Abraham Do?
Abraham Has A Dominant Strategy
Abraham Should Play O Strategy
What Will God Do?
God will play R/R*

Outcome is (4,4)

Abraham: O or O*

God:
  R /R be merciful regardless
  R*/R* be adamant regardless
  R /R* tit-for-tat
  R*/R tat-for-tit

The Payoff Matrix For
(b): Abraham Wavers Somewhat

	R	R*	R/R	R*/R*	R/R*	R*/R
O	(4,4)	(2,3)	(4,4)	(2,3)	(4,4)	(2,3)
O*	(3,1)	(1,2)	(3,1)	(1,2)	(1,2)	(3,1)

What Should Abraham Do?

Abraham: O or O*

God:
 R /R be merciful regardless
 R*/R* be adamant regardless
 R /R* tit-for-tat
 R*/R tat-for-tit

The Payoff Matrix For
(b): Abraham Wavers Somewhat

	R	R*	R/R	R*/R*	R/R*	R*/R
O	(4,4)	(2,3)	(4,4)	(2,3)	(4,4)	(2,3)
O*	(3,1)	(1,2)	(3,1)	(1,2)	(1,2)	(3,1)

What Should Abraham Do?
Abraham Has No Dominant Strategy

Abraham: O or O*

God:
  R /R be merciful regardless
  R*/R* be adamant regardless
  R /R* tit-for-tat
  R*/R tat-for-tit

The Payoff Matrix For
(b): Abraham Wavers Somewhat

	R	R*	R/R	R*/R*	R/R*	R*/R
O	(4,4)	(2,3)	(4,4)	(2,3)	(4,4)	(2,3)
O*	(3,1)	(1,2)	(3,1)	(1,2)	(1,2)	(3,1)

What Should Abraham Do?
Abraham Has No Dominant Strategy
Consider What God Will Do.

Abraham: O or O*

God:
  R /R be merciful regardless
  R*/R* be adamant regardless
  R /R* tit-for-tat
  R*/R tat-for-tit

The Payoff Matrix For
(b): Abraham Wavers Somewhat

	R	R*	R/R	R*/R*	R/R*	R*/R
O	(4,4)	(2,3)	(4,4)	(2,3)	(4,4)	(2,3)
O*	(3,1)	(1,2)	(3,1)	(1,2)	(1,2)	(3,1)

What Should Abraham Do?
Abraham Has No Dominant Strategy
Consider What God Will Do.
God has a Dominant Stratgy: R/R*

Abraham: O or O*

God:
  R /R be merciful regardless
  R*/R* be adamant regardless
  R /R* tit-for-tat
  R*/R tat-for-tit

The Payoff Matrix For
(b): Abraham Wavers Somewhat

	R	R*	R/R	R*/R*	R/R*	R*/R
O	(4,4)	(2,3)	(4,4)	(2,3)	(4,4)	(2,3)
O*	(3,1)	(1,2)	(3,1)	(1,2)	(1,2)	(3,1)

What Should Abraham Do?
Abraham Has No Dominant Strategy
Consider What God Will Do.
God has a Dominant Stratgy: R/R*
God Will Play R/R*
Abe's Best Response:

The Payoff Matrix For
(b): Abraham Wavers Somewhat

$$
\begin{array}{c}
\quad\quad R \quad\quad R^* \quad\quad R/R \quad\quad R^*/R^* \quad R/R^* \quad R^*/R \\
\begin{array}{c} O \\ O^* \end{array}
\left(
\begin{array}{cc|cccc}
(4,4) & (2,3) & (4,4) & (2,3) & (4,4) & (2,3) \\
(3,1) & (1,2) & (3,1) & (1,2) & (1,2) & (3,1)
\end{array}
\right)
\end{array}
$$

What Should Abraham Do?
Abraham Has No Dominant Strategy
Consider What God Will Do.
God has a Dominant Stratgy: R/R*
God Will Play R/R*
Abe's Best Response: O
Outcome is (4,4)

Abraham: O or O*

God:
 R /R be merciful regardless
 R*/R* be adamant regardless
 R /R* tit-for-tat
 R*/R tat-for-tit

The Payoff Matrix For
(c): Abraham Wavers Seriously

	R	R*	R/R	R*/R*	R/R*	R*/R
O	(4,4)	(1,3)	(4,4)	(1,3)	(4,4)	(1,3)
O*	(3,1)	(2,2)	(3,1)	(2,2)	(2,2)	(3,1)