Thus, according to my estimates, the highest-priority concern I should have about the game's success is that no one will care. Accordingly, I made a plan to publicize the game project.

End Notes

1. Bulletproofing. *http://www.mycoted.com/creativity/techniques/bulet-proof.php*.
2. Keegan, Gerard. "Likert Scale" (glossary entry). *http://www.gerardkeegan.co.uk/glossary/gloss_l.htm*.
3. Wikipedia entry. "Likert Scale." *http://en.wikipedia.org/wiki/Likert_scale*.
4. Wikipedia entry. "Risk aversion." *http://en.wikipedia.org/wiki/Risk_aversion*.

HACK #45

Predict the Length of a Lifetime

Many of us instinctively trust that things that have been around a long time are likely to be around a lot longer, and things that haven't, aren't. The formalization of this heuristic is known as Gott's Principle, and the math is easy to do.

Physicist J. Richard Gott III has so far correctly predicted when the Berlin Wall would fall and calculated the duration of 44 Broadway shows.[1] Controversially, he has predicted that the human race will probably exist between 5,100 and 7.8 million more years, but no longer. He argues that this is a good reason to create self-sustaining space colonies: if the human race puts some eggs in other nests, we might extend the life span of our species in case of an asteroid strike or nuclear war on the home planet.[2]

Gott believes that his simple calculations can be extended to almost anything at all, within certain parameters. To predict how long something will be around by using these calculations, all you need to know is how long it *has* been around already.

In Action

Gott bases his calculations on what he calls the Copernican Principle (and what some people call, in this specific application, Gott's Principle). The principle says that when you choose a moment in time to calculate the lifetime of a phenomenon, that moment is probably quite ordinary, not special or privileged, just as Copernicus told us the Earth does not occupy a privileged place in the universe.

It's important to choose subjects at ordinary, unprivileged moments. Biasing your test by choosing subjects that you already believe to be near the beginning or end of their life span—such as the human occupants of a neonatal ward or a nursing home—will yield bad results. Further, Gott's Principle is less useful in situations where actuarial data already exists. Plenty of actuarial data is available on the human life span already, so Gott's Principle is less useful here.

Having chosen a moment, let's examine it. All else being equal, there's a 50% chance the moment is somewhere in the middle 50% of the phenomenon's lifetime, a 60% chance it's in the middle 60%, a 95% chance it's in the middle 95%, and so on. Therefore, there's only a 25% chance that you've chosen a moment in the first fourth of its lifetime, a 20% chance it's in the first fifth, a 2.5% chance it's in the last 2.5% of the subject's lifetime, and so on.

Table 5-4 provides equations for the 50%, 60%, and 95% confidence levels. The variable t_{past} represents how long the object has existed, and t_{future} represents how long it is expected to continue.

Table 5-4. Confidence levels under Gott's Principle

Confidence level	Minimum t_{future}	Maximum t_{future}
50%	$t_{past} / 3$	$3t_{past}$
60%	$t_{past} / 4$	$4t_{past}$
95%	$t_{past} / 39$	$39t_{past}$

Let's look at a simple example. Quick: whose work do you think is more likely to be listened to 50 years from now, Johann Sebastian Bach's or Britney Spears'? Bach's first work was performed around 1705. At the time of this writing, that's 300 years ago. Britney Spears' first album was released in January 1999, about 6.5 years or 79 months ago.

Consulting Table 5-4, for the 60% confidence level, we see that the minimum t_{future} is t_{past} / 4, and the maximum is $4t_{past}$. Since t_{past} for Britney's music is 79 months, there is a 60% chance that Britney's music will be heard for between 79 / 4 months and 79 × 4 months longer. In other words, we can be 60% sure that Britney will be a cultural force for somewhere between 19.75 months (1.6 years) and 316 months (26.3 years) from now.

> Sixty percent is a good confidence level for quick estimation; not only is it a better-than-even chance, but the factors 1/4 and 4 are easy to use because of the phenomenon of aliquot parts **[Hack #36]**.

By the same token, we can expect people to listen to Bach's music for somewhere between another 300 / 4 and 300 × 4 years at the 60% confidence level, or somewhere between 75 years and 1,200 years from now. Thus, we can predict that there's a good chance that Britney's music will die with her fans, and there's a good chance that Bach will be listened to in the fourth millennium.

How It Works

Suppose we are studying the lifetime of some object that we'll call the *target*. As we've already seen, there's a 60% chance we are somewhere in the middle 60% of the object's lifetime (Figure 5-2).[3]

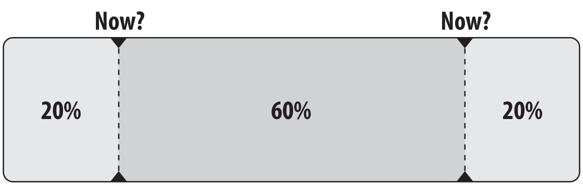

Figure 5-2. The middle 60% of the lifetime

If we are at the very end of this middle 60%, we are at the second point marked "now?" in Figure 5-2. At this point, only 20% of the target's lifetime is remaining (Figure 5-3), which means that t_{future} is equal to one-fourth of t_{past} (80%). This is the minimum remaining lifetime we expect at the 60% confidence level.

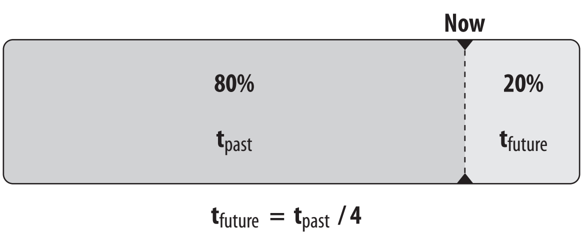

Figure 5-3. The minimum remaining lifetime (60% confidence level)

Similarly, if we are at the beginning of the middle 60% (the first point marked "now?" in Figure 5-2), 80% of the target's existence lies in the future, as depicted in Figure 5-4. Therefore, t_{future} (80%) is equal to 4 × t_{past} (20%). This is the maximum remaining lifetime we expect at the current confidence level.

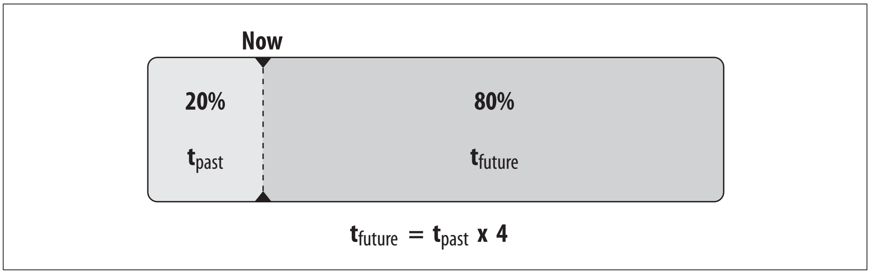

Figure 5-4. The maximum remaining lifetime (60% confidence level)

Since there's a 60% chance we're between these two points, we can calculate with 60% confidence that the future duration of the target (t_{future}) is between t_{past} / 4 and 4 × t_{past}.

In Real Life

Suppose you want to invest in a company and you want to estimate how long the company will be around to determine whether it's a good investment. You can use Gott's Principle to do so. Although it's not publicly traded, let's take O'Reilly Media, the publisher of this book, as an example.

> I certainly didn't pick O'Reilly Media at random, and plenty of historical information is available about how long companies tend to last, but let's try Gott's Principle as a rough-and-ready estimate of O'Reilly's longevity anyway. After all, there's probably good data on the longevity of Broadway shows, but Gott didn't shrink from analyzing them—and I hesitate to say that now that O'Reilly has published *Mind Performance Hacks*, its immortality is assured.

According to the Wikipedia, O'Reilly started in 1978 as a consulting firm doing technical writing. It's July 2005 as I write this, so O'Reilly has existed as a company for approximately 27 years. How long can we expect O'Reilly to continue to exist?

Here's O'Reilly's likely lifetime, calculated at the 50% confidence level:

Minimum
: 27 / 3 = 9 years (until July 2014)

Maximum
: 27 × 3 = 81 years (until July 2086)

Here are our expectations at the 60% confidence level:

Minimum
: 27 / 4 = 6 years and 9 months (until April 2012)

Maximum
: 27 × 4 = 108 years (until July 2113)

Finally, here's our prediction with 95% confidence:

Minimum
: 27 / 39 = 0.69 years = about 8 months and 1 week (until mid-March 2006)

Maximum
: 27 × 39 = 1,053 years (until July 3058)

In the post-dot-com economy, these figures look pretty good. For example, Apple Computer's aren't much better, and Microsoft was founded in 1975, so the same can be said for it. A real investor would want to consider many other factors, such as annual revenue and stock price, but as a first cut, it looks as though O'Reilly Media is at least as likely to outlive a hypothetical investor as to tank in the next decade.

End Notes

1. Ferris, Timothy. "How to Predict Everything." *The New Yorker*, July 12, 1999.
2. Gott, J. Richard III. "Implications of the Copernican Principle for Our Future Prospects." *Nature*, 363, May 27, 1993.
3. Gott, J. Richard III. "A Grim Reckoning." *http://pthbb.org/manual/services/grim*.

HACK #46 Find Dominant Strategies

Sometimes, you can find the best of all possible strategies in what is far from the best of all possible worlds.

Some situations in life are like games, and the mathematical discipline of game theory, which studies game strategies, can be applied to them.

In game theory, a *dominant strategy* is a plan that's better than all the other plans that you can choose, no matter what your opponents do. In other words, a dominant strategy is better than some courses of action in some of the possible situations, and never worse than other courses. Look for a dominant strategy before looking for any other kind of strategy.[1]

In *sequential games*, such as chess or Go, players take turns. You consider your opponent's previous moves, look ahead to anticipate her best moves, and extrapolate to find the optimal move to counter her; the initiative then passes to your opponent, who does the same.

On the other hand, in *simultaneous games*, where players' moves are planned and are executed at the same time, seeking a dominant strategy is helpful. For example, in a presidential debate, you can only guess what your opponent will say and do. In such a situation, using a dominant strategy to know the best possible move regardless of your opponent's move, which you cannot know, is indispensable—if a dominant strategy exists.

In Action

On that world-famous cookery game show, *Titanium Chef*, the contestants are busy cooking on opposite sides of the room, and neither can see what the other is doing. That makes *Titanium Chef* a simultaneous game and an ideal place to look for a dominant strategy.

Consider two contestants, Andi and Bruno. These two chefs must cook in one of two styles: Haute Cuisine and Home Cookin'. Both contestants have made a careful study of the judges' previous preferences, and they know that two of the ten judges prefer Haute Cuisine, and the other eight prefer the guilty pleasure of Home Cookin'.

Furthermore, if Andi cooks in one style and Bruno cooks in the other style, each contestant will get all of the votes from the judges who prefer the particular style. If both contestants cook in the same style, they will split the votes of the judges who prefer that style, and the rest of the judges will pout and abstain. The winner receives $100,000; if there is a tie, the chefs split the prize.

Consider Figure 5-5, which shows the number of votes Andi can expect to get in each possible situation.

		Bruno's Choices	
		Home Cookin'	Haute Cuisine
Andi's Choices	Home Cookin'	4	8
	Haute Cuisine	2	1

Figure 5-5. Possible votes for Andi

If both contestants cook in the Home Cookin' style, they can expect to split the eight votes of the judges who prefer that style, so Andi will get four votes. If both opponents cook Haute Cuisine, they will split the two available votes, and Andi will get one vote.

On the other hand, if Andi cooks Haute Cuisine and Bruno cooks Home Cookin', Andi will get both available votes for Haute Cuisine, for a total of two. If Andi selects Home Cookin' and Bruno chooses Haute Cuisine, Andi will get all eight available votes for Home Cookin'.

No matter what Bruno does, Andi will fare better if she selects Home Cookin', so Home Cookin' is Andi's dominant strategy. You can check this by comparing the top row with the bottom row. Both values in the top row are better than their corresponding values in the bottom row. This means that Home Cookin' *strongly dominates* the Haute Cuisine strategy. If a pair of cells being compared in this case were the same in value, the Home Cookin' strategy would be said to *weakly dominate* the other one.[2]

Now, let's examine Bruno's choices. Figure 5-6 shows Bruno's expected outcome, depending on what each competitor picks.

Andi's Choices \ Bruno's Choices	Home Cookin'	Haute Cuisine
Home Cookin'	4	2
Haute Cuisine	8	1

Figure 5-6. Possible votes for Bruno

Bruno also can expect eight points if he chooses Home Cookin' and Andi chooses Haute Cuisine, two points if the opposite happens, one point if both contestants choose Haute Cuisine, and four points if both contestants choose Home Cookin'.

This time, we're comparing columns, not rows. Both values in the left column (Home Cookin') are bigger than the values in the right column (Haute Cuisine), so Bruno's dominant strategy is also Home Cookin'.

If both players are rational, both will select Home Cookin', since it's the dominant strategy for both of them. If they do so, this episode of *Titanium Chef* will be a foregone conclusion: it will be a 4-4 tie, and each player will receive $50,000.

From Andi's perspective, however, it's always possible that Bruno will miscalculate or not have done his homework and will cook Haute Cuisine instead. In that case, her payoff is huge: she will sweep the judges, receive eight votes, and win $100,000. The same is true from Bruno's perspective.

The worst either of them will do by choosing the dominant strategy is to tie and split the prize, but they have a chance to win outright if their opponent makes a mistake. Without the dominant strategy, they could be the one making the wrong choice, losing outright, and going home with empty pockets.

This simple example is intended for clarity of explanation only. For a more complex example of dominant and dominated strategies, see "Eliminate Dominated Strategies" [Hack #47].

Finding dominant strategies is important because a dominant strategy is your best strategy independent of the impact of your opponents' strategies. It's a way to maximize your potential win and minimize your loss, even before you start and regardless of what happens afterward.

> What is "best" is considered here from a strictly selfish point of view, of course; you might wish to adopt the Golden Rule in some situations despite the fact that it probably wouldn't be a dominant strategy in the game-theory sense.

You can find a dominant strategy in a simultaneous game by creating a table like those shown in Figures 5-5 and 5-6. Populate your table with values calculated any way you prefer, as long as you are consistent. A Likert Scale [Hack #44] provides a human-friendly way of evaluating outcomes.

Note that in our *Titanium Chef* example, both players have a dominant strategy, and it's the same one. Sometimes, however, each player has a different dominant strategy; if that were true on *Titanium Chef*, the contest would still be a foregone conclusion, but there would be a single winner.

Sometimes a player won't have a dominant strategy at all. In that case, he should calculate what the other player's dominant strategy is (if she has one) and make his best response to *that* strategy. It's also important to avoid dominated strategies [Hack #47]. There are also situations (such as a game of Rock Paper Scissors) where no player has a dominant strategy; in such situations, don't overthink things [Hack #48].

In Real Life

Imaginary game shows can be fun, but you might be wondering when you would get a chance to employ dominant strategies in real life. Remember, many real-life situations are gamelike, so you can apply game theory to them. During the Cold War, game theory was even applied to the nuclear arms race, so it can be applied to some very serious "games" indeed. Game theory is also widely used in economics and has even been used to explain some puzzles in evolutionary biology, such as why animals have evolved to cooperate. Consider that all of the following can be modeled as simultaneous games to which game theory can apply:

- Deciding on a legal defense in a courtroom
- Choosing which toys to manufacture for the holiday season
- Deciding whether to attack at dawn
- Deciding whether to be an early adopter of a new technology, or to wait and see if it catches on

As John von Neumann, one of the founders of game theory and inventors of the computer, put it:[3]

> And finally, an event with given external conditions and given actors (assuming absolute free will for the latter) can be seen as a parlor game if one views its effects on the persons involved... There is scarcely a question of daily life in which this problem [of successful strategy] does not play a role.

It is often said that life is a game, but seldom is it said by someone who can back it up with hard figures. Pay attention to dominant strategies, and your life's parlor games may be a little more successful.

End Notes

1. Dixit, Avinash K., and Barry J. Nalebuff 1991. *Thinking Strategically*. W.W. Norton & Company, Inc.
2. Economic Science Laboratory. "Iterated deletion of Dominated strategies." *Economics Handbook. http://www.econport.org:8080/econport/request?page=man_gametheory_domstrat*.
3. Bewersdorff, Jörg, translated by David Kramer. 2005. *Luck, Logic, and White Lies: The Mathematics of Games*. A K Peters, Ltd. An excellent recent book on applying game theory to situations people would normally think of as games, such as chess and poker.

HACK #47

Eliminate Dominated Strategies

Find your strongest strategy by systematically eliminating all of your weaker choices.

We've already seen that it's important to find dominant strategies [Hack #46] when you make decisions, if possible. If you're lucky enough to have a single dominant strategy, your choice is clear.

Sometimes, however, neither opponent has a dominant strategy. In that case, the opponents should try to eliminate strategies from consideration that are *dominated* and to continue eliminating weaker strategies until a single strategy emerges as clearly superior. When each opponent has settled on a single strategy, they have reached a *pure strategy equilibrium*, which is the best that either opponent can rationally hope for.[1]

In Action

Welcome back to that world-famous cookery game show, *Titanium Chef*. On this episode, we have two time-traveling celebrity chefs named Pasta and Futurio. The ground rules for this episode are as follows:

- Both chefs will choose a cuisine from their respective periods. Pasta will choose between Incan and Sumerian cuisine, and Futurio will choose among Andromedan, Rigelian, and Venusian cooking.
- There are 10 judges on this episode, each of whom may either cast one vote for a chef or abstain from voting.
- Each contestant will take home $10,000 times the number of votes she receives.

The *Titanium Chef* studio has been temporally shielded so that Pasta and Futurio can't use their chronovision sets to predict their opponent's cuisine. However, both Pasta and Futurio do have access to advanced computer simulations that can predict how many votes each chef will receive, depending on which cuisine she chooses. Figure 5-7 shows the possible outcomes in each situation.

Remember, a *dominant strategy* is a plan that's better than all the other plans that you can choose, no matter what your opponents do. In this scenario, consider a row where P consistently beats F. If there are no other rows with a better outcome, it's a dominant strategy for P to choose that row. The same would go for F and a winning column.

Futurio's Choices

Pasta's Choices	Andromedan	Rigelian	Venusian
Incan	P=1 F=3	P=1 F=9	P=6 F=1
Sumerian	P=3 F=6	P=3 F=1	P=3 F=1

Figure 5-7. All possible outcomes

As you can see, neither opponent has a dominant strategy. For example, Andromedan cuisine does not dominate Rigelian for Futurio, and vice versa, because each is better for one of Pasta's strategies and worse for the other. However, Andromedan cooking *does* dominate Venusian cooking; Andromedan cooking is a better strategy than Venusian whether Pasta cooks Incan or Sumerian.

Thus, since both players are rational, and each knows the other to be rational as well (each knows the other has a reliable simulation of the contest), they both eliminate the *dominated strategy* of Venusian cooking from their calculations, leaving a simplified game that looks like Figure 5-8.

Futurio's Choices

Pasta's Choices	Andromedan	Rigelian
Incan	P=1 F=3	P=1 F=9
Sumerian	P=3 F=6	P=3 F=1

Figure 5-8. Simplified game without Venusian cuisine

Futurio now has no clear choice, but eliminating Venusian cuisine as an option means that one of Pasta's strategies is now dominated: the Incan row can be eliminated, since both of her values in the Sumerian row are higher. After eliminating the Incan cooking row, the game looks like Figure 5-9.

Futurio's Choices

Pasta's Choices	Andromedan	Rigelian
Sumerian	P=3 F=6	P=3 F=1

Figure 5-9. Simplified game without Incan cuisine

Narrowing Pasta's choices down to Sumerian means that Futurio now has a dominant strategy. Andromedan food clearly dominates Rigelian food, with six votes to Rigelian cuisine's one vote.

Eliminating the dominated Rigelian strategy means that the final pure strategy equilibrium is Sumerian versus Andromedan food. The outcome is that Pasta receives three votes ($30,000) and Futurio receives six votes ($60,000), as shown in Figure 5-10.

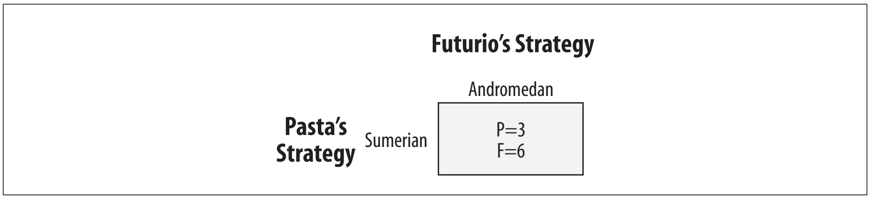

Figure 5-10. The Titanium Chef pure strategy equilibrium

Thus, this episode of *Titanium Chef* was a foregone conclusion, and we didn't even need to watch it or use a time machine to discover how it would turn out. Reality TV tends to work that way...

How It Works

This hack assumes that both opponents are rational. That might seem peculiar; what if your opponent isn't?

It is sometimes possible to do better than game theory predicts, just as it's possible to make a dumb move in chess that *might* pay off, and hope that your opponent doesn't notice how dumb your move was. However, "maybe they won't notice" is not a consistently winning strategy, so the wise player will put up the best possible defense and not pin all his hopes on his opponent being an idiot.[2]

Iterated elimination of dominated strategies works because it simplifies the game in question to a point where it can be handled more easily. Eliminating strategies which neither you nor any rational opponent would play may expose other strategies that can be eliminated the same way. Eventually, either each player will have only one strategy, or the game will at least be simplified to the point that you can analyze it in another way.[3] Think of the process as analogous to reducing a fraction to its lowest terms: the situation being analyzed remains the same, but you can see the answer more clearly.

In Real Life

You can use iterated elimination of dominated strategies in the same real-life situations in which you can find a dominant strategy [Hack #46]. In fact, finding a dominant strategy is just a special case of iterated elimination: in effect, all dominated strategies have already been eliminated.

End Notes

1. Dixit, Avinash K., and Barry J. Nalebuff. 1991. *Thinking Strategically*. W.W. Norton & Company, Inc. The best book of which I'm aware on applying game theory to everyday life.
2. Bewersdorff, Jörg, translated by David Kramer. 2005. *Luck, Logic, and White Lies: The Mathematics of Games*. A K Peters, Ltd.
3. Economic Science Laboratory. "Iterated deletion of Dominated strategies." *Economics Handbook*. *http://www.econport.org:8080/econport/request?page=man_gametheory_domstrat*.

See Also

- The EconPort digital economics library has an *Economics Handbook* with a wonderfully lucid exposition of basic concepts in game theory: *http://www.econport.org:8080/econport/request?page=man*.

HACK #48

Don't Overthink It

When each side in a game—or an important decision—is trying to outsmart the other, it might be time to flip a coin.

On our third trek through the foothills of game theory, let's leave the wilds of *Titanium Chef* behind. Instead, imagine you are playing a game in which you hold a black Go stone in one hand and a white Go stone in the other. Your opponent must choose the hand holding the white stone. If she chooses correctly, she wins $1 from you; if she does not, she pays you $1.

Now imagine that your opponent is super-intelligent and will always outguess you. If you intentionally hide the white stone in your right hand, she will choose that hand. If you decide that she knows you will hide the stone in your right hand, and you try to outsmart her and hide it in your left, she will know that you know she knows, and she will decide to pick your left hand. No matter which hand you decide to hide the stone in while trying to outthink her, she will always be able to outthink you and pick the correct hand.