SLOT TECH
MAGAZINE

SLOT MATH

(can be fun?)

A slot manager's guide to slot machine mathematics

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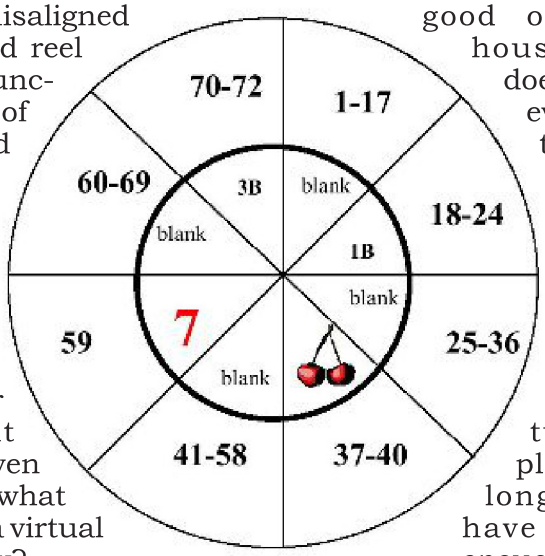
Above PAR

By Ken Locke

"Malfunction Voids All Pays and Plays". Ah, yes, the last saving grace of casino and technician alike. If something goes awry, we don't lose a dime. Or do we?

Let's put that phrase to the test. Is a misaligned or misplaced reel strip a malfunction? Half of you said 'yes', half said 'no'. Next question, does a typical reel-spinner's processor know that reel strips even exist? And, what the heck is a virtual stop anyway?



"Hey, why does '7' get only one virtual?" (Figure 1)

This article is definitely going to separate the mechanics from the technicians. Can you, as 'the expert' decipher a Probability Accounting Report (PAR) and ensure what the glass says is what the reel strip says, is what the software says? These four elements must be accurate to ensure proper game play, and a reel strip and paytable test is essential to that end.

Let's start with reel strips. In short, these are the physical manifestations of the outcome of a random number generator. When the handle is pulled, three randomly selected numbers are created in the MPU and a signal is sent to each reel to interpret these numbers into a location on the reel strip.

Typically, reel strips contain 22 physical locations or stops, starting with a blank, then a symbol, then blank and so on. So let's do the math.

The possible number of outcomes with three reels with twenty-two stops is 22 X 22 X 22 = 10,648. Sounds like good odds in the house's favor, doesn't it? However a one in ten thousand shot at a prize of 25,000 credits doesn't sound like the kind of game I'd want in my casino. Eventually the player will hit long before we have taken in enough money offset the jackpot and thus making a tidy profit of almost 150%.

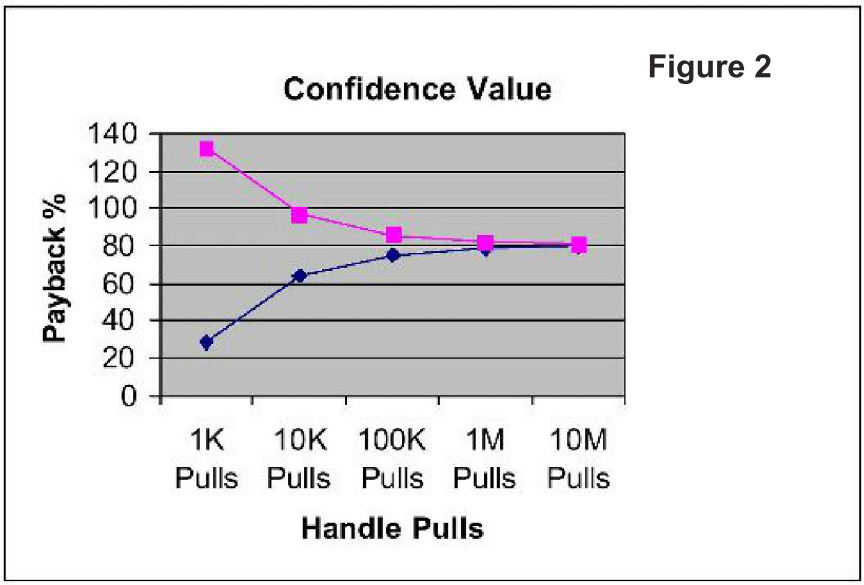
Vir·tu·al (vûr'choo-el) adj. Existing or resulting in essence or effect though not in actual fact, form, or name.

What's really going on here is something called Virtual Stops. Refer to the illustration. With our imaginary reel strip of only eight symbols we can correlate a range of 'virtual' numbers with the physical ones that the player sees.

Now, with a range of seventy-two stops we can create over 30 times the combinations we originally had with only the physical stops. We now have 72 X 72 X 72=373,248 virtual combinations. This number ultimately represents what's known as Machine Cycle.

Don't misunderstand. This is not to say that if I played 373,247 games and I have not yet hit the jackpot, that I will hit it on the very next pull. Think of it as a coin with 373,248 sides. These are your odds on every handle pull.

This begs the question: Is there a limitation on virtual stops? Theoretically, no. 64, 72, 90 and even 200 stop machines are common. Some mega-



progressives can reach well beyond that. The probabilities can really bake your noodle!

Now on to a typical PAR sheet. These are legal documents issued by the manufacturer as proof of the game's theoretical performance. Now the legal mumbo-jumbo starts. But it is in understanding PARs (or PC sheets as they're sometimes called) that you can keep your superiors from crunching antacids whenever customer disputes arise.

Using the sample PAR sheet, we can identify each major section and how it fits in the real world. Section 1 indicates the Average Payback Percentage. This is how much money is returned to the player. This works in tandem with the Hold Percentage, or the amount of money that will be kept by the casino. The sum of these should always equal 100%.

That does not mean that if I deposit $10, I am going to receive $8.04 back. Just below is our "confidence value". This represents that all of the projections on this document are based on 10,000,000 handle pulls. With that many pulls we

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                   Section 1    Section 2

 TYPE 5
                        Section 1
Reel Strip Number  ####  HOLD % 19.634  Denomination:
 MODEL # : XX33X PAYTABLE 245B105
 90% Confidence value, 10,000,000 pulls-    LOW %:  79.84     HIGH %:  80.89
+----+---------+---------+------------+------------+  +----+
|COIN| PERCENT |   HIT   | TOTAL HITS | TOTAL PAYS |  | SYM|  NUMBER / REEL
|  # | PAY BACK|   FREQ  |            |            |  |    | R1  R2  R3
+----+---------+---------+------------+------------+  +----+---+---+---+
|  1 |  80.009%| 11.763%|      43904.|     298632.|  | ~~ | 37| 41| 45|
|  2 |  80.009%| 11.763%|      43904.|     597264.|  | O1 |  9|  0|  7|
|  3 |  80.366%| 11.763%|      43904.|     899896.|  | U1 |  8|  1|  0|
+----+---------+---------+------------+------------+  | 1B |  8|  3| 10|
"NUDGE UP" SYMBOLS:01,02,03.                          | O2 |  0| 10|  0|Section 3
"NUDGE DOWN" SYMBOLS:U1,U2,U3.                        | U2 |  0|  0|  2|
                                                      | 2B |  3|  9|  2|
                                                      | O3 |  1|  0|  0|
                                                      | U3 |  0|  1|  0|
                                                      | 3B |  2|  2|  2|
                                                      | R7 |  2|  3|  3|
                                                      | TD |  2|  2|  1|
                                                      +----+---+---+---+
 This is a  3 reel , 3 Coin  72  stop machine. Reel Combos :     373248.
+----------------+----------------+------------+----------+--------+-----------+
|Section 4       |                |            |          |        |           |
|   PAY COMBO    |   # PER REEL   |   HITS     | PULLS/HIT| PAYS   | TOTAL PAY |
|                |                |            |          |        |           |
+----------------+----------------+------------+----------+--------+-----------+
| TD XX XX       |  2  70  71     |      8726. |       43.|      2.|     17452.|
| XX TD XX       | 70   2  71     |      8502. |       44.|      2.|     17004.|
| XX XX TD       | 70  70   1     |      4088. |       91.|      2.|      8176.|
| AB AB AB       | 31  26  23     |     16592. |       22.|      5.|     82960.|
| TD TD --       |  2   2  72     |       180. |     2074.|     10.|      1800.|
| -- TD TD       | 72   2   1     |        74. |     5044.|     10.|       740.|
| TD -- TD       |  2  72   1     |        82. |     4552.|     10.|       820.|
| 1N 1N 1N       | 25   4  17     |      1700. |      220.|     10.|     17000.|
| AB AB TD       | 31  26   1     |       640. |      583.|     15.|      9600.|
| TD AB AB       |  2  26  23     |       896. |      417.|     15.|     13440.|
| AB TD AB       | 31   2  23     |       540. |      691.|     15.|      8100.|
| 2N 2N 2N       |  3  19   4     |       228. |     1637.|     20.|      4560.|
| 1N 1N TD       | 25   4   1     |       100. |     3732.|     30.|      3000.|
| TD 1N 1N       |  2   4  17     |       136. |     2744.|     30.|      4080.|
| 1N TD 1N       | 25   2  17     |       850. |      439.|     30.|     25500.|
| 3N 3N 3N       |  3   3   2     |        18. |    20736.|     40.|       720.|
| 2N 2N TD       |  3  19   1     |        57. |     6548.|     60.|      3420.|
+----------------+----------------+------------+----------+--------+----
```

become 90% confident that numbers are correct. It could never be 100% since the machines are based on random events.

Section two shows us the Hit Frequency. This is the average frequency at which a winning condition will occur. It is calculated by dividing the number of hits by the number of possible outcomes.

Machine Cycle / Total Hits = Hit Frequency

Section 3 is called the Distinct Symbols Chart. It shows the total virtual stops associated with the symbols on each individual reel strip. For example; Reel Strip #2 has 41 virtual blanks, even though only eleven appear physically.

Section 4 is the Complete Paytable. Slot machine glass usually only represents an abbreviation, but this is the whole enchilada. Every possible paying condition is shown along with virtual stops, hits and pays.

Section 5 is the Physical Reel Strip Listing. It is here where attention to detail counts! Notice that not all the reel strips are exactly alike. Verify reel strip installation using this chart. Never rely on numbers printed on the bottom of the reel strip. Everybody makes mistakes, including the manufacturer.

Section 6 is the Virtual Reel Strip listing (a.k.a. Expanded Reel Strip Listing). By now, the lights should be coming on. Using the Physical and Virtual Reel Strip listing, we can effectively create a wheel like figure 1.

Take a moment to study both charts. Some very interesting things should start to appear. First, you can see the range of virtual numbers that correspond to the physical. Second, you can note the preponderance of blanks. Casino owners certainly prefer blanks to winning symbols. Lastly, find the top award symbols. In this case it is "TD" . There is a large amount of blanks on either side of this symbol. What's going on here?

This is what I like to call the "Aww Shucks!" Principle. When players see the top award symbol appear just above or just below the payline, it builds anticipation and encourages more play. "Aww Shucks! Just missed it. One more spin and I'll get it."

Section 7 is known as Ninety Percent Confidence Value Chart. And, with this chart we can deduce the probable perfor-

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Section 5

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                        PHYSICAL REEL STRIP LISTING    REEL STRIP # :####
 ------------------------------------------------------------------------------
Line #   1 O1 U3 ~~
Line #   2 1B 1B 3B
Line #   3 ~~ ~~ ~~
Line #   4 R7 R7 R7
Line #   5 ~~ ~~ ~~
Line #   6 1B 1B 2B
Line #   7 U1 U1 U2
Line #   8 2B 2B 1B
Line #   9 ~~ ~~ ~~
Line #  10 TD TD TD
Line #  11 ~~ ~~ ~~
Line #  12 1B 1B 3B
Line #  13 O3 O2 O1
Line #  14 3B 2B 1B
Line #  15 ~~ ~~ ~~
Line #  16 2B 3B 2B
Line #  17 ~~ ~~ ~~
Line #  18 TD TD 1B
Line #  19 ~~ ~~ ~~
Line #  20 1B 2B R7
Line #  21 ~~ ~~ ~~
Line #  22 3B 3B 1B

             3  3  3
             9  9  9
             3  3  3
             2  3  4
```

mance of a given machine.

In theory, if you were to flip a fifty-cent piece ten times, it could land on heads every time. Further, in theory, if you were to flip the same coin 100 times it could land tails every single time. But if we follow the law of averages over time, say 1000 flips, our ratio would fall to 50/50. In other words the longer we do something over and over again, the more accurately we can predict the outcome of the next event. But ultimately we can never predict with 100% certainty.

In fact, to be reasonable, we can kick out 10% reliability because some really wacky stuff can happen based such a small sampling. What's left is a 90% confidence value in our predictions.

Refer to the graph in figure 2. This supports the previous statements. The upper and lower end possibilities converge to the center over time. Furthermore, the average of the upper and lower percentages always equal Average Payback Percentage and conversely the Hold Percentage.

Does your brain ache yet? Hold on, I haven't told you about Volatility Index yet.

At this point the arithmetic can get very complex. We'll keep it simple, but explaining this to your slot director just might get

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SS:####  3R3CM  MU  PRC:80.366  HTFQ:11.763   P:H  15:17:47   2-SEP-97 Page:
                                  Section 6
                          EXPANDED REEL STRIP LISTING  REEL STRIP # :####
 ---------------------------------------------------------------------------
Line #   1 O1 U3 ~~       Line #  40 TD O2 O1
Line #   2 O1 1B ~~       Line #  41 ~~ O2 O1
Line #   3 O1 ~~ ~~       Line #  42 ~~ O2 O1
Line #   4 O1 ~~ 3B       Line #  43 ~~ O2 1B
Line #   5 O1 ~~ ~~       Line #  44 ~~ O2 1B
Line #   6 O1 ~~ ~~       Line #  45 1B 2B ~~
Line #   7 O1 ~~ ~~       Line #  46 1B ~~ ~~
Line #   8 O1 R7 ~~       Line #  47 O3 ~~ 2B
Line #   9 O1 R7 ~~       Line #  48 3B ~~ ~~
Line #  10 1B R7 ~~       Line #  49 ~~ ~~ ~~
Line #  11 1B ~~ R7       Line #  50 ~~ 3B 1B
Line #  12 ~~ ~~ ~~       Line #  51 ~~ ~~ ~~
Line #  13 ~~ ~~ ~~       Line #  52 ~~ ~~ ~~
Line #  14 ~~ ~~ ~~       Line #  53 ~~ ~~ ~~
Line #  15 ~~ ~~ ~~       Line #  54 2B ~~ ~~
Line #  16 ~~ ~~ ~~       Line #  55 2B ~~ ~~
Line #  17 R7 1B ~~       Line #  56 ~~ TD ~~
Line #  18 R7 U1 2B       Line #  57 ~~ ~~ ~~
Line #  19 ~~ 2B U2       Line #  58 ~~ ~~ ~~
Line #  20 ~~ 2B U2       Line #  59 ~~ ~~ R7
Line #  21 ~~ 2B 1B       Line #  60 ~~ ~~ R7
Line #  22 ~~ 2B 1B       Line #  61 ~~ ~~ ~~
Line #  23 1B ~~ 1B       Line #  62 TD 2B ~~
Line #  24 1B ~~ ~~       Line #  63 ~~ 2B ~~
Line #  25 U1 ~~ ~~       Line #  64 ~~ 2B ~~
Line #  26 U1 ~~ ~~       Line #  65 ~~ 2B ~~
Line #  27 U1 ~~ ~~       Line #  66 ~~ ~~ ~~
Line #  28 U1 TD ~~       Line #  67 1B ~~ ~~
Line #  29 U1 ~~ TD       Line #  68 1B ~~ ~~
Line #  30 U1 ~~ ~~       Line #  69 ~~ ~~ 1B
Line #  31 U1 ~~ ~~       Line #  70 ~~ ~~ 1B
Line #  32 U1 ~~ ~~       Line #  71 ~~ ~~ 1B
Line #  33 2B ~~ ~~       Line #  72 3B 3B 1B
Line #  34 ~~ 1B ~~
Line #  35 ~~ O2 3B                  3  3  3
Line #  36 ~~ O2 O1                  9  9  9
Line #  37 ~~ O2 O1                  3  3  3
Line #  38 ~~ O2 O1                  2  3  4
Line #  39 ~~ O2 O1
```

you that pay raise and buy your kids that G.I. Joe with the Kung Fu grip. Suffice it to say this number represents how fast the upper and lower percentages converge to the center of the chart or how quickly the numbers get reliable.

Another way to view this number is to think of it as a "risk" to the casino. The higher the number, the higher the risk. For example, A game with a top award of 2500 credits will have a lower V.I. than a game with 50,000 as it top award. Both games are susceptible to hit the jackpot in the very first handle pull but the latter will cost the casino more. Additionally, the lower paying game will not entice nearly as many players as the higher paying machine. Having a grasp on these concepts can help Slot Operations decide which games are right for the property. So, it's a calculated risk. What can the casino afford?

Various other data are contained on the PAR sheet. Unique symbols, paytable firmware identification and game type just to name a few.

To be fair, the sample PAR used was one of the easiest I could find to read. The more paylines, reels and bonus games, the more sophisticated the PAR sheet becomes. But this is a good foundation to understanding even latest and more complex documents out there.

Feeling a new appreciation for the word "malfunction"?

How much can a misaligned reel strip cost us? A few dollars, big bucks, our jobs?

Part two of this article will address stepper motor theory and effective Reel Strip and Paytable tests and one more thing that only best slot techs know. But you'll just have to read about it in next month's issue, won't you? Hopefully, by then you will be up to PAR.

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                          Section 7
                 90% CONFIDENCE VALUES     VOLATILITY INDEX =   16.483
   HANDLE PULLS     LOWER         UPPER
                  PERCENTAGE   PERCENTAGE
        1000.      28.24         132.49
       10000.      63.88          96.85
      100000.      75.15          85.58
     1000000.      78.72          82.01
    10000000.      79.84          80.89
 PAY TABLE  FILE NAME  : PTDAT:SS####.PAY
 REEL STRIP FILE NAME  : RSDAT:SS####.LAY
 OPERATOR'S INITIALS: DL
                              COMMENTS
_____________________________________________________________

 PAY TYPE........:   Pays Only Highest Winner Per Lit Line
                 :_____________________________________________
 FROM SS #.......:
                 :_____________________________________________
 TO SS #.........:
                 :_____________________________________________

 Special Symbols
AB : O1,U1,1B,O2,U2,2B,O3,U3,3B
1N : O1,U1,1B
2N : O2,U2,2B
3N : O3,U3,3B
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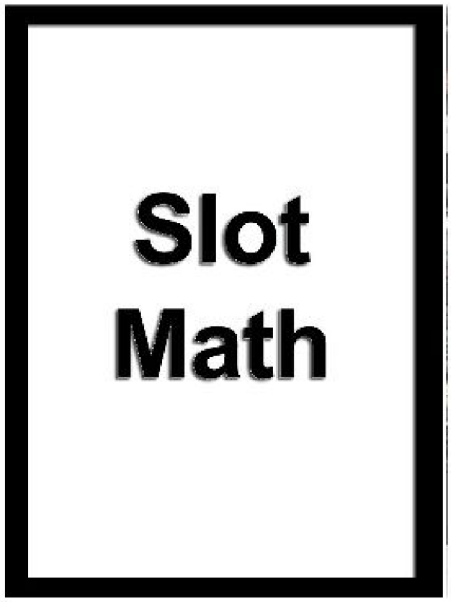
PAR Excellance: Improve Your Edge



By John Wilson

Most technicians working with slot machines, computers, or automobiles, generally have a thirst for the smallest details of how something works. When working with a slot machine, the diagnostics you perform are more meaningful if you know how they work and what they are testing for. While you might not use PAR sheets every day, having an understanding of how the slot machine plays and pays and possessing a general 'feel' for the game can only help you. Whether you are attempting to settle a customer dispute by determining if a machine is working correctly or just answering questions for your supervisor, the more detailed knowledge you have, the better.

In December 2003, we took an in-depth look at part of a PAR sheet, the Volatility Index. This month, we'll take some time to examine the basics of a PAR sheet and try to make sense of all the information these reports contain.

The basic piece of information that all PAR sheets contain is the payout percentage and number of hits for each coin. A sample PAR sheet summary is shown in table 1.

The first thing that you are likely to notice is that all of our numbers are nice, even numbers. It is very unlikely that you will ever see all of the numbers work out so evenly. Although this isn't from an actual PAR sheet, the numbers are still valid. For the purpose of explaining the PAR sheets, however, using even numbers simplifies our calculations.

This example is obviously a 3-coin machine. A few years ago, manufacturers didn't always include the totals for the middle coins - in this case they would only have listed coin 1 and coin 3. Most of them are showing you all of the details now.

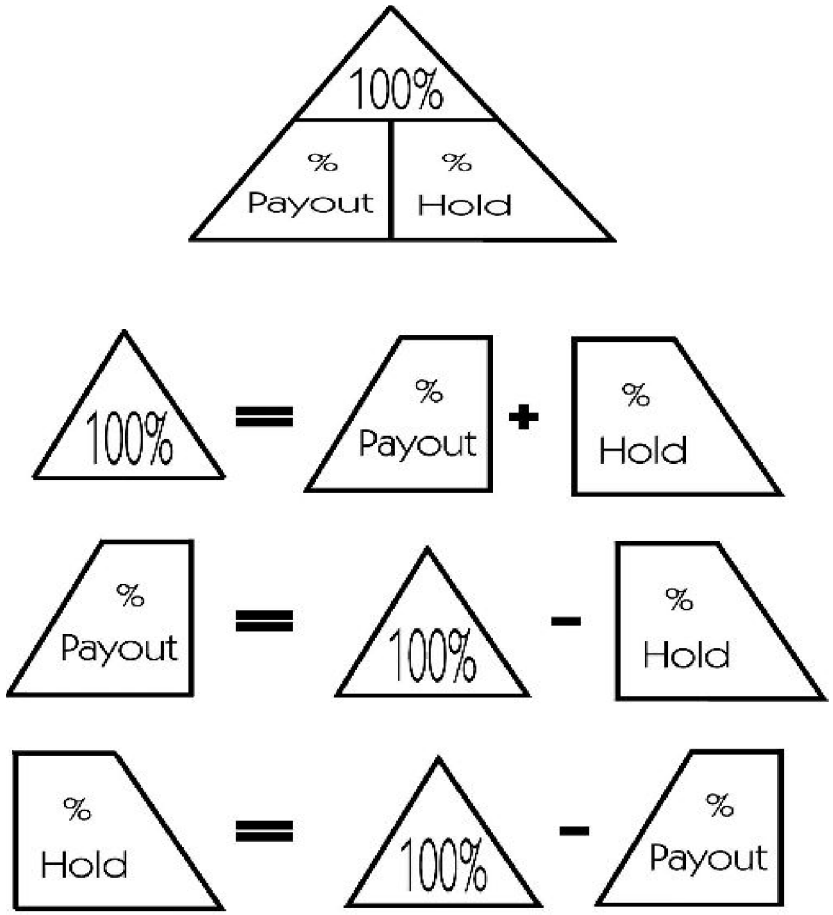
The payout percentage and hit frequency tell us quite a bit about the game. By also examining the volatility index and the number of stops per reel, we can generally tell what type of game it is and the payout type. By this I mean if the machine has a large jackpot, is an intermediate paying game, or if the majority of the pays are through small wins.

Table 1

Coin #	Percent Payback	Hit Frequency	Total Hits	Total Pays
1	90.00	10.00	100,000	100,000
2	90.00	10.00	100,000	200,000
3	90.00	10.00	100,000	300,000

Payout Percentage

Take a look at the payout percentage. The Normal Payout % is always based upon the maximum number of coins. This is a 90.00% machine, meaning that over the long-term, the machine will pay back 90% of what it takes in. The other 10%, therefore,



Many of you may be familiar with the Ohm's Law triangle. This is a variation on it and will help you to remember the formula we're using. The bottom two values always add up to the top value. (Payout % + Hold % = 100%) To determine the value on the left, subtract the value from the right from the top value (Payout % = 100% - Hold %). Similarly, to determine the value on the right, subtract the value on the left from the top value (Hold % = 100% - Payout %).

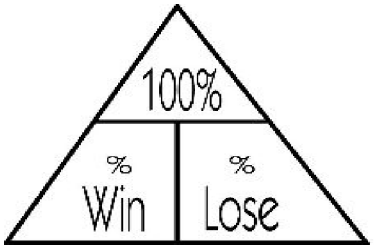
must be held back. This is called the Hold %. If we know the hold % or the payout % we can calculate the other one. They always add up to 100%.

The payout percentage is usually higher for each coin. It might be the same, but it can't be lower and meet most gaming requirements.

Hit Frequency

The hit frequency tells us how often the machine will have a winning game. Hit frequency could also be called win frequency. In our case, a 10% hit frequency means that on average the player will win 10% of the time. Or, stated another way, they will lose 90% of the games. The winning games and losing games always add up to 100%.

The total hits relate directly to the hit frequency. Somewhere on the pay sheet will be a summary of the total combinations available, also called the cycle. In our example, it would be as shown



100% = Win frequency + Lose frequency -or- Win Frequency = 100% - Lose frequency -or- Lose Frequency = 100% - Win frequency.

in Table 1

This is a 3 reel, 3 coin, 100 stop machine. Reel Combos: 1,000,000 We are interested in the number of reel combinations. There are 1,000,000 possible combinations of unique game outcomes in this game. (100 stops per reel with 3 reels: 100 x 100 x 100 = 1,000,000 combinations)

For each coin played, we can examine the hit frequency and determine the total number of winning games. 10% hit frequency * 1,000,000 games = 0.10 x 1,000,000 = 100,000 games, or Hit Frequency % x Games = # of Winning Games

Each game has the same hit frequency whether one, two or three coins are played. The payout amount changes because we are changing the total amount wagered, but the number of hits remains the same.

Volatility Index

If you remember the December issue, we learned that the Volatility Index is a gauge by which we can measure how

volatile or wide-ranging the slot machine pays out. A large Volatility Index means that the game will pay out widely and take a long time to reach its theoretical payout percentage. A small Volatility Index means that the overall pays don't vary too much and the game should pay close to the theoretical payout percentage in the short term.

A game with many small payments, such as a cherry symbol, will usually have a larger volatility index than one that has the smallest payout for mixed bars.

A small volatility index would be less than 10. A game with double and triple symbols may have a volatility index between 12 and 18. A game with a volatility index of 30 would likely have a number of wild symbols and multiplier values. It may have a very large jackpot award as well.

Again, as this is an index, it gives you an idea about the play but it isn't absolute. The values I chose for 'small' and 'large' aren't precise, either. I have picked these values only to give you a general idea of the range you might find. Take some time to examine the PAR sheets and volatility indices for the games in your casino and you'll develop a pretty good feel for the machines on your floor.

Reel Stops

The number of virtual stops on the reels also gives you a good idea about the game. If it has 32 stops per reel, the maximum number of combinations is 32 x 32 x 32 or 32,768. At 3 coins, the game will take in 98,304 coins so all of the payouts including the jackpot must be less than this value. A 40,000 coin jackpot is out of the question.

Many games have 64 or 72 stops, for a total of 262,144 or 372,248 combinations. At 3 coins and 72 stops, the total coins in equals just over 1 million. The game may have a large jackpot (28,000 credits for example) or a smaller jackpot that occurs multiple times per cycle. New games with 256 stops have 16,277,216 combinations with 3 reels. This obviously allows a large jackpot (mega jackpot) a number of multiplier values (10x with 5x for example) or a significant number of smaller jackpots.

As a general rule of thumb, the higher the number of reel stops, the higher the volatility index will be and the more varied the payouts will be. Although this article discusses spinning-reel slots, the same concepts apply to video slots as well. The high-hit frequency and low average payout coupled with the bonus games changes these results a bit.

The guidelines discussed here aren't absolute, either. While they apply to the majority of games, some will have special features or unique properties about them. Your mileage may vary.

Types of Games:Multipliers, Buy-a-Pay, Line Games

Multipliers

A multiplier is a game where the payout for any combination of symbols is multiplied by the number of coins played. A single coin will pay for any combination of symbols, including the jackpot and two coins will double this amount. In some cases, there is a bonus payment for playing extra coins but each coin will pay for all combinations of symbols. In the case of a coin multiplier game, the payout

Table 2

Example "1"			Example "2"			Example "3"	
	Payout %			Payout %			Payout %
Coin 1	87.50		Coin 1	87.50		Coin 1	87.50
Coin 2	87.50		Coin 2	87.50		Coin 2	89.32
Coin 3	87.50		Coin 3	89.32		Coin 3	90.00

percentage can be the same for each coin played if there is no bonus for the maximum coins played.

In the three examples shown in table 2, we are looking at multipliers. In the first case, there is no bonus for playing 3 coins. In the second example, there is a bonus for the 3rd coin being played. In the 3rd example, each coin played provides a bonus. Take a look at the associated payglass (right) for these games and it will make sense.

Three multiplier payglass - A multiplier will always have the same hit frequency for each coin, and the payout percentage will vary depending upon any bonus payments for playing more coins.

Line Games

A line game is like a multiplier but each coin pays the same amount as the coin before. The player is buying extra paylines, not multiplying the payout amount by the coins played. A single coin buys all combinations of symbols including the jackpot, just as the multiplier does. There may be a bonus paid for higher paylines, especially for the jackpot. Most spinning-reel line games have 3 or 5 paylines although some have 9, 15 or higher.

A line game may show the same hit frequency for each coin or it may show the hit frequency being doubled for the second coin, tripled for the third coin, etc. It depends upon the manufacturer and how they wish to report the hit frequency for line games. If the hit frequency is the same for each coin, then they are showing you the hit frequency for each line, not for the game. In this case, the hit frequency will usually be referred to as "Hit Frequency per Line." If the hit frequency refers to the total game, then

Example "A"			Example "B"	
	Hit Frequency Per Line			Hit Frequency
1st Coin	11.45%		1st Coin	11.45%
2nd Coin	11.45%		2nd Coin	22.90%
3rd Coin	11.45%		3rd Coin	34.35%
4th Coin	11.45%		4th Coin	45.80%
5th Coin	11.45%		5th Coin	57.25%

Table 3

the value shown is the hit frequency for that line plus all lines before it. This is illustrated in the example in Table 3.

In Example "A", we are shown the hit frequency for each line. Obviously the "Hit Frequency per Line" tells us that this is a line game. Example "B" shows the hit frequency per game. With one coin, we have a hit frequency of 11.45%. With two coins, we win on the 1st and 2nd paylines, so the hit frequency is 11.45% per line, for a total of 22.90%. For five coins, we win on all 5 paylines, so the hit frequency is 11.45% per line, for a total of 57.25%.

The line games will generally have the same hit frequency and a similar payout percentage for each coin. The jackpot amount is generally larger with each coin, so the payout % increases. For example, the pay table might look like this on a 3-line game (right).

In this case, the payout percentage increases with the bonus for each line. If all of the lines paid 1,000 for the jackpot, then the payout percentage would remain constant.

Buy-a-Pay

The Buy-a-Pay game does not pay for all combinations of symbols for each coin. The jackpot amount would not be paid for a single coin. The pay table shows the payments that each coin 'buys'. Many Buy-a-Pay games are a combination of Buy-a-Pay and multiplier. The Blazing 7's and Sizzling 7's games (in the 3-coin version) pay for bars on the first coin and various '7' symbols on the 2nd and 3rd coin. The 2nd coin buys the '7' symbols and the 3rd

coin multiplies the 2nd coin payout combinations. This would be referred to as a 2-coin Buy-a-Pay, 3 coin multiplier on the PAR sheet.

If the hit frequency is the same for all coins, it rules out a Buy-a-Pay game. The Buy-a-Pay will have a different hit frequency for each coin. For example, if the first coin buys bars, the second buys SILVER, and the 3rd coin buys GOLD, the payout percentage won't be identical for each coin. Each coin's hit frequency must increase, as each coin buys the pays for that coin plus the ones before it. For example:
Coin 1 Buys BAR symbols
Coin 2 Buys SILVER symbols and BAR symbols
Coin 3 Buys GOLD symbols and SILVER symbols and BAR symbols.

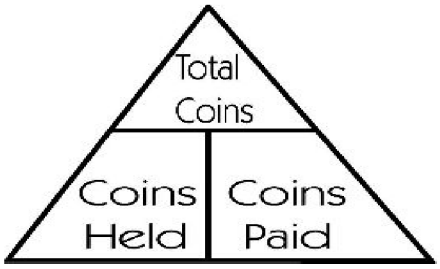
In our first example, we are paid 90% for each coin played. This means that it is either a line game or a multiplier. For a spinning-reel slot machine, a line game will have either 3 or 5 coins. Video games have more lines, 5, 9, or more. If the game takes a maximum of 1, 2 or 4 coins, it can't be a line game.

When we look at the payout % for each coin, it tells us quite a bit about the game. In this case, we are paid 90% for every coin. This must therefore be either a line-game (3-line or 5-line) or a multiplier. If there are only 3 coins played, it can't be a 5-line game. If there are only 2 coins then it's not a line game (need at least 3 coins), but it could be a multiplier or a Buy-a-Pay. If it is a Buy-a-Pay, we will have a different payback percentage for each coin.

Note: The total pays + total held always equals the total amount of coins taken in.

1 coin * 1,000,000 games = 1,000,000 coins in. 900,000 held + 100,000 paid = 1,000,000 coins in.

Therefore, the following formulas apply: Coins In = Coins Paid + Coins Held -or- Coins Paid = Coins In - Coins Held -



or- Coins Held = Coins In - Coins Paid

How do we know if this is a large jackpot, intermediate pay or low-win paying machine?

The payout % for each coin will give us a good idea how the machine pays.

If the top-coin payout % is significantly higher than the lower coin %, it is likely that this has a substantial jackpot. Generally, most multipliers and line games will have the top-coin payout percent only a few percent higher than the lowest coin payout percentage.

If the hit frequency is large, then we must have a significant number of smaller paying wins. Consider the Bally Roaring 20's and similarly-themed games. We have a payout for a single bar on any reel, which increases the hit frequency tremendously. A significant amount of winning combinations are single-digit winnings, creating a very large hit frequency. The hit frequency may be over 30% on games like these.

Don't forget to check the volatility index. A small volatility index means that the game payout does not vary widely. In this case, it likely has a relatively low jackpot and an