



by Sheryl L. Ashley

Understanding Slot Machine Math Basics

Understanding slot machine math can be daunting for even the most seasoned individual. You do not have to be an accountant, analyst, or even a statistician to understand the fundamentals of slot math. The take-away is to know why this math is so important in monitoring performance and compliance at your property.

Slot machine math will assist in determining:

- Whether a machine is performing as the vendor intended.
- The customers’ preferences for a machine on the floor.
- How much is reinvested in a customer with players club rewards.

To determine whether an individual slot machine is performing as the vendor intended we first need to know the benchmark. This benchmarking information can be obtained from the probability accounting report or “PAR worksheet.” Typically, this worksheet is provided by the vendor at the purchase date and is based on the game software purchased. Often, when game software is purchased, the vendor provides many different choices of game themes that can be turned-on for the customer to select from. In the following example, a machine with only one active game theme will be utilized. Although PAR worksheets can span from just a few pages to hundreds of pages, typically, only four pieces of information are focused upon:

1. **The payback percentage** – this is the theoretical percentage of what the customer should retain.
2. **The hold percentage** – this is the theoretical percentage of what the casino should retain.
3. **The confidence interval** – the probability that the payback and hold percentages will fall within the parameters set by the manufacturer (provided by the vendor, usually a 90% or 95% probability).
4. **The volatility index** – determines the frequency and size of the payouts on a machine. It is presented on the PAR

worksheet as a number. The bigger the number, the more volatile the machine is.

For example, say that a customer inserts a \$100 bill and plays \$100 of credits on a machine. According to the PAR worksheet, the theoretical payback percentage is 92%. If the machine behaves perfectly (which would most likely not be true in real life due to the low amount of play), the customer should have \$92 left over in credits before cashing out. The casino would have made \$8 based on the theoretical hold percentage. Expanding on this example; over a period of one month customers play 237,000 games on the machine, yet the casino only holds 4% for that month. The question is, given the information provided by the vendor, is it acceptable to have a 4% hold rather than the 8% theoretical hold previously experienced?

From PAR Worksheet Provided by the Vendor:
 Payback Percentage = 92%
 Hold Percentage = 8%
 Confidence Interval = 90%
 Volatility Index = 22.5

Payback Low/High % can be calculated as follows:

$$\text{Payback percentage } \pm \left(\frac{\text{volatility index}}{\text{square root of \# of games played at machine}} \right)$$

The calculation for 237,000 games played is:

Payback Low %	=	0.92 +	22.5 / (√ 237000)	=	87.38%
Payback High %	=	0.92 -	22.5 / (√ 237000)	=	96.62%

A chart can be built to evaluate if the machine is performing as the manufacturer intended as follows:

Number (#) of Games Played At the Slot Machine	Payback Low %	Payback High %
1,000	20.85%	163.15%
10,000	69.50%	114.50%
100,000	84.88%	99.12%
1,000,000	89.75%	94.25%
10,000,000	91.29%	92.71%
# of Games Played in Example: 237,000	87.38%	96.62%

Notice that this is still not exactly 92% even if customers played ten million games!
 The inverse of this is the hold of 12.62% / 3.38%

Based on the math and with a 90% confidence interval provided by the vendor, the casino will hold between 3.38% and 12.62%. Therefore, it is likely that the machine in this example is performing within expectations given the volume of play. If the result was not within expectations, the most common procedure would be to perform an investigation on the machine.

The customers’ preferences for a machine on the floor can be determined through evaluation of which game themes a customer plays the most. By reviewing the metered credits played for the various game themes offered on each machine, management can determine the favored game and is better suited to design the casino floor. However, it is also important to understand how the favored game can change the theoretical

payback/hold percentages for the machines. In the previous example, the benchmark provided was based on one game theme played. On a machine with several game themes offered, a weighted average theoretical percentage must be utilized in order to capture the most accurate payback and hold percentages. In this example, three game themes will be offered. To determine the weighted average payback/hold, the vendor's theoretical payback percentages per game theme and metered credits played per game theme must be known. The basic calculation is as follows:

Game:	Vendor's Theoretical Payback %	Metered Credits Played	Theoretical Payback (Calculated)	
Paleoman	94.00%	45,902.75	43,148.59	
Keno Keno	86.00%	9,743.00	8,378.98	
Gems	96.00%	22,426.00	21,528.96	
		<u>78,071.75</u>	<u>73,056.53</u>	Sum of the columns
Basic Average	<u>92.00%</u>			(94+86+96)/3
Weighted-Average Payback			<u>93.57614%</u>	(73,056.53/78,071.75)

To obtain the theoretical payback, multiply the vendor's theoretical payback percentage by the metered credits played.

According to the metered credits played above, the customers prefer the Paleoman game. The benchmark to be used in the future will be 93.58% theoretical payback to the customer, or a 6.42% theoretical hold for the casino.

A means to determine how much is reinvested in a customer with players club rewards would be the reinvestment formula. When the players club decides how many points to provide players based on their play, often it is not translated into what the dollar cost will be to the casino. Using the same information above, how much the customers would have earned in players club rewards and how the theoretical hold can affect the reinvestment percentage can be calculated. For this example, the players club only offers cash back:

\$1.00 credits wagered = 1 point	78,071.75	(Same as metered credits played above)
1 point = \$.01	780.72	(Metered credits played multiplied by .01)
Theoretical hold from above is 6.42386%	5,015.22	(78,071.75 multiplied by 6.42386)
Reinvestment percentage	15.57%	(780.72/5,015.22)

Whether or not this percentage is too large depends on the internal budgeting for the players club. To illustrate the effect of the changes in the reinvestment percentage, use the same information, but change the theoretical hold percentage:

\$1.00 credits wagered = 1 point	78,071.75	(Same as metered credits played above)
1 point = \$.01	780.72	(Metered credits played multiplied by .01)
Theoretical hold reduced to 2%	1,561.44	(78,071.75 multiplied by 2.00%)
Reinvestment percentage	50.00%	(780.72/1,561.44)

It is important to note that the casino reinvests the same dollar amount regardless of the hold percentage, thereby making the reinvestment percentages much larger on smaller

theoretical holds (an inverse relationship). It is also important to review these numbers consistently to ensure that the reinvestment percentage aligns with the intention of the players club.

In summary, the basics of slot machine math are not all that complicated. Don't be afraid to ask questions, delve into PAR worksheets, or have the 'numbers people' describe how they calculated the information. Often, when the math is overlooked, it can be very costly to the casino. ♣

Sheryl L. Ashley is Director of Risk Consulting at Egghart LLC | CPAs. She can be reached by calling (775) 827-5999 or email sheryl@egghart.com.

Keep Your Casino
TITLE 31
COMPLIANT
 with **FABITrack®**

FABICASH
 your cash access company
 A DIVISION OF FIRST AMERICAN BANKCARD, INC.

504.837.2626
www.fabicash.com

ATMs • Cash Advance • Ticket Redemption
 FABITrack/Title 31 • Integrated Check Cashing
 FABICash Mobile • 24/7 Customer Service

First American Bankcard, Inc. is a Registered Agent
 of Citizens Bank, N.A., Providence RI