SLOT DESIGNER

Tools for professional mathematicians

Elements Of Slot Design 2nd Edition

GameDesignAutomation.com

Copyright © 2013 Game Design Automation Pty Ltd

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical or photocopying, recording, or otherwise without the prior permission of the publisher

http://slotdesigner.com/

CHAPTER 1 INTRODUCTION

This document is intended as an introduction to Slot game mathematics and design. In time it should expand to provide a comprehensive tutorial and reference to all aspects of Slot design.

The fundamentals of Slot mathematics are introduced so that games can be designed from the ground up in Microsoft Excel, code, or using Slot Designer. It assumes a basic understanding of probability and Slot machines.

Unfortunately there is no standardized method of performing these calculations, designing spread sheets, or even terminology. Different countries and companies for example refer to symbols as icons, and reel strips as reel bands. This document therefore uses the terminology defined by Slot Designer, which is the commercial product of the author.

While the intent is to produce a very much larger book, practical constraints dictate this will take some time. In the meantime feedback would be appreciated as to the content and future direction.

Robert Muir muir@GameDesignAutomation.com

CHAPTER 2 THE BASICS

We'll start by considering a very simple slot game with 3 reels, each of 10 symbols, 1 payline, and 1 pay rule, and a cost to play each game of 1 credit. Each reel contains 10 symbols in total, with 1 A and 9 X symbols,



Figure 1. Simple 3x3 Game

The game's single pay rule awards 1000 credits when we line up 3 A symbols across the payline. When spinning the reels we can see the probability of stopping with an A on the payline for each reel is 1/10, hence the probability of getting 3 A's across the 3 reels is 1/1000.

$$p(A, A, A) = \frac{1}{10} \times \frac{1}{10} \times \frac{1}{10} = \frac{1}{1000}$$
 Equation 1

When we win the rule awards 1000 credits, so the average win per game is 1 credit

average win = prize × probability of prize

average win = prize × $p(a, a, a) = 1000 \times \frac{1}{1000} = 1$ credit

When we play the game (spin the reels) we pay 1 credit, so the average cost to play each game (the bet) is simply 1 credit.

The RTP (return to player) of a game is defined as the average win as a percentage of the bet, which for this game is 100%.

$$RTP = \frac{average \ win}{average \ bet} \times 100\%$$

$$RTP = \frac{1}{1} \times 100\% = 100\%$$
Equation 4

In other words, over the long term as we play this game, we will win 100% of what we bet even though we win only once in 1000 games. When playing a game with an RTP over 100% the player wins money over the long term, and below 100% the player loses money.

If we were to change the prize value from 1000 credits to 500 credits, then the average win (Equation 2) is 0.5 credits, and the RTP (Equation 3) is 50%.

If we were to add a second A symbol on the first reel only, we would double the probability of A on that reel, hence doubling the probability of 3 A occurring on the payline. With the original 1000 credit prize, the average win is then 2 credits (Equation 2), and the RTP 200% (Equation 3). We now win once in every 500 games.

$$p(A, A, A) = \frac{2}{10} \times \frac{1}{10} \times \frac{1}{10}$$
$$= \frac{2}{1000}$$
$$= \frac{1}{500}$$

Combining a second A on the first reel with the prize value of 500 credits, we're doubling the probability and halving the prize, hence the RTP remains at 100%. With 2 A on each of the 3 reels, we would have 8 times the probability, resulting in an RTP of 400% (with the 500 credit prize).

The winning pattern of 3 A symbols is called a "combination", and the complete list of combinations comprises the game's pay table. We can write this as {A,A,A}.

In Slot Designer we can implement the game with the script shown on the right, and the basic statistical report for the pay rules on the left.



COUNTING HITS

Rather than perform all the calculations as probabilities, we usually count the number of winning combinations over the game cycle and divide by the cycle at the end. The difference is subtle and end result is the same, but it's easier to work with. We can rewrite Equation 1 using hits instead of probability

Equation 5

 $p(A, A, A) = \frac{hits}{cycle}$ $= \frac{1 \times 1 \times 1}{10 \times 10 \times 10}$

 $=\frac{1}{1000}$

The hit rate tells us how many games we have to play on average to win a particular prize, while the hit frequency tells us what percentage of games win the prize. This is particularly useful when looking at how often the player will trigger a feature game.

The hit rate can be calculated several different ways

$$hitrate = \frac{1}{probability}$$
 Equation 6

$$hitrate = \frac{cycle}{hits}$$
 Equation 7

And the hit frequency

$$hit \ frequency = \frac{100\%}{hit \ rate}$$
 Equation 8

In the game of Equation 1 the hit rate is 1000, or 1000 games between hits.

hit rate $(A A A) = \frac{cycle}{cycle}$	Equation 9
hits	
1000	
=	
= 1000	

And the hit frequency is 0.1%

hit frequency
$$(A, A, A) = \frac{100\%}{1000}$$

= 0.1%

VOLATILITY

If we have a game that wins 1 credit for every play, the average win is then 1 credit, and with an average bet of 1 credit this gives us an RTP of 100% (Equation 3). In the previous section we also calculated a RTP of 100% for a game that wins 1000 credits once in every 1000 games, and zero every other play.

These two games have the same RTP, yet would be fundamentally different to play. The key difference between these two games lies in their volatility. The game that wins every time has a very low volatility, and the other a very high volatility. Indeed, their volatility is so extreme that neither would be a practical design.

We can also see that as the chance of winning increases the prize won must correspondingly decrease to achieve the same RTP.

SIMPLE PAY RULES

We can add a second pay rule to the game in Figure 1, which wins 100 credits when we get A on the left 2 reels, but not on the 3rd reel. This is commonly referred to as a left to right combination, and we can write it as the combinations {A,A,#A}, where # means "not".

Counting the hits for this rule we have 1 on reels 1 and 2 as before, but on reel 3 there are 9 hits where A does not occur. We don't count 10 hits for 'any' symbol as matching the combination on reel 3, as another A on reel 3 would match the left 3 A pay rule instead. Left 2 A and left 3 A are mutually exclusive.

The number of hits is then

$$hits(left 2 A) = hits(A, A, #A)$$
$$= 1 \times 1 \times (10 - 1)$$
$$= 9$$

The average win due to this pay rule is then 0.9 credits (using Equation 2 and Equation 5)

average win =
$$prize \times \frac{hits(left \ 2 \ A)}{cycle}$$

= $100 \times \frac{9}{1000}$
= $0.9 \ credits$

Hence, using Equation 3, the RTP contributed to the game by this pay rule is 90%. The total RTP of the game is the sum of the individual contributions, and since the left 3 A rule contributes 100% the total RTP is therefore 190%.

Instead of a left to right pay rule we could add instead an 'any' pay rule, such that any 2 A pays 100 credits. This pay rule comprises 3 combinations, {A,A,#A}, {A,#A,A}, and {#A,A,A}, each of which has exactly 2 A symbols, and are mutually exclusive. There are 27 hits on any 2 A

$$hits(any \ 2 \ A) = hits(A, A, \# A) + hits(A, \# A, A) + hits(\# A, A, A)$$

= 1×1×(10-1)+1×(10-1)×1+(10-1)×1×1
= 9+9+9
= 27

And the RTP for this pay rule is therefore 270%, and the total RTP for the game is 370%.

$$RTP(any \ 2 \ A) = prize \times \frac{hits(any \ 2 \ A)}{cycle \cdot bet}$$

$$= 100 \times \frac{27}{1000} \times 100\%$$

$$= 270\%$$
Equation 14

Adding another 'any' rule to pay 10 credits on "any 1 A", we have combinations {A,#A,#A}, {#A,A,#A}, and {#A,#A,A}. There are 243 hits due to this pay rule.

$$hits(any \ 2 \ A) = hits(A, \# A, \# A) + hits(\# A, A, \# A) + hits(\# A, A, A)$$
Equation 15
= 1×(10-1)×(10-1) + (10-1)×1×(10-1) + (10-1)×(10-1)×1
= 81+81+81
= 243

The RTP for this rule is therefore 243%.

$$RTP(any \ 1 \ A) = prize \times \frac{hits(any \ 1 \ A)}{cycle \cdot bet}$$

$$= 10 \times \frac{243}{1000} \times 100\%$$

$$= 243\%$$
Equation 16

The RTP for the game is the sum of the RTP's of each of its pay rules, which for the 3 "any" rules is 613%

100%+270%+243% = 613%.

SCATTER

Normal, or non-scattered symbols, only pay (hit) when they are on the payline. A scattered symbol hits when it is visible in the play window anywhere on the reel, i.e. on, above or below the payline.



x x

Consider what happens when the reel moves through the window, as the reel brings the scattered symbol (S) into each of the 3 possible positions (top, middle, bottom).

Rather than a total of one hit as the reel stops on the payline in each of its 10 possible positions we see that there are 3. The number of hits for the combination $\{S,S,S\}$ is then

 $hits(S, S, S) = 3 \times 3 \times 3 = 27$

And the hits for left 2 S, is

 $hits(S, S, \#S) = 3 \times 3 \times (10 - 3) = 63$

Note that if the window were 4 symbols high we would instead have 4 hits per reel, and 64 hits for left 3 S.

When we add a second scattered symbol to the reel we can see that there are 6 hits on reel 3 (2 \times 2), hence the total number of hits for 3 S is $3 \times 3 \times 6=54$.

Similarly for the combination {S,S,#S} there are only 4 stop positions on the last reel where the S does not hit (i.e. is not visible in the window), and we have $3\times3\times4 = 36$ hits.

In the next example we again have $2 \times S$ symbols on reel 3, but they are stacked on top of each other. Looking carefully at reel 3 as the reel rotates through the play window we can see that there are only 4 stop positions that causes hits instead of the 6 we had before with the scattered symbols spread out. However 2 of these 4 stop positions have 2 hits each instead of 1, so the total number of hits over the reel remains the same (6).



As the total hits over the cycle remain the same the RTP is unchanged. However the prizes awarded by the game are different. When a win is due to the 2 stacked symbols the number of hits doubles, hence the prize for that win is also doubled. While the RTP is the same, the volatility is slightly changed.

Previously we counted 4 hits of #S with 2 separated scatter symbols on the reel, but now there are 6 hits with no compensating change in the number of hits at each – these remain zero. Hence we can see that the reelstrip layout can change the RTP of games that have scatter symbols. Normally scatter symbols are separated on the reels, so that multiple scatter symbols cannot be seen on the same reel at once.

When designing games, especially using Excel, the calculations are typically performed assuming scatters are spread out on the reels so that this effect does not occur, and when the actual game is built the symbols are spread out to match this assumption. In the event that the scatters are not properly separated an error will result.

In Slot Designer a symbol can be globally scattered with the scatter command.

scatter A;	
We can also scatter it only where it is used in a combination	
pay 100 on left 3 A.s;	

WILD SYMBOLS

A wild or substitute symbol is one that can be used in place of other symbols in the pay table combinations.

Consider the game of Figure 1 (page 4), where one of the X symbols is replaced by the wild symbol 'W' on reel 3.



For the combination {A,A,A} we have 1 hit on reels 1 and 2, but on reel 3 both the A and W will hit for this combination, hence we now have 2 hits where before we had only one.

$$hits(A, A, A) = 1 \times 1 \times 2$$
$$= 2$$

An alternate notation to represent this combination, embedding the wild, is

{A,A,{A,W}}

This indicates that A or W is counted on the 3rd reel of the payline.

This is equivalent to adding a second A to reel 3, however if we had other symbols and combinations, the wild symbol could substitute for other symbols than just A.

One well known variation on substitution is to double the prize when a wild is used to match the combination, so that {A,A,W} would pay double the prize of {A,A,A}. This simply requires counting the hits for the various combinations, and determining the RTP from the appropriate prize values.

The RTP of this game where $3 \times A$ pays 100 credits, W is wild and doubles the prize, and the bet is 1 credit, is 30%.

$$hits(A, A, A) = 1 \times 1 \times 1 = 1$$

$$hits(A, A, W) = 1 \times 1 \times 1 = 1$$

$$RTP(A, A, A) = \frac{hits \times prize}{cycle \times bet} \times 100\% = \frac{1 \times 100}{1000 \times 1} = 10\%$$

$$RTP(A, A, W) = \frac{1 \times 200}{1000 \times 1} = 20\%$$

$$Total RTP = 10\% + 20\%$$

$$= 30\%$$

In Slot Designer substitution can be implemented in several ways. We can include the wild symbol 'W' in the pay rules

pay 100 on left 3 { A, W };

Alternately we can use the substitute command to automatically modify all the combinations to include the wild symbol.

```
substitute W = all;
pay 100 on left 3 A;
```

The wild symbol does not usually apply to the scattered symbol 'S'.

```
substitute W = all except S;
```

We can automatically double the prize value when the wild symbol is used.

```
substitute W = all except S pay = pay * 2;
```

EXPANDING WILD

A popular variation on substitution is to scatter the wild symbol, so that if the wild is anywhere on the reel it substitutes into the payline combination. Normally the wild symbol substitutes only when it is on the payline. In this example the combination {A,A,A} hits due to the off-payline scattered wild symbol W.



As with other types of scattered symbol this can result in multiple hits on the reel when the combination symbol is on the payline (1 hit) and the wild symbol is above or below the payline (1 more hit).



Given that an expanding wild usually displays an animation that expands to cover the entire reel and payline combination symbol cannot be seen, the hit from the payline symbol is usually not counted – i.e. we count 1 hit, not 2. We can then use the RTP contribution saved in another part of the game where it will be visible to the player.

In Slot Designer expanding wild, where the wild symbol W substitutes for A and W is scattered, and where we count multiple (2) hits for both A on the payline and scattered wild off the payline, can be implemented as

pay 100 on left 3 { A, W.s };

When we want to reduce the multiple (2) hits to a single hit we use the merge attribute

```
pay 100 on left 3 { A, W.s }.merge;
```

PRIORITISATION

Consider a game where the wild symbol W substitutes for symbols A and B, and the reels stop with symbols {W, W, A} on the payline. This matches both left 3 A and left 2 B pay rules (combinations {A,A,A} and {B,B,#B} respectively).

While we could pay both, it is more common to pay on the highest win only, hence the common rule on slot games of "Highest win pays on each payline". This is also referred to as prioritization, as we order the priority of the pay rules, and determine which single rule to pay.



The hits without prioritization, including wild, are

$$hits(A, A, A) = (4 + 4) \times 1 \times 2$$

= 16
$$hits(B, B, \# B) = (2 + 4) \times 1 \times (10 - 1)$$

= 54
Equation 19

The RTP for the non-prioritized game is then 860%

$$rtp = \frac{16 \times 200 + 54 \times 100}{1000 \times 1} \times 100\%$$

= 860%

Consider the winning combination {W,W,A}. When all wins pay this would hit both left 2 B and left 3 A. When only the highest win pays then we need to decide to pay either the 2 B or 3 A, and choose 3 A as it's the highest (otherwise the player would be quite upset). We need adjust, or discount, the hits for left 2 B to exclude those hits that pay as left 3 A instead.

The combinations where we pay left 3 A instead of left 2 B are those where stop with {W,W,A} on the payline, for which there are 8 hits

$$hits(W, W, A) = 4 \times 1 \times 2$$
Equation 21
= 8

The number of hits on left 2 B is then 54 - 8 = 46 hits.

The RTP for the game is 780%, a considerable drop from the non-prioritized 860%.

$$rtp = \frac{16 \times 200 + 46 \times 100}{1000 \times 1} \times 100\%$$

= 780%

Where pay rules have the same prize value the priority is chosen by the game designer.

In a real game using Excel the discounting gets quite involved.

Prioritization in slot designer is implemented as

```
prioritise highest
{
    pay 200 on left 3 A;
    pay 100 on left 2 B;
}
```

MULTILINE

Most games have more than one payline, and some have 100 or more. There is no standard layout for paylines, apart perhaps from the first 3.



The number of paylines and their layout is usually of little concern mathematically, as the RTP tends to be independent of the number of paylines in the game; in Excel the RTP is usually calculated for a single payline only. The hits and therefore win increases linearly with additional paylines, hence the bet is similarly increased to keep the RTP constant.

As hits for scatter combinations are independent of paylines their prizes are multiplied by the bet to keep the RTP constant.

The maximum number of paylines in a game is the product of the individual window heights for each reel., and in games where it is used is sometimes described as "ways to win". In a 5 reel 3 row games this is 3^5 , or 243 lines or ways to win. Similarly for a 5 by 4 game there's a maximum of 4^5 or 1024 paylines. A game with a window of 3, 4, 5, 4, 3 symbols visible on reels 1 to 5 respectively would have a maximum of $3 \times 4 \times 5 \times 4 \times 3 = 720$ paylines.

The 5 paylines shown above were created by the following Slot Designer code

```
payline line01 { 2,2,2,2,2 } // define the lines
payline line02 { 1,1,1,1,1 }
payline line03 { 3,3,3,3,3 }
payline line04 { 1,2,3,2,1 }
payline line05 { 3,2,1,2,3 }
payline line01, line02, line03, line04, line05; // instantiate the paylines into the game
```

VIRTUAL REELS

Virtual reels were originally used in mechanical stepper games to implement symbol weightings, as described in the Telnaes patent (US 4448419). While not common, some game designers also like to use them in video slots.

In a mechanical stepper machine the reel is a physical device, and mechanical constraints on the size of the reel and symbols limit the number of symbols around the reel to about 22. If there were 100 symbols per reel for example, then each symbol would be so small the player wouldn't be able to see them, or conversely the gaming machine would be enormous to fit the massive reels.

Considering a 3 reel game this limits the cycle to 22³, or 10648 different positions. If we wanted a 20K credit prize, and only one combination of the 10648 games hit, we would still have an RTP from that one prize of around 188%. This severely limits the maximum prizes on the pay table, and flexibility in designing the game.

Virtual reels model a longer virtual reel, which maps multiple virtual stopping positions to a single physical stop position on the actual reel.



In this example we have a virtual reel with one stack of $6 \times A$ symbols and another 1 $\times A$ symbol. The virtual symbols map to the physical reel, so that when the virtual reel is spun and a stop position is determined, it determines a corresponding stop position on the physical reel.

When we spin the virtual reel we can see that the chance of a hit on the stack of 6 A symbols is 6 size times higher than hitting the single A symbol, and also 3 times that of hitting the B symbol. Hence we can see that the weighting of the symbols on the virtual reel affects the probability of stopping on a symbol on physical reel.

Consider again the previous example of a 3 reel game, with a single combination that wins 20K credits. We could easily make a virtual reel of 100 symbols, giving a cycle of $100^3 = 1$ million games. The RTP due to that prize is now only 0.2% instead of the 188% we had without the virtual reel.

On stepper machines virtual reels allow vastly increased prizes, and flexibility in pay table design.

Unlike normal games, the win (hence RTP) of each combination is different for each payline, greatly complicating Excel spread sheets. To understand why this happens consider a virtual reel with a very large weighting at one position. When the reel spin stops, it is highly likely that this symbol will stop on payline 1, and correspondingly highly unlikely that it will ever stop on the position above or below that (i.e. on another payline).

It is possible to balance the symbols on the reel so that the RTP for each payline is the same.

The symbols must be carefully arranged on the reel such that there are pivot points where the symbols directly above and below each pivot point are repeated around another pivot point, and the weights balance each other.

In the diagram to the right the pair of symbols A, B at positions 6, 7 around the pivot have weights of 3, 2 and are balanced by the pair B, A at positions 13, 14 with weights 3, 2.

Only the symbols next to the pivot points require balancing.



It may not be possible to balance the symbol layout, for example when converting a video game to a stepper format. In this case it may be considerable amount of work to not only calculate the RTP for each payline, but where the player may select different numbers of paylines to play, to keep the RTP for each player selection approximately the same. It may be a regulatory requirement to have the RTP the same or increase as the number of paylines increase.

IRREGULAR WINDOW

Most games have the usual 3x3 or 5x3 window, but some games have more unusual shapes. The RTP for these games is easily calculated using the same principles outlined so far. The normal payline combinations are independent of the height of the window; it is only scatter wins that are sensitive to window height.

This example shows a window with 3,5,5,5,3 symbols visible on reels 1 to 5 respectively.



For example the number of hits for a scatter symbol on all 5 reels is 1125.

$$hits(S, S, S, S, S) = 3 \times 5 \times 5 \times 5 \times 3$$
$$= 1125$$

In Slot Designer the window is described with the following code, which first defines the maximum size of the window, then defines which locations within it are used.

window 5,3,{2,3,4},{1,2,3,4,5},{1,2,3,4,5},{1,2,3,4,5},{2,3,4};

PLAYER CHOICE

A feature of some games is to present the player with a set of choices (e.g. boxes) with hidden prizes and ask them to pick one or more of them. As each prize is chosen the value of the prize is revealed, and the player wins the sum of the prizes chosen. These are also known as pick games.

For this simple case the average win is

average win = number of choices \times average prize value Equation 23

There are many variations of these types of features, such as picking other feature games, multipliers, or prizes that immediately terminate the choices. Some are quite complex, and are beyond the current scope of this document.

FREE GAMES

A common game feature is free spins, where a base game triggers into a series of free games.

Consider first the case where free games do not retrigger additional free games. The average win of the base game and free game is B_0 and B_1 respectively, and the base game triggers n_1 free games with a trigger probability of p_1 per spin. Hence the average number of free games is n_1p_1

$$E(free games) = n_1 p_1$$
 Equation 24

The final win, F, of the combined series of base and free games is then

$$F = B_0 + n_1 p_1 B_1$$
 Equation 25

As usual the RTP is the win divided by the bet.

$$final \ rtp = \frac{B_0 + n_1 p_1 B_1}{bet} \times 100\%$$

Now consider what happens when the free game is able to retrigger n_2 games with probability p_2 . The average number of free spins is

$$E(freespins) = n_1 p_1 + n_1 p_1 (n_2 p_2) + n_1 p_1 (n_2 p_2)^2 + n_1 p_1 (n_2 p_2)^3 + \dots$$

= $n_1 p_1 \sum_{i=0}^{\infty} (n_2 p_2)^i$
= $n_1 p_1 \left(\frac{1}{1 - n_2 p_2}\right)^i$

The volatility index based on 90 and 99% confidence intervals is 1.64 σ and 2.58 σ respectively.

And the RTP is again the base win plus the average free game win times the average number of free games, divided by the bet.

STANDARD DEVIATION

 $\sigma = \sqrt{\sum_{i=1}^{n} p_i (x_i - \overline{x})^2}$

The standard deviation σ is calculated (Equation 29) using the probabilities of each prize in the base and feature games, times the difference between that prizes credit value and the mean credit win of the entire series of base/feature games.

Equation 29

Equation 28

The standard deviation suitable for regulatory approval can be calculated in Excel. The probability of each prize in a feature game is the total probability of reaching that feature game times the probability of that prize being awarded within the feature game.

The probability of the base game itself is 1.0, and the probability of the free game is the expected value of the free spins as calculated by Equation 27.

While there are usually no zero credit prizes, there is a probability of not winning any credit prize, and this value can be omitted.

VOLATILITY INDEX AND CONFIDENCE INTERVALS

rtp range = *rtp* $\pm \frac{volatility index}{\sqrt{N}}$

The confidence intervals show the range of the RTP on a gaming machine after N games

volatility index = $1.96 \cdot \sigma$

If the measured RTP is outside this range then, with 95% confidence, we can say it is not working as expected. This calculation assumes the game has a normal distribution, which may not be the case.

---- 95% ---- Hole 45 50 % 45.30 % 45.10 % 44 90 % 44 70 9 100.000 1.000.000 10,000,000 Game

Slot Designer displays the confidence levels to show the expected margin to the game operator, to 90, 95, and 99% confidence levels.





Equation 31

CHAPTER 3 243 WAYS GAMES

¹Slot games have historically used paylines to determine winning combinations of symbols across the play window. Originally a single payline passed through the center of the window, but over time the number of paylines has increased to 100 and more. As the number of paylines has increased it has become progressively more difficult for players to understand why they won a particular prize.

By removing the concept of paylines entirely, 243 ways games make it relatively easy for the player to understand why a particular combination wins. They simply count the number of symbols appearing on the reel, typically from left to right, without regard to their position on the reel. For example, if 3 ACE symbols appear anywhere, one on each of the first 3 reels, they win the 3 ACE combination without having to consider if it's on a payline or not.

WAYS VS. PAYLINES

A 243 ways game is so called because there are up to 243 "ways" to win, but it's not a 243 payline game.

There are a maximum of 243 possible paylines in a 5×3 game, as can be understood from the following diagram showing all the paylines for the first 2 reels. For a single reel there are 3 possible paylines, and for every additional reel each payline splits into 3 further paylines, hence 3, 9 (3×3), 27 (3×3×3), 81 (3×3×3×3), and 243 (3×3×3×3×3), for 1 to 5 reels respectively.



We can see that 243 ways is not 243 paylines by considering the following diagram. According to the basic idea behind the 243 ways game, 5 A symbols anywhere on the 5 reels counts as a single 5 of a kind win. However if we evaluate this as a 243 line game we can see that it is counted as at least 3 coinciding wins of 3, 4, and 5 A. Therefore we can think of 'ways' as being similar to lines, but where a win occurs on a line a subset of those symbols cannot be used by themselves to make a win on another line.



Figure 2.

¹ This chapter was contributed by Mark Sinosich of Imagine Numbers

We cannot prioritise the wins to select only a single win only for the highest number of symbols, as can be seen from the next diagram where there are valid wins on multiple paylines.



We can however treat the 243 ways game as a 1 (or 0) line game where all the symbols are scattered, and this provides a simple means of calculating the RTP provided that there are no wild symbols on the leftmost reels.



By varying the window size we can see different numbers of ways are possible (e.g. $3 \times 4 \times 4 \times 4 = 576$).



Вет

Payline games usually have a bet of 1 credit per payline, but 243 ways games typically have a bet in the region of 25 to 30 credits. This value is a balance between having a large enough bet to get reasonable size wins, and not having such a large bet that the game is too expensive to play.

It is generally considered undesirable to have wins smaller that the bet, as these wins are in fact losses. While a bet around 30 credits is quite high, 243 ways games tend not to have 2 of a kind wins with their associated low prize values (due to the large number of hits), and do have a significant number of coinciding wins, thus reducing the potential for wins less than bet.

WILD ON REEL 1

When we have wild symbols on the leftmost reels the determination of the win is considerable more complex. In the following two examples the symbol W is wild for symbols A, B, C, D, and A pays more than B, B more than C, and C more than D.

In the next diagram there are 32 (2^5) possible paylines through the top 2 rows of the window, and given that W is wild for A, we have 32 winning paylines for 5A. There are also 32 paylines through the bottom 2 rows, and W is wild for B, so we have 32 winning paylines for 5B. However the A and B wins share a single payline through the center row, and as this is a 'ways' game only one of the combinations will pay, in this case A since its prize is higher than that of B. Hence there are only 32 - 1 = 31 wins for the 5B combination.

Given that W is wild for symbols C and D, the center line also matches the 5C and 5D combinations, but only the higher paying 5A is awarded.



The overlap in the combinations for the different symbols is caused by the wilds on the leftmost reels, and it is this overlap that prevents the calculation of the win by scattering symbols, as we would count 32 hits on each of A, B, C and D. Removing the wild from the leftmost reels (usually reel 1) would eliminate the overlap, simplify the calculations, and significantly reduce the number coinciding hits.

In the next example with 4 wild symbols there are multiple ways we can interpret the win. On the left diagram, wins of 5A, 5B, 4A, and 3A (the 4W symbols match all of 4A, 4B, 4C and 4D, but only the highest, 4A, is awarded). Note however that this contradicts the example above showing how 243 ways games differ from line games, for this special case of subsets of wilds causing wins. On the right we can interpret the rules to mean there are no wins due to the subsets of the winning wild symbols. From a game design view point we may prefer the rules on the left as it is more generous to the player. However it would be even better to avoid this situation completely as it is confusing to the player.



In the above example we have the non-paying symbol 'x' for which wild does not substitute, for example a scatter or bonus, and would typically not be placed next to a wild symbol. Using normal paying symbols, and considering only 4 and 5 of a kind wins, for both of the above scenarios we would then have the following.

	$\sim\sim$	ı.	$\sim \sim$	1	$\sim\sim$	1	$\sim \sim$	I	$\sim \uparrow$	1	
	С		С		С		С		В		1 × left 5 A +
	W		W		W		W		А		$1 \times 1011 5 B +$ $16 \times 10ft 5 D +$
	D		D		D		D		D		15 x left 4 C
											15

By moving the symbols on reel 5 to reel 4 (and using the rule interpretation on the left above) the wins in the next example are similar, but note how the 3 winning paylines at reel 4 would each split into a further 3 (i.e. 9 in total) on reel 5, but there are no further wins due to the subset rule (Figure 2, page 16).



We can calculate the RTP of these games (using the rule interpretation on the left above) by calculating the hits as usual, then removing any hits on the wilds that would be awarded to another symbol. For example the hits for 5A are calculated for the combination

hits(5A)= hits({{A.s,W.s}, {A.s,W.s}, {A.s,W.s}, {A.s,W.s}, {A.s,W.s})

The hits for 5B are similar, but we must account for the hits due to 5W being attributed to 5A instead of 5B

hits(5B)= hits({{B.s,W.s}, {B.s,W.s}, {B.s,W.s}, {B.s,W.s}, {B.s,W.s}) – hits({W,W,W,W,W})

Similarly hits for 4A are

hits(4A)= hits({{A.s,W.s}, {A.s,W.s}, {A.s,W.s}, {A.s,W.s}, #{A.s,W.s}})

And the hits for 4B are similar, minus the hits for 4W which are attributed to 4A instead of 4B

hits(4B)= hits({{B.s,W.s}, {B.s,W.s}, {B.s,W.s}, {B.s,W.s}, #{B.s,W.s}) - hits({W,W,W,W,#W})

CHAPTER 4 SIMULATION VS THEORETICAL CALCULATION

The calculation of RTP in Excel is a theoretical calculation based on the probability of combinations, and produces statistics for each combination or win independently. We cannot determine the probability of wins occurring on multiple paylines at the same time, or a payline win combined with an off-payline scatter win.

For example, we can calculate the probability of a win due to $3 \times A$, and $3 \times$ scattered S independently, but not the probability of getting both at the same time.



Similarly we can calculate the probability of wining 100 credits and 10 credits independently, but not the probability of winning 110 credits.



A win that comprises multiple independent wins is referred to as a coinciding win, and provides important statistics related to game performance. It gives a more accurate picture of the game from the player's perspective, and in some cases is required for regulatory compliance.

When a player wins on multiple paylines their experience is of winning the coinciding win, not the individual parts – i.e. they think they won 110 credits, not 100 and 10.

Coinciding statistics can be determined by creating a simulation of the game with a custom program, for example in C# or C++, so that for each reel stopping position in the game the coinciding win is determined and recorded. This not only provides the coinciding statistics, but can be used for checking the calculations in the spreadsheet before it is implemented on the gaming platform.

The simulation is typically done in two ways, either as an exhaustive cycle through all possible stop positions (referred to as full cycle), or using a random sampling of the possible outcomes (Monte Carlo). One or both methods may be used depending on the game and the required statistics. The full cycle simulation allows an exact match to the calculations in the spreadsheet, but is not capable of calculating coinciding statistics across a series of feature games. Monte Carlo simulation calculates coinciding wins across series of base/feature games, but does not provide a perfectly accurate result.

Slot Designer supports all these types of calculations and simulations.

PROFILE

When we look at the profile of the game, dividing all the possible wins into ranges, we get a different picture of the game depending on the use of coinciding or non-coinciding statistics, and while it's easy in Excel to calculate the non-coinciding profile and produce such a chart, it is the coinciding data that is actually more useful.

The following charts show an example of difference between the results depending on how they are determined (these are not from a real game).



STANDARD DEVIATION

The standard deviation of the game reduces as we increase the number of paylines (it's less volatile), but using Excel we have no way of properly calculating the coinciding standard deviation. Fortunately it is not required for regulatory compliance.

MAXIMUM WINS

In some markets the maximum allowable win of the game is specified by government regulation.

The maximum usually results from a number of separate coinciding payline and scatter wins. For example the win may be limited to \$10000, and while there is no individual win exceeding that amount we also need to ensure there is no possible combination of multiline wins and scatters wins over \$10000 either. We probably also want to have a top pay table prize as close as possible to the limit as it's more appealing to the player, yet the closer we get to this prize for a single win the more likely we are to exceed it due to coinciding wins. This can involve numerous iterations of the game as we try variations of the pay table and reelstrip layout to optimize the game.

SIMULATION AND VERIFICATION OF PRODUCT CODE

The implementation of the game in the product code is simulated to provide a final verification of the theoretical game design, and to check for software implementation errors. This type of simulation is generally much slower than any custom simulator the game designer might use due to the overhead of running platform code which has other requirements than just executing the simulation. None the less it is essential to at least check for software bugs in the product.

The game is simulated to model a large number plays and the RTP determined. The RTP should be close to the theoretical RTP calculated by the game designer. While it won't be exactly the same, as the test is a random simulation, a significant discrepancy outside the allowable margin indicates a problem. At this point a comprehensive breakdown of the simulated results to show the statistics for the various parts of the game is essential for quick diagnosis.

If the only information is that the simulated RTP is 90.2% and the theoretical result is 90.0%, it could take a very long time to work out what is causing the error, especially since modifying the game and rerunning large simulations is very time consuming. To make matters worse this typically occurs when the game is almost finished.

Slot Designer provides a verification tool called "Compare Server Play" to aid in verifying the product code and quickly diagnose errors. The product software is modified to write log files recording reel stopping positions and corresponding credits won, and a series of games is randomly played. The verification utility reads the log file and verifies it against the Slot Designer game model. When a difference between the two implementations is found, the reel stopping positions (essentially the symbols on the screen), and the two different win values are reported. From there it's easy to diagnose the problem. The full product code simulation should still be run, but by that point an entire class of potential errors has been eliminated.

CHAPTER 5 ANALYSIS OF A GAME

To illustrate how the basic principles are used we calculate the RTP of a very simple base and free game, with left to right pays, wild, and scatter. Free games are triggered by 3, 4, or 5 scatter symbols and retrigger. First we use Excel, then Slot Designer

ANALYSIS USING MICROSOFT EXCEL

					JAJAnary	SIS.ABA - MILLIO.	JOIL EXC		-				
Home	Insert Page	Layout Form	nulas Data	Kevlew V	iew Add-In	s Load lest	AC	DDat PKZP	r leam	n 🚥 (S AutoSum v	
Calib	ori * 11	т А́л́	= = = 🍕	🕅 📅 Wrap	Text	General		·		🖌 🗄 i	P 🔳	E Fill *	ŻΓ (
В	I <u>U</u>	<u> - A</u> -		🛙 🗊 🔤 Merg	e & (enter *	\$ - % ,	•.0.•	Conditiona	I Format Ce	ell Insert D	elete Format	Clear *	Sort & F
ard G	Font	6		Alianment	5	Number		Formatting	* as lable * Style Styles	es * *	Cells	Edit	Filter * So
AC149	- (=	£	,	arginiterit		Tumo u			NULL NULL		6607		
AC145	P	,	D	F		Ć.	ц	1		V	1	6.4	N
A vs left to righ	b t evcent scatter w	hich nave any	U	E	F	0	н	1	J	K	L	IM	. N
1 3 scatters n	av 25 15 10 free	games											
ee games are	the same as the b	ase game											
ild substitute:	s for all symbols ex	cept scatter											
t	1												
mbol Distribu	tion						1	Fits Any 4 scat					
	Reel 1	Reel 2	Red 3	Reel 4	Reel5				scat, scat, scat,	scat,#scat	196830		
ld	1	1	1	2	3				scat, scat, scat,	#scat, scat	137781		
at	3	3	3	2	1				scat, scat, #scat	t, scat, scat	99144		
	5	4	4	4	4				scat,#scat,scat	, scat, scat	8/480		
	6	3	4	5	4		-		mscal, scal, scal	Total	619921		
	5	4	6	4	5		-			Total	010321		
	10	11	12	11	10								
	9	8	9	8	5			Fits Any 3 scat					
	8	6	8	6	4				scat, scat, scat,	#scat,#scat	2066715		
	7	8	9	8	3				scat, scat, #scat	t, scat, #scat	1487160		
n	6	7	8	9	2				scat, scat, #scat	t,#scat,scat	1041012		
ie	10	9	8	7	2				scat,#scat,scat	t, scat, #scat	1312200		
tal	76	69	77	69	48				scat,#scat,scat	t,#scat,scat	918540		
									scat,#scat,#sca	at, scat, scat	660960		
cle	1337345856								#scat, scat, scat	t, scat, #scat	1465290		
									#scat, scat, scat	t,#scat,scat	1025703		
ts									#scat, scat, #sca	at, scat, scat	738072		
	5	4	3	2	1	Total			#scat,#scat,sca	at, scat, scat	651240		
at	13122	618921	11366892			11998935				rotal	11366892		
	6300	36900	453600			496800							
	10290	60270	624960			695520 coss ~~		Probability					
	6720	22600	516096			695520	-	nobability	E	4	•		
	290004	790790	4612608			5692292		eat	9 911975-06	0.000162798	0.00919959	2	
	230004	360000	2548800			2980800		s.at 01	4 71082E-06	275925-05	0.000339179	0	
	31752	185976	1660176			1877904		P2	7.69434E-06	4.50669E-05	0.000467314	0	
	43200	302400	2039040			2384640		P3	7.53732E-06	3.76866E-05	0.000474851	0	
1	27720	238392	1403136	12612096		14281344	i	P4	5.02488E-06	2.51244E-05	0.000385911	0	
ie	44550	383130	2851200	24773760		28052640		4	0.00021685	0.000583828	0.003449076	0	
tal	542616	2431848	17344656	37385856	0	57704976	1	k	5.3838E-05	0.00026919	0.001905865	0	
								Q	2.37425E-05	0.000139064	0.001241396	0	
ay Table								J	3.23028E-05	0.00022612	0.001524692	0	
	5	4	3	2	1		1	ten	2.07276E-05	0.000178258	0.001049195	0.009430691	
at	100	20	10				1	rine	3.33123E-05	0.000286485	0.002131984	0.018524572	
L	1000	750	500										
2	750	500	100										
3	750	100	15				-	Ease Game p(v	vin-ave.win)^2				
•	500	40	15				-		5	4	3	2	
	400	50	15				-	sat	4 701097554	0.168150268	0.69/880/53	0	
	400	50	10					12	4.701985554	15.48105409	84.47073822	0	
	200	25	10					12	4.31/24131/	0.269922962	4.585817135	0	
n	150	25	10	5				01	1 251507233	0.009823903	0.076302563	0	
ne l	150	25	10	5				4	34,53341501	1.405281907	0.681954157	0	
	150	20	10	5				r k	8573695125	0.647943706	0.156485912	0	
								0	0.94080826	0.080510435	0.101928027	0	
in								1	1.280011239	0.130911276	0.12518873	0	
	5	4	3	2	1	Total		ten	0.460552806	0.103201723	0.086146821	0.155553073	
at	0.000981	0.009256	0.084996	0.000000	0.000000	0.095233		nine	0.740174153	0.165859912	0.175052037	0.305550679	
	0.004711	0.020694	0.169590	0.000000	D.000000	0.194994							
:	0.005771	0.022533	0.046731	0.000000	0.000000	0.075036							
	0.005653	0.003769	0.007123	0.000000	0.000000	0.016544							
	0.002512	0.001005	0.005789	0.000000	0.000000	0.009306		Free Game p(v	/in-ave.win)^2				
	0.086740	0.029191	0.051736	0.000000	0.000000	0.167668			5	4	3	2	
	0.021535	0.013459	0.019059	0.000000	0.000000	0.054053		sat	0.009777278	0.017074618	0.070865466	0	
	0.004749	0.003477	0.012414	0.000000	0.000000	0.020639		10	0.47/457294	1.572066101	8.5/8089306	0	
	0.006461	0.005653	0.015247	0.000000	0.000000	0.02/360		12	0.438389165	1.1397/3903	0.405661314	0	
	0.003109	0.004456	0.010492	0.04/153	0.00000	0.005211		01	0.127092005	0.03293630	0.003533/36	0	
tal	0.004597	0.120654	0.021520	0.129776	0.000000	0.120102		1	2506651200	0.14269767	0.069218219	0	
	0.14/219	0.120030	0.4444.90	0.133770	5.0000	0.03214/		k l	0.870605612	0.065794669	0.015890175	0	
se Game Wir	1	0.852147						0	0.095533249	0.008175336	0.01035016	0	
ature Game	Win	0.852147						j l	0.12997721	0.013293229	0.01271214	0	
							1	ten	0.046766284	0.010479495	0.008747676	0.015795451	
igger N scat	5	4	3					rine	0.075160099	0.016842046	0.01777545	0.031026778	
ee Spins	25	15	10										
obability	9.81197E-06	0.000462798	0.00849959				·	Total	201.2073571				
eespins	0.000245299	0.00694197	0.084995904					Std.Dev	14.18475792				
ee spins			0.092183173										
trigger free s	spins		0.092183173										
freespins)			0.10154380										
-hue-													
I AT WIN	0.93867699												
ait Ir	95.80/099%												

The calculations are illustrated by calculating several exemplary values from which the spreadsheet can be understood.

First we calculate the hits for the payline combinations and the scatters to determine the average base and free game win. We then determine the probability of the free games occurring, and combine the base and free games wins to calculate the final RTP of the game. Last we calculate the standard deviation.

PAYLINE COMBINATIONS HITS

The calculation of hits for left 4 P1 is shown, and includes the wild symbols.

$$hits(left \ 4 \ P1) = hits(P1, P1, P1, P1, \#P1)$$

$$= (5+1) \times (4+1) \times (4+2) \times (48-4-3)$$

$$= 36900$$
Equation 32

The other non-scatter hits are calculated in a similar manner.



SCATTER COMBINATION HITS

Scatter hits are a little more complex as they are "any" pay rules rather than left to right, and are the sum of the different combinations that make up the rule. For the rule "any 4 scat" we need to calculate the hits for 5 combinations, the first of which is

$$hits(scat, scat, scat, scat, \#scat) = (3*3) \times (3*3) \times (3*3) \times (2*3) \times (48 - 1*3)$$

= 196830



AVERAGE WIN

From the hits we can calculate the probability of each rule, and from that the average credit win.

The probability of "left 4 P1" is 2.7592×10⁻⁵.

$$probability(left 4 P1) = \frac{hits(left 4 P1)}{cycle}$$
$$= \frac{36900}{1337345856}$$
$$= 2.7592 \cdot 10^{-5}$$

The average win for "left 4 P1" is then 0.020694 credits.

win(left 4 P1) = probability × prize
=
$$2.7592 \cdot 10^{-5} \times 750$$

= 0.20694

The total win of the base game is the sum of the wins of all the rules in the pay table. As the free game has identical rules to the base game it has the same average win.

Equation 34

16	K	9	8	9	8	5		Hits Any 3 scat	t				
17	Q.	8	6	8	6	4			scat, scat, scat,	#scat,#scat	2066715		
18	1	7	8	9	8	3			scat, scat, #sca	t,scat,#scat	1487160		
19	ten	6	7	8	9	2			scat, scat, #sca	t,#scat,scat	1041012		
20	nine	10	9	8	7	2			scat,#scat,sca	t,scat,#scat	1312200		
21	Total	76	69	77	69	48			scat,#scat,sca	t,#scat,scat	918540		
22			nuchel	all the diam	4 = 1) hit	- / evela			scat,#scat,#sc	at, scat, scat	660960		
23	Cycle	1337345856	probat	biiity(ieit -	4 p1 = nit	5/CYCIE	45056		#scat,scat,sca	t,scat,#scat	1465290		
24			_		= 30	900/13373 7502E-05 c	43630		#scat, scat, sca	t,#scat,scat	1025703		
25	Hits				- 2.1	J92L-0J C	ieurs		#scat, scat, #sc	at_scat,scat	738072		
26		5	4	3	2	1	Total		#scat,#scat,sc	at, scat, scat	651240		
27	scat	13122	618921	11366892			11998935			Total	11366892		
28	P1	6300	36900	453600		_	496800						
29	P2	10290	60270	624960			695520						
30	P3	10080	50400	635040			695520	Probability					
31	P4	6720	33600	516096			556416		5	4	3	2	1
32	A	290004	780780	4612608			5683392	scat	9.81197E-06	0.000462/98	0.00849959	0	0
33	К	72000	360000	2548800			2980800	P1	4.71082E-06	2.7592E-05	0.000339179	0	0
34	0	31752	185976	1660176			1877904	P2	7.69434E-06	4.50669E-05	0.000467314	0	0
35	1	43200	302400	2039040			2384640	P3	7.53732E-06	3.76866E-05	0.000474851	0	0
36	ten	27720	238392	1403136	12612096		14281344	P4	5.02488E-06	2.51244E-05	0.000385911	0	0
37	nine	44550	383130	2851200	24773760		28052640	A	0.00021685	0.000583828	0.003449076	0	0
38	Total	542616	2431848	17344656	37385856	0	57704976	K	5.3838E-05	0.00026919	0.001905865	0	0
39			2.020.0	2.011000				0	2.37425E-05	0.000139064	0.001241396	0	0
40	Pay Table							Ň	3.23028E-05	0.00022612	0.001524692	0	0
41	ruy rubic	5	4	3	2	1	/	ten	2.07276E-05	0.000178258	0.001049195	0.009430691	0
42	scat	100	20	10	_			nine	3.33123E-05	0.000286485	0.002131984	0.018524572	0
43	P1	1000	• 750	500									-
44	P2	750	500	100	win(left 4	p1)=prize	* probability	(left 4 p1)					
45	P3	750	100	15		= 750	2.7592E-05	Base Game p					
46	P4	500	40	15		= 0.0	20694 credits		5	4	3	2	1
47	A	400	50	15				scat	0.09628631	0.168150268	0.697880753	0	0
48	K	400	50	10		/		P1	4.701983554	15.48165469	84.47673822	0	0
49	0	200	25	10	/			P2	4.317241917	11.2244555	4.585817139	0	0
50	1	200	25	10				P3	4.229134939	0.369823963	0.093887919	0	0
51	ten	150	25	10	5			P4	1.251507233	0.038334468	0.076302563	0	0
52	nine	150	25	10	5			A	34,53341501	1.405281907	0.681954157	0	0
53					-			К	8.573695125	0.647943706	0.156485912	0	0
54								0	0.94080826	0.080510435	0.101928027	0	0
55	Win							1	1.280011239	0.130911276	0.12518873	0	0
56		5	4	3	1	1	Total	ten	0.460552806	0.103201723	0.086146821	0.155553073	0
57	scat	0.000981	a series i	0.084996	2000000	0.000000	0.095233	nine	0.740174153	0.165859912	0.175052037	0.305550679	0
58	P1	0.004111	0.020694	109590	0.000000	0.000000	0.194994		0.740174200	0.1000000012	0.270002007	0.00000070	-
59	P2	0.005771	0.020034	0.046731	0.000000	0.000000	0.075036						
60	P3	0.005653	0.003769	0.007123	0.000000	0.000000	0.016544						
61	P4	0.002512	0.001005	0.005789	0.000000	0.000000	0.009306	Free Game pla	vin-ave.win\^2				
62	Δ.	0.086740	0.029191	0.051795	0.000000	0.000000	0.167668	e oune p(5	4	2	2	1
63	ĸ	0.021535	0.013459	0.019059	0.000000	0.000000	0.054053	scat	0.009777278	0.017074618	0.070865466	2	1
64	0	0.004749	0.003477	0.012414	0.000000	0.000000	0.020639	P1	0.477457294	1.572066101	8578089306	0	0
65	~ I	0.006461	0.005653	0.015247	0.000000	0.000000	0.027360	P2	0.438389165	1.139773903	0.465661314	0	0

COMBINE BASE AND FREE GAME WIN TO CALCULATE FINAL RTP

Using Equation 28 (page 15) we calculate the final RTP. First, the expected number of free spins triggered, per spin, by the base game is is the sum of the individual triggers, 0.092183173

$$freespins = \sum n \cdot p$$

= 25×9.81197 \cdot 10^{-6} + 15×0.000462798 + 10×0.00849959
= 0.092183173

The number of free spins for the free game is the same as the base game, as the games are identical (except for the bet), and the free game retriggers.

The final RTP is then 93.867699%

$$F = \frac{B_0 + B_1 n_1 p_1 \left(\frac{1}{1 - n_2 p_2}\right)}{bet} \times 100\%$$

=
$$\frac{0.852147 + 0.852147 \times 0.092183173 \left(\frac{1}{1 - 0.092183173}\right)}{1} \times 100\%$$

= 93.867699%

Equation 37

	3 9	- 6 -	∓				5x8Analy	/sis.xlsx - Micro:	oft Exce	1					- 0 ×
F	ile	Home	Insert Page	e Layout Form	mulas Data	Review \	/iew Add-In	s Load Test	Acr	obat PKZ	IP Tean				a 🕜 — 🖻
ľ	& 1	Cali	bri 👻 1	ı · A A	= = = *	- 🔐 Wra	p Text	Number	÷			j = i	*	Σ AutoSum -	27 🗥
Pa	ste 🦪	В	IU·	<u>ð</u> - <u>A</u> -		📰 📰 Mer	ge & Center 🔻	\$ - % ,	◆.0 .00 ◆.0 •.0	Condition	al Format C	ell Insert D	elete Format	Q Clear ▼	Sort & Find &
Clip	board	6	Font			lignment	G.	Number	6	i	Styles		Cells	Edit	ing
	B	83	- (° (fx =C70+C	71*D78*(1/(1·	078))									
	A	4	В		D	NE	F	G	Н	I.	J	K	L	M	N
64	Q		0.004745	9 0.0034 77	0.012414	000000	0.000000	0.020639	P	1	0.477457294	1.572066101	8.578089306	0	
65	l		0.006461	L 0.005653	0.015247	0.000000	0.000000	0.027360	P	2	0.438389165	1.139773903	0.465661314	0	
66	ten		0.00310	9 0.004456	0.010492	0.0 7153	0.000000	0.065211	P	3	0.429442447	0.037553332	0.009533736	0	
67	nine		0.004997	7 0.007162	0.021320	0.092623	0.000000	0.126102	P	4	0.127082805	0.003892628	0.007748052	0	
68	Total		0.147219	0.120656	0.444495	0.139776	0.000000	0.852147	A		3.506654308	0.14269767	0.069248219	0	
69									K		0.870605613	0.065794668	0.015890175	0	
70	Base Ga	ameWi	n	0.852147	· \				C	2	0.095533249	0.008175336	0.01035016	0	
71	Feature	Game	Win	0.852147	`\\				J		0.12997721	0.013293229	0.01271214	0	
72				//			L		t	en	0.046766284	0.010479495	0.008747676	0.015795451	
73	Trigger	N scat		4	3				n	ine	0.075160099	0.016842046	0.01777545	0.031026778	0
74	Free Sp	ins		15	10		1		-						
75	Probab	ility	9.8119/E-00	5 0.000462798	0.00849959	K			1	otal	201.20/35/1				
76	Freespi	ns	0.000245295	9 0.00694197	0.084995904				2	ta.Dev	14.184/5/92				
77	F				000100170					_					
78	Free sp	ins ar fra a		C C	0.092183173	2		probabil	ity(a	any 3 so	cat)=hits(any 3 sc	at)/cycle		
20	E/froor	er nee	spins		0.10154290		//				=1136	56892/13	3734585	56	
81	r(inces	<i>J</i> III 3 <i>J</i>			0.10134380		/								
82			1/												
83	Final W	in	0.9386769												
84	Final RT	TP I	93.867699%	5											
85			N												
86			`\												
87															
88															
89				Λ											
90				\mathbf{X}											
91				rtp =	win/bet*	100%									
92															
93															
94															
95															
96															

STANDARD DEVIATION

We calculate the standard deviation using Equation 29 (page 15). We build two tables for containing the probability of a prize occuring times the square of the prize minus the games average win. Each cell contains

$$p_i(x_i - \overline{x})^2$$

The probability for base game prizes is simply the probability of the combination occurring, which we calculated as 2.7592×10^{-5} for left 4 P1 with Equation 34 (page 24). Thus the cell representing left 4 P1 contains

$$2.7592 \cdot 10^{-5} (750 - 0.93867699)^2 = 15.48165469$$
 Equation 39

The corresponding cell in the free game uses takes into account the probability of free game occurring (after the initial trigger and any number of retriggers), which is the expected number of free spins from Equation 27 (page 14), and as shown in the similar Equation 37, is 0.10154380.

Equation 40

Equation 38

$$E(freespins) = n_1 p_1 \left(\frac{1}{1 - n_2 p_2}\right)$$

= 0.852147 × 0.092183173 $\left(\frac{1}{1 - 0.092183173}\right)$
= 0.10154380

The table entry for left 4 P1 in the free game is then 1.572066101

$$0.10154380 \times 15.48165469 = 1.572066101$$
 Equation 41

The standard deviation is then the square root of the sum of these two tables

$$\sigma = \sqrt{201.2073571} = 14.18475792$$

The relevant part of the spread sheet in more detail

30	P 3	10080	50400	635040			695520	Probability					
30	P.5	6720	33600	53040 516005			655520 EE 6416	Frobability		4	2	2	1
32	r4 A	200004	790790	4612609			550410	cent	0.911075.06	4	0.0004.005.0	2	1
32	A V	230004	260000	4012003 25.4.9900			2080332	5Cat	4.710925.06	0.000402738	0.000330170	0	
35	N 0	72000	195.076	2548800			2980800	P2	4.710822-06	4 E0660E 0E	0.000339179	0	
34	Q I	31/52	185976	2020040			2204.640	P2	7.09434E-00	4.50009E-05	0.000467314	0	
30	J	43200	302400	2039040	10010000		2384640	P3	7.53/32E-06	3 /0800E-05	0.000474851	0	0
30	ten	2//20	238392	1403136	12612096		14281344	P4	5.02488E-06	251244E-05	0.000385911	0	0
3/	nine	44550	383130	2851200	24//3/60		28052640	A	0.00021685	0.000583828	0.003449076	0	0
38	Total	542616	2431848	17344656	37385856	0	57/04976	К	5.3838E-05	0.00026919	0.001905865	0	0
39								Q	2.37425E-05	0.000139064	0.001241396	0	0
40	Pay Table							J	3.23028E-05	0.00022612	0.001524692	0	0
41		5	4	3	2	1		ten	2.07276E-05	0.000178258	0.001049195	0.009430691	0
42	scat	100	20	10				nine	3.33123E-05	0.000286485	0.002131984	0.018524572	0
43	P1	1000	750	500		probability	**************************************				0 0 0 0 0 0 0 0 0 0 0 0 0	2600)_1E 4016	55460
44	P2	750	500	100		probability	y square(pri	ze-average	w(1) = 2.75	926-03 (7.	0-0.93607	099)=15.4610	55409
45	P3	750	100	15				Base Game p(win-ave.win)^2				
46	P4	500	40	15					5	4	3	2	1
47	A	400	50	15				scat	0.09628631	0.168150268	0.697889753	0	0
48	К	400	50	10				P1	4.701983551	15.48165469	84,47673822	0	0
49	Q	200	25	10				P2	4.317241917	11.2244555	4.585817139	0	0
50	J	200	25	10				P3	4.229134939	0.869823963	0.093887919	0	0
51	ten	150	25	10	5			P4	1.251507233	0.038334468	0.076302563	0	0
52	nine	150	25	10	5			Δ.	34 5 33(1501	1 405 281 907	0.681954157	0	0
52	mile	150	25	10				r v	9572695125	0.547942706	0.156195912	0	
55								0	0.04000226	0.047545700	0.101029027	0	
54	14.0%							Q I	0.94080820	0.080510455	0.101928027	0	0
55	Win	-						1	1.280011239	0.130911276	0.125188/3	0	0
56		5	4	3	2	1	Total	ten	0.460552806	0.103201723	0.086146821	0.155553073	0
57	scat	0.0000001	0.000000.01	0.024995	0,000000	~ ~~~~	0.005.000	mino	0 740174160		0 1 TE 0E 2027	0 205550679	
57	stat	0.000981	0.009256	0.004330	0.00000	0.00000	0.095233	Inne	0.7401/4153	0.103859912	0.1/505203/	0.303330073	0
58	P1	0.000381	0.009256	0.169590	0.000000	0.000000	0.194994	mile	0.7401/4153	0.105859912	0.1/5052037	0.303330073	0
58 59	P1 P2	0.004711 0.005771	0.020694 0.022533	0.169590 0.046731	0.000000	0.000000	0.095233 0.194994 0.075036	F	freespins)	* 15 4816	5469 = 1	572066101	0
58 59 60	P1 P2 P3	0.005771 0.005653	0.009256 0.020694 0.022533 0.003769	0.169590 0.046731 0.007123	0.000000 0.000000 0.000000	0.000000 0.000000 0.000000	0.095233 0.194994 0.075036 0.016544	E	freespins)	* 15.4816	5469 = 1.	572066101	0
58 59 60 61	P1 P2 P3 P4	0.00531 0.004711 0.005771 0.005653 0.002512	0.009256 0.020694 0.022533 0.003769 0.001005	0.169590 0.046731 0.007123 0.005789	0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000	0.095233 0.194994 0.075036 0.016544 9.009306	Free Game p(freespins)	* 15.4816	5469 = 1.	572066101	0
58 59 60 61 62	P1 P2 P3 P4 A	0.00551 0.005711 0.005771 0.005653 0.002512 0.086740	0.009256 0.020694 0.022533 0.003769 0.001005 0.029191	0.169590 0.046731 0.007123 0.005789 0.051736	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.095233 0.194994 0.075036 0.016544 0.009306 0.167668	E(freespins) win-ave.win)^2	* 15.4816	5469 = 1.	572066101	1
58 59 60 61 62 63	P1 P2 P3 P4 A K	0.000371 0.005771 0.005653 0.002512 0.086740 0.021535	0.009256 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459	0.169590 0.046731 0.007123 0.005789 0.051735 0.019059	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.0000000 0.0000000 0.0000000 0.000000	0.055233 0.194994 0.075036 0.016544 0.009306 0.167668 0.054053	Free Game p(freespins) win-ave.win)^2 0.009777278	* 15.4816 4	5469 = 1. 3	572066101 2 0	1
58 59 60 61 62 63 64	P1 P2 P3 P4 A K Q	0.000371 0.005771 0.005653 0.002512 0.086740 0.021535 0.004749	0.009256 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477	0.064333 0.169590 0.046731 0.007123 0.005789 0.051736 0.019059 0.012414	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.055233 0.194994 0.075036 0.016544 0.009306 0.167668 0.054053 0.020639	Free Game p(scat	freespins) win-ave.win)^2 0.009777278 0.47745764	* 15.4816 4 001-7074618	5469 = 1. 3 2070865466 3578089306	572066101 2 0 0	1 0 0
57 58 59 60 61 62 63 63 64 65	P1 P2 P3 P4 A K Q J	0.000381 0.004711 0.005771 0.005653 0.002512 0.086740 0.021535 0.004749 0.006461	0.009256 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653	0.064333 0.169590 0.046731 0.007123 0.005789 0.051735 0.019059 0.012414 0.015247	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.055233 0.194994 0.075036 0.016544 9.009306 0.167668 0.054053 0.020639 0.027360	Free Game p(scat P1 P2	freespins) win-ave.win)^2 0.009777278 0.477457194 0.438389165	* 15.4816 4 0017074618 1572066101 1.139773903	5469 = 1. 3 2070865466 3578089306 0.465661314	572066101 2 0 0 0	1 0 0 0 0
58 59 60 61 62 63 63 64 65 65	P1 P2 P3 P4 A K Q J ten	0.000381 0.004711 0.005771 0.005653 0.002512 0.086740 0.021535 0.004749 0.006461 0.003109	0.009256 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456	0.04453 0.1695590 0.046731 0.007123 0.005789 0.051736 0.019059 0.012414 0.015247 0.010492	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.055233 0.194994 0.075036 0.016544 9.009306 0.167668 0.054053 0.020639 0.027360 0.027360	Free Game p(scat P1 P2 P3	freespins) win-ave.win)^2 0.009777258 0.477457194 0.438389165 0.429442447	* 15.4816 4 0.012024618 1.139773903 0.037553332	5469 = 1 3 4070865466 3578089306 0.465661314 0.009533736	572066101 2 0 0 0	1 0 0 0 0
58 59 60 61 62 63 64 65 65 66 67	P1 P2 P3 P4 A K Q J J ten nine	0.000381 0.004711 0.005653 0.002512 0.086740 0.021535 0.004749 0.006461 0.003109 0.004997	0.009256 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162	0.0445590 0.046731 0.007123 0.005789 0.051736 0.019059 0.012414 0.015247 0.010492 0.021320	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05523 0.194994 0.075036 0.016544 0.009306 0.167668 0.054053 0.020639 0.027360 0.065211 0.126102	Free Game p(scat P1 P2 P3 P4	freespins) win-ave.win)^22 0.009777278 0.47745764 0.43839165 0.429442447 0.127082805	* 15.4816 4 0.120246101 1.1397/3903 0.03755332 0.003892628	0.175052037 5469 = 1. 3 6070865466 8578089306 0.465661314 0.009533736 0.007748052	572066101 2 0 0 0 0	1 0 0 0 0 0
57 58 59 60 61 62 63 64 65 65 66 67 68	P1 P2 P3 P4 A K Q J ten nine Total	0.0004711 0.005771 0.005653 0.002512 0.086740 0.021535 0.004749 0.006461 0.003109 0.004997 0.147219	0.00926 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120556	0.04759 0.169590 0.046731 0.007123 0.0051736 0.019059 0.012414 0.015247 0.010492 0.021320 0.444495	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.1055233 0.134994 0.075036 0.016544 0.009306 0.167668 0.02639 0.027360 0.025211 0.126102 0.852147	Free Game p(scat P1 P2 P3 P4 A	freespins) win-ave.win)^22 0.009777278 0.477457634 0.438389165 0.429442447 0.127082805 3.506664308	* 15.4816 4 0.12024618 1.572066101 1.139773303 0.037553332 0.003892628	0.175052037 5469 = 1. 3 2070865466 3578089306 0.465661314 0.009533736 0.007748052	572066101 2 0 0 0 0 0	
57 58 59 60 61 62 63 64 65 66 65 66 67 68 69	P1 P2 P3 P4 A K Q J ten nine Total	0.000351 0.005771 0.005653 0.002512 0.086740 0.021535 0.004749 0.006461 0.003109 0.004997 0.147219	0.009269 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656	0.169590 0.046731 0.007123 0.0051736 0.019059 0.012414 0.015247 0.010492 0.021320 0.4444496	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.193523 0.19394 0.075036 0.016544 0.009306 0.167668 0.054053 0.020639 0.027360 0.0055211 0.126102 0.852147	Free Game p(scat P1 P2 P3 P4 A K	freespins) win-ave.winj^2 0.009777278 0.477457 64 0.478457 64 0.429442447 0.127082805 3.506634308 0.820665613	* 15.4816 0.1/3074518 1.3977303 0.037553332 0.00352628 0.14269767 0.00574668	0.175052037 5469 = 1 3 6070865466 0.465661314 0.009533736 0.007748052 0.069248219 0.015890175	572066101 2 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 62 63 65 66 65 66 67 68 69 70	P1 P2 P3 P4 A K Q J J ten nine Total	0.000/371 0.005/571 0.005/53 0.002512 0.086740 0.0215/35 0.004749 0.006461 0.003109 0.004997 0.147219	0.009269 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656	0.169590 0.046731 0.007123 0.0051735 0.012414 0.012547 0.010492 0.021320 0.444495	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.055233 0.134994 0.075036 0.046544 0.009306 0.167668 0.054053 0.020639 0.027560 0.065211 0.126102 0.852147	Free Game p(scat P1 P2 P3 P4 A K	freespins) win-ave.winj^2 0.009777278 0.47745764 0.43839165 0.429442447 0.127082805 3.506654308 0.87065613	* 15.4816 4 572066101 1.39773903 0.037553332 0.003892628 0.14269767 0.0065794668	0.175052037 5469 = 1 3 2070865466 3578089306 0.465661314 0.009533736 0.007748052 0.069248219 0.01935016	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 63 65 66 67 68 69 70 71	P1 P2 P3 P4 A K Q J ten nine Total Base Game Win	0.000/3711 0.005/5711 0.005/5731 0.0025/32 0.006/400 0.00215/35 0.0004/401 0.0003109 0.0004461 0.0003109 0.0004497 0.147219	0.00925 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656	0.163590 0.046731 0.007123 0.005789 0.005789 0.012414 0.015247 0.010492 0.021320 0.0444496	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05/253 0.194994 0.075036 0.046544 0/059306 0.054053 0.020639 0.027560 0.065211 0.126102 0.852147	Free Game p(scat P1 P2 P3 P4 A K Q	freespins) win-ave.win)^22 5 0.009777278 0.477457641 0.43339165 0.429442447 0.127042805 3.506654308 0.870605613 0.05533249 0.12907271 0.12707273	* 15.4816 • 15.4816 • 15.4816 • 15.4816 • 15.4816 • 14.57266101 • 1.39773903 • 0.003892628 • 0.003892628 • 0.003892628 • 0.004275336 • 0.005794668 • 0.008175336	0.175052037 5469 = 1. 3 2070865466 3578089306 0.465661314 0.009748052 0.007748052 0.009748052 0.0015890175 0.01035016	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 71 72	P1 P2 P3 P4 A K Q J ten nine Total Base Game Win Feature Game	0.000371 0.005653 0.002512 0.006540 0.021555 0.004749 0.006461 0.003109 0.0064997 0.147219	0.009250 0.022694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656 0.852147 0.852147	0.163590 0.046731 0.007123 0.005789 0.051735 0.019059 0.012414 0.015247 0.010492 0.021320 0.444495	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05233 0.19494 0.075036 0.016544 0/009306 0.167668 0.054053 0.020639 0.027360 0.020639 0.027360 0.0265211 0.126102 0.852147	Free Game p(Free Game p(P1 P2 P3 P4 A K Q J t cn	0.740174133 freespins) win-ave.win}^2 0.009777278 0.47745764 0.438389165 0.438389165 0.42944247 0.127042805 3.506643038 0.870605613 0.095533249 0.12597721 0.016756324	* 15.4816 4 0.12724618 1.139773903 0.03755332 0.03892628 0.14269767 0.065794668 0.008175336 0.008175336	0.175052037 5469 = 1. 3 2070865466 0.465661314 0.007533736 0.069248219 0.015890175 0.01035016 0.01271214	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 62 63 64 65 66 67 68 69 70 71 72 72	P1 P2 P3 P4 A K Q J J ten nnine Total Base Game Wim Feature Game V	0.000/3711 0.005/771 0.005/673 0.0025/12 0.086740 0.0215/32 0.004749 0.006461 0.003109 0.004799 0.004799 0.004799 0.004799 0.004799	0.009250 0.022694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.0004456 0.007162 0.120656 0.120656	0.163590 0.046731 0.007123 0.005789 0.051735 0.019059 0.012414 0.015247 0.010492 0.021320	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05/253 0.13/994 0.075036 0.016544 0.039306 0.167668 0.054053 0.020639 0.027360 0.027360 0.025211 0.126102 0.652147	Free Game p(scat P1 P2 P3 P4 A K Q J J ten	0.74014133 freespins) win-ave.win)^22 5 0.009777278 0.47745764 0.429442447 0.127082805 3.506684308 0.870605613 0.005538249 0.12997721 0.0476284	* 15.4816 4 0.17074618 1.7377300 0.03755332 0.03755332 0.03892628 0.14269767 0.065794668 0.008175336 0.013293229 0.010479495	0.175052037 5469 = 1 3 6070865466 0.465661314 0.009533736 0.007748052 0.009248219 0.015890175 0.01035016 0.01271214 0.008747676 0.01277245	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
578 579 60 61 62 63 64 65 66 66 67 68 69 70 71 72 73	P1 P2 P3 P4 A K Q J ten nine Total Base Game Win Feature Game V Trigger N scat	0.000/3711 0.005/5711 0.005/5731 0.0025/53 0.00215/35 0.0021/535 0.0004740 0.003109 0.000461 0.003109 0.000461 0.003109 0.000461 0.003109 0.000461 0.003109 0.000461 0.003109 0.000461 0.00310 0.0004711 0.00553 0.000543 0.000553 0.000543 0.000543 0.000543 0.000543 0.000543 0.000543 0.000543 0.000543 0.000543 0.000543 0.000543 0.000545 0.0004497 0.000445 0.000545 0.000445 0.000545 0.000445 0.00055 0.00045 0.00055 0.00045 0.00055 0.00055 0.00055 0.00055 0.00055 0.00055 0.00055 0.00055 0.00055 0.00055 0.00055 0.00055 0.00055 0.00050	0.009250 0.022694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.005456 0.120656 0.120656 0.852147 0.852147 0.852147	0.163590 0.046731 0.007123 0.005789 0.012414 0.015247 0.010492 0.021320 0.444495	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05/233 0.194994 0.075036 0.046544 0/059306 0.0654053 0.020639 0.027360 0.065211 0.126102 0.852147	Free Game p(Free Game p(P1 P2 P3 P4 A K Q J ten nime	freespins) win-ave.win)^22 5 0.009777278 0.47745704 0.42842447 0.127042805 0.506664308 0.870605613 0.055533249 0.12997721 0.046766284 0.075160099	* 15.4816 * 15.4816	0.173032037 5469 = 1. 3 2070865466 3578089306 0.465661314 0.009533736 0.069248219 0.015890175 0.01035016 0.01271214 0.008747676 0.01777545	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74	P1 P2 P3 P3 P4 A K Q J ten nine Total Base Game Vin Feature Game V Trigger N scat Free Spins	0.000371 0.005653 0.00553 0.002512 0.086740 0.021535 0.004740 0.002461 0.003109 0.006461 0.003109 0.004497 0.147219	0.009250 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656 0.852147 0.852147 4 15	0.163590 0.046731 0.007123 0.005789 0.05789 0.012414 0.012547 0.010492 0.021320 0.444495 3 10	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05233 0.19394 0.075036 0.016544 0.009306 0.167668 0.054053 0.02639 0.027360 0.027360 0.065211	Free Game p(Free Game p(P1 P2 P3 P4 A K Q J ten nine	0.740174133 freespins) win-ave. win/22 0.009777278 0.47745764 0.429442447 0.127042805 3.506634308 0.870665613 0.029573249 0.12997721 0.04576284 0.075160099	* 15.4816 4 0.112724618 1.139773903 0.037553322 0.037553322 0.037553322 0.04269767 0.045794668 0.008175336 0.013293229 0.010479495 0.016842046	0.173032037 5469 = 1. 3 2070865466 0.465661314 0.009533736 0.007748052 0.069248219 0.015390175 0.01035016 0.01271214 0.008747676 0.01777545	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75	P1 P2 P3 P4 A K Q J J ten nnine Total Base Game Win Feature Game V Trigger N scat Free Spins Probability	0.000371 0.005471 0.005512 0.005512 0.006740 0.001535 0.004749 0.006461 0.003109 0.00499 0.00499 0.0147219 0.147219 V/m	0.009269 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656 0.120656 0.852147 0.852147 4 15 0.000462798	0.163590 0.046731 0.007123 0.005789 0.051736 0.019059 0.012414 0.015247 0.010492 0.021320 0.021320 0.02144496	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05/253 0.194994 0.075036 0.016544 0.0054053 0.020639 0.027360 0.027360 0.027360 0.027360 0.027360 0.027360 0.025211	Free Game p(scat P1 P2 P3 P4 A K Q J ten nine Total	freespins) wh-ave.winj^22 0.009777278 0.477457780 0.477457780 0.42842447 0.127042805 3.506654308 0.870605613 0.095533249 0.1297721 0.04676284 0.075160099 201.2073571	* 15.4816 * 15.4816 1.33773303 0.037553332 0.003892628 0.14269767 0.005794668 0.013293229 0.010479495 0.016842046	0.173082037 5469 = 1. 3 2070865466 0.465661314 0.00533736 0.007748052 0.0105016 0.01271214 0.008747676 0.01777545	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75	P1 P2 P3 P4 A K Q J ten nine Total Base Game Win Feature Game V Trigger N scat Free Spins Probability Freespins	0.000/31 0.005/71 0.005/63 0.005/53 0.002/53 0.006/461 0.003/109 0.006/461 0.003/109 0.004/997 0.147219 0.147219 5 5 9.81197E-06 0.000245299	0.009250 0.022694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003479 0.005653 0.004456 0.007162 0.120656 0.852147 0.852147 4 15 0.000462798 0.000462798	0.163590 0.046731 0.007123 0.005789 0.019059 0.012414 0.015247 0.010492 0.021320 0.444495 3 10 0.00849959 0.0849959 00	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05/253 0.194994 0.075036 0.046544 0/059306 0.054053 0.020639 0.027360 0.065211 0.126102 0.852147	Free Game p(Free Game p(P1 P2 P3 P4 A K Q J ten nine Total Std.Dev	0.74014133 freespins) win-ave.win)^22 5 0.009777278 0.47745764 0.438389165 0.429442447 0.12702805 3.506654308 0.870605613 0.06756284 0.06756284 0.06756284 0.075160099 201.2073571 14.18475792	* 15.4816 * 15.4816 1.1397/3503 0.037553332 0.003592628 0.0425794668 0.008175336 0.014293229 0.010479455 0.016842046	0.173032037 5469 = 1. 3 2070865466 3578089306 0.465661314 0.009533736 0.069248219 0.015890175 0.01035016 0.01271214 0.008747676 0.01777545	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76	P1 P2 P3 P4 A K Q J ten nine Total Base Game Win Feature Game V Trigger N scat Free Spins Probability Freespins	0.00034711 0.005653 0.002512 0.0066740 0.0021535 0.0004741 0.0004741 0.000461 0.0003109 0.000461 0.0003109 0.0004997 0.147219 V/m 5 25 9.81197E-06 0.000245299	0.009250 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656 0.852147 0.852147 4 15 0.000462798 0.006942798	0.163590 0.046731 0.007123 0.005789 0.019059 0.019059 0.012414 0.015247 0.010492 0.021320 0.444495 3 10 0.0084995904	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05233 0.19394 0.075036 0.016544 9:009306 0.167668 0.054053 0.020639 0.027360 0.027360 0.065211 0.126102 0.852147	Free Game p(Free Game p(P1 P2 P3 P4 A K V Q J ten nine Total Std.Dev	0.74014133 freespins) win-ave.win/22 0.009777278 0.47745764 0.429442447 0.127082805 0.870665613 0.0495533249 0.12997721 0.047556654308 0.870665613 0.046766284 0.075160099 201.2073571 14.18475792	* 15.4816 4 0.112021618 1.139773503 0.0037553332 0.0037553332 0.005794668 0.008175336 0.012092468 0.016842046	0.173052037 5469 = 1. 3 2070805466 357808306 0.465661314 0.009533736 0.007748052 0.069248219 0.015890175 0.01035016 0.01271214 0.00874767 0.01777545	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78	P1 P2 P3 P4 A K Q J J ten nnine Total Base Game Win Free Spins Free Spins Free Spins	0.000371 0.005471 0.005512 0.005512 0.006740 0.001535 0.004749 0.000479 0.00499 0.00499 0.0147219 1.47219 1.47219 5 5 5.81197E-06 0.000245299	0.009250 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.0004563 0.0007162 0.120656 0.120656 0.852147 0.852147 4 15 0.000462798 0.00694197	0.163590 0.046731 0.007123 0.005789 0.051736 0.019059 0.012414 0.015247 0.010492 0.021320 0.021320 0.0244495 0.00849959 0.084995904 0.092183173	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05/253 0.194994 0.075036 0.016544 0.0054053 0.020639 0.027360 0.027360 0.027360 0.027360 0.027360 0.027360 0.027360 0.027360	Free Game p(Scat P1 P2 P3 P4 A K Q J ten nine Total Std Dev	freespins) wh-ave.winj^2 0.009777278 0.477457780 0.477457780 0.429412447 0.127042805 3.506654308 0.870605613 0.095533249 0.12977721 0.046766284 0.075160099 201.2073571 14.18475792	* 15.4816 * 15.4816 1.3977303 0.03753332 0.003892628 0.04269767 0.005794668 0.012593229 0.010479495 0.016842046	0.173082037 5469 = 1. 3 2070865466 0.465661314 0.00533736 0.007748052 0.01035016 0.01271214 0.008747676 0.01777545	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79	P1 P2 P3 P4 A K Q Q J ten nine Total Base GameWin Feature GameV Trigger N scat Free Spins Froe Spins Free spins Free spins Retrigger free s	0.000371 0.005471 0.005512 0.005512 0.006740 0.021535 0.0004740 0.000461 0.003109 0.000461 0.003109 0.000497 0.147219 0.147219 0.147219 0.147219 0.147219 0.147219 0.147219 0.000245299 pins	0.009250 0.022694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656 0.852147 0.852147 4 15 0.000462798 0.000462798	0.163590 0.046731 0.007123 0.005789 0.051736 0.019059 0.012414 0.015247 0.010492 0.021320 0.444495 10 0.00849959 0.084995904 0.092183173 0.092183173	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05233 0.19394 0.075036 0.04654 0.0054053 0.020639 0.027560 0.065211 0.126102 0.852147	Free Game p(Free Game p(P1 P2 P3 P4 A K Q J ten nine Total Std Dev	freespins) win-ave.win)^22 5 0.009777278 0.47745704 0.428442447 0.127082805 0.429442447 0.127082805 0.3506654308 0.870605613 0.055533249 0.12997721 0.046766284 0.075160099 201.2073571 14.18475792	* 15.4816 * 15.4816 1.1397/3503 0.037553332 0.003553332 0.0035794668 0.014269794668 0.001293229 0.010179455 0.016842046	0.173032037 5469 = 1. 3 27070865466 3578089306 0.465661314 0.009533736 0.069248219 0.015890175 0.01035016 0.01271214 0.008747676 0.01777545	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80	P1 P2 P3 P4 A K Q Q J ten nine Total Base Game Win Feature Game V Trigger N scat Free Spins Probability Freespins Retrigger free S E(freespins)	0.000371 0.005653 0.002571 0.005653 0.002512 0.006740 0.0021535 0.0004740 0.0004740 0.00041097 0.147219 0.000445 0.00045219 0.000245299 pims	0.009250 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656 0.852147 0.852147 4 15 0.000462798 0.00694197	0.163590 0.046731 0.007123 0.005789 0.051736 0.019059 0.012414 0.015247 0.010492 0.021241 0.0015247 0.010492 0.021241 0.0024959 0.00849959 0.008499590 0.0092183173 0.002183173 0.002183173	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05233 0.19394 0.075036 0.006544 9009306 0.167668 0.054053 0.020639 0.027360 0.027360 0.065211 0.126102 0.852147	Free Game p(Free Game p(P1 P2 P3 P4 A K Q J ten nine Total Std.Dev	0.74014133 freespins) win-ave.win/22 0.009777278 0.47745764 0.429442447 0.127082805 3.506634308 0.870605613 0.045533249 0.12997721 0.04575160099 201.2073571 14.18475792	* 15.4816 4 0.112021618 1.139773503 0.0037553332 0.0037553332 0.005794668 0.008175336 0.012092468 0.016842046	0.173052037 5469 = 1. 3 2070805466 357808306 0.465661314 0.009533736 0.007748052 0.069248219 0.015890175 0.01035016 0.01271214 0.00874767 0.01777545	572066101 2 0 0 0 0 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81	P1 P2 P3 P4 A K Q J J ten nnine Total Base GameWin Freature Game V Trigger N scat Free Spins Probability Freespins Free spins R etrigger free s E(freespins)	0.000371 0.000512 0.000512 0.000512 0.000512 0.0001749 0.000479 0.000479 0.000499 0.000499 0.0147219 0.000499 0.0147219 0.000495 9.81197E-06 0.000245299 pims	0.009269 0.022694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656 0.852147 0.852147 4 15 0.000462798 0.00694197	0.163590 0.046731 0.007123 0.005789 0.051736 0.019059 0.012414 0.015247 0.010492 0.021320 0.021320 0.00849959 0.084995904 0.092183173 0.092183173 0.092183173	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05/253 0.194994 0.075036 0.016544 0.054053 0.020639 0.027360 0.065211 0.126102 0.852147	Free Game p(Scat P1 P2 P3 P4 A K Q J ten nine Total Std.Dev	freespins) wh-ave.winj^22 5 0.009777278 0.47745778 0.4784574 0.438389165 0.429412447 0.127082805 0.129412447 0.127082805 0.1297721 0.046766284 0.075160099 201.2073571 14.18475792	* 15.4816 1.130724618 1.130775033 0.003892628 0.003892628 0.003892628 0.003892628 0.003892628 0.00329329 0.010479495 0.016842046	0.173082037 5469 = 1. 3 2070865466 3578089306 0.0465661314 0.005533736 0.069248219 0.015890175 0.01035016 0.01271214 0.008747676 0.01777545	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82	P1 P2 P3 P4 A K Q J ten nine Total Base Game Win Feature Game V Trigger N scat Free Spins Probability Freespins Free spins Retrigger free s E(freespins)	0.00034711 0.005653 0.005653 0.002553 0.0021535 0.0004740 0.0004740 0.0004161 0.0003109 0.000461 0.0003109 0.000461 0.00034599 0.000245299 pins	0.009250 0.022694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656 0.852147 0.852147 4 15 0.000462759 0.000462759	0.163590 0.046731 0.007123 0.005789 0.019059 0.012414 0.015247 0.010492 0.021320 0.444495 3 10 0.00849559 0.084995904 0.092183173 0.092183173 0.092183173	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05/253 0.194994 0.075036 0.046544 0/059036 0.054053 0.020639 0.027360 0.065211 0.126102 0.852147	Free Game p(Free Game p(P1 P2 P3 P4 A K Q J ten nine Total Std Dev	0.74014133 freespins) win-ave.win)^2 5 0.009777278 0.47745764 0.438389165 0.429442447 0.12702805 3.506654308 0.870605613 0.0367533249 0.12997721 0.046766284 0.075160099 201.2073571 14.18475792	* 15.4816 4 15.4816 1.1397/3503 0.037553332 0.003592628 0.0425794668 0.01429329329 0.010479455 0.016842046	0.175052037 5469 = 1. 3 2070865466 3578089306 0.465661314 0.009533736 0.007248052 0.015890175 0.01035016 0.01271214 0.00271245	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 80 81 82 83	P1 P2 P3 P4 A K Q Q J ten nine Total Base Game Win Feature Game V Trigger N scat Free Spins Probability Freespins Free spins Retrigger free s E(freespins) Final Win	0.000351 0.000512 0.005512 0.005512 0.005710 0.002512 0.006740 0.002512 0.004749 0.004749 0.004749 0.004749 0.004397 0.147219 Nm 5 5 5 9.81197E-06 0.000245299 pins	0.009250 0.020694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656 0.852147 0.852147 4 15 0.000462798 0.000462798	0.163590 0.046731 0.007123 0.005789 0.051736 0.019059 0.012414 0.015247 0.010492 0.021240 0.012414 0.015247 0.010492 0.021492 0.021492 0.00849959 0.0084995904 0.092183173 0.092183173 0.092183173	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05/253 0.13/994 0.075036 0.016544 0.09306 0.167668 0.054053 0.020639 0.027360 0.027360 0.027360 0.055211 0.126102 0.852147	Free Game p(scat P1 P2 P3 P4 A K Q J ten nime Total Std Dev	freespins) win-ave.winj^2 5 0.009777278 0.4774574 0.438389165 0.438389165 0.438389165 0.438389165 0.438389165 0.12708295 3.506654308 0.870605613249 0.12997721 0.046766284 0.075160099 201.2073571 14.18475792	* 15.4816 * 15.4816 1.139773903 0.03755332 0.03892628 0.14269767 0.065794668 0.0013293229 0.010479495 0.016842046	0.173052037 5469 = 1. 3 207085466 0.465661314 0.007748052 0.01035016 0.01271214 0.003747676 0.01777545	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83	P1 P2 P3 P4 A K C0 J J ten nine Total Base Game Win Feature Game V Trigger N scat Free Spins Probability Free Spins Free Spins Retrigger free S E(freespins)	0.000371 0.000512 0.000512 0.000512 0.000512 0.0004749 0.0004799 0.0004997 0.0004997 0.0004997 0.0004997 0.0004997 0.00047219 0.00045299 9.81197E-06 0.000245299 pims 0.93867699 9.3.867699	0.009269 0.022694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656 0.852147 0.852147 4 155 0.000462798 0.00694197	0.163590 0.046731 0.007123 0.005789 0.051736 0.019059 0.012414 0.015247 0.010492 0.021320 0.021320 0.021320 0.00849959 0.084995904 0.092183173 0.092183173 0.154380	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05/253 0.194994 0.075036 0.04654 0.054053 0.020639 0.027560 0.065211 0.126102 0.852147	Free Game p(Scat P1 P2 P3 P4 A K Q J ten nine Total Std.Dev	6,740174133 freespins) win-ave.winj^22 5 0.009777278 0.4774574 0.438389165 0.429412447 0.127082805 0.129412447 0.127082805 0.12997721 0.046766284 0.075160099 201.2073571 14.18475792	* 15.4816 * 15.4816 • 10.1021458 • 10.1021458 • 10.1021458 • 10.1021458 • 10.1021458 • 10.1021459767 • 0.003892628 • 0.00479495 • 0.016842046	0.175052037 5469 = 1. 3 2070865466 3578089306 0.465661314 0.005533736 0.007748052 0.01055016 0.01271214 0.008747676 0.01777545	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 80 81 82 83 84	P1 P2 P3 P4 A K Q Q J ten nine Total Base Game Win Feature Game V Trigger N scat Free Spins Probability Freespins Free spins Retrigger free s E(freespins) Final Win Final RTP	0.00034711 0.005653 0.005653 0.002553 0.0021535 0.0004740 0.0004740 0.0004740 0.000470 0.000470 0.000470 0.000461 0.0003109 0.000461 0.000345 25 9.81197E-06 0.0000245299 pins 0.93867699 93.867699%	0.009250 0.022694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656 0.852147 0.852147 4 15 0.000462798 0.000462798	0.163590 0.046731 0.007123 0.005789 0.019059 0.012414 0.015247 0.010492 0.021320 0.444495 3 100 0.00849959 0.0849959 0.084995904 0.092183173 0.092183173 0.092183173	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05/253 0.194994 0.075036 0.04654 0/054053 0.020639 0.027360 0.065211 0.126102 0.852147	Free Game p(Free Game p(P1 P2 P3 P4 A K Q J ten nine Total Std Dev	6,740174133 freespins) win-ave.winj^2 5 0.009777278 0.47745764 0.4284447 0.127042805 0.429442447 0.127042805 0.506654308 0.870605613 0.055533249 0.12997721 0.046766284 0.075160099 201.2073571 14.18475792	* 15.4816 4 0.112071618 1.139773503 0.037553332 0.0035794668 0.008175336 0.014297345 0.01047945 0.016842046	0.175052037 5469 = 1. 3 2070865466 3578089306 0.465661314 0.009533736 0.007248052 0.015890175 0.01035016 0.01271214 0.008747676 0.01777545	572066101 2 0 0 0 0 0 0 0 0 0 0 0 0 0	
578 588 599 601 622 633 645 666 677 688 670 712 734 75 766 777 780 812 823 844 858 845	P1 P2 P3 P4 A K CQ J ten nnine Total Base GameWin Feature GameV Trigger N stat Free Spins Probability Freespins Free spins Retrigger free s E(freespins) Final Win Final RTP	0.000371 0.000512 0.005512 0.005512 0.002512 0.006740 0.021535 0.004749 0.0004799 0.0004799 0.0004997 0.147219 N/m	0.009269 0.022694 0.022533 0.003769 0.001005 0.029191 0.013459 0.003477 0.005653 0.004456 0.007162 0.120656 0.852147 0.852147 4 15 0.000462798 0.000462798	0.163590 0.046731 0.007123 0.005789 0.051736 0.019059 0.012414 0.015247 0.010492 0.021320 0.044495 0.00849959 0.084995904 0.092183173 0.092183173 0.092183173 0.092183173	0.000000 0.000000 0.000000 0.000000 0.000000	0.000000 0.000000 0.000000 0.000000 0.000000	0.05/253 0.13/994 0.075036 0.016544 0.054053 0.020639 0.027360 0.065211 0.126102 0.852147	Free Game p(scat P1 P2 P3 P4 A K Q J ten nine Total Std Dev	6,7401,4133 freespins) win-ave.winj^2 5 0.009777278 0.47845778 0.43838946 0.43838946 0.43838946 0.43838946 0.4384946 3.50665430 0.12997721 0.046766284 0.075160099 201.2075571 14.18475792	* 15.4816 4 4 4 5 5 5 6 0.035753322 0.035794688 0.00387263 0.0038726 0.005794668 0.008175336 0.0012733229 0.010479495 0.016842046	0.173052037 5469 = 1. 3 207085466 0.465661314 0.005748052 0.069248219 0.01589017 0.01035016 0.01271214 0.008747676 0.01777545	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	

ANALYSIS USING SLOT DESIGNER

The same is shown in the Slot Designer IDE. Unlike in Excel where the calculations are specified, Slot Designer performs whatever calculations are required itself. The 'code' describing the game shown on the right, and the calculated game statistics on the left.

5×3F	FreeGame -	Slot Desig	jner 4									• ×
Eile	<u>E</u> dit ⊻iew	Tools	Help									✓ Default
1) 🖬 🚦	∑ Analyse	🦻 🔗 Simulate	📴 Play 🛛 🔀 Cance	- 🦄 🕅 🛃 🖕 Select	P	J	• Game ba	se_game		🔹 📀 🐣 🖕 🖾 🖕 🗄 Generate 👬 Compile 🖕	
Score [0	Combination]	[Final	RTP 93.867699	2874]				• 4 X	5x3Fr	eel	Game.sd 5x3FreeGame.rpt	4 Þ 🗙
	Hts	Hit Rate	Probability	RTP %	Prize Prize	Value	Rub Coinciding Base		1		symbol wild, scat, P1, P2, P3, P4, A, K, Q, J, ten, nin	.e; 🔼
_ ⊕-	6,300	212,277	0.0000047108	0.4710823286	1000	1000	left 5 P1		3		window 5,3;	
	36,900	36,242	0.0000275920	2.0693973721	750	750	left 4 P1		5	5	base (base game)	
	453,600	2,940	0.00003391793	0.5770758525	750	750	left 5 P2		7	2	newline line01 (2.2.2.2.2)	
	60,270	22,189	0.0000450669	2.2533438052	500	500	left 4 P2		9		substitute wild = all event scat:	
	624,950 10,080	2,140 132,673	0.0004673137	4.6731366998 0.5652987943	100 750	100 750	left 3 P2 left 5 P3		11	1	subscience wild - all except stat,	
	50,400	26,535	0.0000376866	0.3768658629	100	100	left 4 P3		12	8	payline lineol;	
	635,040 6,720	2,106 199.010	0.0004748510	0.7122764809 0.2512439086	15 500	15 500	left 3 P3 left 5 P4		14	5	scatter stat;	
	33,600	39,802	0.0000251244	0.1004975634	40	40	left 4 P4		16 17	5	pay 1000,750,500 on left 5,4,3 pl; pay 750,500,100 on left 5,4,3 p2;	
 	516,096 290.004	2,591	0.0003859106	0.5788659654	15	15 400	left 3 P4		18		pay 750,100,15 on left 5,4,3 p3; pay 500,40,15 on left 5,4,3 p4;	
. ⊕	780,730	1,713	0.0005838280	2.9191401629	50	50	left 4 A		20		pay 400,50,15 on left 5,4,3 Å; pay 400,50,10 on left 5,4,3 K;	
•	4,612,608	290	0.0034490764	5.1736145657	15	15	left 3 A		22		pay 200,25,10 on left 5,4,3 Q;	
	72,000	18,574 3,715	0.0000538380	2.1535192165	400	400	left 5 K left 4 K		23		pay 200,23,10 on left 5,4,3 0; pay 150,23,10,5 on left 5,4,3,2 ten;	
	2,548,800	525	0.0019058645	1.9058645066	10	10	left 3 K		25 26		pay 150,25,10,5 on left 5,4,3,2 nine; pay 100,20,10 on any 5,4,3 scat;	
	31,752 185.976	42,118 7,191	0.0000237425	0.4748509872	200 25	200 25	left 5 Q left 4 O		27	7	reelstrip: strips;	
	1,660,176	806	0.0012413962	1.2413961524	10	10	left 3 Q		29		pay repeat(free game,25), repeat(free game.15)	
	43,200	30,957	0.0000323028	0.6460557649	200	200	left 5 J		31		repeat(free_game, 10) on any 5,4,3 scat;	
	2,039,040	4,422	0.0002261195	1.5246916053	10	25 10	left 3 J		32		game base_game	
	27,720	48,245	0.0000207276	0.3109143369	150	150	left 5 ten		34	5	1 }	
	238,392	5,610 953	0.0001782576	0.4456438829 1.0491945623	25 10	25 10	left 4 ten left 3 ten		36	5	game free_game	
	12,612,096	106	0.0094306914	4.7153456764	5	5	left 2 ten		38	3	(bet = 0;	
	44,550	30,019	0.0000333123	0.4996837557	150	150	left 5 nine		40		}	
	2,851,200	469	0.0002004054	2.1319840243	10	10	left 3 nine		42		reelstrip: strips	E
B	24,773,750	54	0.0185245723	9.2622861502	5	5	left 2 nine		43	1	reel 1:	
	13,122 618,921	101,916 2,161	0.0000098120	0.0981197193 0.9255960187	100 20	100 20	any 5 scat @ scatte any 4 scat @ scatte	r_line r_line	45	5	<pre>{ wild, PZ, scat, P3, P4, A, K, Q, A,</pre>	
	11,366,892	118	0.0084995904	8.4995904006	10	10	any 3 scat @ scatte	_ _line	47	7	J.J.ten,nine,P1,P2,P3,A,A,K, Q.P4,J.ten,nine,A,scat,P1,P2,P3,	
B-1 ≜-	1,998,935 13,122	111	0.0000098120	8.6530224043 0.0230256808	repeat(free_game.25)		Coinciding Featur	e line	49		K,K,Q,A,J,nine,P4,ten,K,nine, P1,P2,P3,A,K,O,J,K,nine,nine,	
Ū.	618,921	2,161	0.0004627980	0.6516267656	repeat(free_game,15)		any 4 scat @ scatte	_line	51		ten, &, scat, P1, P2, P3, P4, K, Q, A, Q, J, nine ten nine nine P1, P2, P3, A	
⊕-	11,366,892	118	0.0084995904	7.9783699579	repeat(free_game,10)		any 3 scat @ scatte	r_line	53	3	K,P4,Q,Q,J,nine,ten	
									54	5	reel 2:	
									56 57	5	(wild, P2, scat, P3, P4, A, A, K, Q,	
									58 59	3	J,ten,nine,A,K,nine,P1,P2,K,A, J,P3,K,Q,scat,ten,A,Q,P4,J,	
									60		PL, P2, A, K, J, ten, nine, nine, A, P3, 0, J, K, J, P1, P2, A, scat, ten, ten	
									62		nine, P4, A, K, Q, J, P3, nine, P1, P2,	
									64	1	<pre>x,x,cen,cen,0,0,nine,x,nine,nine },</pre>	
									65	5	reer 3: (
Game S	ummary [Cor	mbination]						• ₽ X	67 68	7	wild, P1, P2, scat, P3, P4, A, A, K, Q, J,ten,nine, A, K,nine,nine, K, P4, P3,	
Game	2000	Bet A	ve. Bet Bas	e RTP Base Win	Feature RTP Feature Win	Tota	RTP Std Dev Final	Total Wi	69 70		A,P1,P2,K,Q,Q,scat,A,J,ten, nine,P4,K,A,P3,Q,J,J,nine,ten,	
free_ga	ame	0	0.000 85.2	0.852147	0.086530	93.86	/699 14.104/50	0.93867	71	2	P1, P2, A, K, P4, Q, J, J, A, ten, P3, nine, scat, K, A, Q, J, P4, ten, P1,	
									73		P2, A, K, ten, J, P3, Q, A, ten, nine, P4, K, nine, J, A, ten, 0	
•								F.	75		},	
Symbol	Distribution [[strips]						• 4 ×	76	2	(
		Reel 1		Reel 2	Reel 3	Re	el 4	Reel 5 🔺	78	3	wild, Pl, P2, scat, P3, P4, A, K, K, Q, J, ten, A, ten, nine, nine, P2, K, A, P1,	
wild		1		1	1		2	3	80 81		Q,P3,Q,J,A,ten,K,ten,P4,nine, P2,A,Q,J,wild,P1,A,scat,P3,K,	
P1		3		3 4	3		4	4	82	2	J,ten,J,Å,P2,Q,ten,nine,K,Å, J,P4,J,P1,ten,P3,Å,K.P2.0.	
P2		6		5	4		5	4	84		J.ten, A.ten, nine, K, nine, nine, A	
P3 P4		6		4	5		4 3	5	86		reel S:	
A		10		11	12		11	10	87	8	wild, P1, P2, scat, P3, P4, A, K, Q, A,	
K		9		8	9		8	5	89 90		J.A.ten, P3, P1, P2, wild, P4, A, A, K,Q, nine, P3, A, K, P1, P2, P4, A,	
1		8		8	9		8	3	91 92	2	Q,J,wild,P3,A,K,J,P4,P1,P2, A,ten,Q,P3,A,K,nine,P4	
ten		6		7	8		9	2	93		}	
nine Total		10		9	8		69	2 48 -	00	1		*
Score S	elected Hits	= 11.998.	935. RTP = 8.6	530224043. Rate =	111						D Combination Lire 42	Col 15

The Slot Designer code for the game.

```
symbol wild, scat, P1, P2, P3, P4, A, K, Q, J, ten, nine;
 window 5,3;
 base { base_game }
 payline line01 { 2,2,2,2,2 }
 substitute wild = all except scat;
 payline line01;
 scatter scat;
 pay 1000,750,500 on left 5,4,3
                                                                                                                               p1:
pay 750,500,100 on left 5,4,3
pay 750,500,100 on left 5,4,3
pay 750,100,15 on left 5,4,3
pay 500,40,15 on left 5,4,3
pay 400,50,15 on left 5,4,3
                                                                                                                              p2;
p3;
                                                                                                                                p3;
p4;
A;
pay 400,50,10
pay 200,25,10
pay 200,25,10
pay 150,25,10,5
                                                               on left 5,4,3
on left 5,4,3
                                                                                                                                 Κ;
                                                                                                                                Q;
                                                              on left 5,4,3 J;
on left 5,4,3,2 ten;
                                                              on left 5,4,3,2 nine;
on any 5,4,3 scat;
pay 150,25,10,5
pay 100,20,10
                                                                                                                               scat:
 reelstrips strips;
 pay repeat(free_game,25),repeat(free_game,15),repeat(free_game, 10) on any 5,4,3 scat;
 game base game
 }
game free_game
{
                 bet = 0;
 }
  reelstrips strips
 {
                  reel 1:
                  {
                                 wild,P2,scat,P3,P4,A,K,Q,A,
J,J,ten,nine,P1,P2,P3,A,A,K,
                                J. J. ten, nine, P1, P2, P3, A, A, K,
Q, P4, J, ten, nine, A, scat, P1, P2, P3,
K, K, Q, A, J, nine, P4, ten, K, nine,
P1, P2, P3, A, K, Q, J, K, nine, nine,
ten, A, scat, P1, P2, P3, P4, K, Q, A,
                                Q,J,nine,ten,nine,nine,P1,P2,P3,A,
K,P4,Q,Q,J,nine,ten
                },
reel 2:
{
                                 wild, P2, scat, P3, P4, A, A, K, Q,
                                 J,ten,nine,A,K,nine,P1,P2,K,A,
J,P3,K,Q,scat,ten,A,Q,P4,J,
                                P1, P2, A, K, J, ten, nine, nine, A, P3,
Q, J, K, J, P1, P2, A, scat, ten, ten,
nine, P4, A, K, Q, J, P3, nine, P1, P2,
                                 A,K,ten,ten,J,Q,nine,A,nine,nine
                },
reel 3:
                 {
                                 wild, P1, P2, scat, P3, P4, A, A, K, Q,
                                 J,ten,nine,A,K,nine,nine,K,P4,P3,
                                Signal Sign
                                 P4,K,nine,J,A,ten,Q
                },
reel 4:
                  {
                                 wild,P1,P2,scat,P3,P4,A,K,K,Q,
                                wiii, ri, rc, stat, r5, r4, A, K, K, Q,
J, ten, A, ten, nine, nine, P2, K, A, P1,
Q, P3, Q, J, A, ten, K, ten, P4, nine,
P2, A, Q, J, wild, P1, A, scat, P3, K,
J, ten, J, A, P2, Q, ten, nine, K, A,
D A, J H, ten, B3, K, P2, Q
                                 J,P4,J,P1,ten,P3,A,K,P2,Q,
J,ten,A,ten,nine,K,nine,nine,A
                },
reel 5:
                  {
                                 wild,P1,P2,scat,P3,P4,A,K,Q,A,
                                J,A,ten,P3,P1,P2,wild,P4,A,A,
K,Q,nine,P3,A,K,P1,P2,P4,A,
Q,J,wild,P3,A,K,J,P4,P1,P2,
                                 A,ten,Q,P3,A,K,nine,P4
                }
 }
```

5	x3FreeG	ame - S	Slot Desig	gner 4										
Eile	Edit	⊻iew	Tools	Help										
	💕 🔒		∑ Analyse	s 🔗 Sim	ulate 🔋	Play XCance	i (🎊 D21 🕻	nelect			▼ Game bas	e_game	- 🕞 🐣 📘 🖂	Gener
Score	e [Combi	natio	[Final	RTP 93.8	86769928	374]								
		Hits	Hit Rate	Pro	bability	RTP %		Prize Prize	e Value	Rule		– Final I	RTP	
-	69,70	3,911	19		<	85.2146768831				Coincidin	g Base	i iliar i		
6	Ð.,	6,300	212,277	0.00000	047108	0.4710023286	K	1000	1000	left 5 P1				
	6	36,900	36,242	0.00002	275920	2.0693973721		750	750	(******	*.{wild.P1}.{wild.P1}.{	wild.P1}.{wild.P	21}.#{wild.P1}.*.*.*.*.*	*3
6	± 4:	03,600	3,948	0.00033	391793	16.9589638299		500	500	left 3 P1)(((((d)) 1))(((((d)) 1)))	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	1))# (****3)* 1)))))	,
6	Ð- 1	10,290	129,966	0.00000	076943	0.5770758525		750	750	left 5 P2				
6	Ð- 6	50,270	22,189	0.00002	150669	2.2533438052		500	500	left 4 P2				
	- 62	24,960	2,140	0.00046	573137	4.6731366998		100	100	left 3 P2				
	+) F	50.400	26,535	0.00000	376866	0.376865862		100	100	left 4 P3				
6		35,040	2,106	0.00047	748510	0.7122764809		15	15	left 3 P3				
6	Ð	6,720	199,010	0.00000	050249	0.2512439086		500	500	left 5 P4	Base	ame R	ГР	
6	Ð- 3	33,600	39,802	0.00002	251244	0.1004975634		40	40	left 4 P4				
	51	16,096	2,591	0.00038	859106	0.5788659654		15	15	left 3 P4				
	- 75	30,004	4,611	0.00021	158504	2 9191401629		400	400	left 4 A				
6	4,61	12,608	290	0.00344	490764	5.1736145657		15	15	left 3 A	 Hits for 	left 4 P1	L	
6	Ð 7	72,000	18,574	0.00005	538380	2.1535192165		400	400	left 5 K				
6	9 36	50,000	3,715	0.00026	591899	1.3459495103		50	50	left 4 K				
	2,54	48,800	525	0.00190	058645	1.9058645066		10	10	left 3 K				
	- 1F	31,752	42,118	0.00002	237925	0.4748509872		200	200	left 4 O				
	1,68	50,176	806	0.00124	413962	1.2413961524		10	10	left 3 Q				
6	• • •	13,200	30,957	0.00003	323028	0.6460557649		200	200	left 5 J				
6	9 − 30	02,400	4,422	0.00022	261195	0.5652987943		25	25	left 4 J				
	2,03	39,040	656	0.00152	246916	1.5246916053		10	10	left 3 J				
		27,720	48,245	0.00002	207276	0.3109143369		25	150	left 5 ten				
	B 1,40	03,136	953	0.00104	491946	1.0491945623		10	10	left 3 ten				
6	12,61	12,096	106	0.00943	306914	4.7153456764		5	5	left 2 ten				
6	- - 4	44,550	30,019	0.00003	333123	0.4996837557	Lite	150	150	left 5 nine				
6	9 38	33,130	3,491	0.00028	864854	0.7162133832		25	25	left 4 nine	Fire	t scatte	r combinatio	'n
	2,85	51,200	469	0.00213	319840	2.1319840243		10	10	left 3 nine	1113		Combinatio	
	±- 1	13.122	101.916	0.00000	199120	0.0981197193		100	100	anv 5 scat				
6		10,921	2,161	8.00046	627980	0.9255960187		20	20	any 4 scat		V		
	- 19	96,830	6,194	0.00014	471796	0.2943591579		20	20	{*;*;*; <	scat.s,scat.s,scat.s,	scat.s,#scat.s,*	* ,*,*}	
	1;	37,781	9,706	0.00010	030257	0.2060514105		20	20	{*,*,*,*,*	scat.s,scat.s,stat.s,	#scac.s,scat.s,*	*,*,*,*,*}	
		99,144	13,489	0.00007	741349	0.1482697981		20	20	{*,*,*,*,*,* /*****	",scat.s,scat.s,#scat.s	s,scat.s,scat.s,	• • • • * * * } • * * * * * }	
		97,686	13,690	0.00000	730447	0.1306262924		20	20	1)))) {*****	<pre>>sudus,#stdus,Stdus *.#scatis.scatis </pre>	s,scat.s.scat.s.*	1777777 * * * * * * }	
6	11,3	56,892	118	0.00849	995904	8.4995904006		10	10	any 3 scat	,			
.	11,99	8,935	111			8.6530224043				Coincidin	g Feature			
6	Đ 1	13,122	101,916	0.00000	098120	0.0230256808	repeat(free_	game,25)		any 5 scat				
6	61	18,921	2,161	0.00046	527980	0.6516267656	repeat(free_	game,15)		any 4 scat				
	9 ° 11,30	00,092	110	0.00045	995904	7.9703099579	repeat(rree_	gane, IU)		any 5 scac	Sta	indard D	Deviation	
Game	ne Summary [Combination]													
Game	в		Bet A	ve. Bet	Base	RTP Base Win	Feature RTP	Feature Win	Total	RTE Std I	Dev Final Total Win	Hit Rate	Max Win Std Dev B	ase Skewness
base	_game		1	1.000	85.214	677 0.852147	8.653022	0.086530	93.867	699 14	1.184758 0.938677	19.186095	13.5203	311 36.251603
free	game		0	0.000		0.852147		0.086530			0.938677	19.186095	13.5203	311 36.251603

In more detail the report shows exactly the same statistics as we calculated in Excel.

We can also easily examine many other game statistics.

A random (Monte Carlo) simulation of the game, as if it were being played, shows the coinciding wins and how they are split between base and feature games (light/dark blue for base/feature respectively). These charts are from simulating the game for 100M plays over 12 seconds of simulation. This could also be calculated by a custom simulation in C++ or C# (for example), but not Excel.



We can also model play over a number of gaming sessions, and look at each session in detail. This particular session is very close to average, being only 0.03 standard deviations above the sample mean. The blue line indicates the credit meter, and the red dots are the credit meter when free game wins occurr.



A playable game is automatically generated from the mathematics enabling the game designer to get an immediate feel for how the game performs. Artwork can easily be added if required to further improve understanding of the game.

	5x3FreeGame - Pla	ayer Reelstrips					
Play Bet	Review Option	s Help Edit					6
se_game Play 1 - User 1	User 2 Preset	s v Stop Respin	Take Win				
Play	User Play	G Contro					
Credit	Bet					× Session Pla	101
499	1						
16	17	29	46	42			
P3	P2	J	Q	ten			
17	18	30	47	43			
A	к	ten	ten	Q			
18	19	31	48	44			
A	A	nine	nine	P3			
Play base name'			String Tota	Bet 1 Total Win 0	RTP.0.00%	bace name	Variation 0

CHAPTER 6 ACKNOWLEDGEMENTS

Sections of this book were developed with the aid of the following people



Mark Sinosich of Imagine Numbers. http://www.imaginenumbers.com/

Contributed Chapter 3 "243 Ways Games", page 16