Slot Bank Layout Using Operations Research

A Presentation prepared by Qualex Consulting Services Inc.

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Introduction

Slot banks can be characterized on a number of dimensions:

- Shape: 6 x 6, cubes, squares
- Brand: Wheel of Fortune, Blazing Sevens, Double Diamonds
- Denomination: $0.01--$100
- Digtals vs reels
- Hold percentage of coin-in
- Progressive vs non-progressive games
- Ticketing vs non-ticketing games

The layout problem is to determine the mix of machines and their physical placement in order to maximize gross margin.

Game Mix

The first problem to be addressed is the mix of games to maximize gross margin, as expressed in holding percentage, given limitations of physical space, popularity of a game, minimum and maximum counts of particular games, and, perhaps, statutory requirements of payout percentage.

This is a linear programming problem that can be expressed

$$\max Y = \sum_{g} p_g N_g \bar{y}_g$$

subject to:

$$\sum_{g} \bar{y}_g N_g \leq StatuatoryMaximum$$

$$N_g\_\min \leq N_g \leq N_g\_\max \forall g$$

where:

g indexes the type of game,

p_g is the popularity of game type g (0.0—1.0),

N_g is the number of game type g to be detemined. Type g includes brand, demonination, and hold percentage,

$\bar{y}_g$ is the expected percentage return for game type g,

N_g _min and N_g _max indicate the desired minimum and maximum of game type g. The solution will generate N_g between these values,

StatuatoryMaximum may be a legal requirement that caps the aggregate hold percentage.

This type of problem can be solved using SAS's interior point solver, a linear and quadratic problem solver that is superior to the WWII vintage simplex solver based on matrix algebra.

To solve problems of this type requires setting up a graphical user interface to enter the data and to write background SAS code that expresses the problem in the format for the interior point solver to read and to execute. SAS uses a modification of IBM's MPL format for communicating the problem to the interior point solver. Output will be delivered for examination using SAS's output delivery system that creates reports in Adobe .pdf format, web-based html format, as well as in SAS's listing format.

This is one half of an iterative process. The next step is to model the probability of a game being played given a slot bank layout. SAS's QSIM analytical suite can be invoked for this step. The first step, the model described above, takes into account a game's popularity. This second step, described below, takes into account the probability of a game being played given its location in the slot bank.

Queuing Simulation

Some basic principles, not all of which are understood at this stage, can be taken into account when designing the slot bank layout simulation

High payout with high hold percentage games may be placed near entrances so customers can readily witness high payouts. This is similar to department stores placing women's clothing at the front of the store. The clothing has high utility to the buyer and high markup to the store.

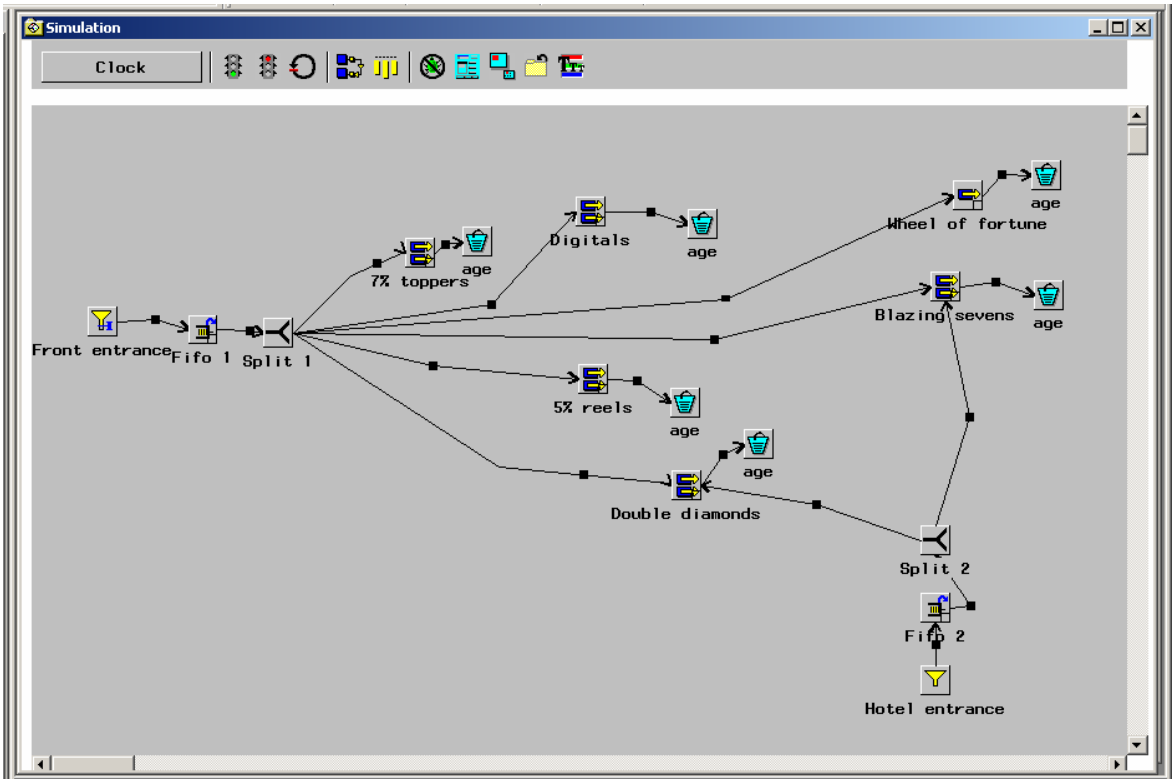
Popular games may be placed near the end of the slot bank requiring the customer to walk through the facility to reach the game. This is similar to grocery stores placing milk and sometimes bread (frequently needed items) near the back of the store so that customers may pick up other items along the way to getting what they originally came in to purchase. Gamers may be enticed to play a game they had not played before on their way to their favorite game.

SAS's version 9 has a number graphically driven analytical programs, one of which is the QSIM queuing simulator. The simulator is quite robust and can handle a complex array of game types within a simulated slot bank.

An Example

Consider a casino that has a single street entrance and a side entrance from its adjoining hotel. Further consider that it has a few 7% toppers of the same denomination at the front entrance followed by 5% digitals and reels in the main area with a Double Diamond machine in the side and Wheel of Fortune and Blazing Sevens near the rear of the bank. A simple graphic of this problem is shown below. It is important to note that different denominations of a game require separate model icons since the margin on a $100 game is so much greater than that on

a $0.01 game necessitating that they be modeled separately. This presentation graphic does not take this into account.



The above is a first cut at a slot bank simulation. It is not run-able until the distribution of arrivals and service (time at a game) have been determined from empirical observation and the splitting connectors have been properly defined.

Two-step Iterative Solution

We envision a two-step iterative approach where the game mix problem is first solved then a simulation of the slot bank is constructed using the solution to the game mix. The queuing simulation is manipulated until the best solution is achieved and then, if indicated by the simulation, the game mix is resolved with different inputs followed by another round of slot bank simulation. This iterative approach is continued until no significant improvement is achieved.