

The Games People Play

(How Statistics and Probability Can Work For You OR Be Used Against You)

A submission for ASA's Booth at the USA 2010 Science and Engineering Festival

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Statistics are prevalent in our society, but as is the case with many sciences, it is widely misused and misunderstood. This is largely because people do not think about the implications of assumptions made when drawing inferences. The Science and Engineering Festival is an ideal venue to highlight assumptions that we make, often without thinking about them. We propose several hands-on activities in order to provide different perspectives on statistics, as follows (with some revisions before final booth):

- 1. Conditional probability.** Here we use the "Monty Hall problem". At the onset of the game, a student will be presented with three cards, one of which leads to a prize. Thus $\Pr(\text{initial selection} \rightarrow \text{win}) = 1/3$. After the student indicates a card, a losing card will be presented to the student and the student will have the opportunity to change their selection. Most students will assume that the information presented by a losing card does not provide them with an opportunity to sufficiently increase their probability of winning (e.g., 1:3 vs 1:2). We will retain frequencies of winning when the student switches versus winning when the student does not switch their guess to show that the presentation of a losing card is informative. *Relevant real life example is => **When you should & should not guess on answers during the ACT & SAT college exams?** ACT – No penalty for guessing so you should ALWAYS guess; SAT – GUESS if you can eliminate one or more of the possible multiple-choice answers, which is to your advantage as 'penalty' hurts you only when purely randomly guessing.*
- 2. Estimation of an unknown.** *Include 2-3 Real life examples as possibilities – 1) Gallup poll-type experiment - ask students if they approve of the job that President Obama is doing (*the Festival is in DC, right!*), then compare Estimate +/- SE to a current national Gallup poll result (and maybe show results for various sample sizes and see if 'students' think there is a difference in opinions or not), and 2) Estimation of the size of BP Oil Spill via random sampling - have a computer experiment where students repeatedly 'throw' bivariate uniformly distributed random darts onto a rectangular grid that encloses the amorphous Oil Spill (see <http://ifitwasmyhome.com>) to calculate the area via fraction of darts that land inside of shaded oil spill area. [**Optional:** and possibly 3) Census 2000/2010 – discussion of how sampling could lead to better population estimate of states, congressional districts, etc. than supposed complete enumeration – *not quite sure of 'hands-on exercise' for students on this one.*]*
- 3. The normality assumption etc..** Students will roll four ten-sided dice and observe the sum of the values on the dice. They will win 1, 2 or 3 cookies depending on the sum total of the value of their roll (**see figure below**). Each student will then be asked if they want to roll the dice again for a 'double or nothing' bet and they will win the bet if they can obtain a more extreme score. We will retain information on the sums from the two rolls the show that 1) sums of numbers tend to exhibit a 'normal' distribution (Central Limit Theorem) and 2) the probability of obtaining consecutive infrequent events can be smaller than one thinks (Double or Nothing bet, to illustrate Sports Illustrated

Jinx – ‘sports stars rarely if ever end up on the cover of Sports Illustrated 2 weeks in a row’, because if you just had your best performance ever it pretty hard to top that in the next short interval of time).

ASA HandsOn Booth for USA 2010 Science & Engineering Festival

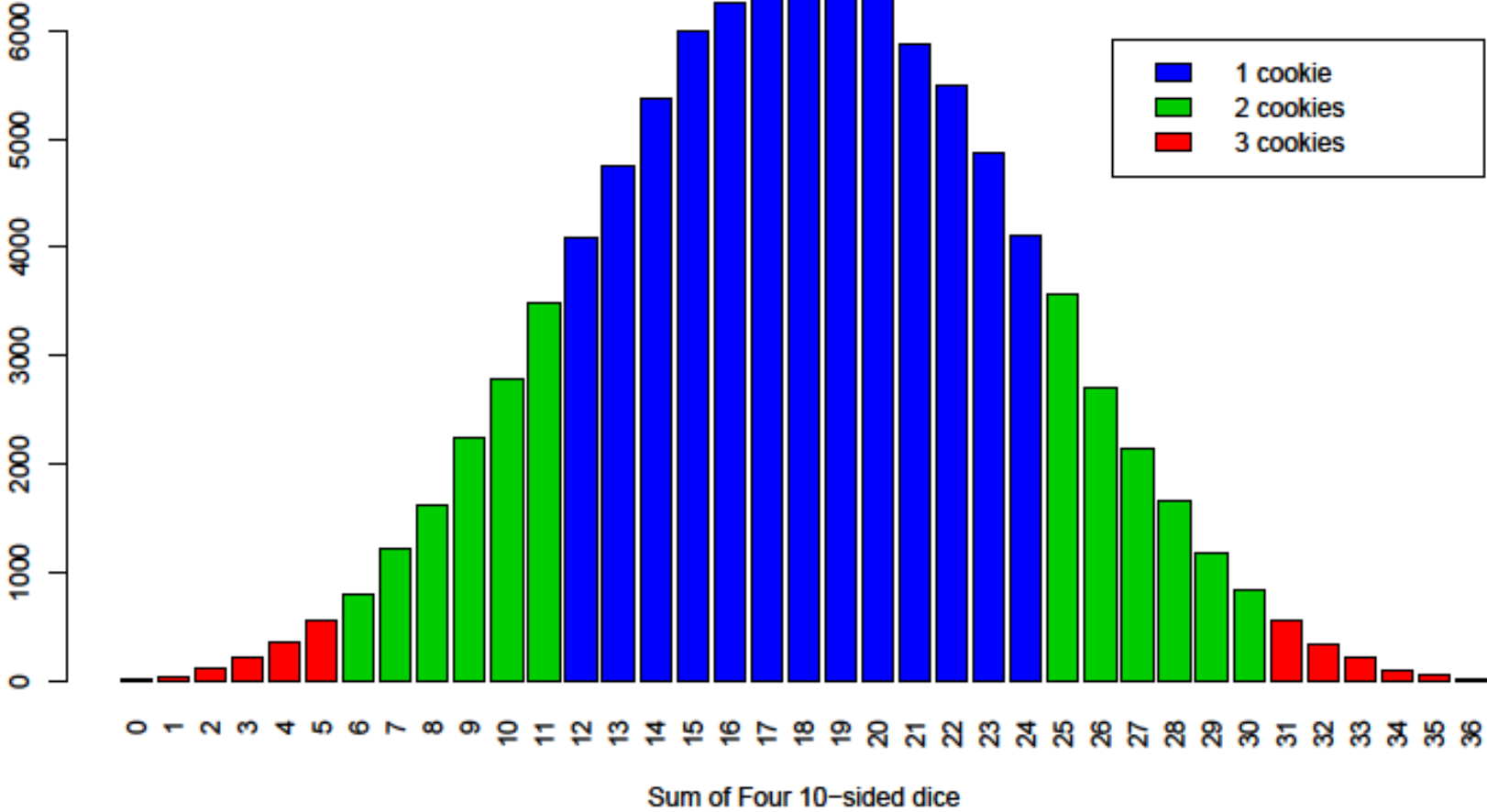


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Activities	Specifics	Intent
<ul style="list-style-type: none"> • “Would You Like to Do Better on College Testing?!” (Let’s Make a Deal) [1] 	<ul style="list-style-type: none"> • 3 cards, take away 1 after 1st guess, allow them to switch • Explain how this relates to ACT and/or SAT test taking 	<ul style="list-style-type: none"> • Conditional probability
<ul style="list-style-type: none"> • “Do You Think Differently than the Rest of the Country?” [2] (and ‘Just How Big is the BP Oil Spill?’) 	<ul style="list-style-type: none"> • Do a Gallup poll-type experiment to estimate Presidential Approval rating (i.e. % approve) • Estimate size of BP Oil Spill via random sampling computer simulation (<i>see example figure below</i>) • Sampling for the Decennial Census?? 	<ul style="list-style-type: none"> • Estimation via Sampling (vs complete enumeration)
<ul style="list-style-type: none"> • “Why Do We Always Assume a Normal Distribution?” [3] (‘Sports Illustrated Jinx’) 	<ul style="list-style-type: none"> • Roll 4 ten-sided(0-9) dice & determine sum of dice to receive 1,2, or 3 fortune cookies (<i>see actual figure below</i>) • Follow-up with Double-or-Nothing bet → need to beat 1st roll 	<ul style="list-style-type: none"> • Central Limit Theorem • Normal distribution • Chance of extreme events
<ul style="list-style-type: none"> • <i>Other things to incorporate??</i> 	<ul style="list-style-type: none"> • <i>Use computer to show real-time results of each game</i> • <i>Hourly raffles to get returnees (flash drives, gift cards, etc.)</i> • <i>Dress wildly to entice game players (hats, clothes, historical, ..)</i> • <i>Put Catchy Phrases onto a Big Display Posterboard (for example, “Quants Needed – Like to Solve Real Problems, Those Afraid of Numbers Need Not Apply”), Include Short Game Teasers on Posterboards as well</i> 	<ul style="list-style-type: none"> •

Dice-rolling game



Visualizing the BP Oil Spill Disaster

Location:

