

Actuarial Figure Skating

THE JUDGING OF INTERNATIONAL FIGURE SKATING COMPETITIONS, such as in the Winter Olympics, has become more objective since the figure skating judge scandal at the 2002 Salt Lake City Winter Olympics. The figure skating at the 2006 Turin, Italy, Winter Olympics showcased to the world the recently developed judging system. Even though my knowledge of figure skating is only as deep as what I learn while watching the Winter Olympics every four years, hearing about this new objective scoring system and all the work that went into its development made me wonder how the process of establishing the judging system compared with the processes actuaries use in their work.



FIGURE 1. Single and Pairs Jumps

ELEMENT	SOV
Double Toe Loop	1.3
Double Salchow	1.3
Double Loop	1.5
Double Flip	1.7
Double Lutz	1.9
Double Axel	3.3
Triple Toe Loop	4.0
Triple Salchow	4.5
Triple Loop	5.0
Triple Flip	5.5
Triple Lutz	6.0
Triple Axel	7.5
Quad Toe Loop	9.0
Quad Salchow	9.5
Quad Loop	10.0
Quad Flip	10.5
Quad Lutz	11.0
Quad Axel	13.0

Source: U.S. Figure Skating™

One aspect of the new judging system receiving attention from the TV commentators was the scale of values (SOV). The SOV, according to U.S. Figure Skating™, assigns a specific base value to each technical element (double axel, for example) that reflects its difficulty. For the sake of keeping this comparison manageable, I considered only jump elements and ignored other elements of a figure skating routine such as spins, steps, and throws.

As background, Figure 1 displays the SOV of jump elements.

I wanted to understand how the SOV was determined, and I hoped to relate that process to how actuaries might have approached the task. I concluded that some similarities existed, but it seemed to me there were even greater differences.

My first reaction was to compare the development of the judging system with ratemaking because they both involve quantifying an amount related to an uncertain event (landing vs. falling in figure skating). Insurance loss cost is often defined as the average loss per exposure unit. The loss cost can be interpreted to be based on probability. Actuaries accept the existing process and estimate the corresponding results.

On the other hand, the rationale for the SOV of each jump element is based on results. Presumably the ob-

jective of the figure skater is to win the competition. As such, skaters are going to perform jump elements to put themselves in the optimal position to win.

The International Skating Union (ISU), the organization responsible for establishing the SOV, relied on a group of skating experts composed of skaters, coaches, and judges to determine the SOV for each element. The group of experts began by relying on their knowledge and experience of completing each element. As a group, they agreed an axel is more difficult than a lutz, which is more difficult than a flip, and so on until the easiest of the jumps: toe loop. This relationship is apparent from the table at left.

More obvious, the group of experts also agreed that a quad is more difficult than a triple, which is more difficult than a double. For example, a triple salchow is more difficult than a double salchow. Therefore the triple element should receive a higher SOV than the double.

The next item they compromised on was the combination of element and quantity considerations. They agreed that the easiest quad is more difficult than the most difficult triple and similarly that the easiest triple is more difficult than the most difficult double.

Once the ordinal relationship shown in the table was established, values were judgmentally assigned to each element while maintaining the established order. The starting point was the amalgamation of the experts' suggestions, proceeding through several rounds of discussion. Finally, the first version of the SOV

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was established and set to be used in a competition.

Since the SOV's unveiling and first test at the Grand Prix of Figure Skating in 2003, its revision effort has been led mostly by trial and error. For example, if (relative to preferred results of the ISU) not enough triples and too many doubles were executed in ensuing competitions, the next step was to increase the SOV of the triple and decrease the SOV of the double, or some combination thereof. According to a representative of the ISU committee that established the SOV, the relationship of SOV as shown in the table is expected to be relatively constant going forward. The SOV is still evolving, however, with tweaks expected annually. To reiterate, the tweaks will be in response to managing a preferred result.

It's apparent the ISU committee relied on experience, logic, and judgment when

establishing the SOV, much as an actuary would. An actuary, however, may have approached the task of creating the SOV differently. First of all, I was surprised to learn how little mathematics went into the determination of the SOV and overall judging system. This limited use of statistical analysis wasn't a result of lack of expertise to perform such analysis. In fact, the ISU committee was chaired by a college math professor.

If an actuary had been assigned to the task of estimating the SOV, for better or worse, the actuary may have requested a database of past figure skating competitions that included skaters with skill levels similar to the skating competitions that plan to use the SOV system in the future. The database might be expected to contain a history of jump attempts and their resulting success or failure. It would also

be necessary for the database to identify the jump element (e.g., triple toe loop). It may also be advantageous to separate the figure skaters by gender in order to make the data more homogenous.

After reviewing the history of jump attempts and their results, the actuary could determine each jump's relative difficulty based on the percentage of successes. The actuary may choose to assign point values in amounts inversely related to the probability of successfully completing the jump. At first thought, it may be advisable to include an ever increasing "risk" margin with each jump element as each jump's difficulty increases in order to encourage more difficult jumps.

With this objective and a simplified binomial outcome of land vs. fall, the expected point value to be awarded for a triple axel (where expected point value

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Actuaries must rely on judgment, then revise their selections over time with the benefit of development.

equals the probability of landing times the point value for landing) would be higher than the expected point value for landing a double axel.

Within any given routine and competition, however, the figure skater can receive credit only for a limited number of jump attempts. This constraint may work to dampen the marginal point value in excess of the point value as expected.

Let's assume a figure skater is more likely to complete successfully two triple loops than one quad loop. It would seem advantageous to the figure skater to attempt two triple loops instead of one quad loop, since a quad loop is worth the same value as two triple loops. However, due to the limits in the number of jump elements in a routine for which the figure skater


can receive credit, the figure skater may be better off attempting the quad loop. In the end, whatever the underlying rationale, the assigned point value for more difficult jumps would inevitably rely on judgment to some degree.

Overall, the ISU's approach and an actuarial approach seem to have little in common, but similarities do exist. For example, insurance premiums may be estimated initially by actuaries, but the final premium that insureds ultimately pay reflects the considerations of several parties, such as management, marketing, and underwriting. As mentioned earlier, the SOV was the result of compromise among parties with varying involvement.

Further, actuaries may review the numbers and consider them when selecting a

final answer, but as is the case for the ISU and their SOV, judgment and logic ultimately must prevail. Actuaries may be requested to price an insurance coverage for which little if any applicable historical experience exists. In these instances, actuaries must rely on judgment, then revise their selections over time with the benefit of development. The ISU made its initial selections and has been reconsidering them annually.

Given the differences I feel exist between a cursory actuarial approach and the ISU's approach to establishing the SOV, when my wife insists we watch figure skating during the Vancouver Winter Olympics in 2010, I'll wonder how much more, or less, interesting the action would be if actuaries were involved.



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