When does a ‘hot-streak’ become something more?

By Nicholas Romanchuk

I think it would be difficult to overstate how useful advanced statistics can be when it comes to analyzing the game of hockey. Statistics allow us to extrapolate information beyond just a sample of data and in some instances to predict future events with a decent amount of accuracy. For example, if we look at Thatcher Demko, who started the 2019-20 season [saving 93.3% of shots in his first seven games](https://www.hockey-reference.com/players/d/demkoth01/gamelog/2020). I don’t need advanced analytics to tell me he played well over those seven games. I already have the data and it’s obvious he played well. What interest me is whether he will continue to play well over his *next* seven games; or more specifically, if this sample of seven games tells us anything about how he will perform in the long run.

This is where statistics can be useful, the concept of using a sample of data to make inferences about the population that sample was drawn from has already been well fleshed out by statisticians. I won’t go into detail here but essentially if we take repeated samples of a population (ex. 7 game samples) and calculate the mean of each sample (ex. 93.3% saves), those sample means will [approximate a normal distribution](https://en.wikipedia.org/wiki/Central_limit_theorem). Since sample means behave in a predictable way relative to the underling population, we can estimate the probability of observing a sample of data if it was drawn from a given population. And if the probability of observing the sample of data is low (<5%) than we can [reject the conclusion](https://en.wikipedia.org/wiki/Student%27s_t-test) that it came from the population in question. Now this probably (pun intended) sounds like a bunch of nonsense for people who haven’t been forced to sit through a statistics class. But it essentially breaks down to this: is a save percentage of 93.3% over seven games part of the normal fluctuations we should expect for an average goaltender or is this such a rare event that we can reasonably conclude Thatcher Demko is not an average goalie?

Rather than look at any one goalie’s performance, I wanted to extend this concept to establish a general ‘rule-of-thumb’ for hockey fans to follow:

*if our goalie has ‘****x’*** *save percentage over ‘****n’*** *number of games we can reject the conclusion that there is no difference between our goalie and an average one*

To do this, I used the estimates for the average save percentage (91.1%) and standard deviation (5.3%) from a [previous blog](https://lightthelampstats.com/how-long-before-we-can-label-a-goalie-a-bust/). I then calculated the minimum number of games (***n***), at a hypothetical save percentage (***x***), to achieve a <5% probability of observing the data (or data more extreme) if there was no difference between our goalie and an average one (91.1%). Now for any statisticians reading this blog, I fully acknowledge that some of the assumptions behind these statistical tests are being ignored; however, to make a generalizable ‘rule-of-thumb’ some concessions need to be made.

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| **Table 1.** Games needed at a given save percentage to achieve a <5% probability of observing the data if there was no difference between our goalie and an average one | | |
| Save Percentage (%) | Games (#) | Confidence Interval |
| 92.0 | 136 | 91.11, 92.89 |
| 92.5 | 58 | 91.14, 93.86 |
| 93.0 | 33 | 91.19, 94.81 |
| **93.5** | **22** | **91.29, 95.71** |
| 94.0 | 16 | 91.40, 96.60 |
| 94.5 | 12 | 91.50, 97.50 |
| 95.0 | 10 | 91.72, 98.28 |
| 95.5 | 9 | 92.04, 98.96 |
| 96.0 | 8 | 92.33, 99.67 |
| 96.5 | 7 | 92.57, 100.0 |
| 97.0 | 6 | 92.76, 100.0 |
| 97.5 | 6 | 93.26, 100.0 |
| 98.0 | 5 | 93.35, 100.0 |
| 98.5 | 5 | 93.85, 100.0 |
| 99.0 | 5 | 94.35, 100.0 |
| 99.5 | 5 | 94.85, 100.0 |
| 100.0 | 4 | 94.81, 100.0 |

Table 1 tells us that, if there is no difference between our goalie and an average goalie, then there is a less <5% chance of observing a random sample of 22 games where our goalie saves ≥93.5% of shots. Thus, based on the low probability of observing this sample of data, we can reject the conclusion that our goalie is average. In addition, the confidence interval column of Table 1 gives us a range of possible values that will contain our goalies true save percentage 95% of the time. In other words, if we take an infinite number of samples from our goalie and calculate the confidence interval of each sample, our goalies true save percentage will be contained within the confidence interval 95% of the time.

So if I’m a casual hockey fan, and the goalie for my team just saved 93.5% over a 22 game span, I can look at this table and reject the conclusion that there is no difference between my goalie and an average one. In other words, this isn’t just a random hot streak, we have enough data to suggests that there is a true difference between our goalie and the league average. Furthermore, while there may be some regression over the course of the season, it is likely that my goalie’s true save percentage lies between 91.29-95.71%. Thus, we have strong evidence to suggest our goalies strong play will continue into future games.