DIFFERENCES BY SPORT

(The attached PDF file has better formatting.)

{This dialogue discusses differences by sport that your student project may consider.}

Jacob: Why do we have four sports on the NEAS web site? Aren't they the same?

Rachel: The optimal number of years and β parameters depend on the sport: the games per season, stochasticity, draft rules, free agency rules, player turnover, and player injuries.

~ For sports with a few players per team, many games played per season, few injuries, and little stochasticity, the optimal number of years is short, such as 1 or 2.
~ For sports with many players per team, few games played per season, severe injuries, and much stochasticity, the optimal number of years is longer, such as 4 or 5.

Jacob: What do you mean by *stochasticity* in the sport?

Rachel: In sports with little stochasticity, the better team usually wins. If stochasticity is high, chance has a greater effect.

Jacob: Can you give examples?

Rachel: Chess has little stochasticity. If players are at the master level (or better), the better player usually wins. If the two players are about equal, the outcome is uncertain. Two grand-masters of equal skill may play to draws game after game.

Card games, such as poker or bridge, have greater stochasticity.

- A better player might have a poor hand of cards and lose the game.
- A set of twenty games has less stochasticity, but still more than chess.

Jacob: What about these four team sports?

Rachel: In basketball, the better team generally wins, assuming no players are injured. Chance changes the final score by 5 or 10 points but generally doesn't affect the outcome. But one unexpected goal in hockey may turn a game around.

Jacob: Can you state this in statistical language?

Rachel: Consider the distribution of a team's score over the season. In basketball:

- Team A may have mean points of 95 per game with a standard deviation of 10 points.
- Team B may have mean points of 75 per game with a standard deviation of 10 points.

The probability of Team B beating Team A is small.

In ice hockey:

- Team A may have mean goals of 3 per game with a standard deviation of 2 goals.
- Team B may have mean goals of 2 per game with a standard deviation of 2 goals.

The probability of Team B beating Team A is less than 50% but larger than in basketball.

Jacob: How does the number of games affect the relation?

Rachel: Suppose each team has an expected won-loss record between 45% and 55%, and team quality does not change between years.

- If teams play one game a year, the won-loss record is 0% or 100%. Change affects the outcome, so the better team does not always win. If the expected won-loss record is 52% for a team that wins its game the previous year and 48% for a team that loses its game the previous year, the optimal regression equation is Y = 48% + 4% × X.
- If teams play 1,000 games a year, actual won-loss records are close to the expected. The optimal regression equation may be Y = 5% + 90% × X.

Jacob: The project template on sports statistics is taken from an actuarial paper. How do actuaries express these concepts?

Rachel: The β (slope coefficient) is the credibility given to past experience in an experience rating plan. As the volume of business increases, the credibility increases.

Jacob: How does this relate to the four team sports?

Rachel: The volume of business is like the number of games per season. The uncertainty in loss frequency or severity is like the stochasticity in the sport.

- If two sports have the same stochasticity in a single game, the sport with more games per season has less stochasticity in the won-loss records.
- Baseball has ten times as many games per season as football, so its won-loss records are less stochastic.

Jacob: How does the number of players per team affect the relation?

Rachel: Players per team, variation in player quality, and draft rules affect the regression.

- Suppose a team has three players, and player quality varies greatly. The worst team gets the first draft pick, so it changes from a bad team to a good team in one year. The won-loss record in one year does not imply the same won-loss record the next year.
- If teams have 100 players apiece and player quality does not vary much, the first draft pick has little effect. A bad team one year stays a bad team the next year.

The players per team vary from 12 (basketball) to 55 (football). A slightly better measure is the number of starting players, varying from 5 in basketball to about 22 in football.

- In basketball, a bad team one year may become good the next year.
- A really good team, with a dominant player, may stay good for many years.
- Basketball has a low β parameter; football has a higher parameter.

Jacob: How do injuries affect the relation?

Rachel: In rough contact sports, the best player on a team may be sidelined, and a good team becomes a bad team. Professional sports lives are short, since older players do not recover well from injuries. In non-contact sports, skill may be more important that muscle, and players continue for more seasons.

Illustration: Football injuries are more serious than baseball injuries. Players in their 30's may be sidelined for life after a football injury.

- A star baseball player may be a star for 20 years.
- Star football players may last only a few years.

Jacob: Of baseball, basketball, hockey, and football, which is the most stochastic?

Rachel: Opinions differ. Fans of a particular sport tend to say it is not stochastic; the score reflects the performance of the teams. Newcomers to a sport see random action and say the outcome is stochastic. The following ranking is an average from several candidates, but individual opinions differ:

Most = hockey > baseball > football > basketball = least

These relations are for a single game, not for a season.

Illustration: American football depends on physical strength, agility, and speed in addition to the complex play strategies used by professional teams. A physically weak team can not compete well against a physically stronger team, even if has sophisticated strategies.

Illustration: Boxing depends so much on physical strength and arm length that even a champion welter-weight may lose to a mediocre heavy-weight.

Basketball is the least stochastic, since height gives great advantage. The ranking of the other sports varies so much among our sample that the relation above is just a guess.

Jacob: For which sports are the optimal numbers of years least and greatest?

Rachel: The statistical analysis answers that question. The sports differ greatly:

~ Basketball has few players (five starters who play most of the games and a total of 12 players on the roster), many games each season, and low stochasticity. A talented seven-foot draft pick just out of college (or high school) may dominate a game.
~ Football has 55 players on the roster, and even the 22 starting players play only half the game (offense or defense). Plays are complex and involve many players. Even the most promising new draft pick can not dominate a game.

As candidates do the statistical analysis, we will learn the optimal relations for each sport. See the discussion thread *sample student projects* for analyses of different sports.