Use of Indigenous elements in teaching introductory Statistics courses

Dr. Arzu SARDARLI

Professor of Physics and Mathematics

Indigenous Knowledge and Science

First Nations University of Canada

Our Team

Elder Florence Allen

Elder Rose Bird

Cheryl Mercredi, Knowledge Keeper
Jeanie Robillard, Knowledge Keeper
Dr. Vijayaparvathy Agasthian, volunteer
Sheetal Sahatoo, student

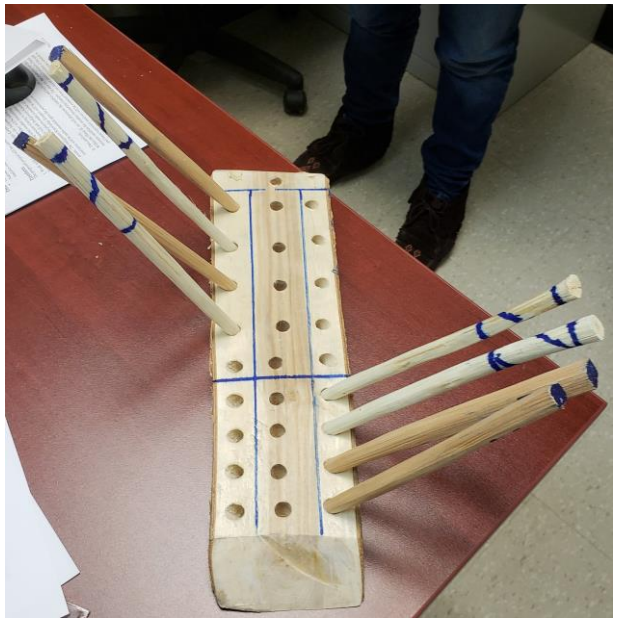
Project Outline

Phase I: Work with Elders and Knowledge Keepers
Phase II: Analysis of collected information
Phase III: Developing examples for Introductory Statistics courses

Phase I: Work with Elders and Knowledge Keepers

- Evaluation of water quality in First Nations communities using Indigenous Knowledge
- Indigenous hand games
- The plum stones game

Phase I: Work with Elders and Knowledge Keepers



Phase II: Analysis of collected information

- Examples on Correlation
- Examples on Hypothesis Testing
- Examples on Probability

Examples on Correlation

Members of the Peepeekisis First Nations community were surveyed within a research project supported by Health Canada regarding the pollution level in recreational water, bird taste, and fish taste in their community for different years, using Indigenous Knowledge (A. Sardarli, Use of Indigenous Knowledge in Modeling the Water Quality Dynamics in Peepeekisis and Kahkewistahaw First Nations Communities, Pimatiswin: A Journal of Aboriginal and Indigenous Community Health 11(1), 2013, 55-63).

Years	1979	1989	1999	2004	2009
Bird taste (in relative units with respect to the year 2009)	1.32	0.64	-0.50	-1.11	0.00
Fish taste (in relative units with respect to the year 2009)	1.27	0.21	-0.55	-1.38	0.00
Pollution level in recreational water (in relative units with respect to the year 2009)	-0.88	-0.48	0.61	1.52	0.00

Refer to the given table and answer the following questions:

a) What is the correlation coefficient between the bird and fish tastes?
b) What is the correlation coefficient between the pollution level in the recreational water and fish taste?
c) What pollution level can be expected in the recreational water in 2020?

Examples on Hypothesis Testing

Members of Peepeekisis and Kahkewistahaw First Nations communities were surveyed within a research project supported by Health Canada regarding the water quality in Calling Lakes (Saskatchewan, Canada). The community members evaluated the water quality in related units using Indigenous Knowledge (A. Sardarli, K. Budsaba, T. Ngamkham, A. Volodin, K. Baidoo, "Modeling of Water Quality Dynamics Using Indigenous Knowledge", Thailand Statistician, Vol. 8(2) July 2010, 207-222). The average level of water quality (monitored and projected) for different years from 1979 to 2029 is given in the table below. Use hypothesis testing and determine if the water quality varies between the two communities. Consider $\alpha = 0.05$.

Years	1979	1989	1999	2004	2014	2019	2024	2029
Peepeekisis	0.89	0.50	-0.43	-0.43	-0.73	-0.65	-0.68	-0.93
Kahkewistahaw	1.03	0.33	-0.35	-0.63	-0.84	-0.82	-1.10	-1.12

Examples on Probability

Hand Game (also known as Stick Game) is an Indigenous guessing game. Two teams compete in this game. Players sitting against each other are considered competitors. In rotation, all players hide a stone in one hand. The player must guess which of his/her competitor's hands the stone was hidden in. Assume that each team consists of four players and each player can make five guesses. Determine the following:

a) What is the probability that the player's three guesses will be correct?
b) What is the probability that at least four of the player's guesses will be correct?
c) What is the probability that the first guesses of all players on a team is not correct?
d) What is the probability that two guesses of the first player and three guesses of the second player are correct?

Examples on Probability

The plum stones game is a traditional Indigenous game that demonstrates probability by tossing a certain number of game pieces and determining the possible outcomes. The pieces are usually made of plum seeds that can also be substituted with round plastic chips or any other similar materials at hand. In order to demonstrate the probability, different versions of the game will be looked at. First, consider an example with five pieces and of these five pieces, three are painted black on one side and white on the other, the remaining two pieces are painted with the colour red on one side and yellow on the other. All of the pieces are placed in a bowl. The players take turns tossing the bowl with the pieces gently. The game score is as follows:

If all of the pieces are not in the air when tossed, then the current player has no score awarded and the next player takes a turn.

Zero points are awarded if the three black and white pieces show differing sides and the next player takes a turn. e.g. black-white-white

One point is awarded if the three black and white pieces show identical sides after being tossed with the other two pieces unmatched. i.e. black-black-black, white-white-white

Two points are awarded if the three pieces show identical sides and the other two pieces match, i.e. red-red, yellow-yellow.

Examples on Probability

The current player participates in the next round if he or she gets a non-zero score. For this particular example, the sample space is determined as: {BBBRR, BBBYY, BBBRY, WWWRR, WWWYY, WWWRY, BBWRR, BBWYY, BBWRY, BWWRR, BWWYY, BWWRY}, where respectively, B and W represent the black and white sides of the three stones and R and Y represent the red and yellow sides of the remaining two stones. For each of these events, the probability is 1/12. Also, the probability of scoring any number of points can be easily determined. For example, what is the probability of scoring one point given that the three black-white stones show identical sides? The sample space shows that there are two events in which the three stones show identical sides while the remaining two stones are unmatched. Therefore, the probability of scoring one point in the game, P(A) is

P(A)= 1/12+ 1/12= 1/6

Also, the probability of scoring two points in the game is

P(A)= 1/12+ 1/12+ 1/12+1/12= 4/12= 1/3

and the probability of receiving zero points is

P(A)= 6/12= 1/2

Overall, since there are twelve possible outcomes, there is a 50% chance of scoring points and a 50% chance of scoring zero points in this game.