Faith in the Numbers: Statistical Applications as a Tool for the PNCC

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Introduction

Statistical analysis and the use of probability distributions are now being utilized more frequently in church settings. For example, the Church of England has used sampling in its Living Ministry program to assess the emotional well-being of its clergy. The use of such techniques is a fertile field for exploration, resulting in **descriptive and predictive analytics**.

Abstract

This paper will explore two such statistical applications for the PNCC. The first is the use of a decay-rate function to project *ceteris paribu*s future church membership at various future dates. The second is to determine the size of an attribute sample to ascertain information about the laity.

Hypothesis

Statistical information can bring useful data to the PNCC free of “noise” and biases, most notably the confirmation and availability biases.

Methodology

Using published data, calculate the decay rates for the Ukrainian Catholic Church, the Byzantine Catholic Church, and the Polish National Catholic Church. They had roots in Eastern Europe and could be described as “national churches." Orthodox Churches with the same characteristics were not included due to a lack of reliable, published data.

Attribute sampling generally requires a surprisingly small sample size to ascertain features of a population. However, attribute sampling generally requires a binary or yes/no answer. This is a well-known technique in the fields of marketing and auditing. The binary outcome, while limiting, allows for more questions in the survey.

Findings

The statistical decay rate for all three churches discussed above from approximately 1900 to the present is approximately 2% per year. This is a long-term rate that incorporates periods of heavy immigration in the early part of the twentieth century. Pastors overseeing their congregations often perceive only small changes from year to year and don’t realize the impact of compounding over a longer period of time.

The formula for calculating a decay rate is $N(t) = N_0 \times e^{(-\lambda t)}$, where λ is the decay rate constant. Using this mathematical model, with the following assumptions, we find:

- Initial population (N_0) = 450,000 (in 1900)
- Current population ($N(t)$) = 25,000 (in 2025)
- Time elapsed (t) = 2025 - 1900 = 125 years

The decay rate is 2.31% per annum.

The decay rate for the Byzantine Catholic Church (Rusyn and Slovak) is approximately 2.11% per year, and for the Ukrainian Catholic Church, it is 1.7% per year. For our purposes, the results can be rounded to 2%. The imprecision can be due to data imperfections and statistical noise. The different results are not statistically significant at the 95% confidence level. **A decay rate of 2% results in a half-life of approximately 30 years.** If the decay rate doubles, the half-life is approximately 17 years. Changes in the half-life can be approximated by the "**Rule of 72.**" A key assumption is that no mitigating steps are taken.

A statistically valid survey of the laity can be achieved through only 100 respondents if attribute sampling is used. The suggested methodology would be cluster sampling, with the parish as the cluster and sampling conducted within it. A survey with a larger sample size across multiple parishes can then be designed. For example, using a population proportion (50%) and a margin of error (10%), a 95% confidence interval would require only 96 survey participants.

Next Steps

Should the PNCC wish to go forward with the sampling project, the survey procedures and instrument would need to be finalized. This is a four-step process consisting of (1) selecting the statistical parameters to determine sample size; (2) finalizing the questions; (3) having the survey instrument reviewed by professional marketing and sampling professionals; and (4) selecting the date for implementation.

Survey results would need to be evaluated. The final step of the process would be to apply Bayesian analysis to determine the future course of action. Bayesian analysis specifically incorporates prior knowledge and belief into the decision process. In Bayesian terminology, the prior beliefs are the "prior distribution." The results of the sample would be the "likelihood." The final course of action would constitute the "posterior distribution." The actual Bayesian analysis is beyond the scope of this paper.