MAT-17 Verification and Validation HW

Using the definitions of verification and validation in the reading module, discuss your Atlanta models. If you were part of a government work group tasked with accrediting a model for Atlanta region planners to use, what would be your opinion?

Verification is the "determination that a program was properly constructed by the stated rules (i.e. are there implementation errors in the actual programming?). There are no analytically solved problems or algorithms to compare to, but the quadratic model and exponential models are close to each other and to the real data for 1900-2000. But, neither model passes through all the real data points, so they are not 100% verified. A higher degree polynomial could pass through more data points and be more verified, but it would be more divergent outside the calibration period so less valid.

Validation is the "determination that program correctly predicts the state of the system." The quadratic model is more divergent from the real data than the exponential model in 2000-2010, so the quadratic model is less valid. There is both epistemic and aleatory uncertainty with any population model. Epistemic uncertainty is "uncertainty in knowledge" and aleatory uncertainty is "uncertainty relating to natural variability." The epistemic uncertainty is because we can't measure exactly all the factors that go into population growth (food availabilty, climate, war, politics, etc.). There is some aleatory uncertainty because future population growth depends on present population, so error is compounded the farther you go from the real data. This tells us we can expect at least some divergence for any model. However, the models do not use limiting factors for population growth, like living space, food and water supply, and traffic. These are real problems, so both models are less valid for not including these.

The exponential model is probably better than the quadratic model. It is verified for the data and the prediction is less than 20% off 10 years in the future. Also, the exponential model is more valid than the quadratic model because it is less divergent. But if the population goes down because of limiting factors the exponential model will be more divergent than the quadratic because it grows faster than the quadratic. The exponential model is also understandable for Atlanta region planners, and it clearly conveys it's prediction for the population. However, both models are still significantly divergent outside 2000, and neither have limiting factors for population growth. So, I wouldn't give accreditation to either of these models because they become too invalid as time goes on.