Goal: time series analysis of Toronto’s temperature. To forecast Toronto’s temperature 50 years into the future with weather records from 1937 – 2018 using machine learning for the analysis of time series data. Chose support vector regression model (SVR) since original project applied 3 different models (ARIMA, multivariate regression and support vector regression) on test data and found SVR to be the most accurate among them. Support Vector Regression fits the time series according to a precise geometric region that stores the data points. This air temperature forecasting in combination with other analytical features of climate change modelling, is useful in establishing strategic planning for reinsurance firms.

Forecasting works by detecting past trends and using them to create predictions into the future: Weather follows a seasonal pattern, so the time series was organized into 4 seasons by creating a data frame called Seasonal with data from the months of January, April, July, and October to depict this pattern.

In order to forecast predictions, 80% of the data frame was split into train data and 20% was used as test data. The models were trained on 1937 – 2002 data then extrapolated to predict data from 2003 – 2018. These extrapolated values were compared to the real values of 2003 – 2018 data from the timeseries to validate the accuracy of each model by looking at the root mean square error (RSME) scores of the training and test data because temperature is a continuous variable. Ideally, the test RSME should be close to the train RSME to avoid overfitting. Overfitting occurs when a model fits the dataset too closely and doesn’t accurately fit new data.

* *ARIMA*: Train RSME = 2.91, Test RSME = 5.65
* *Multivariate Regression*: Train RSME = 7.04, Test RSME = 7.49
* *SVR*: Train RSME = 1.80, Test RSME = 4.52

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The SVR model is the most accurate of all 3 models. The ACF graph of the multivariate regression model indicates that autocorrelation may be present in the model, while SVR has the best-behaved residuals. Even though the difference between the SVR model’s test and train RSME scores suggests that overfitting may be present in the model, the SVR model was the best tool to get predictions since we evaluated the model based on its test set. Because SVR is the most accurate model by lieu of its RSME scores and residual values, we’ll use this model to make predictions.

Chart, histogram

Description automatically generated

The graph of the SVR model reveals the effects global warming has had on Canada’s climate as we can see that in the last 80 years, the upper temperatures remain fairly constant, however, the lower temperatures have been steadily rising, as is evident in the warmer winters we’ve been experiencing.

Chart, histogram

Description automatically generated

I generated predictions 50 years into the future by regressing mean monthly temperature data on year and month variables using support vector regression. According to the SVR model, in Winter 2073, the mean temperature will probably hover around 4.95 degrees Celsius. In 50 years, it can be projected that we can experience increased flooding in Toronto as a result of winters becoming warmer, where more rainfall is expected instead of snow

In the same way that Florida has become insolvent, other disasters will have this impact on Canada and it could be a struggle

I took data of Canada’s insurance catastrophic losses from the Insurance Bureau of Canada and projected their dollar values (in 2022 dollars) into the future. In 25 – 50 years, it can be estimated that Canada will incur 10 – 16 million dollars in catastrophe damages, which is a big increase from present-day incurred losses

We will see extreme storms in similar situations as Florida’s hurricanes if we don’t address this 🡪 can affect Ontario

This slide presents Ontario Climate Consortium’s scenario testing where they evolved Toronto’s weather over the next century. Geographic locations could become so hazardous as a result of storms becoming more extreme with an increased risk of property damage. Thus, we might experience similar situations in Ontario as Florida’s hurricanes if we don’t try to mitigate climate change.