

Jenny Doyle | Part Four: Methods

BAYESIAN ESTIMATION

My Bayesian estimation focused on the impact of 9/11 on terror attacks worldwide. My goal was to prove that 9/11 spurred an increased number of suicide attacks. In order to evaluate this, I chose to select my two groups as follows: the first group is suicide attacks from 1990 - 2000, inclusive; the second group is suicide attacks from 2002 - 2011. Both groups contain 10 years as 1993 is missing from the first group.

It's import to note that 2001, the year of the 9/11 attack, is not included in either group. Since my data represents the total number of suicide attacks per year, I decided to treat the entire year as 2001 to represent 9/11, so that I could get a better picture of the time period before the event versus the time period after the event.

PRIOR DISTRIBUTION

I chose the number of suicide attacks per year for all years in the full dataset as my prior. This way, if we know the distribution for the number of suicide attacks per year, we can use that information to form distributions for the two different time periods, before and after 9/11.

The upper and lower limits for standard deviation were difficult for me to determine as I don't have experience with this, but I decided that since the actual standard deviation was around 130, I would set both limits a bit higher. This helps in explaining the distribution, as the numbers can have huge differences across years.

EVALUATION

My evaluation focused on the highest posterior density intervals of the various distributions that I created with pymc. To determine whether or not I could say the difference in number of suicide attacks during the time periods before and after 9/11 is statistically significant, I ultimately relied on the HPD plots of the statistics comparing the before and after posteriors.

From looking at the HPD charts, I could see that the distributions are all to the right of the reference value of 0. This indicates that they have different distributions and therefore, the populations' difference in mean is statistically significant.

As a result, while I can't say for sure that 9/11 is the reason for the difference in means for the time before and after the attack, I can say that the time period after the attack had a statistically significant increase in mean of suicide attacks.

IMPUTING MISSING 1993 VALUES

To account for the fact that we do not have the total number of terror attacks for 1993, I used an ARMA(1,0) model, which is an AR(1) model. I decided to use the model because I wanted to cover my bases. I knew that I wouldn't need ARIMA because the dataframe I was using was the number of terror attacks per year, so seasonality didn't need to be specified.

Using the ACF and PACF plots, I determined that the number of suicide attacks for a year was related to the number from the year prior, so $p=1$. I wanted to add a $q=1$ just because it seems like terror attacks would be something that could change for no reason, but the plots didn't imply it was necessary.

To confirm my choice, I tested every combination from 0-4 for both p and q and analyzed the AIC scores. This AIC score proved how well the model fit, with the lowest score being the best fit of them all. AR(1) had the lowest AIC score, so I proceeded with my model.

I didn't use a training set, which is probably bad. As there were only ten observations in my dataframe, and that they're timeseries, I didn't want to mess around with picking an appropriate train, test set.

My model predicted that there were 1,706 bombing/explosions. I went ahead and predicted the number for the rest of the attack types and obtained the following:

	Attack Type	1993 Predicted Number of Attacks
0	Assassination	1067.178226
1	Hostage Taking (Kidnapping)	133.048967
2	Bombing/Explosion	1706.562036
3	Facility/Infrastructure Attack	452.215209
4	Armed Assault	1301.687231
5	Hijacking	17.084018
6	Unknown	143.243192
7	Unarmed Assault	43.069859
8	Hostage Taking (Barricade Incident)	22.210933

Overall, my model predicted that there were a total of 4,886 terror attacks in 1993.

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