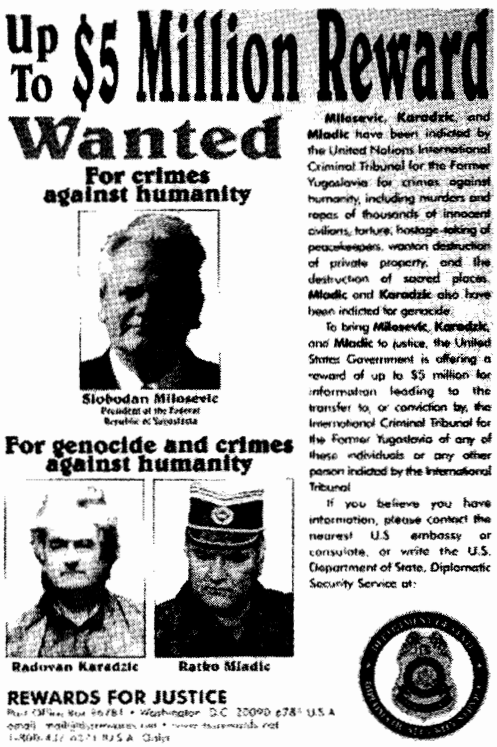
Statisticians recount experiences and share results from investigating the alleged war crimes of Slobodan Milosevic

Statistics and Slobodan: Using Data Analysis and Statistics in the War Crimes Trial of Former President Milosevic

Patrick Ball and Jana Asher



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Wanted poster for Yugoslav President Slobodan Milosevic and Bosnian Serb leaders Radovan Karadzic and Ratko Mladic released by the State Department Thursday, March 2, 2000. The State Department announced a reward of up to $5 million for information leading to the arrest and conviction of the men indicted by an international tribunal.

Today in The Hague, history is being made: for the first time in over fifty years, a state leader is on trial for crimes against humanity. Former Yugoslav President Slobodan Milosevic has been indicted for orchestrating atrocities in Croatia, Bosnia, and Kosovo between 1991 and 1999. The current trial is for war crimes allegedly committed in Kosovo; it will be followed by trials of allegations of crimes in Croatia and Bosnia. On the Kosovo portion of the trial alone, the judges' decision will be based on the testimony of more than one hundred eyewitnesses, diplomats, military experts, and scientists. The International Tribunal for the Former Yugoslavia (ICTY) is trying the case and will make a decision that includes a finding of fact on dozens of questions. As statisticians, the question we addressed in the trial is this: were the forced migration and deaths of ethnic Albanians in Kosovo between March and June of 1999 the result of a systematic Yugoslav government campaign?

The first author of this article gave testimony over two days, March 13–14, 2002. The testimony was based on a detailed statistical study of the pattern of deaths and migration in relation to the patterns of airstrikes carried out by the North Atlantic Treaty Organization (NATO) and the activities of the Kosovo Liberation Army (KLA). The report is now known as Exhibit 67 in the Prosecutor v. Slobodan Milosevic. The authors of the study (Patrick Ball, Wendy Betts, Fritz Scheuren, Jana Dudukovic, and Jana Asher) combined their specialties in data management, statistics, data matching and international relations in order to answer the following questions:

1. Did action by the Kosovo Liberation Army (KLA) motivate Kosovar Albanians to leave their homes and result (directly or indirectly) in Albanians' deaths?

2. Did air attacks by the North Atlantic Treaty Organization (NATO) create local conditions that led to Kosovar Albanians being killed and leaving their homes?

3. Did a systematic campaign by Yugoslav forces lead to Kosovar Albanian deaths and expel Kosovar Albanians from their homes?

Significant positive evidence for the first two questions would support a position (favorable to the defense) that the government of Yugoslavia was not

responsible for the forced migration and deaths of ethnic Albanians. Significant negative evidence for the first two questions, however, coupled with positive evidence for the last question, could undermine Mr. Milosevic's defense.

In order to address these questions, data had to be gathered describing both the migration patterns and the patterns of deaths of ethnic Albanians in Kosovo during the period in question. Additionally, if available, data on NATO bombing, KLA activity, and Yugoslav army activity was required. Analyzing these data together was the goal of the study that Patrick presented to the court. This article describes the steps we and our coauthors took to piece together the puzzle of what happened in Kosovo.

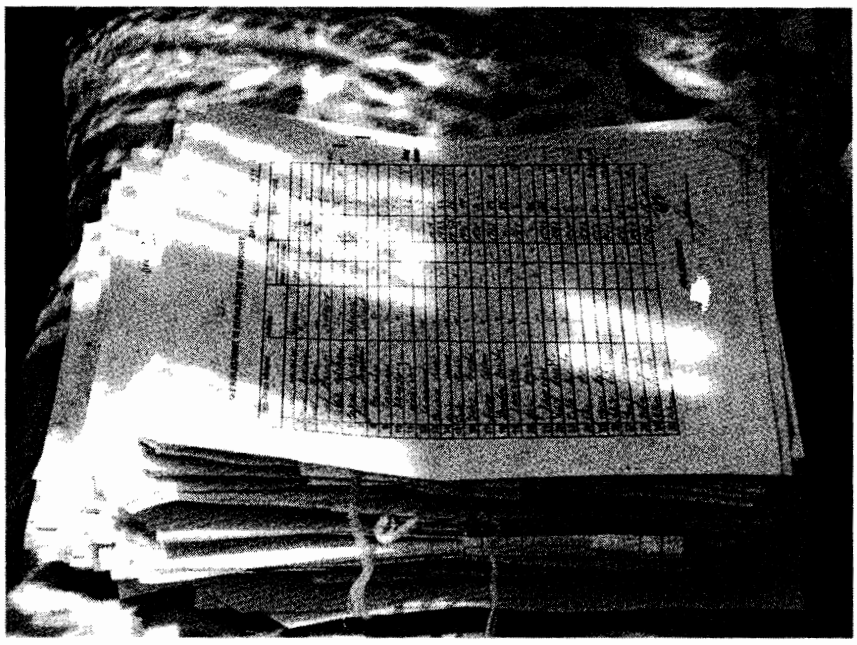


Figure 1. Records maintained by the Albanian border guards at Morina, March-June 1999.

The Forced Migration of Ethnic Albanians

The first step taken by our scientific team was to establish patterns of forced migration of ethnic Albanians; in other words, how many people had left each village in Kosovo over each time point? If we could describe the statistical patterns of migration over time and space, the patterns might lead us to favor one hypothesis relative to the others. To gain some understanding of the refugee flow into Albania during the crisis in Kosovo, and to identify a source of data, Fritz Scheuren and Patrick Ball visited the Albania-Kosovo border in early May 1999.

During this visit, Fritz noticed that the Albanian guards were recording data about the parties crossing into Albania. Through their translator, Fritz and Patrick discovered that the guards were registering every refugee they could in detailed border records. The guards reported a few caveats: sometimes there was shooting or shelling on the Kosovo side of the border, and at other times, the number of people crossing the border became overwhelming. During those moments of chaos, the border guards suspended the registration process and just waved people through as quickly as they could. During a later visit, our Albanian partners convinced the Albanian government to grant us permission to copy the border records.

Determining a way to make those copies, however, proved more difficult. The most plausible method for obtaining these data was to scan the images at the border. There were 690 pages of records, all of which were scanned.

The data was of high quality but incomplete. Several days seemed to be missing chunks of records, and two days in mid-May were entirely missing. We were concerned about the missing information, including the missing days and the moments when the guards suspended their registration. Fortunately, the UN High Commission for Refugees (UNHCR) had conducted an independent count of people on the road from the border to the town of Kükes, some 30km southwest of the border. UNHCR published this count in daily press briefings. By comparing the UNHCR daily counts to the counts in the border records, we found that the two counts differed most often and most significantly on days of very high refugee movement. Furthermore, when the counts differed, the UNHCR count was always higher. These observations are consistent with the guards' explanation that when security conditions were threatening, they suspended registration.

We built a dataset of migrations by combining the data from the border records with the UNHCR counts. The people counted by UNHCR but not registered in the border data were allocated to villages carefully, by using the distribution of origin places found in surveys conducted among Kosovar Albanian refugees in camps. This method avoided the assumption that the people with unknown origin places have the same distribution as the people with known origin places. The adjusted dataset modeled the total number of people crossing the border by the date of crossing and the place of origin. Approximately 404,000 people were in this dataset.

To study the potential reasons for the migrations, however, we needed to know the times people left their homes, not the times they crossed the border. The difference between people crossing the border and people leaving home is the time it took people to travel from their homes to the border — the transit time. From surveys conducted in refugee camps, we were able to determine distributions of transit times. The distributions were disaggregated by places of origin and border-crossing dates. We found that transit distributions did not vary much by origin locations, but the distributions did change over time. We used time-specific transit time distributions to shift backward the border-crossing data, transforming it into home-leaving estimates. That is, approx-

imately 60 percent of people crossing the border each day had left home that same day, approximately 15 percent had left home the previous day, 8 percent two days earlier, and so forth. Thus on day Y, 60 percent of the people crossing from village X were allocated to leaving home also on day Y, 15 percent were allocated to leaving home on day Y-1, 8 percent on day Y-2, etc. The resulting distribution estimates the pattern of people leaving home over time and space.

Plotting the pattern over time, we noted that during the early phase of the conflict, most of the people leaving Kosovo originated from municipalities in the south and west of Kosovo. During the middle phase, a much greater proportion of people leaving Kosovo originated from the northern regions. Then in the third phase, most of the people leaving Kosovo came from the southern region. Each phase was characterized by high volume of refugee flow followed by a much lower level of refugee flow. The wave-like pattern suggested a cause that stopped and started.

The original analysis of migration patterns was published in a report authored by Patrick Ball in March 2000. Patterns of NATO airstrikes were compared to the migration patterns by plotting the dates on which airstrikes occurred in a horizontal bar on top of the time series plots of the quantity of people leaving home for each municipality. Even in this exploratory analysis it was clear that most of the airstrikes occurred after the major flow of refugees in the first phase. Only occasionally did airstrikes precede a local peak in refugee flow. More often we found that there were no airstrikes in a given municipality until after most of the refugee flow had occurred. The possibility that NATO airstrikes had caused migration was not supported by these findings.

We were pleased with the migration data available for our study. The fact that data were available from two independent sources — the border records and the UNHCR reports — helped to support the statistics we developed on migration flow. The next step, determining patterns of killings during the same time period, required completely different data and methods.

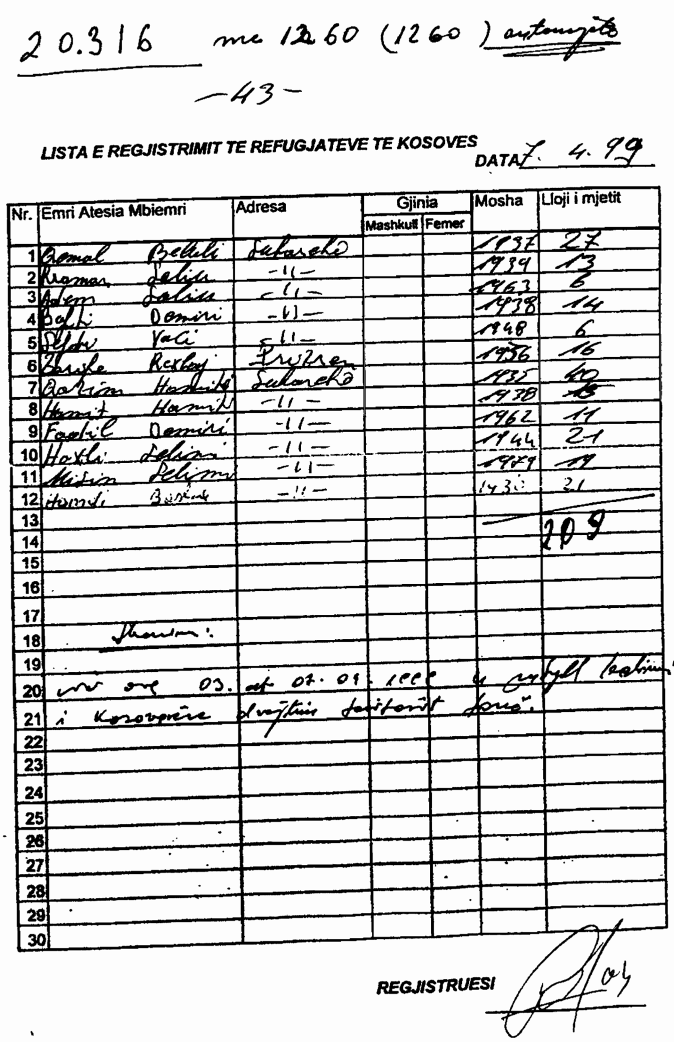


Figure 2. Close up of one border record.

The Data on Albanian Deaths

Estimating the total number of deaths in Kosovo between March and June of 1999, as well as the pattern over time and space of those deaths, turned out to be very complex. Data on killings were available from four sources:

- *The American Bar Association Central and East European Law Initiative (ABA/CEELI) and its partners*: This non-profit organization collected data via 1,674 interviews with ethnic Albanian refugees in five different countries (35 percent in Albania, 16 percent in Macedonia, 10 percent in the United States, 38 percent in Kosovo, Yugoslavia, and less than 1 percent in Poland). The refugees were interviewed in refugee camps and private homes. All interviews were conducted using a standardized questionnaire that allowed for a narrative description of events. The information on the questionnaire was then keyed into a database. 5,089 records were created.
- *Exhumations by international teams on behalf of the International Criminal Tribunal for the Former Yugoslavia (EXH)*: 1,767 exhumations were conducted in locations thought to contain graves of Kosovars killed during the months leading up to the Yugoslav withdrawal. Although exhumations were not evenly spread across Kosovo, exhumations were conducted in 24 of Kosovo's 29 municipalities.

- *Human Rights Watch (HRW)*: Human Rights Watch is the largest non-governmental organization devoted to human rights in the United States. From March to June 1999, HRW interviewed refugees as they left Kosovo. Of all the interviewees who gave statements to HRW, 25 percent were interviewed as they crossed the border into Albania or when they had settled in refugee camps or private homes; 11 percent were interviewed in Macedonia, and 3 percent in Montenegro. From June through December 1999, HRW conducted the remaining 60 percent of interviews in Kosovo. The geographic regions within Kosovo were selected based on refugee reports of mass human rights violations and on reports of mass violations from sources other than refugees. All interviews were conducted to elicit open narratives of what the interviewee had seen. Standardized questionnaires were not used. There were 337 interviews and 1,717 incidents reported in total.
- *The Organization for Security and Cooperation in Europe (OSCE)*: The OSCE Kosovo Verification Mission (OSCE-KVM) collected 1,837 interviews that mention one or more killings. The statements were taken from March through June 1999. The interviews were conducted in more than 90 distinct locations in Albania (37 percent of the interviews) and at least six locations in Macedonia (61 percent of the interviews). There was a small number of interviews (22) for which the place of interview was not noted. No information was gathered in Kosovo itself. Most of the interviews (over 80 percent) were conducted in refugee camps; the remainder of the interviews were collected in public gathering spaces or private homes. OCSE-KVM used standardized interview forms similar to those used by ABA/CEELI. The information was then entered into a database, also similar to that used by the ABA.

Information common to the three lists created from interview data includes place and time of death, as well as the name of the deceased, if available. The exhumation data did not contain place or time of death.

These four sources of data, or lists, represent the highest quality information available about killings of Albanians in Kosovo in 1999, but substantial efforts to standardize and unduplicate each individual dataset, remove anonymous records from each dataset, and then combine the four datasets, were required by our staff. It was essential for us to accurately match across the four lists in order to determine their overlap. In other words, we invested most of our data processing effort to identify which killings appeared in more than one of the datasets. This process would allow us to both determine the number of killings listed uniquely in one or more of the four datasets and also analyze the patterns of overlap between the datasets. From the patterns of overlap, estimates of the total number of killings not captured by any of the datasets could be created.

The process by which two large datasets containing records about the same people are merged to create one record per person is called *record linkage*. The Kosovo killings data represented a record linkage challenge for two reasons. First, it is not possible to automate linking four datasets jointly given current record linkage theory and technology. As a result, the six possible pairs of lists (e.g., HRW and OSCE, HRW and ABA) were separately linked. Second, pre-existing standardization software could not easily be utilized due to substantial differences between Albanian and United States naming conventions. Such software will process each record of a dataset and substitute standardized names for nicknames and alternate spellings; e.g., "William" for "Bill" and "Billy." When two lists are standardized, computer matching is facilitated.

Because of the name standardization issues, and due to the small size of the lists, computer matching via a pre-existing software package was not viable for this study. Instead, native Albanians and Albanian name indices were consulted to determine different spellings of and nicknames for specific Albanian names, and human coders were employed to do the matching across lists. For each pair of lists, the smaller list was designated as the source and the larger as the target. For each source record, possible matches in the target set were determined via software created by Patrick and his American Association for the Advancement of Science (AAAS) colleague Matt Zimmerman. Human coders then used the match-facilitation software to process the source dataset record by record, determining the best match (if any) in the target dataset. Each individual source record in the six pairs of lists was matched 2–4 times by different coders to measure the inter-rater reliability of the matching process. Several subsequent rounds of additional matching (using different blocking variables) were applied in order to identify matches that had been missed in earlier rounds.

The overall results of the matching are listed in Table 1. The total number of individual deaths (killings where the victim can be named) within these data is 4,400. Note that the total number of

Table 1 — Number of Individual Victims of Killing, by Documentation Status (Including Victims with Imputed Dates of Death)

	ABA	yes	yes	no	no	
	EXH	yes	no	yes	no	
HRW	OSCE					Total
yes	yes	27	32	42	123	
yes	no	18	31	106	306	
no	yes	181	217	228	936	
no	no	177	845	1,131	n.a.	
	Total					4,400

deaths for each list is smaller than the original number of incidents recorded when the datasets were created. This is due both to the removal of duplicate records within each individual list, and also the removal of anonymous/group killing reports for all lists. The missing cell in Table 1 represents those deaths which were not identified in any of the four lists; it is to the estimation of this number that we turn next.

Estimating the Patterns of Deaths

The judges for Milosevic's trial are not particularly interested in the number of deaths we were able to record, because this number by itself does not address the cause of those deaths. Of more interest is an estimate of both the true number of deaths and the true pattern of deaths over time. In order to make estimates of the true number of deaths overall and at particular points in time, we used a well-established statistical technique called *multiple systems estimation*.

Multiple systems estimation, as we implemented it, requires the following:

1. The dataset is partitioned into each possible pattern of exclusions and inclusions in the four lists. As an example, in order to estimate the total number of deaths in Kosovo, four lists are used. There are fifteen possible patterns of inclusion and exclusion for a death in this database (e.g., 1111 represents inclusions in every list; 1010 represents inclusion in two lists only, 0001 represents inclusion in one list only).

2. The number of deaths for each pattern of inclusion and exclusion is treated as a *response* variable, and the particular pattern of inclusions and exclusions is used to form *explanatory* variables. The independent variables can include interaction terms.

3. A log-linear model is estimated using these response and explanatory variables.

4. The intercept term for the model represents the log number of deaths not captured by any of the lists.

5. The total number of deaths is then the number of deaths in the dataset (4,400) plus the estimate of the number of deaths not captured by any of the four lists.

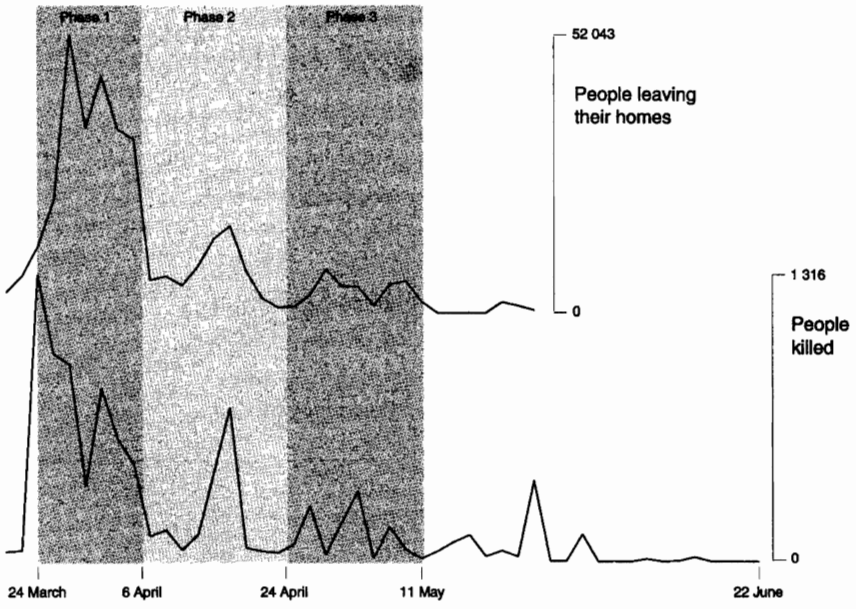


Figure 3. Estimated total refugee migration and killings over time, in Kosovo.

Allowing for explanatory variables that included all possible list interaction terms, there were over 100 potential models we could use to estimate the total number of Albanian killings in Kosovo between March and June of 1999. We selected one of these models by balancing the parsimony (simplicity) of the model with the overall fit of the model. This represents a common issue in model selection; the more complicated the model, the better the model "fits" the data (in other words, the more closely the fitted values produced by the model represent the data). Both overfitting and underfitting a model is considered to be a problem, as is creating too complicated a model. We chose the model for which the χ^2 statistic divided by the degrees of freedom was minimized. The end result was an overall estimate of 10,356 Kosovar Albanian deaths.

To determine the number of deaths for individual two-day time periods, we again used multiple systems estimation, but this time we used the overlap of three lists instead of four. This was simply to allow the most accurate estimation possible. We were concerned that the cell size for the cross-classification table for all four lists for a two-day period was very small, which may have caused highly variable estimation. Again, we obtained many potential models for each two-day period, and used the χ^2 statistic divided by the degrees of freedom to determine the model of choice.

The technical details of this process of model selection and estimate creation, as well as a history of the development of multiple systems estimation techniques, are outlined thoroughly in Appendix 2 of our study. The important point is that we were able to create estimates of the number of ethnic Albanian deaths in Kosovo in particular two-day periods, and for particular regions of the country. We were then able to compare these estimates to both the migration data and to the data we acquired about NATO bombing and KLA activity. The results of this comparison can now be discussed.

Putting it All Together

The first clues toward answering the question of what happened in Kosovo can be found by simply comparing the pattern of deaths and migrations in Kosovo over time. As can be seen in Figure 3, counts of deaths and migrations follow the same trend, with three distinct phases. Each phase is characterized by high points separated by relatively much lower points. This suggests that migrations and deaths are associated, either because one caused the other, or more likely, because both were caused by the same social force. The next logical step was to examine how patterns of NATO, KLA, and Yugoslav army activity related to the pat-

terns of killing and migration. To do this, we needed more data.

NATO and KLA data of reasonably high quality were available to us. Yugoslav press and government sources published information on NATO attacks contemporaneously with the airstrikes, documenting when and where the attacks occurred. We counted the reports, tabulating them by municipality and date. Information on KLA activity was obtained from interview accounts and a variety of non-governmental reports summarized and provided to us by the ICTY. Using that information, we counted the number of reported battles between the KLA and Yugoslav forces occurring in each municipality over time. Isolated KLA attacks that resulted in the injury, disappearance, or deaths of ethnic Serbs were also tabulated by the number of reported casualties. We were unable, however, to obtain data on Yugoslav army activity independent of interactions with the KLA.

To test the hypotheses that KLA or NATO activity (or both) caused migrations and killings of ethnic Albanians, we created several regression models in which the number of killings or migrations served as a response variable, and explanatory variables were formed from the KLA and NATO data. The unit of analysis was different time points, or the region of Kosovo (N, S, E, W) by time points. The explanatory variables used were as follows:

- Dummies indicating the region (for region by time);
- The number of reported Serb casualties caused by conflict with KLA forces (KLA-kill);
- The number of reported conflicts between Serb and KLA forces (KLA-battle);
- The number of reported NATO airstrikes (NATO);
- The number of reported Serb casualties caused by conflict with KLA forces in the previous period (lag-KLA-kill);
- The number of reported conflicts between Serb and KLA forces in the previous period (lag-KLA-battle); and
- The number of reported NATO airstrikes in the previous period (lag-NATO).

Table 2 — Regression Coefficients

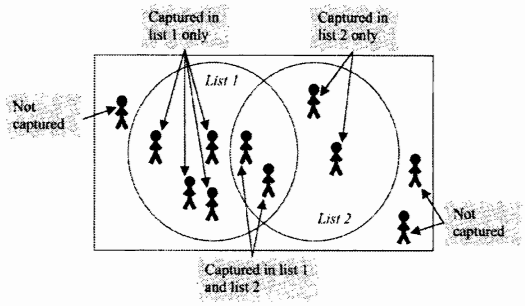
Explanatory Variables	Killings over time	Killings over time and region	Refugee flow over time	Refugee flow over time and region
Region 2		* -52.3		-721.4
		(20.4)		(665.3)
Region 3		*-57.0		**3,017.8
		(21.3)		(1,048.9)
Region 4		-34.4		-193.9
		(25.2)		(862.5)
KLA (kill)	-1.1	1.6	*-634.9	-184.2
	(5.2)	(4.1)	(318.9)	(130.8)
KLA (battle)	34.7	13.3	2,728.6	**1,879.3
	(32.1)	(12.2)	(1,030.5)	(583.2)
Lag-KLA (kill)	0.2	3.3	491.9	277.9
	(4.4)	(3.4)	(384.4)	(167.1)
Lag-KLA (battle)	21.2	11.6	***2,794.3	***2,138.4
	(17.7)	(11.9)	(827.7)	(633.7)
NATO	10.9	11.4	327.6	565.8
	(11.1)	(6.7)	(390.3)	(379.7)
Lag-NATO	-4.8	-2.5	-28.0	29.2
	(6.9)	(4.1)	(325.5)	(234.0)
Constant	83.9	**62.7	122.3	-484.8
	(51.1)	(19.9)	(3,933.2)	(608.8)
R^2	0.3	0.1	0.7	0.5

The results of this analysis are presented in Table 2. The stars next to the coefficients indicate their significance levels: one star indicates $p < 0.05$; two stars indicate $p < 0.01$; and three stars indicate $p < 0.001$. Reviewing first the first two columns, the only significant variables were the regional dummies in the second column. As a result, we were unable to find an association between NATO activity and/or KLA activity and deaths. We therefore reject the hypotheses that NATO or KLA activity were plausible causes of Kosovar Albanians' deaths.

The second two columns examine the relationships of the explanatory variables with refugee flow. Within the regression models, NATO activity has no association with refugee movement. There are, however, significant relationships between KLA killings (marginally) and battles (more strongly) and refugee flow. Separate analyses of the relationship between refugee flow and the explanatory variables, however, suggested that the significance of this relationship is specific to the North and East regions of Kosovo only. We therefore made a qualified finding that there is some evidence of an association between KLA activity and migration patterns in the northern and eastern

A Short Introduction to Multiple Systems Estimation

The origin of multiple systems estimation, capture-recapture, goes back at least to the late nineteenth century as a technique for counting fish populations, and was later extended to multiple captures for other wildlife and human populations. The capture-recapture estimation technique uses two separately collected but incomplete lists of a population to estimate the total population size. A simple example appears in the Venn diagram below.



The basic assumption used to estimate the population size is that the ratio of the number of people captured in both list 1 and list 2 to the number of people captured in list 1 is proportional to the ratio of the number of people captured in list 2 to the number of people in the entire population. In this example, this means:

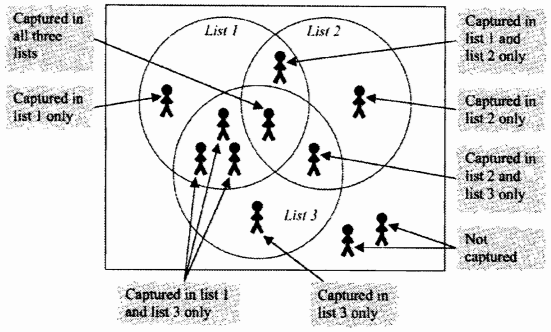
$$\frac{2}{6} :: \frac{4}{N},$$

where N, the total number of people, is unknown. The estimated value of N is then taken as the closest integer to the solution for N in this equality, or

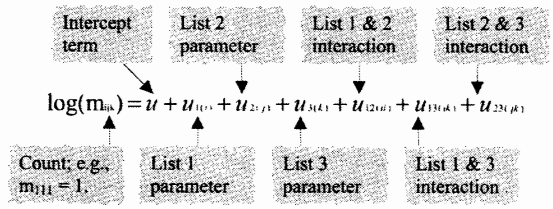
$$\hat{N} = 4 * 6 / 2 = 12.$$

There are many assumptions embedded in this simple ratio solution. Several of these are quite logical (i.e., the individuals on a list have been randomly sampled from the population, individuals aren't moving in or out of the population between the creation of the lists, a list never has the same individual listed twice, and the matching across lists is accurate). Another assumption is that there is no *dependency* between the lists; in other words that the probability that an individual is captured in list 2 is *not* dependent on whether or not that individual is captured in list 1. A final assumption is *homogeneity*: that each individual in the population has an equal probability of capture in a given list.

If any of these assumptions are violated, capture-recapture may not accurately estimate the population size. If there are additional lists available for the population, however, problems such as list dependency can be addressed via modeling. Using the population from the simple example above, we add a third list in the following Venn diagram:



In this case, we can model for dependencies between the three lists via log-linear models (with constraints) of the following form (where the subscript i (or j or k) for a count is 0 if it does not include people from list i (or j or k), and 1 if it does):



If we believe there are no list dependencies, we use just the first four terms on the right hand side of this equation. If we believe there is only dependency between the first and third list, we add that interaction term. In this way, a reduced model can be created (one that contains less parameters). Fitting the data from this simple example to the model with a list 1 & 3 interaction term yields an estimated population size of 12.

Other violations of assumptions can also be addressed via modeling or, in certain situations, can be or are (cautiously) ignored. Further details appear in Appendix 2 of the 2001 Ball et. al. report listed in the Additional Reading section of this article.

regions. However, this association does not fully explain the pattern of migration, especially in the western and southern regions. With this qualification, we concluded that the overall effect of KLA activity and NATO airstrikes does not much change the killing and refugee flow patterns.

But what about the third hypothesis, that the migrations and deaths were due to a systematic governmental campaign? As we explained before, there were no data available to us that detailed Yugoslav government force deployments or movements during the period in question. We

A Practical Joke

Obtaining the data on migrations of ethnic Albanians out of Kosovo was more of an adventure than either Fritz or Patrick first assumed it would be. When Patrick returned to the Kosovo-Albania border in June of 1999, accompanied by translator Ilir Gocaj, he discovered that the Albanian border guards had withdrawn about 500 meters from their original post. There had been shooting just a few days earlier, and a Chilean journalist had been seriously wounded by the gunfire. Patrick asked about the border records and was told that they had been abandoned at the old post.

The Albanian border guards made a point of stating that the walk between the new and old border posts would expose Patrick and Ilir to potential sniper fire. Using his honed logic skills, Patrick quickly concluded that if they would be in danger en route to the old border post, then the data itself might be in danger as well! Patrick and Ilir decided to risk the walk to the old post, and a border guard accompanied them.

The old post was in shambles due to a Serbian attack that occurred after the Albanian border guards had withdrawn. Some sort of small explosive had damaged the windows, and the precious border records were scattered on the ground, mixed with bits of broken glass and splintered wood. In spite of their ominous surroundings, Patrick, Ilir and the border guard carefully gathered together the sheets of records that they could find and searched for stray fragments of paper. They then bravely carried the border records back to the safety of the new Albanian border post.

Upon their safe return, Patrick and Ilir found the Albanian guards laughing. It turns out that they had been the butt of a practical joke. The Serbs on the Kosovo side of the border had been cut off for several weeks from their cigarette suppliers by the NATO bombing, and the Albanian guards had been filling the gap for them. You can understand, the guards told Patrick and Ilir, that the Serbs might shoot journalists (they nodded) but certainly they would not shoot us, their only source of nicotine. Patrick and Ilir nodded again, dazed at having been so easily and thoroughly hoaxed.

could not, therefore, directly test the hypothesis that Yugoslav forces were responsible for ethnic Albanians' deaths and migration. However, on the evening of Tuesday, April 6, official Yugoslav sources announced that Yugoslav forces would observe a unilateral cease-fire beginning at midnight, April 7, in respect of Orthodox Easter. The holiday itself fell on Sunday, April 11, but the cease-fire was to begin earlier. At 3 AM on April 7, the Kosovo-Albania border closed, and there was no refugee movement over the border until Saturday, April 10 (people were leaving their homes during this period, but at a very low rate). Similarly, killings fell from very high daily rates in early April nearly to zero during the period April 7–10. The sequence we observe is thus that the announced unilateral Yugoslav ceasefire is followed within hours by the nearly complete halt to killings and migration. During the same four-day period April 7–10, however, KLA and NATO activity increased dramatically relative to the previous four day period. The increase highlights the unilateral nature of the ceasefire — it was not observed by NATO or by the KLA. So while NATO and KLA activity was increasing, killings and migration were at their lowest points since the conflict's beginning.

The coincidence of the Orthodox Easter ceasefire and the drastic reduction in killings and migration does not prove that Yugoslav forces were responsible for the violations. However, the findings of the analysis we performed are consistent with this hypothesis. Other evidence presented by the prosecution provides additional support for the claim that Yugoslav forces conducted a systematic campaign of ethnic cleansing against Albanians in some parts of Kosovo.

What Did the Statisticians Prove?

In the end, after more than two years of effort — including trips to Albania and a significant contribution to the gross profits of local caffeine suppliers — our work does not prove that Slobodan Milosevic orchestrated systematic war crimes in Kosovo in 1999. The significance in our work, instead, lies in what it disproves. Given the results of our study, key hypotheses which might support the defendant's innocence are simply not plausible.

The trial of Slobodan Milosevic will continue for many months; only at its conclusion when the judges render their decision will we learn what weight they chose to give our analysis. Our hope is that Exhibit 67 will help them to determine who is truly responsible for the suffering of the Kosovar Albanians during the spring of 1999.

Additional Reading

Ball, Patrick, Wendy Betts, Fritz Scheuren, Jana Dudukovic, and Jana Asher. 2002. "Killings and Refugee Flow in Kosovo, March–June 1999: A Report to the International Criminal Tribunal for Former Yugoslavia." Washington, DC: American Association for the Advancement of Science.

Ball, Patrick. 2000. *Policy or Panic: The Flight of Ethnic Albanians from Kosovo, March–May 1999*. Washington, DC: American Association for the Advancement of Science.

Human Rights Watch. 2001. *Under Orders: War Crimes in Kosovo*. New York: Human Rights Watch.

Organization for Security and Cooperation in Europe. 1999. *Kosovo/Kosova As Seen As Told: An Analysis of the Human Rights Findings of the OSCE Kosovo Verification Mission October 1998 to June 1999*. Warsaw, Poland: OSCE Office for Democratic Institutions and Human Rights.