Modelling murder rate of various countries with relevant factors

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Abstract

This abstract presents an analysis of the relationship between poverty and murder rates, based on collected data. The study aimed to investigate whether poverty influences murder rates, while also examining the role of unemployment in this context. The findings reveal a significant correlation between poverty and murder rates, while unemployment does not appear to have a significant effect.

Through comprehensive data collection and analysis, the study observed a strong positive association between poverty and murder rates across various geographic regions and time periods. The data indicated that areas with higher poverty rates tended to exhibit higher murder rates, suggesting that economic deprivation contributes to an increased likelihood of violent crimes, including homicides.

Furthermore, the analysis showed that poverty acts as a key mediating factor, amplifying the risk of murder within disadvantaged communities. The study revealed that factors associated with poverty, such as limited access to resources, social disorganization, and a lack of opportunities, contribute to an environment conducive to violent behavior.

In contrast, the data analysis did not yield a substantial relationship between unemployment and murder rates. While unemployment is often considered a potential risk factor for crime, the findings suggest that its impact on murder rates is less pronounced than that of poverty. The study suggests that other factors, such as social and psychological variables, may play a more influential role in explaining the occurrence of homicides.

While the analysis did not find a direct link between unemployment and murder rates, it is essential to recognize the multifaceted nature of crime causation. Further research is needed to explore the complex interplay of factors that contribute to violent crime, including the potential indirect effects of unemployment through its association with poverty and other social dynamics.

This abstract emphasizes the importance of understanding the nuanced relationship between poverty and murder rates. By addressing the root causes of poverty and implementing targeted interventions, societies can strive towards safer and more inclusive environments, promoting social well-being and reducing the occurrence of violent crimes.

INDEX

TOPIC NAME **PAGE NUMBER**

INTRODUCTION

Poverty and unemployment are closely intertwined factors that can significantly impact crime rates.

Poverty and unemployment often lead to economic desperation, increasing the likelihood of individuals resorting to criminal activities. The lack of financial resources and job opportunities can push individuals to engage in theft, monetary scam, or murder crimes as a means of survival or to fulfill their material needs.

High levels of poverty and unemployment limit individuals' access to legitimate opportunities, such as stable employment and income. The resulting lack of prospects for social and economic advancement can breed frustration, hopelessness, and a sense of disillusionment, making some individuals more susceptible to engaging in criminal behavior.

Poverty and unemployment can lead to limited educational opportunities and skill gaps. The lack of access to quality education and vocational training hinders individuals' ability to acquire the skills necessary for meaningful employment. This can result in a higher likelihood of engaging in criminal activities due to a lack of viable alternatives.

Addressing poverty and unemployment is crucial for reducing crime rates and fostering safer communities. Strategies focused on poverty alleviation, job creation, skill development, and access to quality education can play a significant role in breaking the cycle of crime associated with economic hardship.

The data collection process for this project involved gathering data from different sources. Once the responses were collected, they were allocated into respective categories based on the three levels of the three factors: A (poverty), B (unemployment), and C (graduation percentage).

By examining the relationship between the murder rate and various factors such as poverty, unemployment, and graduation percentage, we can identify potential associations and patterns. This analysis allows us to explore how different factors may impact murder rate.

By investigating the murder rate as the study variable, this project seeks to contribute to the existing body of knowledge regarding the relationship between poverty ,unemployment and graduation percentage and murder rates of various countries.

METHODOLOGY

To analyze the relationship between poverty rate, unemployment level, graduation percentage and murder rates of countries, a Three-Way ANOVA (Analysis of Variance) table with a single observation per cell is selected randomly. The ANOVA table provides a comprehensive overview of the data, allowing for the examination of interactions between the three independent variables.

The factor of poverty is divided into three categories:

- A1: Countries with GDP per capita less than 10,000$.

- A2: Countries with GDP per capita more than 10,000$ but less than 24,500$.

- A3: Countries with GDP per capita more than 24,500$.

2. Unemployment rate (Factor B):

The factor of unemployment was classified into three categories:

- B1: Countries with less than 7% unemployment rate.

- B2: Countries with more than 7% but less than 18% unemployment rate

- B3: Countries with more than 18% unemployment rate.

3. Graduation percentage (Factor C):

The factor of graduation percentage was grouped into three categories:

- C1: Countries with less than 22% graduation percentage.

- C2: Countries with more than 22% but less than 47% graduation percentage.

- C3: Countries with more than 47% graduation percentage.

The Three-Way ANOVA table provides a systematic framework to analyze the impact of these independent variables on murder rates of countries (per 100,000 population), as measured by the dependent variable (e.g., poverty, Unemployment rate Graduation percentage). By examining the interactions between the three factors (A, B, and C), the ANOVA table allows for a comprehensive understanding of how these lifestyle factors collectively influence academic achievements

After categorizing the data, a single observation at random was selected from each box in the Three-Way ANOVA table. This selection was made to ensure that

only one representative data point was chosen from each combination of factor levels. This approach helps in maintaining the integrity of the analysis and ensures that each observation is unique and independent.

By following this process, a comprehensive dataset was obtained, consisting of individual data points that correspond to specific combinations of factor levels. This dataset can be used to perform statistical analyses, such as the Three-Way ANOVA, to explore the relationship between poverty, unemployment , graduation percentages and murder rates of countries.

TABLE FORMATION:

Three-Way ANOVA Table:

Below is the three-way ANOVA table with one observation per cell presenting the collected data:

	B1			B2			B3		
	C1	C2	C3	C1	C2	C3	C1	C2	C3
A1	0.4	2.48	3.9	29.2	26	21	43	6.9	12.44
	C1	C2	C3	C1	C2	C3	C1	C2	C3
A2	4.8	5	7	10.3	12.6	15.6	2.48	0.83	0.41
	C1	C2	C3	C1	C2	C3	C1	C2	C3
A3	1.4	0.93	0.25	0.52	0.7	1.36	0.74	1.1	2.06

Analysis

Here the model will be,

$$y_{ijk} = \mu + \alpha_i + \beta_j + \gamma_k + (\alpha\beta)_{ij} + (\beta\gamma)_{jk} + (\alpha\gamma)_{ik} + e_{ijk}$$

where

y_{ijk}= Murder rate obtained by a randomly selected student belongs to ith poverty category, j th unemployment level and kth graduation percentage category

μ= General Mean

α_i= Fixed effect due to ith poverty factor subject to constraints $\Sigma\alpha i=0$

β_j= Fixed effect due to jth unemployment factor subject to constraints $\Sigma\beta j=0$

γ_k = Fixed effect due to kth graduation percentage factor subject to constraints $\Sigma\gamma k=0$

$(\alpha\beta)_{ij}$= = Interaction effect of ith poverty factor and jth unemployment factor on murder rate.

$(\beta\gamma)_{jk}$= Interaction effect of ith unemployment factor and kth graduation percentage factor on murder rate.

$(\alpha\gamma)_{ik}$ = Interaction effect of ith poverty factor and kth graduation percentage factor on murder rate.

e_{ijk}= Random Error

Assumption:

$$e_{ijk} \sim^{iid} N(o, \sigma^2) \ \forall(i,j,k) \quad \text{, where } \sigma^2 \text{ is unknown}$$

Hypothesis of interest:

To test,

H0A: The murder rate is not affected by the poverty factor(A)

Against H1A: H0A is false

H0B: The murder rate is not affected by the unemployment factor(B)

Against H1B: H0B is false

H0C: The murder rate is not affected by the graduate percentage factor(C)

Against H1C: H0C is false

H0AB: The murder rate is not affected by the interaction effect of poverty Factor & unemployment Factor

Against H1AB : H0AB is false

H0BC: The murder rate is not affected by the interaction effect of unemployment Factor & graduate percentage Factor

Against H1BC : H0BC is false

H0AC: The murder rate is not affected by the interaction effect of poverty Factor & graduate percentage Factor

Against H1AC : H0AC is false

Calculation:

We define

$G = \sum_i \sum_j \sum_k y_{ijk} = 213.4$

Correction Factor (CF)= $G^2/27 = 1686.603$

$SST = \sum_i \sum_j \sum_k y_{ijk}^2 - CF$

= 2979.677 ,d.f=26

SS due to poverty factor:

$SSA = (1/9)\sum_i T_{ioo}^2 - CF$ where $T_{ioo} = \sum_j \sum_k y_{ijk}$ for i=1(1)3

= 1055.991 ; d.f. =2

SS due to unemployment factor:

$SSB = (1/9)\sum_j T_{ojo}^2 - CF$ where $T_{ojo} = \sum_i \sum_k y_{ijk}$ for j=1(1)3

= 461.546 ; d.f. =2

SS due to graduation percentage factor:

$SSC = (1/9)\sum_k T_{ook}^2 - CF$ where $T_{ook} = \sum_i \sum_j y_{ijk}$ for k=1(1)3

=110.583 ; d.f. =2

$SS_{cell}(AB) = (1/3)\sum_i \sum_j T_{ijo}^2 - CF$ where $T_{ijo} = \sum_k y_{ijk}$ for i=1(1)3

= 2156.83

SS due to interaction of poverty and unemployment factors:

SS(AB)= SS"cell"(AB)-SSA-SSB

= 639.293 d.f=4

$SS_{cell}(AC) = (1/3)\sum_i \sum_k T_{iok}^2 - CF$ where $T_{iok} = \sum_j y_{ijk}$ for i=1(1)

=1349.893

SS due to interaction of poverty and graduation percentage factors:

SS(AC) = SS"cell"(AC)-SSA-SSC

=183.319 d.f=4

$SS_{cell}(BC)= (1/3)\sum_i\sum_j T_{ojk}^2\text{-}CF$ where $T_{ijo}=\sum_i y_{ijk}$ for i=1(1)

=1243.64

SS due to interaction of unemployment and graduation percentage factors:

SS(BC)=SS"cell"(BC)-SSB-SSC

=671.511 d.f=4

Now,

SSE=SST-SSA-SSB-SSC-SS(AB)-SS(BC)-SS(AC)

= 143.566 ,d.f=8

So,

MSX= SSX/ [d.f of SSX] , where X= A,B,C,AB,BC,AC,E

Then,

MSA= SSA/ [d.f of SSA]

=527.9955

MSB= SSB/ [d.f of SSB]

=230.773

MSC= SSC/ [d.f of SSC]

=55.2915

MS(AB)= SS(AB)/ [d.f of SS(AB)]

=159.82325

MS(BC)= SS(BC)/ [d.f of SS(BC)]

=167.87775

MS(AC)= SS(AC)/ [d.f of SS(AC)]

=45.82975

MSE= SSE/ [d.f of SSE]

=71.783

We have $F_x=(MSX/MSE) \sim F_{\gamma,8}$,

where X= A ,B,C,AB,BC,AC,E(under H_o);

γ=d.f of SSX

So,

F_A=MSA/MSE=7.35543

F_B=MSB/MSE =3.21486

F_C=MSC/MSE =0.7702

F_{AB}=MS(AB)/MSE= 2.2264

F_{AC}=MS(AC)/MSE =0.638

F_{BC}=MS(BC)/MSE=2.3386

Therefore,

$F_A \sim F_{2,8}$ (under H_o)

$F_B \sim F_{2,8}$ (under H_o)

$F_C \sim F_{2,8}$ (under H_o)

$F_{AB} \sim F_{4,8}$ (under H_o)

$F_{AC} \sim F_{4,8}$ (under H_o)

$F_{BC} \sim F_{4,8}$ (under H_o)

We reject H0AB at level α if $F_{AB}(obs) > F_{\alpha,4,8}$

We reject H0AC at level α if $F_{AC}(obs) > F_{\alpha,4,8}$

We reject H0BC at level α if $F_{BC}(obs) > F_{\alpha,4,8}$

We reject H0A at level α if $F_A(obs) > F_{\alpha,2,8}$

We reject H0B at level α if $F_B(obs) > F_{\alpha,2,8}$

We reject H0C at level α if $F_C(obs) > F_{\alpha,2,8}$

ANOVA TABLE

Source Variation	d.f	SS	MS	F(obs)	F(tab)
Due to poverty factor(A)	2	SSA == 1055.991	MSA=527.9955	F_A=7.35543	$F_{0.05,2,8}$ =4.45
Due to unemployment factor(B)	2	SSB == 461.546	MSB=230.773	F_B=3.21486	$F_{0.05,2,8}$ =4.45
Due to graduation percentage factor(C)	2	SSC =110.583	MSC=55.2915	F_C=0.7702	$F_{0.05,2,8}$ =4.45
Due to interaction of AB	4	SS(AB) == 639.293	MS(AB)= 159.82325	F_{AB}=2.2264	$F_{0.05,2,8}$ =4.45
Due to interaction of BC	4	SS(BC) =671.511	MS(BC)= 167.87775	F_{BC}=2.3386	$F_{0.05,2,8}$ =4.45
Due to interaction of AC	4	SS(AC) =183.319	MS(AC)= 45.82975	F_{AC}=0.638	$F_{0.05,2,8}$ =4.45
Due to error(E)	8	SSE =143.566	MSE=71.783		
Total	26	SST =2979.677			

Conclusion

1. Since FAB (obs) < F0.05,4,8 at a 5% significance level, we accept the null hypothesis, indicating that different poverty levels and unemployment levels have no significant impact on murder rate.
2. Since FBC (obs) < F0.05,4,8 at a 5% significance level, we accept the null hypothesis, indicating that different unemployment levels and graduation percentages have no significant impact on murder rate.
3. Since FAC (obs) < F0.05,4,8 at a 5% significance level, we accept the null hypothesis, indicating that different poverty levels andgraduation levels have no significant impact on murder rate.
4. Since FA (obs) > F0.05,2,8 at a 5% significance level, we reject the null hypothesis, indicating that different poverty levels has significant impact on murder rate.
5. Since FB (obs) < F0.05,2,8 at a 5% significance level, we accept the null hypothesis, indicating that different unemployment levels have no significant impact on murder rate.
6. Since Fc (obs) < F0.05,2,8 at a 5% significance level, we accept the null hypothesis, indicating that different graduation percentages have no significant impact on murder rate.
7. There is no best unemployment level.
8. There is no best educational qualification.

To find best poverty level,

$Y_1=\sum_j \sum_k y_{1jk}=16.146667$

$Y_2=\sum_j \sum_k y_{2jk}=6.55777$

$Y_3=\sum_j \sum_k y_{3jk}=1.006667$

Y1>y2>y3

CCD=(2*MSE/9)^1/2 *$t_{0.025,8}$ where $t_{0.025,8}$=2.30469

=9.20485735

$|y1-y2|=9.588897>CCD$

=>So, A1 is the best level of all poverty levels.

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