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ORIGINAL

Unlocking Accurate Data Categorization: The Range Gem+ Approach To Meaningful Intervals For Global Development Perspectives

Cómo lograr una categorización precisa de los datos: el enfoque Range Gem+ para intervalos significativos desde la perspectiva del desarrollo global

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ABSTRACT

The old range-based method, which identifies class intervals based on highest and lowest values, struggles to maintain equal class widths, hindering effective data organization and interpretation in fields like social sciences. This study aims to enhance statistical practices in organizing and analyzing data by introducing a novel method to address these shortcomings. To overcome the limitations of the traditional range-based method, this study introduces the Range Gem+ (Plus) method. By incorporating a new factor, "Gem+," this innovative approach enhances the range-based method, ensuring equal class widths and non-overlapping intervals. The method involves adding the Gem+ factor to the calculation of class intervals. This makes a framework for organizing data that is fair and correct. We evaluated the effectiveness of this method through detailed investigations and practical applications in the context of physical education research. The application of the Range Gem+ Method demonstrated significant improvements in data organization and interpretation. By ensuring equal class widths and eliminating overlapping intervals, the method provided enhanced clarity and reliability in data analysis. The results highlighted the method's ability to facilitate comparative analysis and support decision-making, particularly in studies involving diverse data sets in physical education research. The Range Gem+ Method offers a novel solution to the limitations of the traditional range-based method. By ensuring equal class widths and non-overlapping intervals, this approach improves data interpretation, enhances comparative analysis, and supports effective decision-making. This method holds promise for broader applications in fields like social sciences, education, and organizational studies, contributing to improved statistical practices and data-driven insights.

Keywords: Class Intervals; Range-Gem+ Method; Data Analysis; Physical Education; Statistical Reporting.

RESUMEN

El antiguo método basado en rangos, que identifica los intervalos de clase en función de los valores más altos y más bajos, tiene dificultades para mantener la igualdad de anchura de las clases, lo que dificulta la organización e interpretación eficaces de los datos en campos como las ciencias sociales. Este estudio

pretende mejorar las prácticas estadísticas de organización y análisis de datos introduciendo un método novedoso para subsanar estas deficiencias. Para superar las limitaciones del método tradicional basado en rangos, este estudio introduce el método Range Gem+ (Plus). Mediante la incorporación de un nuevo factor, «Gem+», este enfoque innovador mejora el método basado en rangos, garantizando anchuras de clase iguales e intervalos no solapados. El método consiste en añadir el factor Gem+ al cálculo de los intervalos de clase. De este modo se crea un marco para organizar los datos que es justo y correcto. Evaluamos la eficacia de este método mediante investigaciones detalladas y aplicaciones prácticas en el contexto de la investigación en educación física. La aplicación del método Range Gem+ demostró mejoras significativas en la organización e interpretación de los datos. Al garantizar la igualdad de anchura de las clases y eliminar los intervalos solapados, el método proporcionó una mayor claridad y fiabilidad en el análisis de los datos. Los resultados pusieron de relieve la capacidad del método para facilitar el análisis comparativo y apoyar la toma de decisiones, en particular en estudios que incluyen diversos conjuntos de datos en la investigación de la educación física. El método Range Gem+ ofrece una solución novedosa a las limitaciones del método tradicional basado en rangos. Al garantizar anchuras de clase iguales e intervalos no solapados, este enfoque mejora la interpretación de los datos, potencia el análisis comparativo y apoya la toma de decisiones eficaz. Este método es prometedor para aplicaciones más amplias en campos como las ciencias sociales, la educación y los estudios organizativos, contribuyendo a mejorar las prácticas estadísticas y los conocimientos basados en datos.

Palabras clave: Intervalos de Clase; Método Range-Gem+; Análisis de Datos; Educación Física; Informes Estadísticos.

INTRODUCTION

In the field of statistics and data analysis, the concept of range score and its relation to establishing class intervals is a foundational topic.[1] Class intervals are essential for organizing data into a format that is easily interpretable, computing weighted mean, mode, and median and facilitating the analysis of frequency and percent distributions. Establishing appropriate class intervals is a crucial aspect of statistical analysis, particularly in the organization and presentation of data. Class intervals are the divisions into which data points are grouped, aiding in the analysis and interpretation of data patterns and trends. The range-based method is a common approach used to determine these intervals.

According to[2], the range-based method for determining class intervals is a widely recognized approach due to its simplicity and ease of application.[3] Numerous studies demonstrate the significance of class intervals in statistical analysis[4] and[5] discuss the utilization of class intervals to determine measures of central tendency and dispersion, as well as to analyze frequency distributions. The range-based method for determining class intervals is a commonly used approach due to its straightforward nature.[6,7]

The range-based technique utilizes the range of a dataset, which is defined as the difference between the highest and minimum values inside that dataset.[8,9] posits that the prevalent range-based approach for determining class intervals may not always be the most effective option, since it may insufficiently consider the distribution of the data. While the range-based method is a prevalent technique, scholars have suggested alternate approaches for determining class intervals[5] Examine Sturges' rule and Scott's normal reference rule, which may be better suitable for specific data distributions.

Numerous studies demonstrate the significance of class intervals in statistical analysis; [4] and[5] discuss the utilization of class intervals to determine measures of central tendency and dispersion as well as to analyze frequency distributions.

Establishing class intervals entails splitting a dataset into distinct, non-overlapping intervals that encompass the complete data range. Typically, each interval has an equal class width, but we can employ other approaches when necessary. The choice of class interval width directly impacts the granularity and interpretability of the resulting frequency distribution. Classical statistical theories ground this approach, widely recognized for its simplicity and ease of application.[10]

According to[11] and[12], the range provides a straightforward measure of data spread, which is essential for creating meaningful class intervals. The equal interval method is a straightforward approach that divides the range into desired equal parts. This method ensures each class interval has an equal width, providing a clear and consistent framework for data interpretation.[13,14]

The application of range-based class intervals is widespread in social sciences, education, and psychology. In educational research, class intervals help categorize student satisfaction or performance levels, facilitating comparative analysis and reporting.[15] In organizational studies, these intervals can delineate employee satisfaction levels, aiding in targeted interventions and policy-making.[16]

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However, there are anchored challenges and limitations, one primary challenge is ensuring that the chosen intervals accurately represent the underlying data distribution. Fixed intervals may not capture the nuances of respondent variability, potentially leading to misinterpretation. Outliers, while less common in Likert data, can still influence mean scores and should be considered when establishing intervals.[17]

Additionally, the subjective nature of custom intervals can introduce bias, emphasizing the need for transparent and justifiable criteria. Researchers must balance simplicity with accuracy, ensuring that intervals are both easy to interpret and reflective of the data's true nature.[18]

By investigation, with respect to establishing well-balanced and non-overlapping class intervals, there are issues regarding the range-based method formula accuracy, more specifically on establishing equal class width (CW). Hence, the researchers aim to contribute to the broader understanding and improvement of statistical practices in organizing and analyzing data, particularly in fields like social sciences, education, and organizational studies where the application of class intervals is prevalent.

RESULTS

Case analysis

Problem: In a certain 20-item self-efficacy research questionnaire utilizing Likert-5 scale, categorize respondents self-efficacy level into: very high, high, moderate, low, and very low.

Given:

Highest Score (expected) = 100
Lowest Score (expected) = 20
Number of class interval (*i*) = 5

Solution: Range (R) = Highest Score (expected) – Lowest Score (expected) = 100 – 20 = 80

Class Width (CW) = R/i = 80/5 = 16 (exact). However, by investigation, this equation does not hold true (refer to provided table).

Table 1. Investigation case

Class Interval	Class Width	Findings
85-100	16	
69-84	16	
53-68	16	
37-52	16	
20-36	17?	CW = 16 is False. The formula has a gap, the ***Gem+***

Introduction of the Range-Gem+ Method

The Range (R) = HS – LS holds the same. The Class Width (CW) from Range-Based Method formula has a discrepancy in obtaining an equal-width and non-overlapping class intervals, the Gem+, to make the formula accurate.

From CW = R/i, the Range-Gem+ Method introduced:

CW = (R+Gem)/i; where: Gem+ =10^{-n} and n = # of decimal places considered (see table below).

Table 2. Introduction of the Range-Gem+ Method

Point of Consideration	(*n*)	*Gem+* = 10^{-n}	*Gem+*
0 decimal (whole #s)	*n* = 0	$10^{-0}=1/10^{0}$ = 1/1 = 1	1
1 decimal place	*n* = 1	$10^{-1}=1/10^{1}$ = 1/10 = 0,1	,1
2 decimal places	*n* = 2	$10^{-2}=1/10^{2}$ = 1/100 = 0,01	,01
3 decimal places	*n* = 3	$10^{-3}=1/10^{3}$ = 1/1000 = 0,001	,001
4 decimal places	*n* = 4	$10^{-4}=1/10^{4}$ = 1/10000 = 0,0001	,0001
…	…	…	…

Sometimes, it is easier to comprehend *Gem+* when simplified (table 3).

Application 1 (As Applied in Research):

Problem: An 11-item Sport Self-Efficacy research questionnaire utilizing Likert-5 scale, categorize the respondent's motivation status into: very good, good, moderate, poor, and very poor (table 4).

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Given: i = 5, HS (Expected)= 55, and LS (Expected)= 11
Solution:
***R** = HS - LS (Expected)*
= 55 - 11
***R** = 54*

CW = (R+Gem)/i
= (44+1)/5
= 45/5
CW = 9 (exact)

Table 3. Tabulation of Gem+

Point of Consideration	Gem+
0 decimal (whole #s)	+ 1
1 decimal place	+ ,1
2 decimal places	+ ,01
3 decimal places	+ ,001
4 decimal places	+ ,0001
…	…

Table 4. Application 1 (As Applied in Research)

Class Interval	Class Width	Equilibrium/Balance Check	Remarks
47-55	9	Mdpt = (HS+LS)/2= (55+11)/2 = 66/2 = 33 Center = (LL+HL)/2 (Mid-Class) = (29+37)/2 = 66/2 = 33	Class width = 9 (exact) is true. Hence, the *Range-Gem+* Method formula is accurate.
38-46	9		
29-37	9		
20-28	9		
11-19	9		

Application 2 (As Applied in Tertiary Grading System):
Problem: In Physical Education setting, establish the ascending 8 class intervals with corresponding grade equivalents after fixed at 60 % passing (Grade = 3,0). Consider two decimal places.
Given: i = 8, HS = 100,00 %, LS = 60,01 %
Sol'n:
R = HS - LS = 100,00 - 60,01 = 39,99
CW = (R+Gem)/i = (39,99+0,01)/8 = 40,00/8 = 5,00 (exact).

Table 5. Application 2 (As Applied in Tertiary Grading System)

Class Interval (%)	Grade	CW	Balance Check	Remarks
95,01-100,00	1,00	5,00	Mdpt = (HS+LS)/2 = (100+60,01)/2 = 160,01/2 Mdpt = 80,005 Center = (HL+LL)/2 = (80,00+80,01)/2 = 160,01/2 Center = 80,005	Class width = 5,00% (exact) is true, the *Range-Gem+* Method formula then is accurate,
90,01-95,00	1,25	5,00		
85,01-90,00	1,50	5,00		
80,01-85,00	1,75	5,00		
75,01-80,00	2,00	5,00		
70,01-75,00	2,25	5,00		
65,01-70,00	2,50	5,00		
60,01-65,00	2,75	5,00		

Range-Gem+ Method in Establishing Appropriate Class Intervals
Developed from the Range-Based Method, the **Range-Gem+ Method** for determining and establishing meaningful and appropriate class intervals is a new tool in statistical analysis. It is a simple but an accurate

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and well-balanced method in establishing class interval for appropriate analysis, interpretation, and reporting; applicable across various fields of specializations; and likewise beneficial among researchers/educators.

Where, establishing class intervals involves: dividing a dataset into a desired number of equal-width and non-overlapping class intervals embracing the expected/or observed entire range of data; ensuring accuracy in terms of formula used and its actual application; adjusting intervals to the midpoint/center to affect equilibrium (balance) possible to avoid bias; and providing a clear and consistent framework for more effective data analysis and for interpretive clarity and reporting.

CONCLUSION

In the above study, we concluded that:

1. The traditional range-based method for determining class intervals often falls short in ensuring equal class widths and non-overlapping intervals. This can lead to issues in data analysis and interpretation.
2. The newly introduced Range-Gem+ Method addresses the limitations of the range-based method by incorporating a "Gem+" factor that ensures the calculated class width is precisely equal and the intervals are non-overlapping.
3. The Range-Gem+ Method has been successfully demonstrated to generate equal-width and balanced class intervals in the context of physical education research, particularly in a self-efficacy questionnaire study and a grading system application.
4. The Range-Gem+ Method offers researchers and educators a robust and versatile tool for establishing meaningful class intervals across various fields, promoting enhanced data interpretation, facilitating comparative analysis, and supporting effective decision-making.

RECOMMENDATIONS

1. Adopt the Range Gem+ Method as the preferred approach for determining class intervals in data analysis, particularly in the field of physical education and related disciplines.
2. Provide training and resources to researchers and educators on the application of the Range Gem+ Method, highlighting its advantages over the traditional range-based method.
3. Encourage the use of the Range-Gem+ Method in research publications and educational reporting to showcase its effectiveness and promote its widespread adoption.
4. Develop user-friendly tools or software that integrate the Range-Gem+ Method, making it easily accessible and implementable for researchers and educators.
5. Incorporate the Range Gem+ Method into the curriculum of statistics and data analysis courses to equip students with the knowledge and skills to create appropriate and meaningful class intervals.
6. The Range Gem+ Method can significantly improve data accuracy, balance, and interpretability in statistical analysis by implementing its recommendations.
7. Conduct further studies to evaluate the performance of the Range Gem+ Method in different research contexts and data types, further validating its utility and expanding its applications.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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