Grouping of Provinces in Indonesia Based on Infrastructure Development Indicators Using the Ward Method with a Multiscale Bootstrap Approach

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ABSTRACT

Infrastructure plays an important role in improving the quality of life and human welfare. Infrastructure is a facility that is needed by every country, including Indonesia, to support various community activities in general in everyday life. However, the problem of inequality in infrastructure development in Indonesia is still a challenge for the government. This study aims to classify provinces in Indonesia based on indicators of infrastructure development. The method used in this grouping is the ward method with the multiscale bootstrap approach to determine the validity of the formed cluster. The results of the grouping show that we obtained 7 clusters where clusters with poor infrastructure development status are cluster 7, clusters with fairly good infrastructure development status, are cluster 6, clusters with good infrastructure development status, are cluster 1, cluster 2, cluster 3 and cluster 4, while cluster with a very good infrastructure development status, are cluster 5. From the 7 clusters formed, we obtained 4 clusters with an approximately unbiased (AU) value greater than and equal to 95, defined as valid clusters and 3 clusters with an AU value of less than and equal to 95, defined as invalid clusters.

1. Introduction (*Heading 1*) (bold, 11 pt)

Infrastructure is a physical facility developed or required by public agents for government functions in facilitating social and economic goals which are seen as the locomotive of national and regional development [4]. The role of infrastructure is very important in improving the quality of life and human welfare, therefore it is necessary to have adequate infrastructure in an area [5]. Infrastructure development is an indicator of a country's progress, with infrastructure development it can spur economic growth [7].

Sebagai negara berkembang, Indonesia menjadikan pembangunan infrastruktur sebagai prioritas utama, mengingat stok infrastrukur Indonesia terhadap produk domestik bruto (PDB) masih dibawah standar internasional, dimana rata-rata standar stok infrastruktur terhadap PDB yaitu sebesar 70%, sedangkan stok infrastruktur Indonesia terhadap PDB masih sebesar 43%. Berdasarkan Global Competitiveness Report yang disusun oleh World Economic Forum, pada tahun 2019 infrastruktur di Indonesia menempati peringkat ke-71 dari 141 negara yang disurvei dan masih berada di bawah beberapa negara kawasan Asia Tenggara [2].

Dalam mengejar ketertinggalan, Indonesia perlu melakukan percepatan pembangunan infrastruktur yang masif dan merata, akan tetapi sampai saat ini ketimpangan pembangunan masih terjadi, hal ini terlihat dari perekonomian yang belum merata antara kawasan Timur Indonesia (KTI) dengan kawasan Barat Indonesia (KBI). Salah satu penyebab adanya ketimpangan tersebut dikarenakan pemenuhan infrastruktur dibeberapa provinsi yang belum memadai [3]. Umumnya kawasan barat Indonesia memiliki kondisi infrastruktur yang lebih baik dibandingkan dengan

kawasan timur Indonesia, hal ini akan menyebabkan pertumbuhan ekonomi lebih terkonsentrasi pada wilayah tertentu [6].

Peningkatan infrastruktur sangat diperlukan dalam pemerataan perekonomian serta meningkatkan daya saing antar provinsi di Indonesia. Proses pembangunan infrastruktur memerlukan adanya informasi literal dan kestatistikan dalam mendukung perencanaan dan program pembangunan, salah satu upaya yang dapat dilakukan yaitu dengan mengelompokan provinsi-provinsi di Indonesia berdasarkan indikator pembangunan infrastruktur menggunakan analisis cluster. Sehingga hasil yang diperoleh dapat dijadikan sebagai informasi dan evaluasi untuk membantu pemerintah dalam peningkatan infrastruktur di wilayah dengan kondisi infrastruktur yang masih rendah. Pada penelitian ini digunakan analisis cluster hirarki metode ward dengan pendekatan multiscale bootstrap.

Cluster hirarki merupakan analisis cluster yang membentuk tingkatan tertentu seperti struktur pohon yang dikarenakan pengelompokan dilakukan secara bertahap. Terdapat beberapa metode dalam analisis cluster hirarki, salah satunya yaitu metode ward. Metode ward disebut juga sebagai metode varian yang bertujuan untuk menghasilkan cluster dengan varian internal sekecil mungkin yang berdasarkan pada sum square error (SSE). Metode ward dikenal sebagai metode terbaik dalam analisis cluster hirarki [8].

Multiscale bootstrap merupakan salah satu pendekatan yang dilakukan untuk memberikan ukuran ketidaktentuan dalam metode pengelompokan cluster hirarki. Metode ini bekerja dengan pendekatan bootstrap resampling untuk setiap kelompok, sehingga diperoleh ukuran validasi yaitu nilai p-value dalam membentuk kelompok yang mempunyai kemiripan satu dengan yang lain. Multiscale bootstrap digunakan untuk menghitung nilai approximately unbiassed (AU) p-value, untuk memberikan taksiran yang lebih baik dalam mengatasi bias [1].

Beberapa penelitian sebelumnya yang dilakukan berhubungan dengan metode ward dan multiscale bootstrap antara lain pengelompokan provinsi di Indonesia berdasarkan variabel penyakit menular menggunakan metode complete linkage, average linkage, dan metode ward [10]. Penelitian lain dilakukan oleh Safarina (2019) dalam pengelompokkan kabupaten/kota di Kalimantan Timur berdasarkan indeks pembangunan manusia (IPM) tahun 2017 dengan menggunakan hierarchical clustering multiscale bootstrap [9]. Berdasarkan beberapa penelitian sebelumnya, maka pada penelitian ini akan dibahas mengenai pengelompokan provinsi di Indonesia berdasarkan indikator pembangunan infrastruktur menggunakan metode ward dengan pendekatan multiscale bootstrap.

2. The Proposed Method/Algorithm (Optional) (bold, 11 pt)

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3.2. Units

- Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as "3.5-inch disk drive."

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- Do not mix complete spellings and abbreviations of units: "Wb/m2" or "webers per square meter," not "webers/m2." Spell units when they appear in text: "...a few henries," not "...a few H."

- Use a zero before decimal points: "0.25," not ".25." Use "cm3," not "cc." (*bullet list*)

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$$a + b = \gamma \tag{1}$$

Note that the equation is centered using a center tab stop. Be sure that the symbols in your equation have been defined before or immediately following the equation. Use "(1)," not "Eq. (1)" or "equation (1)," except at the beginning of a sentence: "Equation (1) is ..."

3.4. Some Common Mistakes

- The word "data" is plural, not singular.

- The subscript for the permeability of vacuum μ_0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter "o."

- In American English, commas, semi-/colons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)

- A graph within a graph is an "inset," not an "insert." The word alternatively is preferred to the word "alternately" (unless you really mean something that alternates).

- Do not use the word "essentially" to mean "approximately" or "effectively."

- In your paper title, if the words "that uses" can accurately replace the word using, capitalize the "u"; if not, keep using lower-cased.

- Be aware of the different meanings of the homophones "affect" and "effect," "complement" and "compliment," "discreet" and "discrete," "principal" and "principle."

- Do not confuse "imply" and "infer."

- The prefix "non" is not a word; it should be joined to the word it modifies, usually without a hyphen.

- There is no period after the "et" in the Latin abbreviation "et al."

- The abbreviation "i.e." means "that is," and the abbreviation "e.g." means "for example."

An excellent style manual for science writers is [7].

4. Results and Discussion

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Headings, or heads, are organizational devices that guide the reader through your paper. There are two types: component heads and text heads.

Component heads identify the different components of your paper and are not topically subordinate to each other. Examples include ACKNOWLEDGMENTS and REFERENCES, and for these, the correct style to use is "Heading 5." Use "figure caption" for your Figure captions, and "table head" for your table title. Run-in heads, such as "Abstract," will require you to apply a style (in this case, italic) in addition to the style provided by the drop down menu to differentiate the head from the text.

Text heads organize the topics on a relational, hierarchical basis. For example, the paper title is the primary text head because all subsequent material relates and elaborates on this one topic. If there are two or more sub-topics, the next level head (uppercase Roman numerals) should be used and, conversely, if there are not at least two sub-topics, then no subheads should be introduced. Styles named "Heading 1," "Heading 2," "Heading 3," and "Heading 4" are prescribed.

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Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation "Fig. 1," even at the beginning of a sentence.

Table 1.   Table Styles

Table Head	Table Column Head		
	Table column subhead	*Subhead*	*Subhead*
copy	More table copy[a]		

[a.] Sample of a Table footnote. *(Table footnote)*

We suggest that you use a text box to insert a graphic (which is ideally a 300 dpi resolution TIFF or EPS file with all fonts embedded) because this method is somewhat more stable than directly inserting a picture.

To have non-visible rules on your frame, use the MSWord "Format" pull-down menu, select Text Box > Colors and Lines to choose No Fill and No Line.

Fig. 1. Example of a figure caption. *(figure caption)*

Figure Labels: Use 10 point Times New Roman for Figure labels. Use words rather than symbols or abbreviations when writing Figure axis labels to avoid confusing the reader. As an example, write the quantity "Magnetization," or "Magnetization, M," not just "M." If including units in the label, present them within parentheses. Do not label axes only with units. In the example, write "Magnetization (A/m)" or "Magnetization (A (m(1)," not just "A/m." Do not label axes with a ratio of quantities and units. For example, write "Temperature (K)," not "Temperature/K."

5. Conclusion

Provide a statement that what is expected, as stated in the "Introduction" chapter can ultimately result in "Results and Discussion" chapter, so there is compatibility. Moreover, it can also be added the prospect of the development of research results and application prospects of further studies into the next (based on result and discussion).

References

The template will number citations consecutively within brackets [1]. The sentence punctuation follows the bracket [2]. Refer simply to the reference number, as in [3]—do not use "Ref. [3]" or "reference [3]" except at the beginning of a sentence: "Reference [3] was the first ..."

Number footnotes separately in superscripts. Place the actual footnote at the bottom of the column in which it was cited. Do not put footnotes in the reference list. Use letters for table footnotes.

Unless there are six authors or more give all authors' names; do not use "et al.". Papers that have not been published, even if they have been submitted for publication, should be cited as "unpublished" [4]. Papers that have been accepted for publication should be cited as "in press" [5]. Capitalize only the first word in a paper title, except for proper nouns and element symbols.

For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

[1] G. Eason, B. Noble, and I.N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955. (*references*)

[2] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.

[3] I.S. Jacobs and C.P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.

[4] K. Elissa, "Title of paper if known," unpublished.

[5] R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.

[6] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," IEEE Transl. J. Magn. Japan, vol. 2, pp. 740-741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].

[7] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

Supplementary Material

Supplementary material that may be helpful in the review process should be prepared and provided as a separate electronic file. That file can then be transformed into PDF format and submitted along with the manuscript and graphic files to the appropriate editorial office.