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Split-plot designs with general minimum lower-order confounding. (English) Zbl 1189.62124
Sci. China, Math. 53, No. 4, 939-952 (2010).

Summary: Split-plot designs have been widely used in industrial experiments. Up to now, most methods for choosing this kind of designs are based on the minimum aberration (MA) criterion. Recently, by introducing a new pattern, called aliased effect-number pattern (AENP), *R. Zhang* et al. [Stat. Sin. 18, No. 4, 1689–1705 (2008; Zbl 1255.62223)] proposed a general minimum lower-order confounding (denoted by GMC for short) criterion and established a general minimum confounding (also denoted by GMC for saving notations) theory. It is proved that the GMC criterion selects optimal designs in a more elaborate manner than the existing ones, and when an experimenter has a prior about the importance ordering of factors in experiments the GMC designs are better than other optimal designs. We extend the GMC criterion to the split-plot design case and give a GMC-FFSP criterion for ranking split-plot designs. Some comparisons of the new criterion with the MA-MSA-FFSP criterion are given, and the optimal 32-run split-plot designs up to 14 factors under the two criteria are tabulated for comparison and application.

MSC:

62K05 Optimal statistical designs
62K15 Factorial statistical designs
65C60 Computational problems in statistics (MSC2010)
62Q05 Statistical tables

Cited in **4** Documents

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fractional factorial design; GMC criterion; minimum aberration; split-plot

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References:

[1] Ai M Y, Zhang R C. Minimum secondary abberation fractional factorial split-plot designs in terms of consulting designs. Sci China Ser A, 2006, 49: 494–512 · Zbl 1123.94010 · doi:10.1007/s11425-006-0494-x

[2] Bingham D, Sitter R R. Minimum aberration two-level fractional factorial split-plot designs. Technometrics, 1999, 41: 62–70 · Zbl 0957.62065 · doi:10.2307/1270995

[3] Bingham D, Sitter R R. Design issues in fractional factorial split-plot experiments. J Quality Technol, 2001, 33: 2–15

[4] Bisgaard S. The design and analysis of 2k {\(\times\)} 2q split-plot experiments. J Quality Technol, 2000, 32: 39–56

[5] Box G E P, Jones S. Split-plot designs for robust product experimentation. Appl Statist, 1992, 19: 3–26 · doi:10.1080/02664769200000001

[6] Cheng C S, Steinberg D M, Sun D X. Minimum aberration and model robustness for two-level factorial designs. J Roy Statist Soc Ser B, 1999, 61: 85–93 · Zbl 0913.62072 · doi:10.1111/1467-9868.00164

[7] Cheng Y, Zhang R C. On construction of general minimum lower order confounding 2n designs with N/4 + 1 n 9N/32. J Statist Plan Inference, in press, 2010, doi: 10.1016/j.jspi.2010.02.006 · Zbl 1188.62253

[8] Fries A, Hunter W G. Minimum aberration 2k designs. Technometrics, 1980, 22: 601–608 · Zbl 0453.62063 · doi:10.2307/1268198

[9] Goos P. Optimal versus orthogonal and equivalent-estimation design of blocked and split-plot experiments. Statist Neerlandica, 2006, 60: 361–378 · Zbl 1108.62073 · doi:10.1111/j.1467-9574.2006.00333.x

[10] Goos P, Vandebroek M. Optimal split-plot Designs. J Quality Technol, 2001, 33: 435–450 · Zbl 1079.62532

[11] Goos P, Vandebroek M. D-optimal split-plot designs with given numbers and sizes of whole plots. Technometrics, 2003, 45: 235–245 · doi:10.1198/004017003000000050

[12] Huang P, Chen D, Voelkel J. Minimum aberration two-level split-plot designs. Technometrics, 1998, 40: 314–326 · Zbl 1064.62552 · doi:10.2307/1270532

[13] Jones B, Goos P. D-optimal design of split-split-plot experiments. Biometrika, 2009, 96: 67–82 · Zbl 1162.62396 · doi:10.1093/biomet/asn070

[14] Li P F, Zhao S L, Zhang R C. A theory on constructing 2m designs with general minimum lower order confounding. Submitted to Statist Sinica, 2009

[15] Mcleod R G. Optimal block sequences for blocked fractional factorial split-plot designs. J Statist Plan Inference, 2008, 138: 2563–2573 · Zbl 1173.62057 · doi:10.1016/j.jspi.2007.10.012

[16] Mcleod R G, Brewster J F. The design of blocked fractional factorial split-plot experiments. Technometrics, 2004, 46: 135–146 · doi:10.1198/004017004000000176

[17] Mcleod R G, Brewster J F. Blocked fractional factorial split-plot experiments for robust parameter design. J Quality Technol, 2006, 38: 267–279

[18] Mukerjee R, Fang K T. Fractional factorial split-plot designs with minimum aberration and maximum estimation capacity. Statist Sinica, 2002, 12: 885–903 · Zbl 1002.62063

[19] Mukerjee R, Wu C F J. A Modern Theory of Factorial Designs. Springer Series in Statistics. New York: Springer Science+Business Media Inc, 2006 · Zbl 1271.62179

[20] Wu C F J, Hamada M S. Experiments: Planning, Analysis and Parameter Design Optimization. New York: Wiley, 2000 · Zbl 0964.62065

[21] Yang J F, Li P F, Liu M Q, et al. \(2^{(n_1 + n_2) - (k_1 + k_2)} \) fractional factorial split-plot designs with clear effects. J Statist Plan Inference, 2006, 136: 4450–4458 · Zbl 1099.62084 · doi:10.1016/j.jspi.2005.06.009

[22] Yang J F, Zhang R C, Liu M Q. Construction of fractional factorial split-plot designs with weak minimum aberration. Statist Prob Letters, 2007, 77: 1567–1573 · Zbl 1124.62047 · doi:10.1016/j.spl.2007.03.043

[23] Zhang R C, Cheng Y. General minimum lower order confounding designs: an overview and a construction theory. J Statist Plan Inference, 2010, 140: 1719–1730 · Zbl 1184.62137 · doi:10.1016/j.jspi.2009.12.024

[24] Zhang R C, Li P, Zhao S L, et al. A general minimum lower-order confounding criterion for two-level regular designs. Statist Sinica, 2008, 18: 1689–1705 · Zbl 1255.62223

[25] Zhang R C, Mukerjee R. Characterization of general minimum lower order confounding via complementary. Statist Sinica, 2009, 19: 363–375 · Zbl 1153.62060

[26] Zhang R C, Mukerjee R. General minimum lower order confounding in block designs using complementary sets. Statist Sinica, 2009, 19: 1787–1802 · Zbl 1176.62076

[27] Zhang R C, Park D K. Optimal blocking of two-level fractional factorial designs. J Statist Plan Inference, 2000, 91: 107–121 · Zbl 0958.62072 · doi:10.1016/S0378-3758(00)00133-6

[28] Zi X M, Zhang R C, Liu M Q. Bounds on the maximum numbers of clear two-factor interactions for \(2^{(n_1 + n_2) - (k_1 + k_2)} \) fractional factorial split-plot designs. Sci China Ser A, 2006, 49: 1816–1829 · Zbl 1106.62089 · doi:10.1007/s11425-006-2032-2