

VU Research Portal

Advances in Derivative Estimation:

Volk-Makarewicz, W.M.

2014

document version

Publisher's PDF, also known as Version of record

[Link to publication in VU Research Portal](#)

citation for published version (APA)

Volk-Makarewicz, W. M. (2014). *Advances in Derivative Estimation: Ranked Data, Quantiles, and Options*. Amsterdam Business Research Institute.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

E-mail address:

vuresearchportal.ub@vu.nl

Bibliography

- [1] J. H. M. ANDERLUH, *Pricing Parisians and barriers by hitting time simulation*, *The European Journal of Finance*, 14 (2008), pp. 137–156.
- [2] B. AROUNA, *Robbins-Monro algorithms and variance reduction in finance*, *Journal of Computational Finance*, 7 (2004), pp. 35–61.
- [3] S. ASMUSSEN AND P. W. GLYNN, *Stochastic Simulation: Algorithms and Analysis*, Springer, New York, USA, 2007.
- [4] R. R. BAHADUR, *A note on quantiles in large samples*, *The Annals of Mathematical Statistics*, 37 (1966), pp. 577–580.
- [5] A. BASSAMBOO, S. JUNEJA, AND A. ZEEVI, *Portfolio credit risk with extremal dependence: Asymptotic analysis and efficient simulation*, *Operations Research*, 56 (2008), pp. 593–606.
- [6] E. BENHAMOU, *Optimal Malliavin weighting function for the computation of the Greeks*, *Mathematical Finance*, 13 (2003), pp. 37–53.
- [7] C. BERNHARD AND P. BOYLE, *Monte Carlo methods for pricing discrete Parisian options*, *The European Journal of Finance*, 17 (2011), pp. 169–196.
- [8] Z. BODIE, A. KANE, AND A. J. MARCUS, *Investments*, McGraw-Hill, New York, USA, 9th ed., 2011.
- [9] O. J. BOXMA AND H. DADUNA, *Sojourn times in queueing networks*, Report BS-R8916, CWI, 1989. Department of Operations Research, Statistics, and System Theory.
- [10] M. BROADIE AND P. GLASSERMAN, *Estimating security price derivatives using simulation*, *Management Science*, 42 (1996), pp. 269–285.
- [11] P. J. BURKE, *The output of a queueing system*, *Operations Research*, 4 (1956), pp. 699–704.
- [12] M. CARTER AND B. VAN BRUNT, *The Lebesgue-Stieltjes Integral: A Practical Introduction*, Springer-Verlag, New York, USA, 2000.
- [13] C. G. CASSANDRAS, Y. WARDI, B. MELAMED, AND C. G. PANAYIOTOU, *Perturbation analysis for online control and optimization of stochastic fluid models*, *IEEE Transactions on Automatic Control*, 47 (2002), pp. 1234–1248.

BIBLIOGRAPHY

- [14] N. CHEN AND P. GLASSERMAN, *Malliavin Greeks without Malliavin calculus*, Stochastic Processes and their Applications, 117 (2007), pp. 1689–1723.
- [15] Z. CHEN AND P. GLASSERMAN, *Sensitivity estimates for portfolio credit derivatives using Monte Carlo*, Finance and Stochastics, 12 (2008), pp. 507–540.
- [16] R. CONT AND R. DEGUEST, *Equity correlations implied by index options and model uncertainty analysis*, Mathematical Finance, (2012). Forthcoming.
- [17] A. DASSIOS, *The distribution of the quantile of a brownian motion with drift and the pricing of related path-dependent options*, The Annals of Applied Probability, 5 (1995), pp. 389–398.
- [18] H. A. DAVID AND H. N. NAGARAJA, *Order Statistics*, Wiley, Hoboken, NJ, USA, 3rd ed., 2003.
- [19] N. DENSON AND M. JOSHI, *Fast and accurate Greeks for the LIBOR market model*, The Journal of Computational Finance, 14 (2011), pp. 115–140.
- [20] D. DUFFIE AND J. PAN, *An overview of value at risk*, The Journal of Derivatives, 4 (1997), pp. 7–49.
- [21] S. E. ELMAGHRABY, *Project Planning and Control by Network Models*, Wiley, New York, USA, 1977.
- [22] ———, *On criticality and sensitivity in activity networks*, European Journal of Operational Research, 127 (2000), pp. 220–238.
- [23] E. FOURNIÉ, J.-M. LASRY, J. LEBUCHOUX, AND P.-L. LIONS, *Applications of Malliavin calculus on Monte Carlo methods in finance. II*, Finance and Stochastics, 5 (2001), pp. 201–236.
- [24] E. FOURNIÉ, J.-M. LASRY, J. LEBUCHOUX, P.-L. LIONS, AND N. TOUZI, *Applications of Malliavin calculus on Monte Carlo methods in finance*, Finance and Stochastics, 3 (1999), pp. 391–412.
- [25] M. C. FU, *Sample path derivatives for (s, S) inventory systems*, Operations Research, 42 (1994), pp. 351–364.
- [26] ———, *Gradient estimation*, in Simulation, S. G. Henderson and B. L. Nelson, eds., vol. 13 of Handbooks in Operations Research and Management Science, Elsevier, 2006, pp. 575–616.

-
- [27] ———, *Sensitivity analysis in Monte Carlo simulation of stochastic activity networks*, in Perspectives in Operations Research, F. B. Alt, M. C. Fu, and B. L. Golden, eds., vol. 36 of Operations Research/Computer Science Interfaces Series, Springer, 2006, pp. 351–366.
- [28] ———, *Variance-gamma and Monte Carlo*, in Advances in Mathematical Finance, M. C. Fu, R. A. Jarrow, J. Y. J. Yen, and R. J. Elliott, eds., Applied and Numerical Harmonic Analysis, Birkhäuser, 2007, pp. 21–34.
- [29] M. C. FU, *What you should know about simulation and derivatives*, Naval Research Logistics, 55 (2008), pp. 723–736.
- [30] M. C. FU AND J.-Q. HU, *Sensitivity analysis for Monte Carlo simulation of option pricing*, Probability in the Engineering and Informational Sciences, 9 (1995), pp. 417–446.
- [31] M. C. FU AND J.-Q. HU, *Conditional Monte Carlo: Gradient Estimation and Optimization Applications*, Kluwer Academic Publishers, Boston, USA, 1997.
- [32] M. C. FU, J.-Q. HU, AND L. J. HONG, *Conditional Monte Carlo estimation of quantile sensitivities*, Management Science, 55 (2009), pp. 2019–2027.
- [33] E. GARSVA, *Computer system survivability modelling by using stochastic activity network*, in Proceedings of the 25th International Conference on Computer Safety, Security, and Reliability, J. Górski, ed., vol. 4166 of Lecture Notes in Computer Science, Gdansk, Poland, 2006, Springer, pp. 71–84.
- [34] J. K. GHOSH, *A new proof of the Bahadur representation of quantiles and an application*, The Annals of Mathematical Statistics, 42 (1971), pp. 1957–1961.
- [35] M. GILES AND P. GLASSERMAN, *Smoking adjoints: fast Monte Carlo Greeks*, Risk, 19 (2006), pp. 92–96.
- [36] P. GLASSERMAN, *Gradient Estimation via Perturbation Analysis*, Kluwer Academic Publishers, Boston, USA, 1991.
- [37] ———, *Regenerative derivatives of regenerative sequences*, Advances in Applied Probability, 25 (1993), pp. 116–139.
- [38] ———, *Monte Carlo Methods in Financial Engineering*, Springer-Verlag, New York, USA, 2004.

BIBLIOGRAPHY

- [39] P. GLASSERMAN AND S. TAYUR, *Sensitivity analysis for base-stock levels in multiechelon production-inventory systems*, *Management Science*, 41 (1995), pp. 263–281.
- [40] P. GLASSERMAN AND D. D. YAO, *Some guidelines and guarantees for common random numbers*, *Management Science*, 38 (1992), pp. 884–908.
- [41] P. GLASSERMAN AND X. ZHAO, *Fast greeks by simulation in forward libor models*, *Journal of Computational Finance*, 3 (1999), pp. 5–39.
- [42] P. W. GLYNN, *Optimization of stochastic systems via simulation*, in *Proceedings of the 1989 21st Winter Simulation conference*, E. A. MacNair, K. J. Musselman, and P. Heidelberger, eds., Washington D.C., USA, 1989, pp. 90–105.
- [43] P. W. GLYNN AND W. WHITT, *The asymptotic efficiency of simulation estimators*, *Operations Research*, 40 (1992), pp. 505–520.
- [44] I. S. GRADSHTEYN AND I. M. RYZHIK, *Tables of Integrals, Series, and Products*, Academic Press, New York, USA, 4th ed., 1980.
- [45] G. GRIMMETT AND D. STIRZAKER, *Probability and Random Processes*, Oxford University Press, Oxford, UK, 3rd ed., 2001.
- [46] B. E. HANSEN, *Bandwidth selection for nonparametric distribution estimation*, tech. report, University of Wisconsin, 2004. Manuscript.
- [47] Y.-C. HAO AND X.-R. CAO, *Perturbation Analysis of Discrete Event Dynamic Systems*, Kluwer Academic Publishers, Boston, USA, 1991.
- [48] B. HEIDERGOTT, *A differential calculus for random matrices with applications to (max, +) linear stochastic systems*, *Mathematics of Operations Research*, 26 (2001), pp. 679–699.
- [49] ———, *Option pricing via Monte Carlo simulation: a weak derivative approach*, *Probability in the Engineering and Informational Sciences*, 15 (2001), pp. 335–349.
- [50] B. HEIDERGOTT AND T. FARENHORST-YUAN, *Gradient estimation for multicomponent maintenance systems with age-replacement policy*, *Operations Research*, 58 (2010), pp. 706–718.
- [51] B. HEIDERGOTT, A. HORDIJK, AND H. LEAHU, *Strong bounds on perturbations*, *Mathematical Methods of Operations Research*, 70 (2009), pp. 99–127.

- [52] B. HEIDERGOTT AND H. LEAHU, *Weak differentiability of product measures*, *Mathematics of Operations Research*, 35 (2010), pp. 27–51.
- [53] B. HEIDERGOTT, F. J. VÁZQUEZ-ABAD, G. C. PFLUG, AND T. FARENHORST-YUAN, *Gradient estimation for discrete-event systems by measure-valued differentiation*, *ACM Transactions on Modeling and Computer Simulation*, 20 (2010), pp. 1–28.
- [54] B. HEIDERGOTT, F. J. VÁZQUEZ ABAD, AND W. VOLK-MAKAREWICZ, *Sensitivity estimation for Gaussian systems*, *European Journal of Operations Research*, 187 (2008), pp. 193–207.
- [55] B. HEIDERGOTT AND W. VOLK-MAKAREWICZ, *Quantile sensitivity estimation*, in *Network Control and Optimization: Third Euro-NF Conference, NET-COOP 2009*, R. Núñez-Queija and J. Resing, eds., vol. 5894 of *Lecture Notes in Computer Science*, Eindhoven, The Netherlands, 2009, Springer, pp. 16–29.
- [56] B. HEIDERGOTT, W. VOLK-MAKAREWICZ, AND F. J. VÁZQUEZ ABAD, *Gradient estimation for quantiles of stationary waiting times*, in *WODES 2010: Preprints of the 10th International Workshop on Discrete Event Systems*, J. Raisch, A. Giua, S. Lafortune, and T. Moor, eds., Berlin, Germany, 2010, Elsevier, pp. 251–256.
- [57] L. J. HONG, *Estimating quantile sensitivities*, *Operations Research*, 57 (2009), pp. 118–130.
- [58] L. J. HONG AND G. LIU, *Simulating sensitivities of conditional value at risk*, *Management Science*, 55 (2008), pp. 281–293.
- [59] ———, *Pathwise estimation of probability sensitivities through terminating or steady-state simulations*, *Operations Research*, 58 (2010), pp. 357–370.
- [60] R. A. JARROW AND D. B. MADAN, *A characterization of complete security markets on a brownian motion*, *Mathematical Finance*, 1 (1991), pp. 31–43.
- [61] M. JOSHI AND D. PITT, *Fast sensitivity computations for Monte Carlo valuation of pension funds*, *ASTIN Bulletin*, 40 (2010), pp. 655–667.
- [62] O. KALLENBERG, *Foundations of Modern Probability*, Springer, New York, USA, 2nd ed., 2001.

BIBLIOGRAPHY

- [63] R. KAPUŚCIŃSKI AND S. TAYUR, *A capacitated production-inventory model with periodic demand*, Operations Research, 46 (1998), pp. 899–911.
- [64] R. KAWAI AND A. TAKEUCHI, *Sensitivity analysis for averaged price dynamics with gamma processes*, Statistics and Probability Letters, 80 (2010), pp. 42–49.
- [65] ———, *Greeks formulas for an asset price model with gamma processes*, Mathematical Finance, 21 (2011), pp. 723–742.
- [66] S. LANG, *Real and Functional Analysis*, Springer, New York, USA, 3rd ed., 1993.
- [67] H. LEAHU, *European option sensitivities via Monte Carlo techniques*, Research Memorandum 2, Vrije Universiteit Amsterdam, 2013. Faculty of Economics and Business Administration.
- [68] P. L'ECUYER, N. GIROUX, AND P. W. GLYNN, *Stochastic optimization by simulation: Numerical experiments with the M/M/1 queue in steady-state*, Management Science, 40 (1994), pp. 1245–1261.
- [69] P. L'ECUYER AND P. W. GLYNN, *Stochastic optimization by simulation: Convergence proofs for the G/G/1 queue in steady-state*, Management Science, 40 (1994), pp. 1562–1578.
- [70] P. L'ECUYER AND G. PERRON, *On the convergence rates of IPA and FDC derivative estimators*, Operations Research, 42 (1994), pp. 643–656.
- [71] G. LIU AND L. J. HONG, *Kernel estimation of quantile sensitivities*, Naval Research Logistics, 56 (2009), pp. 511–525.
- [72] ———, *Kernel estimation of the Greeks for options with discounted payoffs*, Operations Research, 59 (2011), pp. 96–108.
- [73] D. O. LOFTSGAARDEN AND Q. C. P., *A nonparametric estimate of a multivariate density function*, Annals of Mathematical Statistics, 36 (1965), pp. 1049–1051.
- [74] Y.-D. LYUU AND H.-W. TENG, *Unbiased and efficient Greeks of rainbow options*, Finance and Stochastics, 15 (2011), pp. 141–181.
- [75] D. B. MADAN, P. P. CARR, AND E. G. CHANG, *The variance gamma process and option pricing*, European Financial Review, 2 (1998), pp. 79–105.

- [76] D. B. MADAN AND F. MILNE, *Option pricing with v.g. martingale components*, *Mathematical Finance*, 1 (1991), pp. 39–55.
- [77] S. MAHAJAN AND G. VAN RYZIN, *Stocking retail assortments under dynamic consumer substitution*, *Operations Research*, 49 (2002), pp. 334–351.
- [78] B. MAKAROV AND A. PODKORYTOV, *Real Analysis: Measures, Integrals and Applications*, Springer-Verlag, London, UK, 2013.
- [79] R. C. MERTON, *An intertemporal capital asset pricing model*, *Econometrica*, 41 (1973), pp. 867–887.
- [80] M. P. MUNDT, *Social network analysis of peer effects of binge drinking among U.S. adolescents*, in *Proceedings of the 2013 International Conference on Social Computing, Behavioral-Cultural Modeling and Prediction*, A. M. Greenberg, W. G. Kennedy, and N. D. Bos, eds., vol. 7812 of *Lecture Notes in Computer Science*, Washington D.C., USA, 2013, Springer, pp. 123–134.
- [81] L. T. NIELSEN, *Pricing and Hedging of Derivative Securities*, Oxford University Press, Oxford, UK, 1999.
- [82] V. V. PETROV, *Limit Theorems of Probability Theory: Sequences of Independent Random Variables*, Oxford University Press, Oxford, UK, 1995.
- [83] G. C. PFLUG, *Optimization of Stochastic Models*, Kluwer Academic Publishers, Norwell, USA, 1996.
- [84] M. T. PICH, C. H. LOCH, AND A. DE MEYER, *On uncertainty, ambiguity and complexity in project management*, *Management Science*, 75 (1996), pp. 137–176.
- [85] C. C. PUGH, *Real Mathematical Analysis*, Springer, New York, USA, 2002.
- [86] R. PYKE, *Spacings*, *Journal of the Royal Statistical Society. Series B (Methodological)*, 27 (1965), pp. 395–449.
- [87] E. REICH, *Waiting times when queues are in tandem*, *Annals of Mathematical Statistics*, 28 (1957), pp. 768–773.
- [88] R. Y. RUBINSTEIN, *Sensitivity analysis of discrete event systems by the "push out" method*, *Annals of Operations Research*, 39 (1992), pp. 229–250.

BIBLIOGRAPHY

- [89] R. Y. RUBINSTEIN AND A. SHAPIRO, *Discrete Event Systems: Sensitivity Analysis and Optimization by the Score Function Method*, Wiley, Chichester, USA, 1993.
- [90] M. SCHRÖDER, *Brownian excursions and Parisian barrier options: A note*, *Journal of Applied Probability*, 40 (2003), pp. 855–864.
- [91] P. K. SEN, *On the moments of sample quantiles*, *Calcutta Statistical Association*, 9 (1959), pp. 1–19.
- [92] ———, *Asymptotic normality of sample quantiles for m -dependent processes*, *The Annals of Mathematical Statistics*, 39 (1968), pp. 1724–1730.
- [93] ———, *On the Bahadur representation of sample quantiles for sequences of ϕ -mixing random variables*, *Journal of Multivariate Analysis*, 2 (1972), pp. 77–95.
- [94] R. J. SERFLING, *Approximation Theorems of Mathematical Statistics*, Wiley, New York, USA, 1980.
- [95] W. F. SHARPE, *A simplified model for portfolio analysis*, *Management Science*, 9 (1963), pp. 277–293.
- [96] A. N. SHIRYAEV, *Probability*, Springer, New York, USA, 2nd ed., 1989.
- [97] T. A. B. SNIJDERS, J. KOSKINEN, AND M. SCHWEINBURGER, *Maximum likelihood estimation for social network dynamics*, *Annals of Applied Statistics*, 4 (2010), pp. 567–588.
- [98] T. A. B. SNIJDERS, C. E. G. STEGLICH, AND M. SCHWEINBURGER, *Modeling the co-evolution of networks and behavior*, in *Longitudinal Models in the Behavioural and related Sciences*, K. van Monfort, J. Oud, and A. Satorra, eds., Lawrence Erlbaum, 2007, pp. 41–71.
- [99] J. C. SPALL, *Introduction to Stochastic Search and Optimization: Estimation, Simulation, and Control*, Wiley, Hoboken, NJ, USA, 2003.
- [100] R. SURI AND M. A. ZAZANIS, *Perturbation analysis gives strongly consistent estimates for the M/G/1 queue*, *Management Science*, 34 (1988), pp. 39–64.
- [101] A. W. VAN DER VAART, *Asymptotic Statistics*, Cambridge University Press, Cambridge, UK, 2000.

- [102] F. J. VÁZQUEZ-ABAD AND D. DUFRESNE, *Accelerated simulation for pricing Asian options*, in Proceedings of the 1998 Winter Simulation Conference, D. J. Medeiros, E. F. Watson, J. S. Carson, and M. S. Manivannan, eds., Washington D.C., USA, 1998, pp. 1493–1500.
- [103] Y. WANG, M. C. FU, AND S. I. MARCUS, *Sensitivity analysis for barrier options*, in Proceedings of the 2009 Winter Simulation Conference, M. D. Rossetti, R. R. Hill, B. Johansson, A. Dunkin, and R. G. Ingalls, eds., Austin, USA, 2009, pp. 1272–1282.
- [104] R. WU AND M. C. FU, *Optimal exercise policies and simulation-based valuation for American-Asian options*, Operations Research, 51 (2003), pp. 52–66.
- [105] W. B. WU, *On the Bahadur representation of sample quantiles for dependent sequences*, Annals of Statistics, 33 (2005), pp. 1934–1963.
- [106] C. YAO AND C. G. CASSANDRAS, *Perturbation analysis of stochastic hybrid systems and applications to resource contention games*, Frontiers of Electrical and Electronic Engineering in China, 6 (2011), pp. 453–467.
- [107] C. YAO AND C. G. CASSANDRAS, *Resource contention games in multiclass stochastic flow models*, Nonlinear Analysis: Hybrid Systems, 5 (2011), pp. 301–319.
- [108] J. YU, *Consistency of a k -nearest neighbor probability density function estimator*, Acta Mathematica Scientia, 6 (1986), pp. 467–477.
- [109] ———, *Consistency of an alternative nearest neighbor probability density function estimator*, Statistical Research Report 1993-6, Umeå Universitet, 1993.
- [110] ———, *Uniform convergence rates for a nearest neighbor estimator for a class of probability density functions*, Statistical Research Report 1993-11, Umeå Universitet, 1993.
- [111] ———, *Uniform convergence rates for a nearest neighbor density estimator under dependence assumptions*, Communication in Statistics - Theory and Methods, 26 (1997), pp. 601–616.