Joshua P. Swanson

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Curriculum Vitae

RTPC Assistant Professor of Mathematics
University of Southern California — Los Angeles, CA, USA
Department of Mathematics — Office: KAP 438 D

Academic Positions

University of Southern California, Los Angeles, CA — August 2021 — Present
RTPC NTT Assistant Professor of Mathematics

University of California, San Diego, La Jolla, CA — August 2018 — July 2021
Stefan E. Warshawski
Visiting Assistant Professor of Mathematics

Education

University of Washington, Seattle, WA
Ph.D. in Mathematics — September 2012 — June 2018
Thesis: *Major Index Statistics: Cyclic Sieving, Branching Rules, and Asymptotics.*
Adviser: Sara Billey
M.S. in Mathematics — September 2012 — June 2015

Harvey Mudd College, Claremont, CA — September 2006 — June 2010
B.S. in Math/CS (Joint Major)

Awards

2025 — **ICERM Topical Workshop**
Lead organizer for *Webs in Algebra, Geometry, Topology, and Combinatorics*

2024—2026 — **NSF DMS-2348843 grant**
$180,000 award for *Combinatorial representation theory of quantum groups and coinvariant algebras*

2024 — **Collaborate@ICERM**
Web Bases, Promotion, and Plabic Graphs II

2023 — **USC Dornsife Summer Undergraduate Research Fund (SURF)**
$3000 stipend for summer undergraduate research assistant for *Hourglass Plabic Graphs in SageMath*

2023 — **Collaborate@ICERM**
Web Bases, Promotion, and Plabic Graphs I

2022—2024 — **AMS-Simons Travel Grant**
$5000 award

2019 — **Personal prize from Doron Zeilberger**
$300 award for the proof in "On a theorem of Baxter and Zeilberger via a result of Roselle"

2012—2014 — **McKibben and Merner Fellow**
$10,000 University of Washington departmental award for academic excellence

RESEARCH INTERESTS

Algebraic combinatorics, webs for quantum groups, plabic graphs, invariant theory, symmetric functions, Coxeter groups, complex reflection groups, higher coinvariant algebras, tableau combinatorics, Stirling numbers, dynamical algebraic combinatorics, q-analogues, limit laws, cumulants, free Lie algebras

PAPERS

29. (2025) "Web bases for two-column tableaux from hourglass plabic graphs".
With None. 12 pages. Extended abstract to appear in FPSAC 2025 conference proceedings.
28. (2025) "On a super version of Thrall's problem".
With None. 12 pages. Extended abstract to appear in FPSAC 2025 conference proceedings.
27. (2024) "q-Stirling numbers in type B".
With Bruce Sagan. 35 pages. arXiv:2205.14078. Published in *European J. Combin.* 118 (2024), Paper No. 103899.
26. (2024) "Super major index and Thrall's problem".
With Sam Armon. 23 pages. arXiv:2411.04302. To appear in *Algebraic Combinatorics*.
25. (2024) "Stirling numbers for complex reflection groups".
With Bruce Sagan. 26 pages. arXiv:2408.13874. Too appear in *Annals of Combinatorics*.
24. (2024) "Web bases in degree two from hourglass plabic graphs".
With Christian Gaetz, Oliver Pechenik, Stephan Pfannerer, and Jessica Striker. 24 pages. arXiv:2402.13978. Submitted.
23. (2023) "Rotation-invariant web bases from hourglass plabic graphs".
With Christian Gaetz, Oliver Pechenik, Stephan Pfannerer, and Jessica Striker. 65 pages. arXiv:2306.12501. Submitted.
22. (2024) "Promotion permutations for tableaux".
With Christian Gaetz, Oliver Pechenik, Stephan Pfannerer, and Jessica Striker. 55 pages. arXiv:2306.12506. Published in *Comb. Theory* 4 (2024), no. 2.
21. (2023) "An SL_4-web basis from hourglass plabic graphs".
With Christian Gaetz, Oliver Pechenik, Stephan Pfannerer, and Jessica Striker. 12 pages. Extended abstract published in *Sém. Lothar. Combin*, 89B (2023), Art. 9, 12 pp.
20. (2024) "Cyclotomic generating functions".
With Sara C. Billey. 44 pages. arXiv:2305.07620. Published in *Electron. J. Combin.* 31 (2024), no 4. Paper 4.4.
19. (2024) "q-Stirling numbers in type B".
With Bruce Sagan. 35 pages. arXiv:2205.14078. Published in *European J. Combin.* 118 (2024), Paper No. 103899.
18. (2022) "Curious cyclic sieving on increasing tableaux".
With Christian Gaetz, Oliver Pechenik, and Jessica Striker. 9 pages. arXiv:2112.09228. Published in *Enumer. Combin. Appl.* ECA 2:3 (2022) Article S2R17.
17. (2024) "Tanisaki witness relations for harmonic differential forms".
26 pages. arXiv:2109.05080. Published in *Algebr. Comb.* 7 (2024), no. 1.
16. (2023) "Harmonic differential forms for pseudo-reflection groups II. Bi-degree bounds".
With Nolan R. Wallach. 43 pages. arXiv:2109.03407. Published in *Comb. Theory* 3 (2023), no. 3, Paper No. 17.
15. (2022) "The metric space of limit laws of q-hook formulas".
With Sara C. Billey. 58 pages. arXiv:2010.12701. Published in *Combinatorial Theory* 2 (2) (2022), #5, 58 pp.
14. (2020) "On the distribution of the major index on standard Young tableaux".
With Sara C. Billey and Matjaž Konvalinka. arXiv:2005.10341. Talk at FPSAC 2020. Extended abstract published in *Sém. Lothar. Combin*, 84B (2020), Art. 44, 12 pp.

13. (2021) "Harmonic differential forms for pseudo-reflection groups I. Semi-invariants". With Nolan R. Wallach. 30 pages. arXiv:2001.06076. Published in *J. Combin. Theory Ser. A* 182 (2021), Paper No. 105474.

12. (2019) "Thrall's problem: cyclic sieving, necklaces, and branching rules". With Connor Ahlbach. Talk at FPSAC 2019. Extended abstract published in *Sém. Lothar. Combin*, 82B (2019), Art. 37, 12 pp.

11. (2020) "Existence and hardness of conveyor belts". With Molly Baird, Sara C. Billey, Erik D. Demaine, Martin L. Demaine, David Eppstein, Sándor Fekete, Graham Gordon, Sean Griffin, Joseph S. B. Mitchell. 21 pages. arXiv:1908.07668. Published in *Electron. J. Combin.* 27 (2020), no 4. Paper 4.25.

10. (2019) "Alternating super-polynomials and super-coinvariants of finite reflection groups". 18 pages. arXiv:1908.00196. Superceded by joint work with Nolan Wallach, *Harmonic differential forms for pseudo-reflection groups I. Semi-invariants.*

9. (2020) "Asymptotic normality of the major index on standard tableaux". With Sara C. Billey and Matjaž Konvalinka. 28 pages. arXiv:1905.00975. Published in *Adv. in Appl. Math.* 113 (2020), 101972.

8. (2022) "On a Theorem of Baxter and Zeilberger via a Result of Roselle". 9 pages. arXiv:1902.06724. Published in *Ann. Comb.* (2022).

7. (2020) "Tableau posets and the fake degrees of coinvariant algebras". With Sara C. Billey and Matjaž Konvalinka. 45 pages. arXiv:1809.07386. Published in *Advances in Mathematics* 371 (2020).

6. (2018) "Cyclic sieving, necklaces, and branching rules related to Thrall's problem". With Connor Ahlbach. 38 pages. arXiv:1808.06043. Published in *Electron. J. Combin.* 25 (2018), no. 4, Paper 4.42.

5. (2018) "Major Index Statistics: Cyclic Sieving, Branching Rules, and Asymptotics". 206 pages. Ph.D. Thesis at the University of Washington under Sara Billey. ISBN 978-0438-52242-8.

4. (2018) "Refined cyclic sieving on words for the major index statistic". With Connor Ahlbach. 24 pages. arXiv:1706.08631. Published in *European J. Combin.* 73 (2018), 37-60.

3. (2018) "On the Existence of Tableaux with Given Modular Major Index". 20 pages. arXiv:1701.04963. Published in *Algebraic Combinatorics* Volume 1 (2018), no. 1 pp. 3-21.

2. (2017) "Refined cyclic sieving". With Connor Ahlbach. Poster presentation at FPSAC 2017. Extended abstract published in *Sém. Lothar. Combin*, 78B (2017), Art. 48, 12 pp.

1. (2017) "Standard tableaux and modular major index". Poster presentation at FPSAC 2017. Extended abstract published in *Sém. Lothar. Combin*, 78B (2017), Art. 50, 9 pp.

In Progress

- "Webs, pockets, and buildings". With Christian Gaetz and Jessica Striker and Haihan Wu.
- "Strong Knuth equivalence". With Stephan Pfannerer and Anne Schilling.
- "The dihedral sieving phenomenon".
- "Generalized bivariate γ-positivity".

With Sheila Sundaram.

- "A joint local limit law for inv and maj on permutations".
- "Canonical inclusions and rim hook tableaux".
- "Euler–Mahonian refined cyclic sieving".
  With Connor Ahlbach and Brendon Rhoades.

Invited Talks

2025 Nov	ICERM Workshop on Computation in Representation Theory
2025 May	CanaDAM '25 Mini-symposium on Web Graphs
2025 Apr	UC Berkeley Combinatorics Seminar
2025 Apr	AMS Special Session on Recent Progress on Categorification and Quantum Groups
2025 Feb	University of Michigan Combinatorics Seminar
2024 Nov	UCLA Combinatorics Forum
2024 Oct	USC MGSA CV Workshop
2024 Oct	USC Combinatorics Seminar
2024 Oct	University of Waterloo Algebra and Enumerative Combinatorics Seminar
2024 Apr	IPAM GSMI Workshop II: Integrability and Algebraic Combinatorics
2024 Apr	SoCalDM 2024
2024 Mar	CombinaTexas 2024
2024 Feb	UC Berkeley Combinatorics Seminar
2024 Feb	Bruce Sagan 70th Birthday Conference, University of Florida
2023 Oct	North Dakota State University, Combinatorics Seminar
2023 Aug	University of Southern California, Combinatorics Seminar
2023 May	University of California, Davis Algebra and Discrete Math Seminar
2023 Apr	University of Washington Combinatorics Seminar
2023 Mar	SCMC 2023 High School Math Competition
2023 Mar	AMS Special Session on Macdonald Theory at Georgia Institute of Technology
2022 Nov	Cornell Discrete Geometry and Combinatorics Seminar
2022 Nov	USC Combinatorics Seminar
2022 Oct	MIT-Harvard-MSR Combinatorics Seminar
2022 Oct	NDSU Mathematics Department Colloquium
2022 Jun	AlCoVE poster presentation
2022 Mar	University of Waterloo Algebraic and Enumerative Combinatorics Seminar
2021 Nov	UCSD Combinatorics Seminar
2021 Oct	UCLA Combinatorics Seminar
2021 Sep	USC Algebra Seminar
2021 Mar	ICERM workshop on Geometry and Combinatorics of Root Systems
2021 Feb	UCSD Graduate Road Map 2021
2021 Feb	CombinaTexas 2021
2021 Jan	Michigan State University Combinatorics and Graph Theory Seminar
2020 Dec	University of Ljubljana Discrete Math Seminar

2020 Oct*	BIRS Workshop on Dynamical Algebraic Combinatorics, Banff, Alberta, Canada
2020 Jul	FPSAC 2020 Online (Contributed)
2020 Jun*	SIAM Conference on Discrete Mathematics (DM20) in Portland, Oregon
2020 May*	AMS Spring Western Sectional Meeting at Cal State Fresno: Special Session on Combinatorics Arising from Representations
2019 Nov	SIAM TX/LA Section at SMU, Dallas
2019 Jul	FPSAC 2019, University of Ljubljana, Slovenia (Contributed)
2019 May	Southern California Discrete Math Symposium (Contributed)
2019 Mar	CombinaTexas 2019 at Texas A-M, College Station (Contributed)
2019 Feb	USC Combinatorics Seminar
2018 Oct	AMS Fall Western Sectional Meeting at SFSU: Special Session on Combinatorial and Categorial Aspects of Representation Theory
2018 May	University of Washington Combinatorics Seminar
2018 Mar	University of Washington Probability Seminar
2018 Jan	University of Michigan Combinatorics Seminar
2018 Jan	JMM in San Diego: AMS Special Session on Dynamical Algebraic Combinatorics
2017 Nov	AMS Fall Western Sectional Meeting at UC Riverside: Special Session on Combinatorial Representation Theory
2017 Feb	UCSD Combinatorics Seminar
2016 Nov	University of Minnesota Combinatorics Seminar
2015 Mar	University of Washington Combinatorics Seminar

*Postponed or canceled due to COVID-19

Other Activities

2024	ICERM Topical Workshop on *Webs in Algebra, Geometry, Topology, and Combinatorics* lead organizer
2024	CanaDAM'25 minisymposium Organizing Committee
2023—Present	Undergraduate research supervisor
2023—Present	Co-organizer, USC combinatorics seminar
2023	SoCalDM '23 Organizing Committee
2022—2023	FPSAC '23 Organizing Committee member
2022—2023	Faculty advisor, ICI USC student club
2016	Organized graduate student seminar on the $n!$ theorem, primary lecturer
2015—2016	Co-organizer, U. Washington combinatorics seminar
2015, 2016	Led UW Math Day sessions on SageMath, Mathematical Magic Tricks
2013—2015	Wrote/edited lecture notes in LaTeX for graduate-level courses; see web site. Topics: enumerative/algebraic combinatorics, algebraic groups, group cohomology, etc.
2006—Present	Wrote and maintain data management software for Mid-American Research Chemical Corp., and provide tech support for roughly 50 traveling sales representatives

Referee for 58 items submitted to:

– *Advances in Applied Mathematics*

- *Advances in Mathematics*
- *Annals of Combinatorics*
- *Algebraic Combinatorics*
- *Ars Mathematica Contemporanea*
- *Ars Combinatoria*
- *Bulletin of the London Mathematical Society*
- *Combinatorics, Probability, and Computing*
- *Combinatorial Theory*
- *Communications of the AMS*
- *Discrete Mathematics*
- *Electronic Journal of Combinatorics*
- *European Journal of Combinatorics*
- *FPSAC proceedings*
- *Journal of Algebra*
- *Journal of Algebraic Combinatorics*
- *Journal of the American Mathematical Society*
- *Journal of Combinatorial Theory (Series A)*
- *Journal of Combinatorics*
- *Journal of Difference Equations and Applications*
- *Journal of Pure and Applied Algebra*
- *Mathematical Reviews*
- *Mathematische Zeitschrift*
- *Order*

TEACHING: INSTRUCTOR

UCSD

Calculus III	UCSD, Math 20C 2021 WI, 2020 FA, 2019 FA, 2019 WI
Combinatorics	UCSD, Math 184A 2019 SP
Enumerative Combinatorics	UCSD, Math 184 2020 SP
Introduction to Discrete Mathematics	UCSD, Math 15A 2020 WI
Introductory Probability and Statistics	UCSD, Math 11 2021 WI, 2019 SP
Mathematical Reasoning	UCSD, Math 109 2020 FA, 2020 WI, 2018 FA

USC

Applied Probability	USC, Math 505a 2024 FA
Calculus II	USC, Math 126g 2022 SP
Fundamental Concepts of Analysis	USC, Math 425a 2023 FA
Linear Algebra and Differential Equations	USC, Math 225 2021 FA
Probability Theory	USC, Math 407 2024 SP, 2023 FA, 2023 SP, 2022 FA

University of Washington

Calculus with Analytic Geometry III	University of Washington, Math 126 2013 SU
Introduction to Differential Equations	University of Washington, Math 307 2017 SP, 2015 SU
Matrix Algebra with Applications	University of Washington, Math 308 2018 SP, 2017 SU, 2016 FA, 2015 SP

TEACHING: TA

University of Washington

Calculus with Analytic Geometry I	University of Washington, Math 124 2014 AU
Calculus with Analytic Geometry II	University of Washington, Math 125 2015 WI, 2014 WI, 2012 AU
Calculus with Analytic Geometry III	University of Washington, Math 126 2018 WI, 2017 FA, 2014 SP, 2013 AU 2013 SP, 2013 WI
Graduate Algebra	University of Washington, Math 506 2016 SP, 2016 WI, 2015 FA

COMPUTER SKILLS

Programming Languages

Expert in: Python, LaTeX, C#

Familiar with: Java, C, C++

Systems

SageMath, Mathematica, Visual Studio

PERSONAL INFORMATION

Citizenship: USA

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