Examples of Markov chains from Hopf algebras (in the sense of [Pan15a]). This version: January 8, 2016. Curated by Amy Pang. Printer-friendly version, plus related summary tables, available at my website.
If you spot an error, or know of any other Markov chains built in a similar way, please let me know.

Markov chain	Hopf algebra / Hopf monoid	algebra is...				basis	basis is...					$\lvert\mathscr{B}_1\rvert$	product	coproduct	rescaling	stationary distribution	references
		commutative?	cocommutative?	free?	cofree?		free-commutative?	free?	cofree?	self-dual?	multigraded?						
shuffling	shuffle algebra $\mathscr{S}$	x			x	words / decks of cards			x		x	arbitrary	shuffle	deconcatenation	none	uniform	[Pan14, Sec. 6.1]
inverse-shuffling	free associative algebra $\mathscr{S}^*$		x	x		words / decks of cards		x			x	arbitrary	concatenation	deshuffle	none	uniform	[DPR14, Sec. 6] [Pan14, Ex. 4.6.2, Ex. 4.7.2]
edge-removal	$\bar{\mathscr{G}}$	x	x			unlabelled graphs	x					1	disjoint union	induced on subsets	none	absorbing at empty graph	[DPR14, Ex. 3.1] [Pan14, Sec. 5.1]
edge-removal	$\mathscr{G}$		x	x		labelled graphs		x				1	disjoint union	induced on subsets	none	absorbing at empty graph	[DPR14, Ex. 3.2]
restriction-then-induction	representations of symmetric groups	x	x		x	irreducible representations				x		1	external induction	sum of restrictions	dimension	plancherel	[Pan14, Ex. 4.1.4, Ex. 4.3.2, Ex. 4.4.3, Ex. 4.5.3, Ex. 4.6.4] [Pan15a, Ex. 3.5] [Pan15b, Sec. 2]
rock-breaking	symmetric functions (partitions)$\subseteq \bar{\mathscr{G}}$	x	x		x	elementary or complete	x					1	disjoint union	$\Delta((n)) = \sum (i) \otimes (n-i)$	$\frac{n!}{\prod \lambda_i!}$	absorbing at $(1,1,\dots,1)$	[DPR14, Sec. 4] [Pan14, Sec. 5.2]
tree-pruning	Connes-Kreimer	x				rooted forests	x					1	disjoint union	cut branches $\otimes$ trunks	$\frac{n!}{\prod \mathrm{desc}(v)}$	absorbing at disconnected forest	[Pan14, Sec. 5.3] [Pan15a, Ex. 5.3]
descent-set-under-shuffling	quasisymmetric functions	x			x	fundamental (compositions)			x			1	(non-explicit - use Projection Theorem)		none	proportion of permutations with this descent set	[Pan13][Pan14, Sec. 6.2]
jeu-de-taquin	Poirier-Reutenauer **FSym**			x		standard Young tableaux						1	B2R: add outer box	B2R: unbump	dimension of shape	proportion of standard tableaux with this shape	[Pan15b, Sec. 4]
shuffle with standardisation	Malvenuto-Reutenauer **FQSym**			x	x	fundamental (permutations)						1	shifted shuffle	deconcatenate and standardise	none	uniform	[Pan15b, Sec. 5]

References

[DPR14] P. Diaconis, C. Y. A. Pang, and A. Ram. Hopf algebras and Markov chains: two examples and a theory. *J. Algebraic Combin.*, 39(3):527–585, 2014.
[Pan13] C. Y. A. Pang. A Hopf-power Markov chain on compositions. In *25th International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC 2013)*, Discrete Math. Theor. Comput. Sci. Proc., AS, pages 499–510. Assoc. Discrete Math. Theor. Comput. Sci., Nancy, 2013.
[Pan14] C. Y. A. Pang. Hopf algebras and Markov chains. *ArXiv e-prints*, December 2014. A revised thesis.
[Pan15a] C. Y. A. Pang. Card-shuffling via convolutions of projections on combinatorial Hopf algebras. In *27th International Conference on Formal Power Series and Algebraic Combinatorics (FPSAC 2015)*, Discrete Math. Theor. Comput. Sci. Proc., AU, pages 49–60. Assoc. Discrete Math. Theor. Comput. Sci., Nancy, 2015. available on Arxiv.
[Pan15b] C. Y. A. Pang. Lifting the down-up chain on partitions to permutations. *ArXiv e-prints*, August 2015.