



<b>Title</b>	Appendix to Hops, Skip and a Jump: The Regional Uniqueness of Beer Styles
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# Appendix

**Table A: Glossary**

Term	Definition	Formula
<b>Node</b>	Connection point in a network graph	
<b>Edge</b>	Link between two nodes in a network graph	
<b>Edge List</b>	Data frame containing the starting point and end of every edge, as well as its weight	
<b>Adjacency Matrix</b>	A square matrix where each element designates the edges between a pair of nodes	$S = [s_{ij}]$
<b>Network</b>	Graphical representation of nodes and edges	
<b>Degree (Centrality)</b>	Sum of all the edges incident to a node	$\sum_{i \neq j}^n S_{ij}$
<b>Eigenvector Centrality</b>	A measure of a node's influence. We calculate it as the weighted sum of the centrality of all adjacent nodes	$\lambda c(v_i) = \sum_{j=1}^n s_{ij} c(v_j)$
<b>Density</b>	The share of existing edges out of all possible links in the network	$\frac{m}{n(n-1)/2}$
<b>Diameter</b>	The largest distance between any two pair of nodes	
<b>Clustering Coefficient</b>	The proportion of existing edges among each node's neighbours	
<b>Network Robustness</b>	Percentage of nodes one can delete before the network becomes fragmented into many unconnected components	
<b>Molloy-Reed Criterion</b>	Threshold at which a complex network will lose its largest connected component	$\frac{\sum_{i=1}^N k_{is}^2}{\sum_{i=1}^N k_{is}} < 2$
<b>Unrelated Variety</b>	A measure of diversity among components of a recipe-ingredient incidence matrix	$\sum_{i=1}^N P_{is} \log_2 \left( \frac{1}{P_{is}} \right)$
<b>Relatedness</b>	A measure of similarity between nodes in the global network	$\frac{s_{ij}}{\sqrt{N_i * N_j}}$
<b>Average Relatedness</b>	The average relatedness across all nodes in a style's network	$\frac{\sum_i \sum_j R_{ij} (N_i N_j) + \sum_i 2N_i}{P_s (P_s - 1)}$

**Table B: Style List**

Style	Family	Country	Region	No. Recipes
American IPA	IPA	United States	West Coast	14694
American Pale Ale	Pale Ale	United States	West Coast	12363
American Light Lager	Pale Lager	United States	Midwest	4638
Saison	Pale Ale	Belgium	Wallonia	4163
Blonde Ale	Pale Ale	United States	West Coast	3605
New England IPA	IPA	United States	New England	3020
American Amber Ale	Amber Ale	United States	West Coast	2924
Irish Red Ale	Amber Ale	Ireland	Ireland	2133
American Stout	Stout	United States	West Coast	1996
Weissbier	Wheat Beer	Germany	Bavaria	1818
Witbier	Wheat Beer	Belgium	Flemish Brabant	1704
Strong Bitter	Amber Ale	United Kingdom	England	1582
Sweet Stout	Stout	United Kingdom	England	1571
American Porter	Porter	United States	East Coast	1560
English IPA	IPA	United Kingdom	England	1527
Oatmeal Stout	Stout	United Kingdom	England	1513
Imperial IPA	IPA	United States	West Coast	1498
American Brown Ale	Brown Ale	United States	West Coast	1452
Double IPA	IPA	United States	West Coast	1366
Russian Imperial Stout	Stout	Russia	Baltic	1341
Black IPA	IPA	United States	West Coast	1136
Best Bitter	Amber Ale	United Kingdom	England	1128
Ordinary Bitter	Amber Ale	United Kingdom	England	1111
British Brown Ale	Brown Ale	United Kingdom	England	1069
California Common	Amber Lager	United States	San Francisco	1015
Belgian Pale Ale	Pale Ale	Belgium	Flemish Brabant	1008
American Wheat Beer	Wheat Beer	United States	Pacific Northwest	969
Kölsch	Pale Ale	Germany	Cologne	946
Belgian Blond Ale	Pale Ale	Belgium	Flemish Brabant	918
Märzen	Amber Lager	Germany	Bavaria	910
Red IPA	IPA	United States	West Coast	893
Cream Ale	United States	United States	Midwest	857
Berliner Weisse	Wheat Beer	Germany	Berlin	824
Belgian Dubbel	Amber Ale	Belgium	Flemish Brabant, Antwerp	812
Robust Porter	Porter	American	East Coast	720
Belgian Tripel	Strong Ale	Belgium	Antwerp	712
British Golden Ale	Pale Ale	United Kingdom	England	705

Style	Family	Country	Region	No. Recipes
American Lager	Pale Lager	United States	Midwest	682
Brown Porter	Porter	United Kingdom	England	674
Dunkles Weissbier	Wheat Beer	Germany	Bavaria	612
Irish Stout	Stout	Ireland	Ireland	583
Rye IPA	IPA	United States	West Coast	573
Belgian Golden Strong Ale	Strong Ale	Belgium	Flemish Brabant, Antwerp	565
Belgian Dark Strong Ale	Strong Ale	Belgium	Flemish Brabant, Antwerp	563
German Pils	Pilsner	Germany	Bavaria	558
White IPA	IPA	United States	West Coast	553
Imperial Stout	Stout	United Kingdom	England	546
Vienna Lager	Amber Lager	Austria	Vienna	503
Dark Mild	Brown Ale	United Kingdom	England	501
Foreign Extra Stout	Stout	United Kingdom	England	475
English Porter	Porter	United Kingdom	England	465
Bohemian Pilsener	Pilsner	Czech Republic	Plzeň	451
American Barleywine	Strong Ale	United States	West Coast	441
Scottish Export	Amber Ale	United Kingdom	Scotland	439
English Barleywine	Strong Ale	United Kingdom	England	426
Old Ale	Strong Ale	United Kingdom	England	400
Belgian IPA	IPA	Belgium	Flanders	386
British Strong Ale	Strong Ale	United Kingdom	England	384
Belgian Specialty Ale	Strong Ale	Belgium	Flemish Brabant, Antwerp	376
Dry Stout	Stout	United Kingdom	England	375
American Strong Ale	Strong Ale	United States	West Coast	359
Weizenbock	Bock	Germany	Bavaria	346
Doppelbock	Bock	Germany	Bavaria	332
Baltic Porter	Porter	Scandinavia	Baltic	331
Helles Bock	Bock	Germany	Bavaria	319
Bi`ere de Garde	Pale Ale	France	Northern France	311
Altbier	Amber Ale	Germany	Düsseldorf	304
Mild	Amber Ale	United Kingdom	England	299
Munich Dunkel	Dark Lager	Germany	Bavaria	290
Scottish Heavy	Amber Ale	United Kingdom	Scotland	290
Trappist Single	Pale Ale	Belgium	Flemish Brabant, Antwerp	255
Strong Scotch Ale	Strong Ale	United Kingdom	Scotland	248
Flanders Red Ale	Sour Ale	Belgium	West Flanders	243
Schwarzbier	Dark Lager	Germany	Thuringia, Saxony & Franconia	241
Munich Helles	Pale Lager	Germany	Munich	238

<b>Style</b>	<b>Family</b>	<b>Country</b>	<b>Region</b>	<b>No. Recipes</b>
<b>Wee Heavy</b>	Strong Ale	United Kingdom	Scotland	222
<b>Czech Premium Pale Lager</b>	Pale Lager	Czech Republic	Plzeň	213
<b>Scottish Light</b>	Pale Ale	United Kingdom	Scotland	183
<b>Lambic</b>	Wheat Beer	Belgium	Brussels	172
<b>Australian Sparkling Ale</b>	Pale Ale	Australia	Australia	154
<b>Brown IPA</b>	IPA	United States	Westcoast	153
<b>Traditional Bock</b>	Bock	Germany	Einbeck	151
<b>Roggenbier</b>	Wheat Beer	Germany	Regensburg	150
<b>Festbier</b>	Pale Lager	Germany	Munich	147
<b>Czech Pale Lager</b>	Pale Lager	Czech Republic	Plzeň	141
<b>Fruit Lambic</b>	Wheat Beer	Belgium	Brussels	138
<b>Irish Extra Stout</b>	Stout	Ireland	Ireland	131
<b>Gose</b>	Wheat Beer	Germany	Leipzig	119
<b>Gueuze</b>	Wheat Beer	Belgium	Brussels	116
<b>Oud Bruin</b>	Sour Ale	Belgium	East Flanders	110

**Table C: Malt List**

<b>Malt Name</b>	<b>Recipes</b>	<b>EBC</b>	<b>Styles</b>	<b>Countries</b>
Pale 2-Row	37806	2.18	American Lager, Cream Ale, etc.	AR, AU, BE, CA, DE, DK, FI, FR, UK, US
Pilsner	25483	1.7	Altbier, Belgian Tripel, Berliner Weisse, etc.	AR, AU, BE, BR, CA, DE, FI, FR, NL, NZ, UK, US
Maris Otter Pale	19820	3.66	Best Bitter, Mild, Ordinary Bitter, etc.	BE, CA, UK, US
Pale	14814	2.95	Belgian IPA	AR, AU, BE, BR, CA, CL, DE, FI, IE, NL, NZ, SE, UK, US, ZA
Wheat	13826	2.09	Dunkles Weissbier, Fruit Lambic, Weizenbock	AR, AU, BE, CA, DE, FI, IE, NL, NZ, UK, US
Chocolate	13654	371.69	American Porter, American Stout, etc.	AR, AU, BE, CA, CL, DE, FI, IE, NL, NZ, UK, US
Munich Light	11486	8.07	Märzen	AU, BE, CA, DE, FI, NL, UK, US
Vienna	11322	3.95	Festbier, Vienna Lager	AR, AU, BE, BR, CA, CL, DE, FI, FR, IE, NL, NZ, UK, US
Caramel/Crystal60L	10970	59.95	American Brown Ale	AR, BE, CA, DE, NL, UK, US
Carapils Dextrine	9424	1.8	Strong Scotch Ale	DE, FI, US
Roasted Barley	9092	411.03	Irish Extra Stout	AR, AU, BE, CA, DE, FI, NL, NZ, UK, US
Caramel/Crystal40L	7790	40.01	Robust Porter	CA, DE, UK, US
CaraMunich	7682	47.03	Flanders Red Ale	BE, DE, NL, UK, US
Munich	7213	14.42	Traditional Bock	AR, AU, BE, BR, CA, CL, DE, FI, IE, NL, NZ, UK, US
CaraPils	6659	2.39	Munich Helles	AR, BE, DE, IE, UK, US
White Wheat	6654	2.75	American Wheat Beer	BE, CA, DE, US
Acidulated	5918	3.38	Gose	BE, DE
Caramel/Crystal120L	5000	120	Imperial Stout	BE, CA, DE, UK, US
Caramel/Crystal20L	4692	20.2	American IPA	BE, CA, DE, FI, US
SpecialB	4312	116.08	Belgian Dubbel	BE, UK
Biscuit	4072	23.21	Belgian Dubbel	AR, AU, BE, CA, DE, FI, NL, NZ, UK, US
Dark Munich	4042	15.71	Munich Dunkel	AU, CA, DE, FI, NL, UK, US
Rye	3992	3.56	Roggenbier, Rye IPA	AU, BE, CA, DE, FI, NZ, UK, US
Honey	3828	24.6	Scottish Light	CA, FI, UK, US
Victory	3784	27.98	American Brown Ale	UK, US
Golden Promise	3750	2.96	Wee Heavy	FI, IE, UK
Melanoidin	3530	24.87	Traditional Bock	AR, BE, DE, US
Aromatic	3332	29.24	Flanders Red Ale	BE, DE, FR, NL, UK, US
Caramel/Crystal10L	3107	10.02	Blonde Ale	BE, DE, FI, NL, US
Caramel/Crystal80L	3027	80.01	American Brown Ale	CA, UK, US

Malt Name	Recipes	EBC	Styles	Countries
Black	2690	506.76	Robust Porter	BE, DE, FI, NL, UK, US
Pale Chocolate	2517	209.35	English Porter	FI, NZ, UK, US
CaraRed	2311	20	Red IPA	DE, UK, US
Black Patent	2101	523.74	Robust Porter	UK, US
Carafall	2057	533.7	Black IPA	DE, UK
CaraHell	2036	10.91	Helles Bock	DE, US
Caramel/Crystal30L	2029	29.84	Scottish Export	AR, FI, UK, US
Brown	2017	69.07	English Porter	NL, NZ, UK, US
Pale Wheat	1965	1.71	Weizenbock	BE, CA, DE, UK, US
Caramalt	1930	18.11	Irish Extra Stout	AU, BE, CL, DE, UK, US
Carafoam	1787	1.89	American Light Lager	DE, US
Caramel/Crystal15L	1747	15	American Strong Ale	AR, UK, US
Carafall	1735	426.81	Schwarzbier	DE
Caramel/Crystal45L	1621	44.15	Irish Extra Stout	BE, NL, UK, US
CaraAroma	1609	126.07	Foreign Extra Stout	DE, UK, US
Bohemian Pilsner	1544	1.92	Bohemian Pilsner	DE
Dark Crystal	1499	88.99	English Porter	AU, NZ, UK, US
Amber	1494	27.19	English Porter	AU, BE, CA, DE, IE, NL, UK, US
Caramel/Crystal90L	1395	90.01	Foreign Extra Stout	CL, UK, US
Midnight Wheat	1347	549.76	Black IPA	CA, US
Red Wheat	1281	2.48	Weizenbock	CA, US
Ale	1258	2.96	British Golden Ale	AU, BE, DE, FI, IE, NL, NZ, UK, US
Oats	1257	2.25	New England IPA	AU, BE, CA, FI, IE, NZ, UK, US
Smoked	1207	4.11	Strong Scotch Ale	BE, DE, FI, NL, NZ, UK, US
Caramel/Crystal150L	1150	125.26	Oatmeal Stout	BE, DE, FI, UK, US
Carafal	1126	340.71	Irish Extra Stout	DE
Extra Dark Crystal	1096	133.84	Scottish Light	AU, UK
CaraVienne	1063	20.22	Oud Bruin	BE, US
CaraAmber	1025	23.55	American Amber Ale	DE
Pale 6-Row	1020	1.82	Cream Ale	CA, US
Golden Naked Oats	987	9.79	American Brown Ale	UK
Special Roast	963	50.14	American Brown Ale	BE, US
Chocolate Dark	935	459.39	Irish Extra Stout	FI, NZ, US
Caramel/Crystal50L	857	43.72	Foreign Extra Stout	DE, FI, UK
Caramel/Crystal75L	779	75	Brown Porter	US
RedX	721	11.98	Red IPA	DE, US
Chocolate Wheat	647	411.66	Irish Extra Stout	DE, NL, US
Caramel/Crystal70L	625	69.22	English Porter	FI, UK
Chocolate Rye	606	243.6	Irish Extra Stout	DE, NZ, US
Caramel/Crystal140L	585	139.75	English Porter	BE, CL, DE, UK, US

Malt Name	Recipes	EBC	Styles	Countries
Blackprinz	584	500	Schwarzbier	US
Crystal Light	566	36.06	Brown Porter	AU, NZ, UK
Floor-Malted Bohemian Pilsner	545	2.15	Czech Premium Pale Lager	DE
Coffee	531	158.31	English Porter	BE, CA, CL, DE, FR, NL, NZ, UK, US
Dextrine	524	1.75	Brown Porter	FI, UK, US
Flaked Oats	478	2.07	Oatmeal Stout	BE, CA, DE, NL, UK, US
Abbey	475	17.18	Belgian Dubbel	BE, DE, US
Roasted Wheat	475	49.37	Fruit Lambic	AU, BE, FI, NZ, UK, US
Lager	474	1.53	British Golden Ale	IE, NL, UK
Crystal Medium	472	57.59	English Porter	AU, NZ, UK
Black Barley	469	525.93	Oatmeal Stout	UK, US
Carastan	436	33.8	Russian Imperial Stout	UK
Extra Pale	429	7.76	Belgian Specialty Ale	AU, BE, CL, DE, FI, UK, US
Darkwheat	420	6.55	Weizenbock	DE
CaraCrystal Wheat	404	54.67	Brown IPA	BE, US
Debittered Black	393	566.1	Imperial Stout	BE
Crystal Rye	380	88.59	Black IPA	NZ, UK
Dehusked CarafIII	336	470.22	Black IPA	DE
Carabrown	333	55	American Brown Ale	US
Melanoid	307	27.54	Traditional Bock	BE, DE, FI, NL
Pearl	299	3.28	Strong Scotch Ale	UK, US
Spelt	297	2.04	Lambic	DE, NL
CaraPale	290	3.89	Irish Extra Stout	BE, FI, UK, US
Caramel/Crystal100L	288	40.22	Irish Extra Stout	FI, UK, US
Peated	287	2.51	Strong Scotch Ale	BE, DE, UK
CaraWheat	283	46.05	Dunkles Weissbier	DE, FI
Flaked Barley	283	1.62	Irish Stout	DE, US
Carabelge	257	13.51	Flanders Red Ale	BE, DE
Caramel/Crystal55L	241	55.09	Oud Bruin	CL, UK
CaraBohemian	238	75	Robust Porter	DE
Crystal	232	61.44	Brown Porter	AU, BE, IE, NZ, UK, US
Dehusked CarafII	229	418.03	Schwarzbier	DE
CaraRye	228	66.19	Black IPA	DE, NZ, US
ESB	209	3.47	Mild	CA, UK
Toffee	201	5.65	Irish Extra Stout	NZ
CaraGold	180	33.47	Festbier	BE, IE, UK, US
Gladiator	176	5.14	Fruit Lambic	NZ
Chocolate Light	169	419.6	Irish Extra Stout	AU, FI, NZ, UK, US
Flaked Wheat	164	2.03	Witbier	BE, CA, DE, NZ, US
Mild	136	3.11	Mild	UK
Ashburne Mild	131	5.3	Dark Mild	US
Aurora	125	28.43	Belgian Pale Ale, Brown IPA	NZ



Malt Name	Recipes	EBC	Styles	Countries
Cookie	115	19.26	British Golden Ale	FI
Dehusked Carafl	115	337.29	Schwarzbier	DE
Cararuby	109	21.12	Red IPA	BE, UK
Caramel/Crystal300L	108	114.82	Traditional Bock	FI
Redback	106	33.86	Red IPA	NL, NZ
Shepherds Delight	103	144.93	Red IPA	NZ
Floor-Malted Bohemian Wheat	101	1.98	Gueuze	DE
Sourgrapes	101	2.18	Gose	NZ
Crystalmillet	96	17.67	Helles Bock	US
Kölsch	92	3.29	Kölsch	DE
Buckwheat	91	2.3	Irish Stout	US
Carastan Light	91	15	Scottish Export	UK
Pale Millet	89	1.65	Old Ale	US
Stout	89	18.78	Irish Stout	IE
Chit	85	1.52	Scottish Light	DE, NZ, UK, US
Double Roast Crystal	79	110.04	Scottish Heavy	UK, US
SpecialW	79	114.72	English Porter	BE, DE
Caraplus150	78	59.2	Foreign Extra Stout	FI
Rice	72	58.19	American Wheat Beer	US
Optic	70	2.15	Strong Scotch Ale	UK
Caraplus100	66	38	Black IPA	FI
CaraBlond	63	7.99	White IPA	BE
Caramel/Crystal250L	63	94	Roggenbier	FI
Dark	58	71.12	Brown IPA	CA, DE, FI, NZ, US
Supernova	57	57.62	Brown IPA	NZ
Rolled Oats	56	1.73	Scottish Heavy	NZ
Flakedrice	54	0.93	American Light Lager	US
Pale Crystal	52	28.92	British Strong Ale	UK
Pale Rye	50	3.29	Roggenbier	DE, UK, US
Red	50	22.05	Red IPA	DE, FI, NL, US
Flaked Rye	49	2.29	Dry Stout	US
Munich Millet	49	6.61	Scottish Light	US
Black Pearl	46	350.43	Oatmeal Stout	CL, FI, NZ, US
Heritage	45	6.35	Old Ale	CA, UK
Flaked Corn	42	0.71	Cream Ale	US
Roasted Oats	40	6.22	Belgian Dubbel	CA, UK, US
Dark Roasted Millet	39	298.21	English Porter	US
Caraplus200	38	76.67	Russian Imperial Stout	FI
Specialx	38	128.09	Brown Porter	DE
Distillers	37	2.37	Gueuze	IE, NZ, US
Smoked Wheat	35	2.31	Roggenbier	DE, US
Caramel/Crystal200l	32	83.38	British Strong Ale	BE, FI, UK, US
Lager Light	32	1.43	Fruit Lambic	NZ

Malt Name	Recipes	EBC	Styles	Countries
Fullpint	30	3.45	Strong Bitter	US
Heidelberg	26	1.34	Munich Helles	DE
Opal 44	24	35.33	American Amber Ale	US
CaraMillet	22	32.32	Irish Red Ale	US
Enzyme	21	0.4	Red IPA	FI
Pale Compass	21	2.69	Old Ale	AU
Red Crystal	21	98.59	Foreign Extra Stout	UK
Light Roasted Millet	20	6.7	Irish Red Ale	US
Base	19	1.97	Rye IPA	NZ, US
Caramel/Crystal400L	19	198.24	British Strong Ale	CA, DE, FI, UK
Caramel/Crystal65L	19	65	Scottish Light	UK, US
Caraplast250	19	97.26	American Light Lager	FI
Lamonta	19	2.89	Belgian IPA	US
Barley	18	195.82	Imperial Stout	BR, DE, NL, NZ
Golden	18	4.07	Gose	FI, US

**Table D: Hop List**

Hop Name	Recipes	Alpha	Styles	Country
Cascade	18582	6.91	American Barleywine, American Pale Ale, etc.	United States
Citra	15950	11.88	American IPA, Double IPA, Black IPA, etc.	United States
Centennial	11046	9.79	American Barleywine	United States
Amarillo	10867	8.6	Belgian IPA	United States
East Kent Golding	9833	5.15	British Strong Ale, Scottish Export, Strong Bitter, etc.	United Kingdom
Magnum	9696	13.9	Altbier	Germany
Simcoe	9223	12.96	Imperial IPA	United States
Mosaic	9151	12.58	New England IPA	United States
Columbus	8245	15.01	Imperial IPA	United States
Chinook	7568	12.68	American Barleywine	United States
Saaz	6772	3.48	Bohemian Pilsner, Czech Premium Lager, etc.	Czech Republic
Fuggle	6538	4.57	Mild	United Kingdom
Hallertau	5328	3.88	Munich Helles	Germany
Willamette	4786	4.69	American Brown Ale	United States
Galaxy	3995	14.44	New England IPA	Australia
Northernbrewer	3926	7.95	California Common	United States
Warrior	3127	15.9	Double IPA	United States
Nugget	3052	13.66	Old Ale	United States
Tettnanger	2986	4.18	Altbier	Germany
Styrian Gold	2816	4.87	Belgian Golden Strong Ale	Slovenia
Perle	2721	7.67	Doppelbock	Germany
Hersbrucker	2572	3.68	Munich Dunkel	Germany
El Dorado	2240	15.06	New England IPA	United States
Challenger	2221	7.91	Strong Bitter	United Kingdom
Nelson Sauvin	2159	12.17	Brown IPA	New Zealand
Golding	1671	4.83	British Strong Ale	United States
Azacca	1549	13.75	New England IPA	United States
Mandarina Bavaria	1330	8.33	White IPA	Germany
Summit	1225	17.28	Black IPA	United States
Target	1207	10.78	Strong Bitter	United Kingdom
Motueka	1193	6.84	Belgian IPA	New Zealand
Crystal	1158	4.18	Brown Porter, Cream Ale	United States
Mounthood	1105	5.06	Cream Ale	United States
Galena	1076	13	Fruit Lambic	United States
Ekuanot	949	15.2	New England IPA	United States
Hallertau Blanc	912	9.4	Gose	Germany
Cluster	910	6.87	Cream Ale	United States
Sorachi Ace	887	11.46	Saison	Japan

Hop Name	Recipes	Alpha	Styles	Country
Apollo	814	18.98	Imperial IPA	United States
Ahtanum	788	5.5	Brown IPA	United States
Bravo	760	15.19	White IPA	United States
Falconer's Flight	738	10.16	Black IPA	United States
Liberty	725	4.19	Cream Ale	United States
Lemondrop	712	5.8	Berliner Weisse	United States
Hullmelon	693	6.75	Saison	Germany
Vic Secret	624	16.34	New England IPA	Australia
Sterling	571	8.42	Doppelbock	United States
Bramling Cross	545	6.4	Old Ale	United Kingdom
Brewer's Gold	524	8.28	Belgian Dark Strong Ale	United Kingdom
Horizon	518	12.19	American Amber Ale	United States
Spalt	510	4.17	Altbier	Germany
Idaho 7	503	13.08	New England IPA	United States
Hallertauer Tradition	481	5.43	Festbier	Germany
Calypso	466	13.08	Fruit Lambic	United States
Glacier	463	5.42	Irish Stout	United States
First Gold	444	7.84	British Golden Ale	United Kingdom
Comet	397	10.48	Brown IPA	United States
Pacific Gem	385	14.9	White IPA	New Zealand
Zeus	377	16.13	Belgian IPA	United States
Northdown	372	8.2	Best Bitter	United Kingdom
Admiral	346	14.22	British Golden Ale	United Kingdom
Pacific Jade	345	13.26	Brown IPA	New Zealand
Loral	340	11.68	Fruit Lambic	United States
Rakau	325	10.44	Red IPA	New Zealand
Sabro	323	14.61	New England IPA	United States
Strisselspalt	292	3.98	Lambic	France
Zythos	286	10.72	Belgian Specialty Ale	United States
Cashmere	279	7.96	Gueuze	United States
Palisade	278	7.66	American Strong Ale	United States
Aurora	275	8.21	Belgian Pale Ale, Brown IPA	Slovenia
Equinox	265	13.83	Brown IPA	United States
Belma	262	10.26	American Barleywine	United States
Wakatu	256	7.36	Irish Extra Stout	New Zealand
Ella	247	14.72	British Golden Ale	Australia
Waimea	240	16.55	Belgian IPA	New Zealand
Denali	235	14.12	Belgian IPA	United States
Waiiti	234	2.97	Lambic	New Zealand
Herkules	229	15.33	Weizenbock	Germany
Pacifica	226	5.14	Czech Pale Lager	New Zealand
Tomahawk	223	14.79	Brown IPA	United States
Saphir	214	3.94	Festbier	Germany

Hop Name	Recipes	Alpha	Styles	Country
Jarrylo	201	14.84	Rye IPA	United States
Topaz	199	15.76	White IPA	Australia
Southern Cross	194	12.74	Old Ale	New Zealand
Greenbullet	188	11.71	Red IPA	New Zealand
Pilgrim	184	10.26	British Golden Ale	United Kingdom
Kohatu	163	6.62	Belgian IPA	New Zealand
Progress	159	6.29	Best Bitter	United Kingdom
Southern Star	158	11.28	British Golden Ale	South Africa
Dr.Rudi	156	11.43	Berliner Weisse	New Zealand
Summer	155	6.1	Fruit Lambic	Australia
Polaris	152	19.19	Brown IPA	Germany
Pekko	144	15.09	Irish Extra Stout	United States
Enigma	143	15.77	Fruit Lambic	Australia
Eureka	139	16.82	British Golden Ale	United States
Riwaka	138	5.28	Belgian IPA	New Zealand
Phoenix	135	10.52	Irish Extra Stout	United Kingdom
Millennium	132	15.67	English Barleywine	United States
Celeia	116	3.57	Trappist Single	Slovenia
Strata	116	12.77	New England IPA	United States
Vanguard	114	5.12	Vienna Lager	United States
Spalterselect	110	4.36	Festbier	Germany
Medusa	104	3.96	New England IPA	United States
Pride of Ringwood	103	9.76	American Lager	Australia
Bullion	98	8.36	Scottish Heavy	United Kingdom
Columbia	91	10.38	Traditional Bock	United States
Moutere	85	17.72	Belgian IPA	New Zealand
African Queen	84	12.14	British Golden Ale	South Africa
Bru1	84	14.41	New England IPA	United States
Santiam	79	6.62	Gose	United States
Southern Promise	77	11.46	Brown IPA	Slovenia
Aramis	76	7.17	Saison	France
Bobek	76	4.84	Belgian Tripel	Slovenia
Opal	74	6.88	Gueuze	Germany
Taiheke	68	7.16	British Strong Ale	New Zealand
Archer	66	4.43	Old Ale	United Kingdom
Premiant	64	8.91	Czech Pale Lager	Czech Republic
Lublin	63	4.39	Roggenbier	Poland
Meridian	63	7	Red IPA	United States
Kazbek	62	6	Munich Dunkel	Czech Republic
Marynka	62	8.53	Belgian IPA	Poland
Sladek	61	6.4	Czech Premium Pale Lager	Czech Republic
Newport	60	13.44	Scottish Light	United States
Jester	59	8.57	British Golden Ale	United Kingdom

Hop Name	Recipes	Alpha	Styles	Country
Styrian Wolf	52	12.66	English Barleywine	Slovenia
Sovereign	51	5.42	British Golden Ale	United Kingdom
Pioneer	47	8.87	British Golden Ale	United Kingdom
Callista	45	3.79	Weizenbock	Germany
Hallertauer	42	4.56	Festbier	Germany
Superalpha	42	12.75	English IPA	New Zealand
Triskel	41	4.86	Fruit Lambic	France
Ariana	38	10.6	Belgian Specialty Ale	Germany
Mount Rainier	38	6.18	Munich Dunkel	United States
HBC472	37	9.65	Cream Ale	United States
Zappa	37	6.38	New England IPA	United States
Sticklebract	31	11.76	American Light Lager	New Zealand
Superpride	31	13.8	British Golden Ale	Australia
Pahto	30	17.07	Belgian Specialty Ale	United States
Helga	29	5.93	Gose	Australia
Sonnet	29	5.22	Strong Scotch Ale	United States
Boadicea	28	7.01	British Golden Ale	United Kingdom
HBC438	27	15.66	White IPA	United States
Olicana	27	7.89	English IPA	United Kingdom
Dana	26	11.81	Old Ale	Slovenia
Endeavour	26	9.07	Mild	United Kingdom
HBC342	26	11.94	Imperial IPA	United States
Julius	26	7.36	English IPA	United States
Smaragd	25	5.67	Weizenbock	Germany
Ultra	25	5.09	American Lager	United States
Caliente	24	14.22	American Barleywine	United States
Legacy	24	7.75	British Golden Ale	United States
Minstrel	23	6.05	Weizenbock	United Kingdom
Delta	22	6.39	British Strong Ale	United States
Sybilla	20	5.67	Fruit Lambic	Poland
Merkur	19	12.85	Schwarzbier	Germany
Michigan Copper	19	9.32	Rye IPA	United States
Tahoma	19	6.69	Trappist Single	United States
Triplepearl	19	9.55	Helles Bock	United States
Hallertauer Taurus	17	15.5	Altbier	Germany
Monroe	17	3.36	American Strong Ale	Germany
Lubelska	16	4.39	Belgian Specialty Ale	Poland

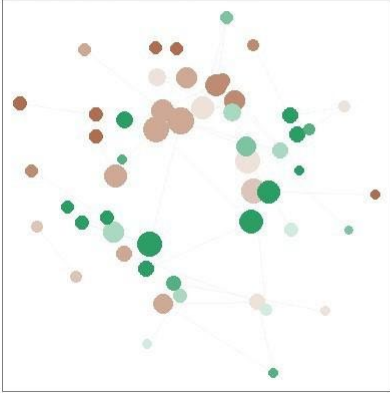
Figure A: An Abridged Sample BeerXML File

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  ...
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11   <AMOUNT>4.8761179775</AMOUNT>
  <YIELD>80.43</YIELD>
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15   ...
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  <HOPS>
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  <ALPHA>12.6</ALPHA>
21   <AMOUNT>0.0283495231</AMOUNT>
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  </HOP>
27   ...
  </HOPS>
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  <USE>Boil</USE>
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35   <AMOUNT>0.00246446</AMOUNT>
36   </MISC>
37   ...
38   </MISCS>
39   ...
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  <CATEGORY>IPA</CATEGORY>
  <CATEGORY NUMBER>21</CATEGORY NUMBER>
  <STYLE LETTER>B</STYLE LETTER>
  <STYLE GUIDE>BJCP</STYLE GUIDE>
  <TYPE>Ale</TYPE>
47   ...
  </STYLE>
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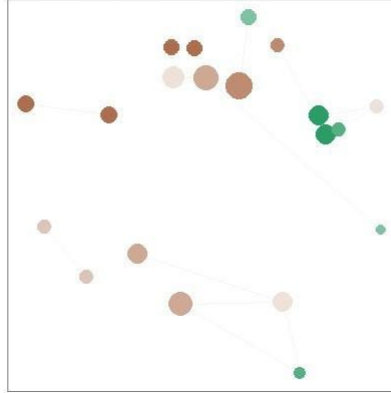
**Figure B: Stress Test – Kölsch**

(A) Targeted Attacks

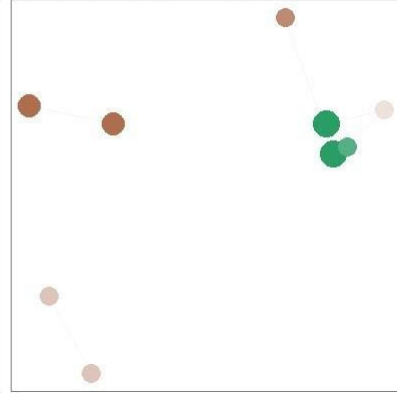
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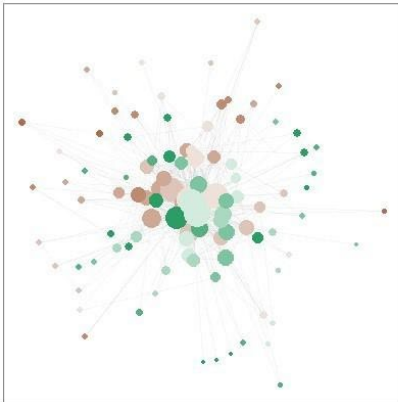


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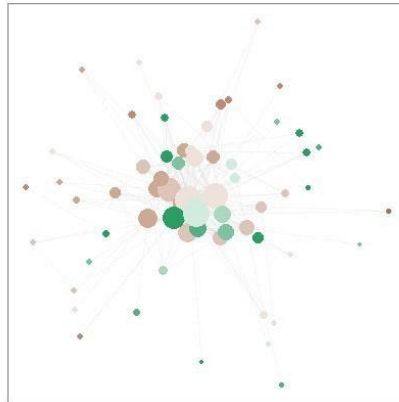


(B) Random Attacks

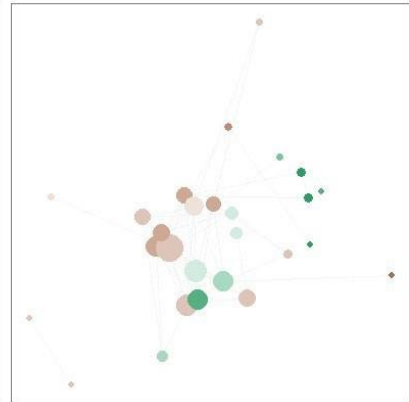
40% Removed



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80% Removed

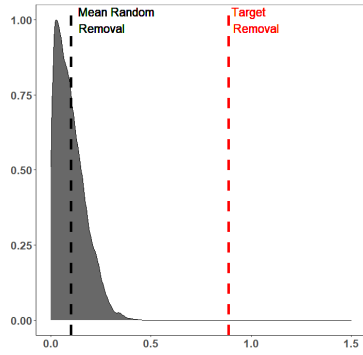


**Note:** Both panels depict the impact of removing 40%, 60% or 80% of the nodes from the Kölsch network. Panel BA shows the effect of targeted deletion according to eigenvector centrality. Panel BB shows a random attack where nodes are deleted in random order.

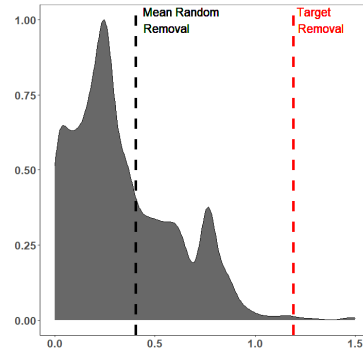


**Figure C: Resiliency Against Random Removal – Kölsch**

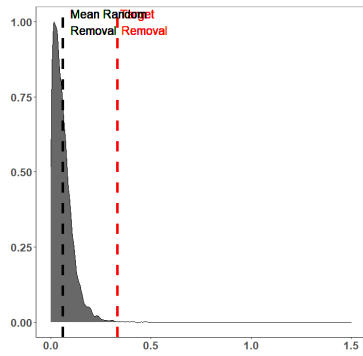
**(A) Net Density**



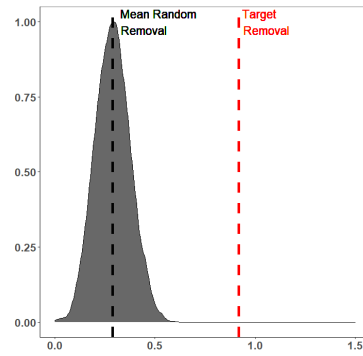
**(B) Net Diameter**



**(C) Avg. Clustering Coefficient**

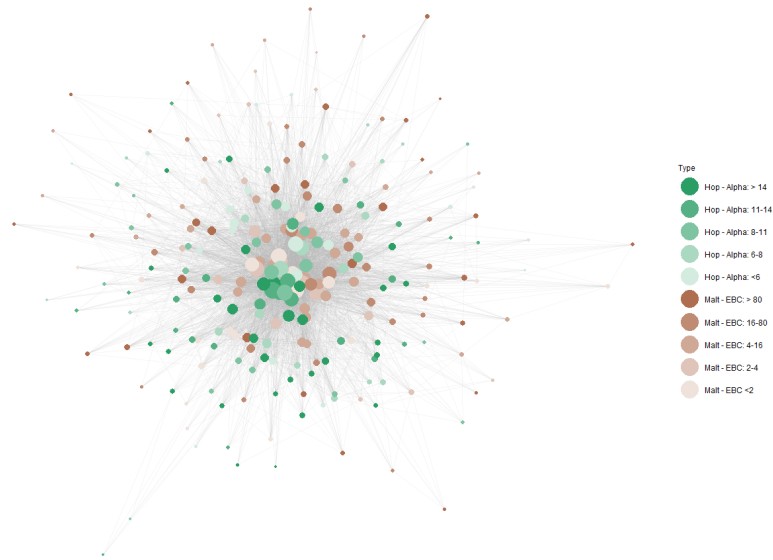


**(D) Avg. Degree**



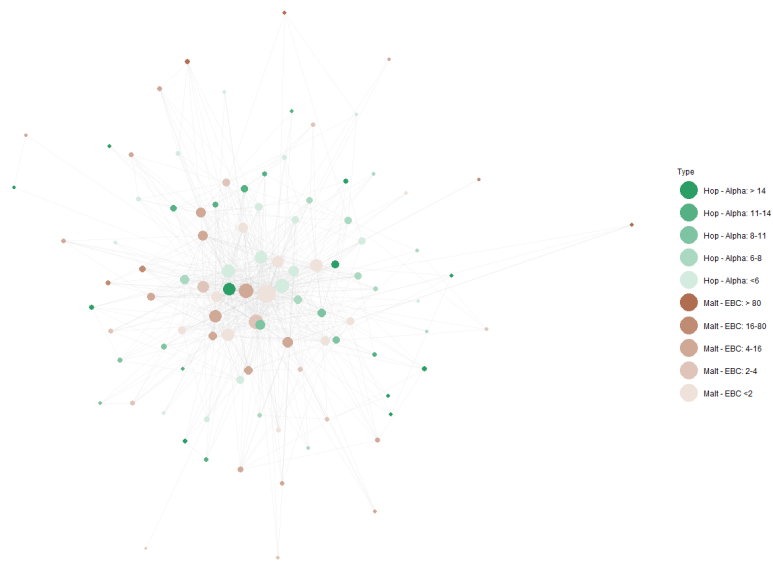
## Figure D: Example Networks

(A) English IPA



Nodes	Density	Diameter	Clustering	Avg. Degree
263	0.19	1.16	0.45	49

(B) Munich Helles



Nodes	Density	Diameter	Clustering	Avg. Degree
98	0.16	1.85	0.42	15.39