

Correlations and other Animals

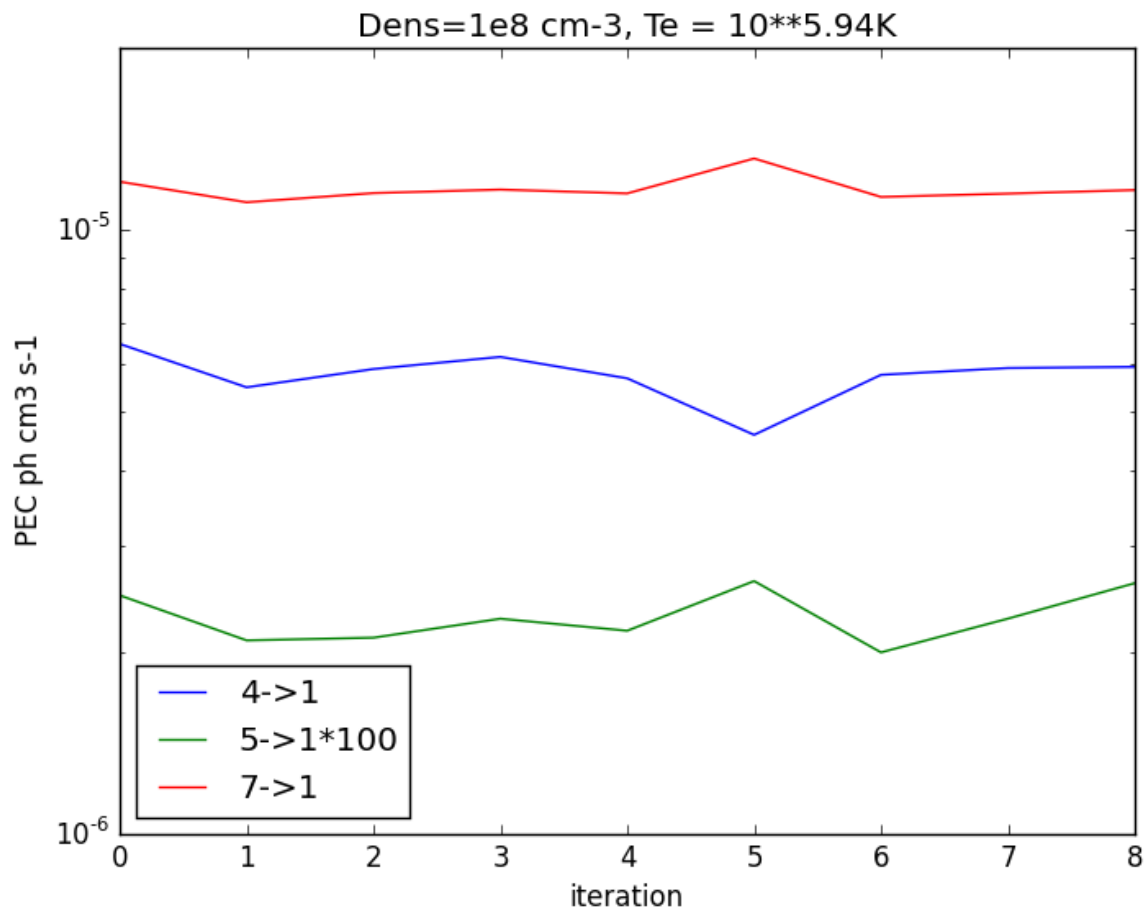
AtomDB is an atomic database, much like CHIANTI and others.

Ultimately, we all create a large matrix for level populations, solve it using [your standard solver of choice], and then produce line emissivities. This is the trivially easy part - solve $Ax=B$

Biggest problem/source of work is the inclusion and validation of the atomic data, and making the results tractable for end users - in CHIANTI, this means producing a code which runs fast enough to allow fitting on the fly. In AtomDB, it means producing interpolable models users can apply without breaking the physics too much (runs faster at the trade off of some physics accuracy).

For our focus, we very much want to look at *useful* applications of uncertainties. This can mean a range of things.

1. Ideally need some way to compress data storage (not store 1000 data sets for each ion)
2. Can we preserve meaningful correlations?



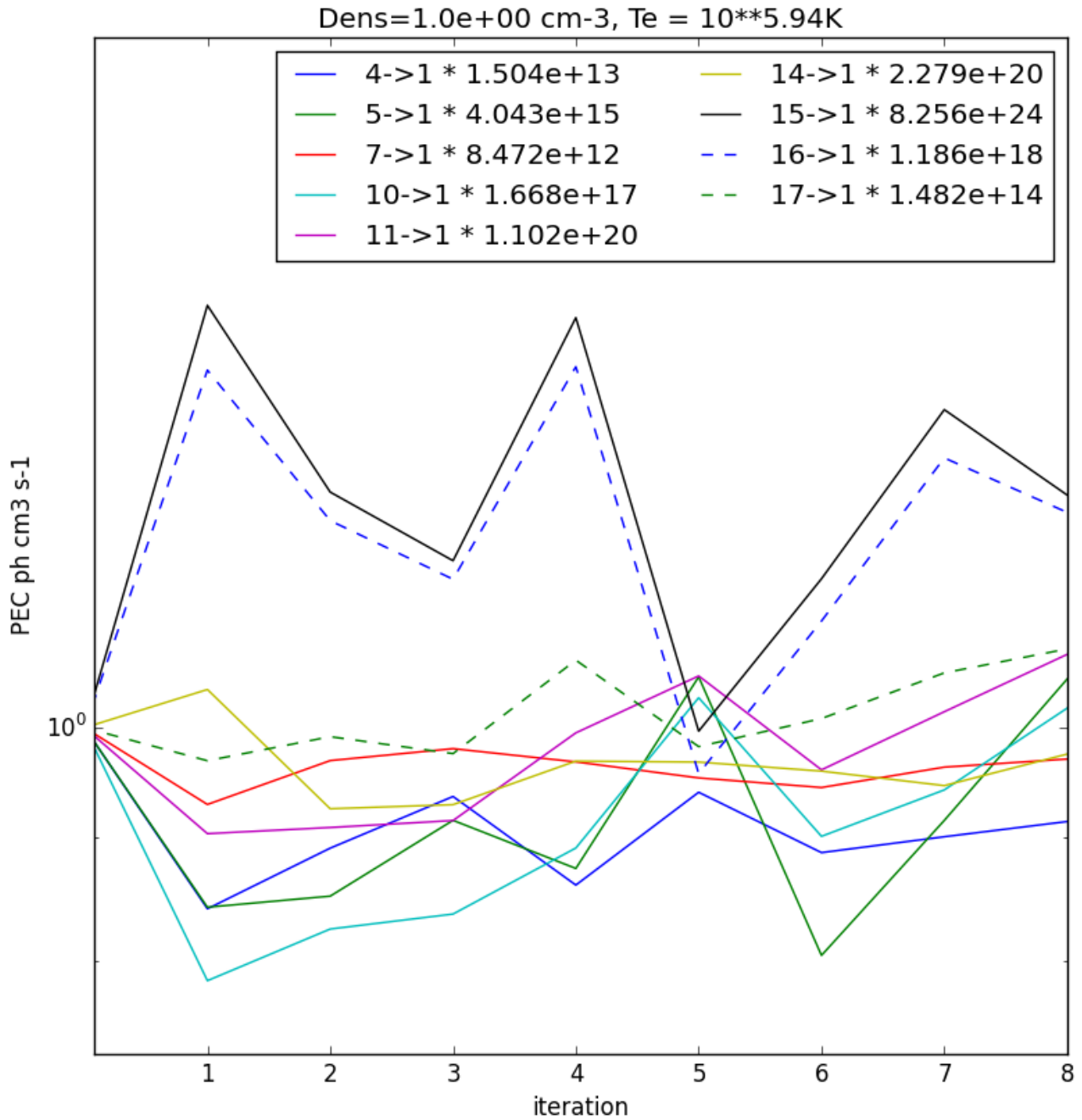
O6+ transitions from Connors 9 iterations (a->j excl. h)

Show Photon emissivity coefficient in lines for the $n=2-1$ transitions (4-1 and 5-1 are the intercombination lines, 7-1 is the resonance line)

- Cannot do anything with the forbidden line (would be 2-1) as Connor's script doesn't by default do non-dipole transitions, so gives 0 A-value for this (should be ~200).

density 1cm^{-3}

trans1	trans2	pearson corr	p_random
(4, 1, 15, 1, -0.8652518517629596, 0.0025855726229394227)			
(4, 1, 16, 1, -0.8282588296067227, 0.0058178859451831376)			
(10, 1, 15, 1, -0.598558224827411, 0.08858853176949243)			
(10, 1, 16, 1, -0.5902637952126453, 0.09427102443689592)			
(5, 1, 15, 1, -0.54170031596642, 0.13195927690494716)			
(5, 1, 16, 1, -0.5175030569169211, 0.15360733902818371)			
(7, 1, 15, 1, -0.4483480706128143, 0.22613194590033167)			
(7, 1, 16, 1, -0.3683745080137382, 0.32931917300201047)			
(7, 1, 14, 1, -0.3238656499284797, 0.39520782080333827)			
(11, 1, 15, 1, -0.308253369163724, 0.41965420983022605)			
(11, 1, 16, 1, -0.30291517516464206, 0.4281652694878256)			
(4, 1, 17, 1, -0.1461253788217265, 0.7075620048304039)			
(4, 1, 14, 1, -0.13182695913666967, 0.735303183975764)			
(14, 1, 17, 1, -0.12465501576174332, 0.7493202867079906)			
(10, 1, 14, 1, 0.03309493724774268, 0.9326410537454487)			
(11, 1, 14, 1, 0.054620785553789554, 0.8890037230215149)			
(5, 1, 14, 1, 0.08886420252412168, 0.8201544263470897)			
(14, 1, 16, 1, 0.18074209305810515, 0.6416721241935823)			
(7, 1, 17, 1, 0.19978470369122664, 0.6062973637881002)			
(5, 1, 17, 1, 0.20495405849186837, 0.5968117910764301)			
(14, 1, 15, 1, 0.21006040642485435, 0.5874931841653597)			
(7, 1, 11, 1, 0.21604561776635564, 0.576637184394336)			
(15, 1, 17, 1, 0.33186562526904445, 0.382943593688884)			
(4, 1, 11, 1, 0.36532327847519586, 0.33365003306933155)			
(16, 1, 17, 1, 0.371026246416905, 0.32557813647135836)			
(7, 1, 10, 1, 0.3724390621700746, 0.3235936395307398)			
(10, 1, 17, 1, 0.4275855495493839, 0.2509674713604643)			
(5, 1, 7, 1, 0.44874232601982667, 0.22567389610987443)			
(4, 1, 10, 1, 0.6332733790126047, 0.06711969355634999)			
(11, 1, 17, 1, 0.6429530747115171, 0.06178390586744891)			
(4, 1, 5, 1, 0.6755241618856028, 0.04582577507791354)			
(4, 1, 7, 1, 0.7669937288715001, 0.01587143467894002)			
(5, 1, 11, 1, 0.7783445784473826, 0.01348706693728029)			
(5, 1, 10, 1, 0.8358046265935815, 0.005010219454877389)			
(10, 1, 11, 1, 0.9391088454040494, 0.00017277554322834253)			
(15, 1, 16, 1, 0.9947004526723723, 3.5492206376291333e-08)			



density 1e8cm⁻³

trans1 trans2 pearson corr p_random

- (7, 1, 15, 1, -0.6928457102411105, 0.0385436679149797)
- (10, 1, 15, 1, -0.5889124173116359, 0.09521741068814407)
- (4, 1, 7, 1, -0.5525482452086449, 0.12287810653902573)
- (5, 1, 15, 1, -0.5303618515287228, 0.14186326224177492)
- (7, 1, 16, 1, -0.457083638889182, 0.21610189461357054)

(10, 1, 16, 1, -0.45105452590475126, 0.22299777048373925)
 (4, 1, 14, 1, -0.38490034138917995, 0.3063534723881782)
 (5, 1, 16, 1, -0.34947608513537787, 0.35658982904219116)
 (11, 1, 15, 1, -0.2993794402186087, 0.4338444961968857)
 (4, 1, 16, 1, -0.2823927124364993, 0.4615859387587418)
 (4, 1, 11, 1, -0.25903894409613265, 0.500914632584088)
 (4, 1, 5, 1, -0.17467717223680299, 0.6530749033016534)
 (4, 1, 10, 1, -0.16516033352394788, 0.6710928744554541)
 (14, 1, 17, 1, -0.15468365129932166, 0.6910968115039096)
 (11, 1, 16, 1, -0.14024876412306134, 0.7189294434231174)
 (7, 1, 17, 1, -0.05697938992795468, 0.884236133852435)
 (4, 1, 15, 1, -0.020697562521520444, 0.9578503213919208)
 (14, 1, 15, 1, 0.03984698305210515, 0.9189317236190432)
 (4, 1, 17, 1, 0.06816529511550214, 0.861671375907171)
 (14, 1, 16, 1, 0.15733568733672837, 0.6860168986316998)
 (11, 1, 14, 1, 0.20749912020893235, 0.5921608428963969)
 (10, 1, 14, 1, 0.20861255578715773, 0.5901301276960023)
 (7, 1, 14, 1, 0.21999843703305638, 0.5695076699681246)
 (15, 1, 17, 1, 0.25341343080025547, 0.5105854159032759)
 (5, 1, 14, 1, 0.27056983481444674, 0.48132850311313485)
 (16, 1, 17, 1, 0.28082915092699723, 0.4641767435374211)
 (5, 1, 17, 1, 0.29740364061797275, 0.43703253762046057)
 (10, 1, 17, 1, 0.5234758635368154, 0.14808449228398746)
 (7, 1, 11, 1, 0.561704926354217, 0.11551127275477754)
 (7, 1, 10, 1, 0.689664554975615, 0.0398205188936306)
 (11, 1, 17, 1, 0.7299361574047711, 0.025572999726239543)
 (5, 1, 7, 1, 0.7513054726576089, 0.019607306873588654)
 (5, 1, 11, 1, 0.7839015947630833, 0.01241274862684533)
 (5, 1, 10, 1, 0.8393195085588541, 0.00466165172332196)
 (10, 1, 11, 1, 0.9407709259134237, 0.00015708402818251358)
 (15, 1, 16, 1, 0.9548057374283594, 6.181445844948699e-05)]

Looking instead at level populations:

density 1e0cm⁻³

levels pearson corr p_random

(6, 16, -0.9231247237949171, 0.0003844824136868575)
 (15, 16, -0.8871217845254825, 0.0014224055398447358)
 (3, 15, -0.8758041828147504, 0.0019645930509509944)
 (3, 6, -0.7112179069300278, 0.031686410530837435)
 (13, 16, -0.7092992726997805, 0.03236203371649439)
 (12, 16, -0.6894529893803911, 0.039906391945693065)
 (2, 16, -0.6643455699423657, 0.05096259990447905)
 (4, 16, -0.6572831201186067, 0.05438942946969562)
 (14, 16, -0.6555893081785605, 0.05523247515994253)
 (2, 3, -0.6338214715920973, 0.06681012425881934)
 (3, 4, -0.6164915463530508, 0.07703671665294272)
 (3, 12, -0.6051519914222436, 0.08422509226214779)
 (3, 13, -0.5823330461420966, 0.09990778311199318)
 (3, 14, -0.5616667702289361, 0.11554140574887393)

(5, 16, -0.5582145432763591, 0.11828726536896321)
(3, 5, -0.4307392038659097, 0.2471053204253521)
(11, 16, -0.3774443496723679, 0.3166118009124443)
(6, 8, -0.3307106943748725, 0.3847029901763096)
(6, 9, -0.3298096999387986, 0.3860781682046652)
(6, 10, -0.32261020392185125, 0.397148764413906)
(9, 15, -0.20307174919449444, 0.6002597629926351)
(10, 15, -0.18741934748343902, 0.6291926711085635)
(7, 16, -0.18263930538320144, 0.6381182749733112)
(8, 15, -0.17790219551816866, 0.647003570198385)
(3, 11, -0.10760836015467563, 0.7828864139342931)
(7, 15, -0.09166490738187644, 0.814564394643245)
(8, 11, -0.03938495667329228, 0.919869267348837)
(10, 11, -0.01923183088204196, 0.9608333094920143)
(9, 11, -0.0071047947351643905, 0.9855268398441136)
(11, 15, 0.0046448299520598065, 0.9905378002418579)
(3, 7, 0.04203035460649515, 0.9145024131136985)
(2, 11, 0.12984019036124905, 0.7391796070765787)
(4, 11, 0.13056080228729422, 0.7377730151371734)
(3, 10, 0.13324341434958994, 0.7325426588612376)
(3, 8, 0.14114117950767754, 0.7172000680052283)
(3, 9, 0.15040612448415816, 0.6993127588952265)
(9, 13, 0.28100311253393107, 0.46388818487731337)
(5, 9, 0.28772618099018366, 0.45279529544504415)
(5, 8, 0.294449707148766, 0.44181802302006545)
(10, 13, 0.30012162738098425, 0.4326496129334219)
(8, 13, 0.30016331120837875, 0.43258254743564883)
(5, 10, 0.30975991637087213, 0.41726611263853985)
(9, 12, 0.3147755293816151, 0.40936010821932506)
(9, 14, 0.3246603376671931, 0.39398149338574506)
(2, 7, 0.32744582573957837, 0.3896970204719014)
(8, 12, 0.33180067338740493, 0.38304243959851814)
(10, 12, 0.33283149893137953, 0.3814751088025929)
(8, 16, 0.3336333492791578, 0.38025801449500446)
(10, 16, 0.3347279787249001, 0.37859947901829677)
(8, 14, 0.34231538710978643, 0.36719770256526507)
(4, 7, 0.3433831096413179, 0.3656065232955663)
(10, 14, 0.34589657123531015, 0.36187387563984613)
(9, 16, 0.35078146278248806, 0.35467216544330443)
(2, 9, 0.36488498106879486, 0.3342744428510204)
(4, 9, 0.37560810972390857, 0.31916430267111673)
(2, 10, 0.375822649269395, 0.31886554743464973)
(5, 15, 0.37850103121528905, 0.31514760455738716)
(2, 8, 0.3816788256745351, 0.3107648658958607)
(6, 7, 0.383247332037497, 0.30861303849348826)
(4, 10, 0.38771270592600876, 0.30252850048084284)
(4, 8, 0.39341369545036114, 0.29484998499071735)
(11, 12, 0.40186459918518824, 0.2836540750826506)
(11, 14, 0.4137344352939927, 0.26830816652142)
(11, 13, 0.4376039173925752, 0.23880938004105146)
(7, 8, 0.46673082111634623, 0.20531563135825398)
(7, 10, 0.48082864040477175, 0.19010387479680377)
(7, 9, 0.4840189316174842, 0.18675246888453653)

(4, 6, 0.4949946839726314, 0.1754793331470556)
 (2, 6, 0.5048383717315171, 0.165707818089917)
 (5, 11, 0.5116703396842915, 0.15911434933759083)
 (7, 12, 0.5337143218112835, 0.13889094285037143)
 (5, 6, 0.5501376401166076, 0.12486288573902342)
 (7, 13, 0.5572453827089218, 0.11906507821043821)
 (7, 14, 0.5804249237200975, 0.10129383367848979)
 (14, 15, 0.5936788332429332, 0.0919051511189727)
 (6, 14, 0.6272208147774122, 0.07059815705190121)
 (13, 15, 0.6402555575030643, 0.0632429676949581)
 (2, 5, 0.6449988755768772, 0.060691633070195705)
 (12, 15, 0.6541740922655175, 0.05594318210006242)
 (6, 11, 0.6649228283216897, 0.050688761481005214)
 (6, 12, 0.6653022846687355, 0.050509268237755346)
 (4, 5, 0.6715108665412365, 0.047629874944108634)
 (6, 15, 0.6955548695085949, 0.0374773873671422)
 (6, 13, 0.6971340569375364, 0.036864751099231055)
 (5, 7, 0.697177988929755, 0.03684780136954855)
 (2, 14, 0.7282995474109902, 0.02607359758894659)
 (2, 13, 0.7354586446090513, 0.023930541464123368)
 (4, 14, 0.7465561895503818, 0.02084350012810058)
 (4, 13, 0.7478523952353098, 0.02050113585142507)
 (4, 15, 0.7484620110267614, 0.020341415017446015)
 (2, 15, 0.7620965780021848, 0.016981481842476907)
 (2, 12, 0.7627134221102984, 0.016838900297843178)
 (4, 12, 0.774917218732957, 0.01417977476032238)
 (5, 13, 0.787258475996503, 0.011792468816660098)
 (5, 12, 0.792165478536849, 0.010923781308496024)
 (3, 16, 0.803979248516092, 0.009011401493172365)
 (7, 11, 0.8243336363837803, 0.006271165644844141)
 (5, 14, 0.8635518937945845, 0.002696863477104108)
 (13, 14, 0.9812478965696817, 2.9192249890760312e-06)
 (12, 14, 0.9871514237466416, 7.817933504624457e-07)
 (12, 13, 0.9940132328378508, 5.4347531088665964e-08)
 (8, 9, 0.9979967147743273, 1.1824714175828059e-09)
 (2, 4, 0.9987442895039581, 2.307384986412633e-10)
 (9, 10, 0.9989413916479766, 1.2695902851664225e-10)
 (8, 10, 0.9991680647694251, 5.463853311937855e-11)

density 1e8cm⁻³

levels pearson corr p_random

[(3, 15, -0.9917610759878953, 1.6580587392910275e-07)

(3, 6, -0.9834570771265113, 1.8865754630912611e-06)
(3, 5, -0.9764075968525945, 6.489868404485493e-06)
(3, 14, -0.9569959364390953, 5.206205884886982e-05)
(3, 13, -0.9539864529146677, 6.57728759557029e-05)
(3, 12, -0.945783979748946, 0.00011584224485213052)
(3, 4, -0.7579614554251154, 0.01795810327898124)
(2, 3, -0.7406789821174458, 0.022443311410791807)
(3, 11, -0.6284549935076064, 0.06987992196975407)
(3, 7, -0.6267320935218167, 0.070883840544991)
(15, 16, -0.6264898906092312, 0.07102568832712626)
(2, 16, -0.6108865430662108, 0.08054021457882538)
(4, 16, -0.5987857572363551, 0.08843569759953494)
(13, 16, -0.5751992683445857, 0.10514928658788945)
(12, 16, -0.5737733167076582, 0.10621653649604443)
(14, 16, -0.5352540505624904, 0.13753819603436945)
(6, 16, -0.5237997252018863, 0.147788393084406)
(5, 16, -0.45402752710391964, 0.2195825014278885)
(11, 16, -0.37055440722540733, 0.32624224667739893)
(3, 10, -0.28240787815102864, 0.4615608396887428)
(3, 8, -0.2689623009077514, 0.4840396582389797)
(3, 9, -0.2628908594748728, 0.4943361478496565)
(7, 16, -0.08636054085749408, 0.8251575242337883)
(8, 11, 0.0553391967333681, 0.8875512228119438)
(10, 11, 0.07480482980377043, 0.8483176844414246)
(9, 11, 0.08281442577517488, 0.8322530632438343)
(9, 15, 0.24485674136229615, 0.525436503383473)
(8, 15, 0.25509341025526394, 0.5076895712145595)
(2, 11, 0.26007243023806687, 0.49914611608840564)
(10, 15, 0.26421396032620953, 0.49208470626975026)
(4, 11, 0.2661555532953878, 0.4887884704274162)
(6, 9, 0.2755103109680383, 0.4730361370724982)
(6, 8, 0.279516860279864, 0.46635596814850677)
(6, 10, 0.29287454230774196, 0.4443791984643564)
(5, 9, 0.33497647694879223, 0.3782234410348674)
(5, 8, 0.33968657836474236, 0.37112933873294734)
(9, 13, 0.3410352615587382, 0.36910976241378163)
(2, 7, 0.35120844050398553, 0.35404599897266364)
(8, 13, 0.3529626015152591, 0.3514791282836741)
(5, 10, 0.35302524766256865, 0.3513876253577481)
(10, 13, 0.3593516790582771, 0.34220676111638637)
(9, 12, 0.3598238322900982, 0.34152633616032035)
(9, 14, 0.3614905253913744, 0.3391297565734799)
(4, 7, 0.3675882276575145, 0.33043252540929396)
(8, 12, 0.37146752458603266, 0.32495765039272867)
(8, 14, 0.373339777806111, 0.32233161738934063)
(10, 12, 0.3773463877804709, 0.31674771506383953)
(10, 14, 0.38048551835468647, 0.3124070188720108)
(8, 16, 0.3883786951184382, 0.30162629772405086)
(2, 9, 0.39196395498677106, 0.2967930336123659)
(10, 16, 0.3926785242104651, 0.2958344982327724)
(2, 10, 0.40119942442021483, 0.2845271986545663)
(4, 9, 0.40331450608290936, 0.2817557147341715)
(9, 16, 0.40510799327149116, 0.27941666151854444)

(2, 8, 0.407513965881328, 0.27629474355416506)
(4, 10, 0.41361839905517017, 0.2684560236211964)
(4, 8, 0.4197979822701831, 0.2606414830925746)
(7, 8, 0.49107934254382407, 0.17945506185376545)
(7, 10, 0.5039863973460375, 0.166540875637825)
(7, 9, 0.5084271786845013, 0.1622250502915831)
(3, 16, 0.5854078410905614, 0.09769867219773573)
(11, 15, 0.6078403036121841, 0.08248495997060286)
(11, 12, 0.6117508366561312, 0.07999366541418035)
(11, 14, 0.6143250892846777, 0.07837943913305528)
(7, 15, 0.61434296857857, 0.0783682989514553)
(11, 13, 0.6418693091302577, 0.062367525899068396)
(7, 12, 0.6546561885468668, 0.0557004305918562)
(7, 14, 0.6707560191185081, 0.0479741983299992)
(5, 11, 0.6718253787424007, 0.04748687844655247)
(2, 5, 0.6766107447027137, 0.04534498175258126)
(7, 13, 0.6822512208630556, 0.04290119366812502)
(2, 6, 0.6825280928737069, 0.04278347041803731)
(4, 5, 0.7013146714129472, 0.03527433978409136)
(4, 6, 0.70449333523258, 0.03409538919853592)
(6, 11, 0.7089836522873789, 0.03247406641226096)
(6, 7, 0.7247143193948989, 0.027192621323950724)
(5, 7, 0.7274600929311222, 0.026332844314576203)
(2, 14, 0.7351285050105286, 0.024026718497918525)
(2, 13, 0.7476926397405631, 0.02054312907350798)
(4, 14, 0.7565315230160619, 0.018304315533117173)
(4, 13, 0.7669665922159639, 0.01587744846333482)
(2, 12, 0.7675481464340423, 0.015748902066838728)
(2, 15, 0.7840168603497361, 0.012391094962899467)
(4, 12, 0.7856835267755796, 0.012080826160644358)
(4, 15, 0.8019234541619935, 0.009326472344891834)
(7, 11, 0.8690287724555406, 0.0023497228116194464)
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