Index

acre, 217	cable, 217
AE, 217	calibration, 78
ampere, 215	correction, 80
analysis of variance, 48	table, 80
Angstrom, 217	calorie, 218
ANOVA, see analysis of	candela, 215
variance	Cauchy distribution, 43
are, 217	cdf, see cumulative distribution
array methods	Celsius, 217
Python code, 170	centi, 215
atmosphere, 218	central limit theorem, 41, 148
atto, 215	central moments, 30
avdp, 217	characteristic function, 31, 141
average	chi-squared distribution, 47
of data series, 57	cdf, 199
standard uncertainty, 154	data sheet, 199
	equation, 199
barn, 217	moments, 199
barrel, 217	Python code, 184
Bayes, 112	table, 200
Bayesian inference, 114	chi-squared test, 95
becquerel, 216	combining uncertainties, 135
Bernouilli trial, 33	compass example, 80
bias, 138	complementary error function, 39
binomial	confidence interval, 11, 31
coefficient, 33	Student's t-distribution, 60
distribution, 32, 143	confidence limit, 31
Python code, 173	constants, see physical constants
bivariate normal distribution, 206	contour
block average	plot for chi-square, 103
method, 155	python code, 184
Python code, 195	convolution, 141
bootstrap method, 65	correlation coefficient, 135
Python code, 175	between parameters, 99
box and whisker display, 8	between coordinates, 91
btu, 218	between parameters, 90
,	r r r

220

correlation length, 59, 152, 154	Eadie–Hofstee plot, 75
coulomb, 216	ellipsoid for chi-square, 164
covariance, 135	enzyme kinetics, 75
covariance matrix, 99, 161	epistemic probability, see
of parameters, 163	probability
Python code, 187	erf, see error function
criterion	erfc, see complementary error
one-sided, 64	function
two-sided, 64	
cumulative distribution	erg, 218
	error, see inaccuracy
function (cdf), 31, 32	error function, 39
of data, 54	error propagation
Python code, 171	in functions, 21, 136
curie, 218	in products, 21, 136
	in sums, 21, 135
data	Monte Carlo, 23
average, 8, 57	with covariances, 22, 136
correlation length, 59	error sum of squares,
cumulative distribution, 54	48, 106
distribution function, 54	
graphical presentation, 71	errors
histogram, 54	classification, 18
mean squared deviation, 8, 57	random, 19
processing, 53	systematic, 18, 138
	truncation, 58
properties, 6	estimate
root-mean-squared deviation, 8	best fit parameters, 88
debye, 218	excess, 60
deca, 215	mean, 58
deci, 215	minimal variance, 158
decile, 31	rank-based, 64
decimal separator, 9	robust, 63
degrees of freedom	sign-based, 64
chi-squared test, 96	skewness, 60
Student's t-distribution, 60	<i>'</i>
density function, 27	standard deviation, 58
derived SI units, 216	unbiased, 162
deviation	variance, 58, 151
systematic, 18	variance of the mean, 154
direct probability, see probability	esu, 218
discrete probability distribution, 27	exa, 215
distribution	excess, 30
cumulative of data, 54	estimate, 60
distribution functions, see	expectation, 29
probability distributions	expected value, see
binomial, 143	expectation
multinomial, 144	experimental design, 48
drachme, 217	explanatory variable, 87
dyne, 217	exponential distribution, 45
dyne, 217	exponential distribution, 43

F-distribution, 47 data sheet, 201 pdf and cdf, 201 Python code, 193 reflexive relation, 201 table, 202	inch, 217 indicator function, 54 inverse probability, <i>see</i> probability inverse survival function, 32 isf, <i>see</i> inverse survival function
use in ANOVA, 201 F-ratio, 48 F-test	jackknife procedure, 155 joule, 216
on ANOVA, 49 on functional fit, 106 factorial design, 48 Fahrenheit, 217 farad, 216 fathom, 217 femto, 215 fermi, 217	kelvin, 215 kgforce, 217 kilo, 215 kilogram, 215 kurtosis, 30 kWh, 218
fit, see least-squares fit fit (Python code), 189 fl.oz., 217 foot, 217 Fourier transform Python code, 194 functions fit to data, 84 linearization, 73 FWHH, 43 gallon, 217 Gauss, 218 Gauss function, 37, 205 giga, 215 grain, 217 gray, 216	least-squares fit, 72, 84, 160 accuracies, 98 best parameter estimates, 88 correlation coefficient, 204 covariances, 99 data sheet, 203 general, 92 general equations, 203 harmonics, Python code, 182 linear parameters a,b, 160 linear regression, 87, 161, 204 nonlinear, 93, 165 nonlinear example, 93 parameter covariances, 163, 203 Python program, 189 residuals, 85 sum of square deviations, 161
Hanes plot, 75 hartree, 219 hazard function, 45 hecto, 215 henry, 216 histogram, 54 python code, 169 horse power, 218 inaccuracy absolute, 10 graphical estimate, 77 relative, 10	uncertainties parameters, 89 uncertainty in <i>x</i> , 88 urease, python code, 183 variances, 89 lifetime distributions, 45 likelihood, 86, 163 linear regression, 87, 161 uncertain x, 88 linearization of functions, 73 Lineweaver–Burk plot, 75 liter, 217 log plot Python code, 172 log-normal distribution, 42
hecto, 215 henry, 216 histogram, 54 python code, 169 horse power, 218 inaccuracy absolute, 10	lifetime distributions, 45 likelihood, 86, 163 linear regression, 87, 161 uncertain x, 88 linearization of functions, 73 Lineweaver–Burk plot, 75 liter, 217 log plot

lumen, 216 lux, 216 marginal distribution, 118 mass function, 27 matrix notation, 160 maxwell, 218 mean, 11, 29 estimate, 58 mean squared deviation, 57 median, 8, 11, 31 mega, 215 mile, 217 mill, 217 mile, 217 mill, 218 mode, 11 mol, 215 molar, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 multivariate normal distribution, 206 characteristic function, 205 data sheet, 205 moler, 208 moler, 217 nolinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 multivariate, 206 one-sided excess table, 208 ene-sided criterion, 64 onne-sided criterion, 64 onte-sided criterion, 61 pdf, see probability densit	Lorentz distribution, 43	table, 205
marginal distribution, 118 mass function, 27 matrix notation, 160 maxwell, 218 mean, 11, 29 estimate, 58 mean squared deviation, 57 median, 8, 11, 31 mega, 215 meter, 215 Michaelis–Menten kinetics, 75 mil, 217 mile, 217 mile, 217 mile, 218 mode, 11 mol, 215 molar, 14 monent, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 nautical mile, 217 newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 monents, 205 multivariate, 206 one-sided excess table, 208 oerstedt, 218 ohm, 216 one-sided criterion, 64 onc-sided criterin, 64 onc-siden siterious, 216 pascel, 216 pdf, see probability d	lumen, 216	two-sided excess table, 207
marginal distribution, 27 matrix notation, 160 maxwell, 218 mean, 11, 29 estimate, 58 mean squared deviation, 57 median, 8, 11, 31 mega, 215 michaelis–Menten kinetics, 75 milc, 217 mill, 217 mill, 217 mill, 218 mode, 11 mol, 215 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 characteristic function, 205 data sheet, 206 characteristic function, 205 one-sided criterion, 64 one-sided criterion, 217 pascal, 216 pdf, see probability density function percentile, 8, 31 percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 172 peta, 215 phot, 218 physical probability, 19 poise, 218 Poisson distribution, 36, 144 mell,	lux, 216	
marginal distribution, 27 matrix notation, 160 maxwell, 218 mean, 11, 29 estimate, 58 mean squared deviation, 57 median, 8, 11, 31 mega, 215 michaelis–Menten kinetics, 75 milc, 217 mill, 217 mill, 217 mill, 218 mode, 11 mol, 215 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 characteristic function, 205 data sheet, 206 characteristic function, 205 one-sided criterion, 64 one-sided criterion, 217 pascal, 216 pdf, see probability density function percentile, 8, 31 percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 172 peta, 215 phot, 218 physical probability, 19 poise, 218 Poisson distribution, 36, 144 mell,		oerstedt, 218
marginal distribution, 118 mass function, 27 matrix notation, 160 maxwell, 218 mean, 11, 29 estimate, 58 mean squared deviation, 57 median, 8, 11, 31 mega, 215 meter, 215 mile, 217 mile, 217 mile, 217 mile, 218 mode, 11 mol, 215 molar, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 nautical mile, 217 newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 multivariate, 206 one-sided criterion, 64 ounce, 217 outliers, 63 parsec, 217 pascal, 216 pdf, see probability density function percentile, 8, 31 percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 poundforce, 217 poundforce, 217 prior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 prior probability density function, 27 direct, 111 epistemic, 111 inverse, 111 morese, 111 posterior, 113 prior, 114 subjective, 111 probability density		· · · · · · · · · · · · · · · · · · ·
mast function, 27 matrix notation, 160 maxwell, 218 mean, 11, 29 estimate, 58 mean squared deviation, 57 median, 8, 11, 31 mega, 215 meter, 215 Michaelis–Menten kinetics, 75 mil, 217 mile, 217 mile, 217 milli, 215 mode, 11 mol, 215 mode, 11 mol, 215 molar, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 nautical mile, 217 newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 multivariate, 206 one-sided excess table, 208 matrix notation, 160 ounce, 217 outliers, 63 parsec, 217 pascal, 216 pdf, see probability density function percentile, 8, 31 percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pondforce, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density		
matrix notation, 160 maxwell, 218 mean, 11, 29 estimate, 58 mean squared deviation, 57 median, 8, 11, 31 mega, 215 meter, 215 mieter, 215 Michaelis–Menten kinetics, 75 micro, 215 mil, 217 mile, 217 mile, 217 mile, 218 mode, 11 mol, 215 molar, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 multivariate normal distribution, 206 characteristic function, 205 data sheet, 205 multivariate, 206 one-sided excess table, 208 outliers, 63 outliers, 63 outliers, 63 outliers, 63 outliers, 63 parsec, 217 pascal, 216 pdf, see probability density function percentile, 8, 31 percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 prior probability, 114 probability density function data sheet, 206 population statistics, 46 posterior probability, 114 probability dansity function metrode, 172 prior probability, 114 probability data sheet, 206 mean and variance, 36 population statistics, 46 posterior probability, 114 probability dansity function percentile, 8, 31 percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 prython code, 172 pota, 215 po	, .	
maxwell, 218 mean, 11, 29 estimate, 58 mean squared deviation, 57 median, 8, 11, 31 mega, 215 meter, 215 micro, 215 mil, 217 mile, 217 milli, 215 minimal variance estimate, 158 mm Hg, 218 mode, 11 mol, 215 molar, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 multivariate, 206 one-sided excess table, 208 parsec, 217 pascal, 216 pdf, see probability density function percentile, 8, 31 percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 111 probability density function	· ·	
estimate, 58 mean squared deviation, 57 median, 8, 11, 31 mega, 215 meter, 215 Michaelis–Menten kinetics, 75 micro, 215 mil, 217 mile, 217 mile, 217 milli, 215 mode, 11 mod, 215 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 multivariate, 206 one-sided excess table, 208 parsec, 217 pascal, 216 pdf, see probability density function percentile, 8, 31 percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 poff, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density density function percentile, 8, 31 percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability, see probability pico, 215 pint, 217 poff, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 111 probability density	· · · · · · · · · · · · · · · · · · ·	outhers, 65
mean squared deviation, 57 median, 8, 11, 31 mega, 215 meter, 215 Michaelis-Menten kinetics, 75 mil, 217 mile, 217 mile, 217 mile, 218 mode, 11 mol, 215 molar, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 206 one-sided excess table, 208 pascal, 216 pdf, see probability density function percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 prior probability, 114 probability density function percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 111 poundforce, 217 prior probability, 111 probability density	mean, 11, 29	managa 217
median, 8, 11, 31 mega, 215 meter, 215 Michaelis–Menten kinetics, 75 micro, 215 mil, 217 milli, 217 milli, 215 minimal variance estimate, 158 mm Hg, 218 mode, 11 mol, 215 molar, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 206 one-sided excess table, 208 pdf, see probability density function percentile, 8, 31 percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability pico, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 pound, 217 poundforce, 217 prior probability, 111 probability density	estimate, 58	•
mega, 215 meter, 215 Michaelis-Menten kinetics, 75 micro, 215 mil, 217 mille, 217 milli, 215 mode, 11 mol, 215 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 nautical mile, 217 newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 208 function percentile, 8, 31 percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 mass function, 27 physical, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density	mean squared deviation, 57	
meter, 215 micro, 215 micro, 215 mil, 217 mile, 217 mile, 218 mode, 11 mol, 215 molar, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 208 percentile, 8, 31 percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density	median, 8, 11, 31	
Michaelis–Menten kinetics, 75 micro, 215 mil, 217 mile, 217 milli, 215 minimal variance estimate, 158 mm Hg, 218 mode, 11 mol, 215 molar, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 208 percentiles python code, 172 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density	mega, 215	
micro, 215 mil, 217 mile, 217 milli, 215 minimal variance estimate, 158 mm Hg, 218 mode, 11 mol, 215 molar, 14 mole, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 mautical mile, 217 newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 209 python code, 172 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density	meter, 215	1
milt, 217 mile, 217 mile, 217 mill, 215 minimal variance estimate, 158 mm Hg, 218 mode, 11 mol, 215 molar, 14 mole, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 36, 144 multivariate normal distribution, 206 nautical mile, 217 newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 multivariate, 206 one-sided excess table, 208 peta, 215 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 prior probability, 114 probability density function, 27 direct, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density	Michaelis–Menten kinetics, 75	•
mile, 217 milli, 215 minimal variance estimate, 158 mm Hg, 218 mode, 11 mol, 215 molar, 14 mole, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 208 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 inverse, 111 posterior, 113 posterior, 114 subjective, 111 probability density	micro, 215	
mile, 217 milli, 215 minimal variance estimate, 158 mm Hg, 218 mode, 11 mol, 215 molar, 14 mole, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 36, 144 multivariate normal distribution, 206 nautical mile, 217 newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 208 phot, 218 physical constants accuracies, 210 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 inverse, 111 inverse, 111 motor, 216 physical constants accuracies, 210 data sheet, 209 python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability posterior probability, 114 probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 inverse, 111 inverse, 111 posterior, 113 posterior, 114 subjective, 111 probability density	mil, 217	•
milli, 215 minimal variance estimate, 158 mm Hg, 218 mode, 11 mol, 215 molar, 14 mole, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 36, 144 multivariate normal distribution, 206 nautical mile, 217 newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 208 python code, 170 table of values, 209, 210 physical probability, see probability poise, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density		± '
minimal variance estimate, 158 mm Hg, 218 mode, 11 mol, 215 molar, 14 mole, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density		physical constants
mm Hg, 218 mode, 11 mol, 215 molar, 14 mole, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 209 Python code, 170 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 posterior, 113 prior, 114 subjective, 111 probability density		
mode, 11 mol, 215 molar, 14 mole, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 36, 144 multivariate normal distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 multivariate, 206 one-sided excess table, 208 molar, 14 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density		
mol, 215 molar, 14 mole, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 36, 144 multivariate normal distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 multivariate, 206 one-sided excess table, 208 table of values, 209, 210 physical probability, see probability pico, 215 pint, 217 pomf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 probability density		Python code, 170
molar, 14 mole, 14 mole, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 36, 144 multivariate normal distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 moments, 205 multivariate, 206 one-sided excess table, 208 physical probability, see probability pico, 215 pint, 217 point, 217 poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density	•	table of values, 209, 210
mole, 14 moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 36, 144 multivariate normal distribution, 206 nautical mile, 217 newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 multivariate, 206 one-sided excess table, 208 moment, 30 pint, 217 pmf, 27, see probability poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density	*	physical probability, see
moment, 30 moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 36, 144 multivariate normal distribution, 206 nautical mile, 217 newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 multivariate, 206 one-sided excess table, 208 pico, 215 pint, 217 point, 217 point, 217 poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 inverse, 111 inverse, 111 posterior, 113 point, 217 mean and variance, 36 population statistics, 46 posterior probability, 114 probability, 114 probability density function, 27 physical, 111 posterior, 113 posterior, 114 subjective, 111 probability density	,	probability
moment-generating function, 141 Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 36, 144 multivariate normal distribution, 206 nautical mile, 217 newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 multivariate, 206 one-sided excess table, 208 pint, 217 pmf, 27, see probability mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density	*	pico, 215
Monte Carlo methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 36, 144 multivariate normal distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 moments, 206 methods, 23 poise, 218 Poisson distribution, 36, 146 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density	· · · · · · · · · · · · · · · · · · ·	pint, 217
methods, 23 Python code, 173 msd, see mean squared deviation multinomial distribution, 36, 144 multivariate normal distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 moments, 206 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density		
Python code, 173 msd, see mean squared deviation multinomial distribution, 36, 144 multivariate normal distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 moments, 206 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density		
msd, see mean squared deviation multinomial distribution, 36, 144 multivariate normal distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 moments, 206 multivariate, 206 one-sided excess table, 208 mean and variance, 36 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density	*	1 /
multinomial distribution, 36, 144 multivariate normal distribution, 206 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 multivariate, 206 one-sided excess table, 208 population statistics, 46 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density		
multivariate normal distribution, 206 posterior probability, 113 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 multivariate, 206 one-sided excess table, 208 posterior probability, 113 pound, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density		•
pound, 217 poundforce, 217 prior probability, 114 probability newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 moments, 206 multivariate, 206 one-sided excess table, 208 pound, 217 poundforce, 217 prior probability, 114 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density		
poundforce, 217 prior probability, 114 probability newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 moments, 206 multivariate, 206 one-sided excess table, 208 poundforce, 217 probability, 114 proba	*	
prior probability, 114 nautical mile, 217 newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 moments, 205 multivariate, 206 one-sided excess table, 208 prior probability, 114 probability	206	* ·
nautical mile, 217 newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 multivariate, 206 multivariate, 206 multivariate, 206 one-sided excess table, 208 probability density function, 27 direct, 111 epistemic, 111 inverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density		
newton, 216 non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 moments, 205 multivariate, 206 one-sided excess table, 208 density function, 27 direct, 111 epistemic, 111 noverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density	nautical mile 217	
non-SI units, 217 nonlinear fit, see least-squares fit normal distribution, 37 bivariate, 206 characteristic function, 205 data sheet, 205 moments, 205 moments, 205 multivariate, 206 one-sided excess table, 208 direct, 111 epistemic, 111 miverse, 111 mass function, 27 physical, 111 posterior, 113 prior, 114 subjective, 111 probability density	•	1 3
nonlinear fit, see least-squares fit normal distribution, 37 inverse, 111 mass function, 27 characteristic function, 205 physical, 111 posterior, 113 moments, 205 prior, 114 subjective, 111 one-sided excess table, 208 probability density		
normal distribution, 37 inverse, 111 bivariate, 206 mass function, 27 characteristic function, 205 physical, 111 data sheet, 205 posterior, 113 moments, 205 prior, 114 multivariate, 206 subjective, 111 one-sided excess table, 208 probability density		
bivariate, 206 mass function, 27 characteristic function, 205 physical, 111 data sheet, 205 posterior, 113 moments, 205 prior, 114 multivariate, 206 subjective, 111 one-sided excess table, 208 probability density		
characteristic function, 205 physical, 111 data sheet, 205 posterior, 113 moments, 205 prior, 114 multivariate, 206 subjective, 111 one-sided excess table, 208 probability density	•	*
data sheet, 205 posterior, 113 prior, 114 prior, 114 subjective, 111 one-sided excess table, 208 posterior, 113 prior, 114 probability density	•	•
moments, 205 prior, 114 multivariate, 206 subjective, 111 one-sided excess table, 208 probability density	•	1 2
multivariate, 206 subjective, 111 one-sided excess table, 208 probability density	•	•
one-sided excess table, 208 probability density		1
	•	
standardized, 38 function, 32	•	
	standardized, 38	function, 32

probability distributions, 27 binomial, 32, 143 bivariate, 212 Cauchy, 43 cdf, 212 central moment, 30 characteristic function, 31, 141 characteristic functions, 211 chi-squared, 47 continuous, 27 cumulative, 31 data sheet, 211 discrete, 27 excess, 30	cumulative distributions, 171 F-distribution, 193 generate contour, 184 harmonic fit, 182 histogram, 169 instructions for use, 169 logarithmic plot, 172 Monte Carlo, 173 nonlinear fit, 183 pdf by Fourier transform, 194 percentiles, 172 physical constants, 170 plotsvg, 169 program "fit", 189
expectation, 211	program "report", 176
exponential, 45	Weibull distributions, 174
F-distribution, 47, 201	
from Poisson to normal, 146 hazard function, 45	quart, 217
kurtosis, 30	quartile, 8, 31
life time, 45	
log-normal, 42	röntgen, 218
Lorentz, 43	rad, 218
moment, 30	random errors, 19
multinomial, 36	rank-based estimates, 64
normal, 37, 205	rank-based methods, 63
normalization, 29	regression
Poisson, 36, 146	linear, 87
properties, 29	regression sum of squares, 48, 106
skewness, 30	rem, 218
Student's t-distribution, 47, 213	report (Python code), 176
survival function, 212	residuals, 85
Weibull, 47	rms, see root-mean-squared
probability function	deviation
meaning of, 32	rms deviation, 30
probability paper, 40	rms error, see rms deviation
probability scale, 40	robust estimates, 63
propagation, see error propagation	root-mean-squared deviation, 57
propagation of errors, 19	rounding numbers, 10
propagation of uncertainties, 20	
Python	s.d., see standard deviation
array methods, 170	second, 215
binomial functions, 173	separator
block average, 195	decimal, 9
bootstrap method, 175	sf, see survival function
chi-squared cdf, 184	SI units
covariance from B matrix, 187	basic, 215
covariance matrix, 187	derived, 216

siamana 216	true aided suitanian 64
siemens, 216	two-sided criterion, 64
sievert, 216	typographical conventions, 14
sign-based estimates, 64	
significant deviation, 41	uncertainties
significant figures, 9	combining, 135
skewness, 30	propagation, 20
estimate, 60	random, 19
Snedecor, see F-distribution	systematic, 22
SSE, see error sum of squares	units
SSQ, see sum of square deviations	atomic, 219
SSR, see regression sum of squares	basic SI units, 215
SST, see total sum of squares	data sheet, 215
standard deviation, 30	derived SI, 216
accuracy, 60, 157	molar, 14
estimate, 58	mole, 14
of fitted parameters, 99	molecular, 219
standard error, see standard	non-SI, 13, 217, 218
uncertainty	prefixes, 215
standard uncertainty, 30	SI, 13
statistical weights, see weights	
stilb, 218	variance, 30
stokes, 218	accuracy, 157
stone, 217	estimate, 58, 151
Student's t-distribution,	estimate with correlation, 152
47, 60	estimate without correlation,
cdf table, 214	151
data sheet, 213	of the mean, 154
equation, 213	
moments, 213	watt, 216
sufficient statistics, 116	weber, 216
sum of square deviations, 161	Weibull distribution, 47
survival function, 32	Python code, 174
systematic errors, 18, 138	weights
exponential function, 138	average, 158
	unequal, 61, 158
t distribution, see Student's	weight factor, 62
t-distribution	weighted average, 62
	weighted average, 62 weighted inaccuracy, 62
tera, 215	weighted inaccuracy, 62
tesla, 216	word 217
ton, 217	yard, 217
torr, 218	yocto, 215
total sum of squares, 106	yotta, 215
trace of a matrix, 160	. 215
transpose of a matrix, 160	zepto, 215
truncation error, 58	zetta, 215