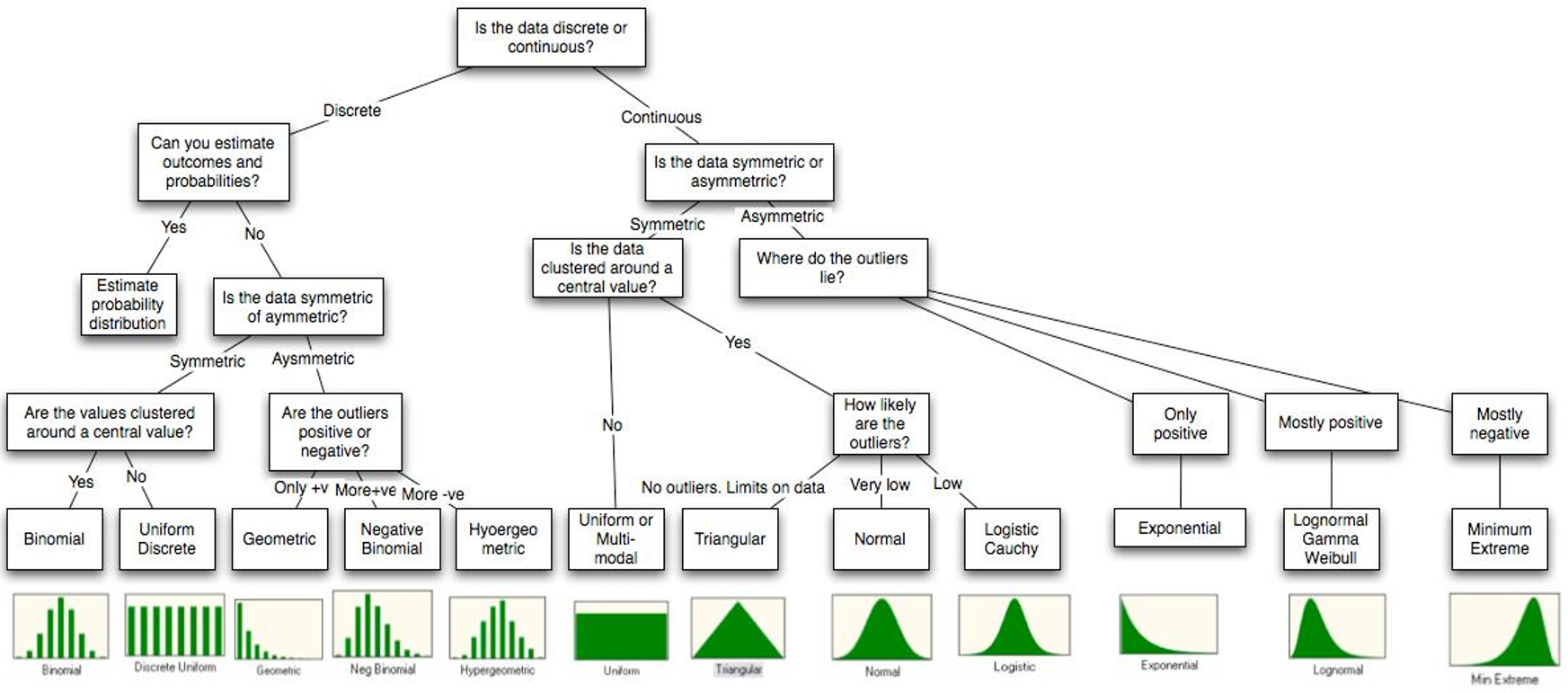
**Harold’s Statistical Distributions**

**Cheat Sheet**

22 October 2022

**PDF Selection Tree to Describe a Single Population**



Qualitative

Quantitative

**Discrete Definitions**

|  |  |  |
| --- | --- | --- |
| **Term** | **Definition** | **Description** |
| **Random Variable** | Red And Blue Dice Stock Photo - Download Image Now - 2015, Blue, Cube Shape  - iStock | A rule that assigns a number to every **outcome** in the sample space, S.  Example: Sum of a pair of dice  Derived from a probability experiment with different probabilities for each X.  **Used in discrete or finite PDFs.** |
| **Event** |  | An event assigns a value to the random variable X with probability:  Example: Sum of a pair of dice |
| **Distribution** | The distribution of a random variable is the set of all pairs *(r, p(X = r))* such that *r ∈ X(S)*. | Set of all outcomes with their probabilities.  Example: Sums of all pair of dice |
| **Sum of Probabilities** |  | A random variable has some fractional probability value for every outcome in the sample space. |
| **Histogram** | Histogram of the distribution over the sum of two dice: | |
| **PMF** | Probability Mass Function | Discrete, Qualitative |
| **PDF** | Probability Density Function | Continuous, Quantitative |

**Discrete Probability Mass Functions (Qualitative)**

|  |  |  |
| --- | --- | --- |
| **Probability Mass Function (PMF)** | **Mean** | **Standard Deviation** |
| **Uniform Discrete Distribution** | http://upload.wikimedia.org/wikipedia/commons/thumb/1/1f/Uniform_discrete_pmf_svg.svg/325px-Uniform_discrete_pmf_svg.svg.png | |
|  |  |  |
| Conditions | * All outcomes are consecutive. * All outcomes are equally likely. * Not common in nature. | |
| Variables | *a* = minimum  *b* = maximum | |
| TI-84 | NA | |
| Example | Tossing a fair die (n = 6) | |
| Online PDF Calculator | <http://www.danielsoper.com/statcalc3/calc.aspx?id=102> | |

|  |  |  |  |
| --- | --- | --- | --- |
| **Probability Mass Function (PMF)** | **Mean** | **Standard Deviation** | |
| **Binomial Distribution** | https://onlinecourses.science.psu.edu/stat414/sites/onlinecourses.science.psu.edu.stat414/files/lesson09/graph_n15_p02.gif | | |
| where |  | |  |
| *p* = probability of success  *q = (1 – p)* = probability of failure | |  |
|  | Use for large to approximate binomial distribution. | | |
| Conditions | * n is ﬁxed. * The probabilities of success () and failure () are constant. * Each trial is independent. | | |
| Variables | *n* = fixed number of trials  *p* = probability that the designated event occurs on a given trial (Symmetric if *p = 0.5*)  = Total number of times the event occurs | | |
| TI-84 | For one x value:  [2nd] [DISTR] A:binompdf(n,p,x)  [2nd] [DISTR] B:binomcdf(n,p,x)  For a range of x values [j,k]:  [2nd] [DISTR] A:binompdf( [ENTER] n, p, [↓] [↓] [ENTER] [STO>] [2nd] [3] (=L3) [ENTER]  [2nd] [LIST] [→→ MATH] 5:sum(L3,j+1,k+1) | | |
| Example | *Larry’s batting average is 0.260. If he’s at bat four times, what is the probability that he gets exactly two hits?*  Solution:  n = 4, p = 0.26, x = 2  binompdf(4,0.26,2) = 0.2221 = 22.2% | | |
| Online PDF Calculator | <http://stattrek.com/online-calculator/binomial.aspx> | | |
| **Probability Mass Function (PMF)** | **Mean** | **Standard Deviation** | |
| **Geometric Distribution** | http://msor.rsscse.org.uk/leaflets/psme/geometric.png | | |
|  |  | |  |
| Conditions | * A series of independent trials with the same probability of a given event. * Probability that it takes a specific amount of trials to get a success.   Can answer two questions:  a) Probability of getting 1st success on the trial  b) Probability of getting success on trials  Since we only count trials until the event occurs the first time, there is no need to count the arrangements, as in the binomial distribution. | | |
| Variables | *p* = probability that the event occurs on a given trial  = # of trials until the event occurs the 1st time | | |
| TI-84 | [2nd] [DISTR] E:geometpdf(p, x)  [2nd] [DISTR] F:geometcdf(p, x) | | |
| Example | *Suppose that a car with a bad starter can be started 90% of the time by turning on the ignition. What is the probability that it will take three tries to get the car started?*  Solution:  *p* = 0.90, *X* = 3  geometpdf(0.9, 3) = 0.009 = 0.9% | | |
| Online PDF Calculator | <http://www.calcul.com/show/calculator/geometric-distribution> | | |

|  |  |  |  |
| --- | --- | --- | --- |
| **Probability Mass Function (PMF)** | **Mean** | **Standard Deviation** | |
| **Poisson Distribution** | http://www.boost.org/doc/libs/1_35_0/libs/math/doc/sf_and_dist/graphs/poisson.png | | |
|  |  | |  |
| Conditions | * Events occur independently, at some average rate per interval of time/space. | | |
| Variables | = average rate  = total number of times the event occurs  There is no upper limit on | | |
| TI-84 | [2nd] [DISTR] C:poissonpdf()  [2nd] [DISTR] D:poissoncdf() | | |
| Example | *Suppose that a household receives, on the average, 9.5 telemarketing calls per week. We want to find the probability that the household receives 6 calls this week.*  Solution:  = 9.5, = 6  poissonpdf(9.5, 6) = 0.0764 = 7.64% | | |
| Online PDF Calculator | <http://stattrek.com/online-calculator/poisson.aspx> | | |

|  |  |
| --- | --- |
| **Bernoulli** | See  <http://www4.ncsu.edu/~swu6/documents/A-probability-and-statistics-cheatsheet.pdf> |
| **tnomial** |
| **Hypergeometric** |
| **Negative Binomial** |

**Continuous Probability Density Functions (Quantitative)**

|  |  |  |
| --- | --- | --- |
| **Probability Density Function (PDF)** | **Mean** | **Standard Deviation** |
| **Normal Distribution / Gaussian Distribution /**  **Bell-Shaped Curve** | http://hanswisbrun.nl/wp-content/uploads/2014/05/bell-curve.jpg | |
|  |  |  |
| Special Case: Standard Normal |  |  |
| z-Score of a Sample |  | |
| Conditions | * Symmetric, unbounded, bell-shaped. * No data is perfectly normal. Instead, a distribution is approximately normal. | |
| Variables | = mean (= median = mode)  = standard deviation  = observed value (all real numbers) | |
| TI-84 | Have scores, need area:  z-scores: [2nd] [DISTR] 1:normalpdf(z, ,  x-scores: [2nd] [DISTR] 1:normalpdf(x, ,  Have boundaries, need area:  z-scores: [2nd] [DISTR] 2:normalcdf(left-bound, right-bound)  x-scores: [2nd] [DISTR] 2:normalcdf(left-bound, right-bound, , )  Have area, need boundary:  z-scores: [2nd] [DISTR] 3:invNorm(area to left)  x-scores: [2nd] [DISTR] 3:invNorm(area to left, , ) | |
| Python | **import** scipy.stats **as** st  mean, sd, z = 0, 1, 1.5  **print**(st.norm.cdf(z, mean, sd)) # P(z **<=** 1.5)  **print**(st.norm.sf(z, mean, sd)) # P(z **>=** 1.5)  mean, sd, x = 55, 7.5, 62  **print**(st.norm.cdf(x, mean, sd)) # P(x <= 62)  **print**(st.norm.sf(x, mean, sd)) # P(x >= 62)  # P(49 < t < 60)  **print**(st.norm.cdf(60, mean, sd) - st.norm.cdf(49, mean, sd)) | |
| Example | *Suppose the mean score on the math SAT is 500 and the standard deviation is 100. What proportion of test takers earn a score between 650 and 700?*  Solution:  left-boundary = 650, right boundary =700, μ = 500, σ = 100  normalcdf(650, 700, 500, 100) = 0.0441 = ~4.4% | |
| Online PDF Calculator | <http://davidmlane.com/normal.html> | |

**Standard Normal Distribution Table:** Positive Values (Right Tail) Only

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Z** | **+0.00** | **+0.01** | **+0.02** | **+0.03** | **+0.04** | **+0.05** | **+0.06** | **+0.07** | **+0.08** | **+0.09** |
| **0.0** | 0.50000 | 0.50399 | 0.50798 | 0.51197 | 0.51595 | 0.51994 | 0.52392 | 0.52790 | 0.53188 | 0.53586 |
| **0.1** | 0.53980 | 0.54380 | 0.54776 | 0.55172 | 0.55567 | 0.55966 | 0.56360 | 0.56749 | 0.57142 | 0.57535 |
| **0.2** | 0.57930 | 0.58317 | 0.58706 | 0.59095 | 0.59483 | 0.59871 | 0.60257 | 0.60642 | 0.61026 | 0.61409 |
| **0.3** | 0.61791 | 0.62172 | 0.62552 | 0.62930 | 0.63307 | 0.63683 | 0.64058 | 0.64431 | 0.64803 | 0.65173 |
| **0.4** | 0.65542 | 0.65910 | 0.66276 | 0.66640 | 0.67003 | 0.67364 | 0.67724 | 0.68082 | 0.68439 | 0.68793 |
| **0.5** | 0.69146 | 0.69497 | 0.69847 | 0.70194 | 0.70540 | 0.70884 | 0.71226 | 0.71566 | 0.71904 | 0.72240 |
| **0.6** | 0.72575 | 0.72907 | 0.73237 | 0.73565 | 0.73891 | 0.74215 | 0.74537 | 0.74857 | 0.75175 | 0.75490 |
| **0.7** | 0.75804 | 0.76115 | 0.76424 | 0.76730 | 0.77035 | 0.77337 | 0.77637 | 0.77935 | 0.78230 | 0.78524 |
| **0.8** | 0.78814 | 0.79103 | 0.79389 | 0.79673 | 0.79955 | 0.80234 | 0.80511 | 0.80785 | 0.81057 | 0.81327 |
| **0.9** | 0.81594 | 0.81859 | 0.82121 | 0.82381 | 0.82639 | 0.82894 | 0.83147 | 0.83398 | 0.83646 | 0.83891 |
| **1.0** | 0.84134 | 0.84375 | 0.84614 | 0.84849 | 0.85083 | 0.85314 | 0.85543 | 0.85769 | 0.85993 | 0.86214 |
| **1.1** | 0.86433 | 0.86650 | 0.86864 | 0.87076 | 0.87286 | 0.87493 | 0.87698 | 0.87900 | 0.88100 | 0.88298 |
| **1.2** | 0.88493 | 0.88686 | 0.88877 | 0.89065 | 0.89251 | 0.89435 | 0.89617 | 0.89796 | 0.89973 | 0.90147 |
| **1.3** | 0.90320 | 0.90490 | 0.90658 | 0.90824 | 0.90988 | 0.91149 | 0.91308 | 0.91466 | 0.91621 | 0.91774 |
| **1.4** | 0.91924 | 0.92073 | 0.92220 | 0.92364 | 0.92507 | 0.92647 | 0.92785 | 0.92922 | 0.93056 | 0.93189 |
| **1.5** | 0.93319 | 0.93448 | 0.93574 | 0.93699 | 0.93822 | 0.93943 | 0.94062 | 0.94179 | 0.94295 | 0.94408 |
| **1.6** | 0.94520 | 0.94630 | 0.94738 | 0.94845 | 0.94950 | 0.95053 | 0.95154 | 0.95254 | 0.95352 | 0.95449 |
| **1.7** | 0.95543 | 0.95637 | 0.95728 | 0.95818 | 0.95907 | 0.95994 | 0.96080 | 0.96164 | 0.96246 | 0.96327 |
| **1.8** | 0.96407 | 0.96485 | 0.96562 | 0.96638 | 0.96712 | 0.96784 | 0.96856 | 0.96926 | 0.96995 | 0.97062 |
| **1.9** | 0.97128 | 0.97193 | 0.97257 | 0.97320 | 0.97381 | 0.97441 | 0.97500 | 0.97558 | 0.97615 | 0.97670 |
| **2.0** | 0.97725 | 0.97778 | 0.97831 | 0.97882 | 0.97932 | 0.97982 | 0.98030 | 0.98077 | 0.98124 | 0.98169 |
| **2.1** | 0.98214 | 0.98257 | 0.98300 | 0.98341 | 0.98382 | 0.98422 | 0.98461 | 0.98500 | 0.98537 | 0.98574 |
| **2.2** | 0.98610 | 0.98645 | 0.98679 | 0.98713 | 0.98745 | 0.98778 | 0.98809 | 0.98840 | 0.98870 | 0.98899 |
| **2.3** | 0.98928 | 0.98956 | 0.98983 | 0.99010 | 0.99036 | 0.99061 | 0.99086 | 0.99111 | 0.99134 | 0.99158 |
| **2.4** | 0.99180 | 0.99202 | 0.99224 | 0.99245 | 0.99266 | 0.99286 | 0.99305 | 0.99324 | 0.99343 | 0.99361 |
| **2.5** | 0.99379 | 0.99396 | 0.99413 | 0.99430 | 0.99446 | 0.99461 | 0.99477 | 0.99492 | 0.99506 | 0.99520 |
| **2.6** | 0.99534 | 0.99547 | 0.99560 | 0.99573 | 0.99585 | 0.99598 | 0.99609 | 0.99621 | 0.99632 | 0.99643 |
| **2.7** | 0.99653 | 0.99664 | 0.99674 | 0.99683 | 0.99693 | 0.99702 | 0.99711 | 0.99720 | 0.99728 | 0.99736 |
| **2.8** | 0.99744 | 0.99752 | 0.99760 | 0.99767 | 0.99774 | 0.99781 | 0.99788 | 0.99795 | 0.99801 | 0.99807 |
| **2.9** | 0.99813 | 0.99819 | 0.99825 | 0.99831 | 0.99836 | 0.99841 | 0.99846 | 0.99851 | 0.99856 | 0.99861 |
| **3.0** | 0.99865 | 0.99869 | 0.99874 | 0.99878 | 0.99882 | 0.99886 | 0.99889 | 0.99893 | 0.99896 | 0.99900 |
| **3.1** | 0.99903 | 0.99906 | 0.99910 | 0.99913 | 0.99916 | 0.99918 | 0.99921 | 0.99924 | 0.99926 | 0.99929 |
| **3.2** | 0.99931 | 0.99934 | 0.99936 | 0.99938 | 0.99940 | 0.99942 | 0.99944 | 0.99946 | 0.99948 | 0.99950 |
| **3.3** | 0.99952 | 0.99953 | 0.99955 | 0.99957 | 0.99958 | 0.99960 | 0.99961 | 0.99962 | 0.99964 | 0.99965 |
| **3.4** | 0.99966 | 0.99968 | 0.99969 | 0.99970 | 0.99971 | 0.99972 | 0.99973 | 0.99974 | 0.99975 | 0.99976 |
| **3.5** | 0.99977 | 0.99978 | 0.99978 | 0.99979 | 0.99980 | 0.99981 | 0.99981 | 0.99982 | 0.99983 | 0.99983 |
| **3.6** | 0.99984 | 0.99985 | 0.99985 | 0.99986 | 0.99986 | 0.99987 | 0.99987 | 0.99988 | 0.99988 | 0.99989 |
| **3.7** | 0.99989 | 0.99990 | 0.99990 | 0.99990 | 0.99991 | 0.99991 | 0.99992 | 0.99992 | 0.99992 | 0.99992 |
| **3.8** | 0.99993 | 0.99993 | 0.99993 | 0.99994 | 0.99994 | 0.99994 | 0.99994 | 0.99995 | 0.99995 | 0.99995 |
| **3.9** | 0.99995 | 0.99995 | 0.99996 | 0.99996 | 0.99996 | 0.99996 | 0.99996 | 0.99996 | 0.99997 | 0.99997 |
| **4.0** | 0.99997 | 0.99997 | 0.99997 | 0.99997 | 0.99997 | 0.99997 | 0.99998 | 0.99998 | 0.99998 | 0.99998 |
| **4.1** | 0.99998 | 0.99998 | 0.99998 | 0.99998 | 0.99998 | 0.99998 | 0.99998 | 0.99998 | 0.99999 | 0.99999 |
| **4.2** | 0.99999 | 0.99999 | 0.99999 | 0.99999 | 0.99999 | 0.99999 | 0.99999 | 0.99999 | 0.99999 | 1.00000 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Probability Density Function (PDF)** | **Mean** | | **Standard Deviation** |
| **Student’s t Distribution** | http://ci.columbia.edu/ci/premba_test/c0331/images/s7/6317178747.gif  This distribution was first studied by William Gosset, who published under the pseudonym *Student*. It has a wider spread because of a slightly larger standard deviation. | | |
| Degrees of Freedom | *df* = degrees of freedom =  A positive whole number that indicates the lack of restrictions in our calculations. The number of values in a calculation can vary.  e.g., means 1 equation 2 unknowns | | |
|  | | (always) |  |
| Where the Gamma function | |  |  |
| t-Score of a Sample |  | | |
| Conditions | * Is typically used:   1. With small sample sizes or   2. When the population standard deviation is unknown * Similar in shape to the normal distribution. * Used for inference about means (Use for variance). | | |
| Variables | x = observed value  *df* = degrees of freedom = | | |
| TI-84 | [2nd] [DISTR] 5:tpdf(x, df)  [2nd] [DISTR] 6:tcdf(-, t, df) | | |
| Python | **import** scipy.stats **as** st  mean, sd, t, df = 0, 1, -0.25, 30  **print**(st.t.cdf(t, df, mean, sd)) # P(t **<=** -0.25)  **print**(st.t.sf(t, df, mean, sd)) # P(t **>=** 1.5)  # P(49 < t < 60)  **print**(st.t.cdf(60, df, mean, sd) - st.t.cdf(49, df, mean, sd))  **print**(st.t.ppf(0.135, df, mean, sd)) # P(t < t\*) = p = 0.135  **print**(st.t.isf(0.405, df, mean, sd)) # P(t > t\*) = p = 0.405 | | |
| Example | *Suppose scores on an IQ test are normally distributed, with a population mean of 100. Suppose 20 people are randomly selected and tested. The standard deviation in the sample group is 15. What is the probability that the average test score in the sample group will be at most 110?*  Solution:  n=20, df=20-1=19, μ = 100, =110, s = 15  tcdf(-1E99, (110-100)/(15/sqrt(20)), 19) = 0.996 = ~99.6% | | |
| Online PDF Calculator | <http://keisan.casio.com/exec/system/1180573204> | | |

**Student’s t Distribution Table:**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cum. Prob.** |  |  |  |  |  |  |  |  |  |  |  |
| **1-tail α** | **0.50** | **0.25** | **0.20** | **0.15** | **0.10** | **0.05** | **0.025** | **0.01** | **0.005** | **0.001** | **0.0005** |
| **2-tails α** | **1.00** | **0.50** | **0.40** | **0.30** | **0.20** | **0.10** | **0.05** | **0.02** | **0.01** | **0.002** | **0.001** |
| ***df*** |  |  |  |  |  |  |  |  |  |  |  |
| **1** | 0.0000 | 1.0000 | 1.3764 | 1.9626 | 3.0777 | 6.3138 | 12.7062 | 31.8205 | 63.6567 | 318.3088 | 636.6192 |
| **2** | 0.0000 | 0.8165 | 1.0607 | 1.3862 | 1.8856 | 2.9200 | 4.3027 | 6.9646 | 9.9248 | 22.3271 | 31.5991 |
| **3** | 0.0000 | 0.7649 | 0.9785 | 1.2498 | 1.6377 | 2.3534 | 3.1824 | 4.5407 | 5.8409 | 10.2145 | 12.9240 |
| **4** | 0.0000 | 0.7407 | 0.9410 | 1.1900 | 1.5332 | 2.1318 | 2.7764 | 3.7469 | 4.6041 | 7.1732 | 8.6103 |
| **5** | 0.0000 | 0.7267 | 0.9195 | 1.1558 | 1.4759 | 2.0150 | 2.5706 | 3.3649 | 4.0321 | 5.8934 | 6.8688 |
| **6** | 0.0000 | 0.7176 | 0.9057 | 1.1342 | 1.4398 | 1.9432 | 2.4469 | 3.1427 | 3.7074 | 5.2076 | 5.9588 |
| **7** | 0.0000 | 0.7111 | 0.8960 | 1.1192 | 1.4149 | 1.8946 | 2.3646 | 2.9980 | 3.4995 | 4.7853 | 5.4079 |
| **8** | 0.0000 | 0.7064 | 0.8888 | 1.1081 | 1.3968 | 1.8595 | 2.3060 | 2.8965 | 3.3554 | 4.5008 | 5.0413 |
| **9** | 0.0000 | 0.7027 | 0.8834 | 1.1000 | 1.3830 | 1.8331 | 2.2622 | 2.8214 | 3.2498 | 4.2968 | 4.7809 |
| **10** | 0.0000 | 0.6998 | 0.8791 | 1.0931 | 1.3722 | 1.8125 | 2.2281 | 2.7638 | 3.1693 | 4.1437 | 4.5869 |
| **11** | 0.0000 | 0.6974 | 0.8755 | 1.0877 | 1.3634 | 1.7959 | 2.2010 | 2.7181 | 3.1058 | 4.0247 | 4.4370 |
| **12** | 0.0000 | 0.6955 | 0.8726 | 1.0832 | 1.3562 | 1.7823 | 2.1788 | 2.6810 | 3.0545 | 3.9296 | 4.3178 |
| **13** | 0.0000 | 0.6938 | 0.8702 | 1.0795 | 1.3502 | 1.7709 | 2.1604 | 2.6503 | 3.0123 | 3.8520 | 4.2208 |
| **14** | 0.0000 | 0.6924 | 0.8681 | 1.0763 | 1.3450 | 1.7613 | 2.1448 | 2.6245 | 2.9768 | 3.7874 | 4.1405 |
| **15** | 0.0000 | 0.6912 | 0.8662 | 1.0735 | 1.3406 | 1.7531 | 2.1314 | 2.6025 | 2.9467 | 3.7328 | 4.0728 |
| **16** | 0.0000 | 0.6901 | 0.8647 | 1.0711 | 1.3368 | 1.7459 | 2.1199 | 2.5835 | 2.9208 | 3.6862 | 4.0150 |
| **17** | 0.0000 | 0.689 | 0.8633 | 1.0690 | 1.3334 | 1.7396 | 2.1098 | 2.5669 | 2.8982 | 3.6458 | 3.9651 |
| **18** | 0.0000 | 0.6884 | 0.8620 | 1.0672 | 1.3304 | 1.7341 | 2.1009 | 2.5524 | 2.8784 | 3.6105 | 3.9216 |
| **19** | 0.0000 | 0.6876 | 0.8610 | 1.0655 | 1.3277 | 1.7291 | 2.0930 | 2.5395 | 2.8609 | 3.5794 | 3.8834 |
| **20** | 0.0000 | 0.6870 | 0.8600 | 1.0640 | 1.3253 | 1.7247 | 2.0860 | 2.5280 | 2.8453 | 3.5518 | 3.8495 |
| **21** | 0.0000 | 0.6864 | 0.8591 | 1.0627 | 1.3232 | 1.7207 | 2.0796 | 2.5176 | 2.8314 | 3.5272 | 3.8193 |
| **22** | 0.0000 | 0.6858 | 0.8583 | 1.0614 | 1.3212 | 1.7171 | 2.0739 | 2.5083 | 2.8188 | 3.5050 | 3.7921 |
| **23** | 0.0000 | 0.6853 | 0.8575 | 1.0603 | 1.3195 | 1.7139 | 2.0687 | 2.4999 | 2.8073 | 3.4850 | 3.7676 |
| **24** | 0.0000 | 0.6848 | 0.8569 | 1.0593 | 1.3178 | 1.7109 | 2.0639 | 2.4922 | 2.7969 | 3.4668 | 3.7454 |
| **25** | 0.0000 | 0.6844 | 0.8562 | 1.0584 | 1.3163 | 1.7081 | 2.0595 | 2.4851 | 2.7874 | 3.4502 | 3.7251 |
| **26** | 0.0000 | 0.6840 | 0.8557 | 1.0575 | 1.3150 | 1.7056 | 2.0555 | 2.4786 | 2.7787 | 3.4350 | 3.7066 |
| **27** | 0.0000 | 0.6837 | 0.8551 | 1.0567 | 1.3137 | 1.7033 | 2.0518 | 2.4727 | 2.7707 | 3.4210 | 3.6896 |
| **28** | 0.0000 | 0.6834 | 0.8546 | 1.0560 | 1.3125 | 1.7011 | 2.0484 | 2.4671 | 2.7633 | 3.4082 | 3.6739 |
| **29** | 0.0000 | 0.6830 | 0.8542 | 1.0553 | 1.3114 | 1.6991 | 2.0452 | 2.4620 | 2.7564 | 3.3962 | 3.6594 |
| **30** | 0.0000 | 0.6828 | 0.8538 | 1.0547 | 1.3104 | 1.6973 | 2.0423 | 2.4573 | 2.7500 | 3.3852 | 3.6460 |
| **40** | 0.0000 | 0.6807 | 0.8507 | 1.0500 | 1.3031 | 1.6839 | 2.0211 | 2.4233 | 2.7045 | 3.3069 | 3.5510 |
| **50** | 0.0000 | 0.6794 | 0.8489 | 1.0473 | 1.2987 | 1.6759 | 2.0086 | 2.4033 | 2.6778 | 3.2614 | 3.4960 |
| **60** | 0.0000 | 0.6786 | 0.8477 | 1.0455 | 1.2958 | 1.6706 | 2.0003 | 2.3901 | 2.6603 | 3.2317 | 3.4602 |
| **70** | 0.0000 | 0.6780 | 0.8468 | 1.0442 | 1.2938 | 1.6669 | 1.9944 | 2.3808 | 2.6479 | 3.2108 | 3.4350 |
| **80** | 0.0000 | 0.6776 | 0.8461 | 1.0432 | 1.2922 | 1.6641 | 1.9901 | 2.3739 | 2.6387 | 3.1953 | 3.4163 |
| **90** | 0.0000 | 0.6772 | 0.8456 | 1.0424 | 1.2910 | 1.6620 | 1.9867 | 2.3685 | 2.6316 | 3.1833 | 3.4019 |
| **100** | 0.0000 | 0.6770 | 0.8452 | 1.0418 | 1.2901 | 1.6602 | 1.9840 | 2.3642 | 2.6259 | 3.1737 | 3.3905 |
| **1000** | 0.0000 | 0.6747 | 0.8420 | 1.0370 | 1.2824 | 1.6464 | 1.9623 | 2.3301 | 2.5808 | 3.0984 | 3.3003 |
| **→ z** | 0.0000 | 0.6745 | 0.8416 | 1.0364 | 1.2816 | 1.6449 | 1.9600 | 2.3263 | 2.5758 | 3.0902 | 3.2905 |
|  | **0%** | **50%** | **60%** | **70%** | **80%** | **90%** | **95%** | **98%** | **99%** | **99.8%** | **99.9%** |
|  | **Confidence Level C** | | | | | | | | | | | |

|  |  |  |
| --- | --- | --- |
| **Probability Density Function (PDF)** | **Mean** | **Standard Deviation** |
| **F Distribution** | F-distribution - Wikipedia  This distribution is also known as **Snedecor's *F* distribution** or the **Fisher–Snedecor distribution** (after [Ronald Fisher](https://en.wikipedia.org/wiki/Ronald_Fisher) and [George W. Snedecor](https://en.wikipedia.org/wiki/George_W._Snedecor)). | |
| Parameters | *d*1, *d*2 > 0 degrees of freedom | |
|  |  |  |
| Conditions | * The F-distribution with *d*1 and *d*2 degrees of freedom is the distribution of where  {\textstyle S\_{1}}and {\textstyle S\_{2}}are independent [random variables](https://en.wikipedia.org/wiki/Random_variable) with [chi-square distributions](https://en.wikipedia.org/wiki/Chi-square_distribution) with respective degrees of freedom  {\textstyle d\_{1}}and {\textstyle d\_{2}}. * Arises frequently as the [null distribution](https://en.wikipedia.org/wiki/Null_distribution) of a [test statistic](https://en.wikipedia.org/wiki/Test_statistic), most notably in the [analysis of variance](https://en.wikipedia.org/wiki/Analysis_of_variance) (ANOVA) and other [*F*-tests](https://en.wikipedia.org/wiki/F-test). | |
| Variables | x = observed value | |
| TI-84 | [2nd] [DISTR] 9: fpdf(x, )  [2nd] [DISTR] 0: fcdf(-, t, ) | |
| Example |  | |
| Online PDF Calculator | <https://stattrek.com/online-calculator/f-distribution.aspx> | |

|  |  |  |
| --- | --- | --- |
| **Probability Density Function (PDF)** | **Mean** | **Standard Deviation** |
| **Gamma Distribution** | Probability density plots of gamma distributions  The gamma function is the continuous version of the discrete factorial function, n!. | |
| Parameters | k > 0 shape  θ > 0 scale | |
|  |  |  |
| Where the Gamma function |  | Where the Gamma function |
| Conditions | * The [exponential distribution](https://en.wikipedia.org/wiki/Exponential_distribution), [Erlang distribution](https://en.wikipedia.org/wiki/Erlang_distribution), and [chi-square distribution](https://en.wikipedia.org/wiki/Chi-square_distribution) are special cases of the gamma distribution. * The gamma distribution is the [maximum entropy probability distribution](https://en.wikipedia.org/wiki/Maximum_entropy_probability_distribution) (both with respect to a uniform base measure and with respect to a 1/*x* base measure) for a random variable *X* for which **E**[*X*] = *kθ* = *α*/*β* is fixed and greater than zero, and **E**[ln(*X*)] = *ψ*(*k*) + ln(*θ*) = *ψ*(*α*) − ln(*β*) is fixed (*ψ* is the [digamma function](https://en.wikipedia.org/wiki/Digamma_function)). | |
| Variables | x = observed value | |
| TI-84 | * GAMFUNC (Gamma function) PRGM * GAMDSTR (Gamma distribution function) PRGM | |
| Example |  | |
| Online PDF Calculator | <https://keisan.casio.com/exec/system/1180573217> | |

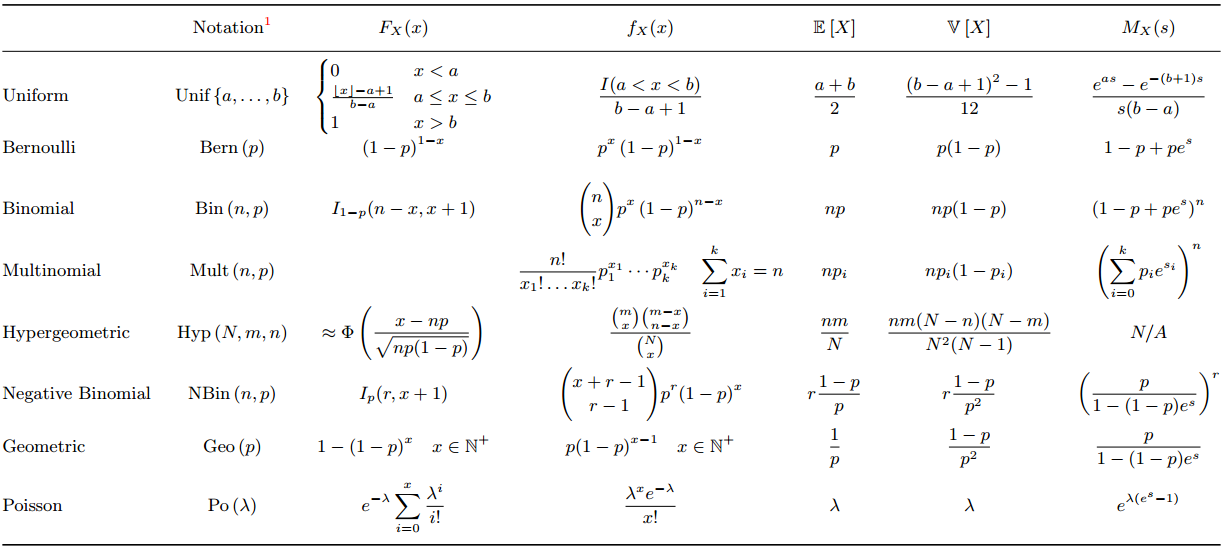
|  |  |  |  |
| --- | --- | --- | --- |
| **Probability Density Function (PDF)** | **Mean** | | **Standard Deviation** |
| **Chi-Square Distribution** | http://www.di-mgt.com.au/images/chisquare-pvalue.gif  Skewed-right (above) have fewer values to the right, and median < mean. | | |
|  | Mode = |  | |
| Conditions | * Used for inference about variance in categorical distributions. * Used when we want to test the independence, homogeneity, and "goodness of fit” to a distribution. * Used for counted data. | | |
| Variables | x = observed value  *= df* = degrees of freedom = | | |
| TI-84 | [2nd] [DISTR] 7:pdf(x, )  [2nd] [DISTR] 8:cdf(x, ) | | |
| Example | pdf() is only used to graph the function. | | |
| Online PDF Calculator | <https://stattrek.com/online-calculator/chi-square.aspx> | | |

|  |  |
| --- | --- |
| **Uniform** | See  <http://www4.ncsu.edu/~swu6/documents/A-probability-and-statistics-cheatsheet.pdf> |
| **Log-Normal** |
| **Multivariate Normal** |
| **F** |
| **Exponential** |
| **Gamma** |
| **Inverse Gamma** |
| **Dirichlet** |
| **Beta** |
| **Weibull** |
| **Pareto** |

**Continuous Probability Distribution Functions**

|  |  |  |
| --- | --- | --- |
| **Cumulative Distribution Function (CDF)** | **Mean** | **Standard Deviation** |
|  | If (the Normal PDF), then no exact solution is known.  Use z-tables or web calculator (<http://davidmlane.com/normal.html>). | |
|  | The area under the curve is always equal to exactly 1 (100% probability). | |
| Integral of PDF = CDF (Distribution) |  | Use the density function, not the distribution function, to calculate and . |
| Derivative of CDF = PDF (Density) |  |
| Expected Value (Mean) |  |  |
| Needed to calculate Variance |  |  |
| Variance |  |  |
| Standard Deviation |  |  |

**Discrete Distributions**



<http://www4.ncsu.edu/~swu6/documents/A-probability-and-statistics-cheatsheet.pdf>

**Continuous Distributions**

