hp calculators

HP 48GII Probability distributions

The MTH (MATH) menu

Probability distributions

Practice solving problems involving probability distributions

The MTH (MATH) menu

The Math menu is accessed from the BLUE shifted function of the SYMB key by pressing ← MTH . When pressed, a CHOOSE box is displayed with a number of choices allowing problems to be solved with different math functions on the HP 48GII calculator.

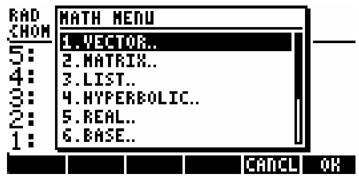

Figure 1

The first choice allows for calculations dealing with vectors. The second choice provides access to many functions for working with matrices. The third choice allows for the manipulation of lists and for using lists to apply mathematical functions to a list of numbers, all at the same time. The fourth function provides access to the hyperbolic trigonometric functions. The fifth selection provides a list of many functions that can be applied to real numbers. The sixth choice displays functions dealing with numbers in different bases. Choices seven through eleven are not displayed in the screen above, but deal with probability, fast fourier transformations, complex numbers, constants and a choice dealing with several special functions.

To display the probability menu, press 7 ENTER . The screen displays the first six of 10 functions involving probability.

Figure 2

Functions 6 through 9 provide a cumulative upper tail probability calculation for several common continuous probability distributions: the chi-squared distribution, the F distribution, the normal distribution and the t distribution. Function 10 provides the calculation for the probability distribution function for the normal distribution

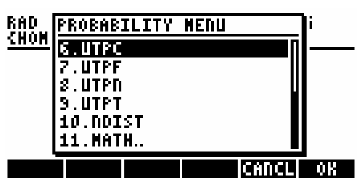

Figure 3

Probability distributions

A probability distribution is simply a distribution of the probabilities. For example, if you flipped a coin 10 times, one would expect to have 5 heads more often than 10. If the probability of each of these outcomes was determined and graphed, the graph would represent the probability distribution for the flipping of a coin 10 times.

The chi-squared distribution is used for many things, including measuring goodness of fit, evaluating hypotheses tests of the population variance, and others. The UTPC function expects two arguments: the degrees of freedom and the value of the chi-squared statistic.

One of the F distribution's primary uses is to test if two population variances are equal. It is commonly seen in the analysis of variance or ANOVA tables. The UTPF function expects three arguments: the degrees of freedom in the numerator (one of the variances), the degrees of freedom in the denominator (the other variance), and the ratio of the variances.
The normal distribution is used for many things. The reason it is called normal is partly due to the frequent relation to the way so many things are distributed. When graphed, the shape it forms is often called a bell curve. It is often used to approximate the discrete binomial distribution, it is the distribution of the sample means regardless of the underlying distribution of the population, and other

uses. The UTPN function expects three arguments: the mean, the variance and the value being evaluated. The normal distribution is often presented in a standardized format where values for Z are looked up in a table, where Z is equal to the formula shown below.

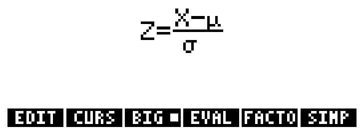

Figure 4

Z is determined by taking the observed value, subtracting the population mean and dividing by the population standard deviation. To use UTPN to calculate the probability for a given Z value would require inputs to the function of 0, 1, and Z.

The t distribution is also used for many things, but the primary use is for situations where sample size is small or the population variance is unknown. The shape of the t distribution is very similar to the normal distribution, except that it is flatter with larger tails on each end, which makes it leptokurtic. The UTPT function expects two arguments: the degrees of freedom and the value of the t statistic. Much like the normal distribution, the t statistic is often presented in a table with the degrees of freedom down the side and a significance level across the top. The values in the table are the t statistic against which a calculated t statistic would be compared. In this manner, the inputs to the UTPT function could be thought of as the degrees of freedom and a value of t. The result would be the probability that remains above this given t value, which could be compared to the significance level under consideration to determine if the t value was under or above it. A calculated t statistic is often determined using the formula below.

Figure 5

This formula is very similar to the formula in Figure 4, except that the denominator uses the standard error rather than the standard deviation (the sample standard deviation divided by the square root of the sample size).

Practice solving problems involving probability distributions

Example 1: What is the normal distribution probability value for an observation of 15, if the population average is 14 and the population variance is 5?

Solution: In RPN mode: 1 4 ENTER 5 ENTER 1 5 ← MTH 7 ENTER 8 ENTER

In Algebraic mode: ← MTH 7 ENTER 8 ENTER 1 4 ↱ , 5 ↱ , 1 5 ENTER

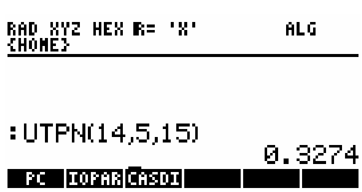

Figure 6

Answer: 0.3274. In a normal distribution as described, 32.74% of all values would be larger than the observed value of 15. The display shows the answer in algebraic mode.

Example 2: What is the t distribution probability value for a calculated t value of 2, if there are 20 degrees of freedom?

Solution: In RPN mode: 2 0 ENTER 2 ← MTH 7 ENTER 9 ENTER

In Algebraic mode: ← MTH 7 ENTER 9 ENTER 2 0 → , 2 ENTER

Figure 7

Answer: 0.0296. In a t distribution as described, only 2.96% of all values would be larger than the calculated t value of 2. The display shows the answer in RPN mode.

Example 3: What is the chi-squared probability distribution value if there are 9 degrees of freedom and the calculated chi-squared value is 16?

Solution: In RPN mode: 9 ENTER 1 6 ← MTH 7 ENTER 6 ENTER

In Algebraic mode: ← MTH 7 ENTER 9 ENTER 9 → , 1 6 ENTER

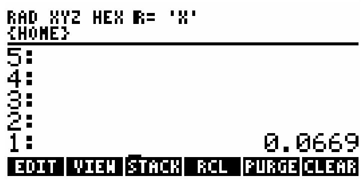

Figure 8

Answer: 0.0669 or 6.69%. The display shows the answer in RPN mode.

Example 4: A comparison of two sample variances is made and the ratio between them is 0.64. The first variance has 9 degrees of freedom and the second has 7 degrees of freedom. Are the variances the same at a 5% significance level?

Solution: We will calculate the probability for observing this F distribution value and if it is between 0.975 and 0.025, it will be within the middle 95% of all possible outcomes. We would then have no basis for concluding the variances are not the same.

In RPN mode: 9 ENTER 7 ENTER 0 • 6 4 ← MTH 7 ENTER 7 ENTER

In Algebraic mode: ← MTH 7 ENTER 7 ENTER 9 → , 7 → , 0 • 6 4 ENTER

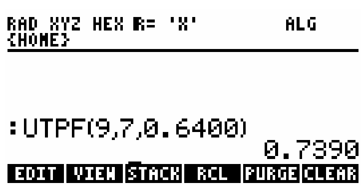

Figure 9

Answer: 0.7390 or 73.90%. Since this value falls within the middle 95%, we would have no reason to conclude the population variances are not equal. The display shows the answer in Algebraic mode.

Example 5: If you flip a coin 10 times, what is the probability that it comes up tails exactly 4 times?

Solution: This is an example of the binomial probability distribution. The formula to find the answer is given by:

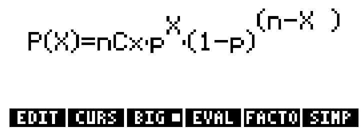

Figure 10

where P(X) is the probability of having X successes observed, nCx is the combination of n items taken x at a time, and p is the probability of a success on each trial.

In RPN mode: 1 0 ENTER 4 ← MTH 7 ENTER ENTER 0 • 5 ENTER 4 y^x × 1 ENTER 0 • 5 − 1 0 ENTER 4 − y^x ×

In Algebraic mode: ← MTH 7 ENTER ENTER 1 0 → , 4 ENTER × 0 • 5 y^x 4 ENTER × ← () 1 − 0 • 5 ▶ y^x ← () 1 0 − 4 ENTER

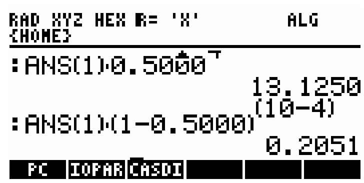

Figure 11

Answer: If you flip a coin 10 times, there is a 20.51% chance of seeing heads 4 times. Figure 4 indicates the display if solved in algebraic mode.