Assignment Requirements for Simpson’s Integral Progam

Personal Software Process for Engineers

# Program Requirements

Use PSP1.1 to write a program to numerically integrate a function using Simpson’s rule and write the function for the normal distribution.

The program should be designed to integrate using various supplied functions.

You will need this program to calculate the values of the various statistical distributions used in later program assignments.

Thoroughly test the program. At a minimum, use this program to calculate the values of the normal distribution integral for three values.

|  |  |
| --- | --- |
| Test | Expected Value |
| −∞ to 2.5 | 0.9938 |
| −∞ to 0.2 | 0.5793 |
| −∞ to −1.1 | 0.1357 |

# Numerical Integration

In principle, numerical integration treats a function as being composed of multiple rectangular areas. It then adds these areas to produce the integral value. The trick is to sum these areas so as to minimize the error.



## Integration Limits

To determine the integration limits,

* most statistical functions are integrated from −∞ to some value
* all statistical functions have a total area of 1.0 when integrated from −∞ to +∞

## Symmetric Functions

With symmetric functions (the normal and *t* distributions), the procedure is as follows.

|  |  |  |
| --- | --- | --- |
| If the value of *X* is… | then integrate from… | and… |
| positive | 0 to *X* | add 0.5 to the results |
| negative | 0 to abs(*X*) | subtract the result from 0.5 |

## Simpson’s Rule

Simpson’s rule for calculating the integral is



where

* *W* is the width of the segments
* *F* is the value of the function for each *x* value

Simpson’s rule in another form\* is



where *N* is the number of segments.

\* Note: The above equation for Simpson’s rule is a simplified form of Equation A5 in the book (p. 518).

## Normal Distribution

The formula for the normal distribution is



Page 518 contains formulas for the χ2 and *t* distributions.

## Hints—Read Appendix A!

Refer to Appendix A for an algorithm to evaluate the integral using Simpson’s rule. Start with *N* = 20 and an acceptable error (E) of 1E-07 (p. 517).

If you are using C or C++, consider designing Simpson’s rule to accept a pointer to a function. (This makes reuse very easy.)

For other languages, separate Simpson’s rule calculation from the normal distribution.

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