Mathematical Methods(CAS) probability distributions using DERIVE

DERIVE contains built in functions for computing binomial, hypergeometric, standard normal and normal probabilities directly. Inverse normal computations can also be readily carried out by numerical equation solving. The following describes these functions and provides an example of each type of calculation.

Binomial distribution

If the random variable *X* is binomially distributed, with probability of success *p* and *n* trials, then the probability of *x* successes is given by:
BINOMIAL_DENSITY(X, n, p). For example, if the probability of success is 0.4 and there are 20 trials then the probability of 8 successes is given by:

#1: BINOMIAL_DENSITY(8, 20, 0.4)

#2: 0.1797057877

Hypergeometric distribution

If the random variable *X* is hypergeometrically distributed, with *D* defectives in a population of size *N*, then the probability of *x* defectives in a sample of size *n* is given by:HYPERGEOMETRIC_DENSITY(x, n, D, N). For example, if *N* = 100 and there are 30 defectives, then the probability of 6 defectives in a sample of size 10 is given by:

#3: HYPERGEOMETRIC_DENSITY(6, 10, 30, 100)

#4: 0.03145116093

The standard normal distribution

If *X* is a normally distributed random variable with mean $\mu = 0$ and standard deviation $\sigma = 1$, then the probability that *X* is less than (or less than or equal to)*a* is given by NORMAL(a).For example, the probability that $X < 1$ is given by:

#5: NORMAL(1)

#6: 0.841344746

The normal distribution with mean μ and standard

deviation σ

If X is a normally distributed random variable with mean μ and standard deviation σ, then the probability that X is less than a is given by NORMAL(x,μ,σ).For example, if $\mu = 30$ and $\sigma = 7$ (the VCE study score distribution with a range of 0 to 50) then the probability that $X < 27$ is given by:

#7: NORMAL(27, 30, 7)

#8: 0.3341175708

Thus, about 33% of the student cohort will have a study score of less than 27.

Note that $\Pr(X > a)$ is computed by $1 - \Pr(X < a)$ and $\Pr(a < X < b)$ is computed by $\Pr(X < b) - \Pr(X < a)$.

Inverse normal calculations

Inverse normal calculations are carried out by evaluation of NSOLVE (NORMAL(a,μ,σ)=k,a) where a is sought such that $\Pr(X < a) = k$. For example, if X is a normally distributed random variable with mean 30 and standard deviation 7, then the value of a such that Pr(X < a) = 0.95 is given by:

#9: NSOLVE(NORMAL(a, 30, 7) = 0.95, a)

#10: a = 41.51397526

Thus the study score (correct to the nearest integer)required to be in the top 5% of the cohort would be 42 or above.