FORTRAN Programs

This distribution contains all the FORTRAN programs described in the paper "The Planning and Analysis of Industrial Selection and Screening Experiments" by Pan, Santner, and Goldsman (2001).

For completeness, we have included the program `tlibv4.f` that includes the useful public domain FORTRAN programs `mvnprd` and `mvtprd` described in Dunnett (1989). His programs calculate

$$P\{a_i \leq W_i \leq b_i \ \ (1 \leq i \leq p)\}$$

for given a_i and b_i when $\boldsymbol{W} = (W_1, \ldots, W_p)$ has the multivariate normal distribution [multivariate t-distribution with arbitrary degrees of freedom] with arbitrary mean vector, unit variances and product correlation structure i.e., for correlations of the form $\lambda_i \times \lambda_j$ for $i \neq j$. Dunnett's programs allow any of the endpoints a_i to be $-\infty$ and any of the endpoints b_i to be $+\infty$.

The driver program `use-mvnprd-mvstud.f` uses the Dunnett programs to compute probabilities of *given* hyper-rectangular regions under the multivariate normal and multivariate t-distributions with product correlation structure.

Perhaps more importantly, the driver program `find-zt.f` performs the inverse calculation. *Given* a target probability $P^\star$ and a specific multivariate normal or multivariate t-distribution. with given product correlation structure, it uses `mvnprd` or `mvtprd` to calculate the value of h solving

$$P\{W_i \leq h \ \ (1 \leq i \leq p)\} = P^\star, \tag{0.1}$$

i.e., the upper-α equicoordinate point of the multivariate normal or multivariate t-distribution. In the case of the multivariate normal distribution, because this value, denoted by $Z_{p,1/2}^{(1-P^\star)}$ is frequently occurring and simple to compute, we include the stand-alone program `USENB` to determine its value.

The main stand-alone programs contained in this collection are described in 1–4, below. The main program programs are available as executable programs (compiled for use in an MS-DOS window, assuming a pentium class PC and as source code. In addition the main programs, supporting files including the INCLUDE file GLQUAD, and the functions and subroutine given in A–I, below

Main FORTRAN Programs

Section 2

`usenb.f`

Description: Calculates $P^\star$, $\delta^\star$ or n so that procedure $\mathcal{B}_1$ from Section 2.2 satisifies the probability requirement (2.2) for fixed t and σ.

`find-zt.f`

Description: Calls Dunnett (1989) FORTRAN program to calulate equi-coordinate quantiles for a given target probability under a multivariate normal or a multivariate t-distribution with unit variances and product correlation structure. Can be used to implement $\mathcal{B}_1$

`rinott.f`

Description: Calculates critical values to implement the Rinott procedure $\mathcal{B}_2$ of Section 2.2.2.

Section 3

`find-zt.f`: Can be used to implement $\mathcal{G}_1$ and $\mathcal{G}_2$

`eval-ng.f`

Description: Uses Monte Carlo simulation to to study performance characteristics of procedure $\mathcal{G}_1$ from Section 3.2.

`use-gs.f`

Description: Calculates n, h or $\delta^\star$ so that procedure $\mathcal{G}_3$ of Section 3.4 satisfies the probability requirement (3.4) for fixed t and σ and given q and $P^\star$.

Section 6

`use-mvnprd-mvstud.f`

Description: Calls Dunnett (1989) FORTRAN program to calulate quadrant probabilities for multivariate normal and multivariate t-distributions with unit variances and product correlation structure. Can be used to implement $\mathcal{B}_4$ when γ_ω is known and σ_ϵ^2 is unknown.

Supporting FORTRAN Routines and Input File

`FACTOR`

Description: Function that calculates $n!/x!(n-x)!$ where n, x and $(n-x) \geq 0$.

`MULTZ`

Description: Function that calculates the one-sided upper-$(1-P^\star)$ equicoordinate point of the p-dimensional multivariate normal distribution with common correlation 1/2 and unit variances, $Z_{p,1/2}^{(1-P^\star)}$.

`PCSNGS`

Description: Function that evaluates the $P\{\text{CS}\}$ for procedure $\mathcal{G}_1$ at the slippage configuration $\boldsymbol{\mu} = (0, \ldots, 0, \delta)$, for fixed t and σ and specified q, n and yardstick h.

`PCSNB`

Description: Function that evaluates the $P\{\text{CS}\}$ for procedure $\mathcal{B}_1$ at the slippage configuration $\boldsymbol{\mu} = (0, \ldots, 0, \delta)$, for fixed t and σ and respective sample sizes $(n(1), \ldots, n(t))$.

GLQUAD

Description: Input file containing weights and zeroes to compute 64-point Gauss-Laguerre quadrature.

RNORML

Description: Function that generates standard normal random variates using code from Bratley, Fox, and Schrage (1987).

UNIF

Description: Function that generates U(0,1) random numbers using code from Bratley, Fox, and Schrage (1987).

ZCDF

Description: Function that approximates the $N(0,1)$ c.d.f. using Equation (26.2.17) from Abramowitz and Stegun (1972).

References

ABRAMOWITZ, M., AND STEGUN, I. A. (1972). *Handbook of Mathematical Functions.* New York: Dover Publications.

BRATLEY, P., FOX, B. L., AND SCHRAGE, L. E. (1987). *A Guide to Simulation*, 2nd Edition. New York: Springer Verlag.

DUNNETT, C. W. (1989). Multivariate normal probability integrals with product correlation structure. *Applied Statist.* **38**, 564–579. Correction: **42**, 709.

PAN G-H., SANTNER, T. AND GOLDSMAN, D. (2001) The Planning and Analysis of Industrial Selection and Screening Experiments, to appear in *Handbook in Statistisc: Industrial Experimentation*, **23**.