

## F77 Program 21

```

c Fortran 77 program to do a simulation of the Weibull distribution
c of the uncensored model.
c This program may be adapted for censored models as well as for
c uncensored models.
c *****
c By Derek Dhammaloka FDX3 - 25th Feb. 1991
c *****
c Define the following variables
c
c cdf is the cumulative density function of the probability
c function and is between 0 and 1. The function urand will
c generate the random numbers between 0 and 1. It has 1
c parameter iy, the seed to initialise the generator.
c t is the remission time in arbitrary units
c kappa is the to be entered by the user
c rho is the rate for the control group to be entered by
c the user.
c rho2 is the rate for the treated group.
c loop,loop2 are used in loop counters
c n is the no. of uncensored individuals per treatment
c to be entered by the user.
c trt is the no. of treatments
c a is the acceleration factor to be entered by the user
c surf is the survivor function
c hazard is the hazard function
c pdf is the probability density function
c ihazard is the integrated hazard
c iy is the seed to be entered by the user
c *****
c Obtain the survivor, hazard and probability density
c functions. Also the integrated hazard.
c *****
real cdf(2,5000),t(2,5000),surf(2,5000)
real kappa,rho,rho2,hazard,pdf,ihazard,a
integer loop,loop2,n,iy(2),trt
trt=2
c *****
c Input the no. of individuals
c Also the index (kappa) and the rate (rho)
c *****
print*, 'How many individuals per treatment'
read*,n
do 3 loop=1,trt
    print*, 'Seed for treatment ',loop
    read*,iy(loop)
3 continue
do 9 loop=1,trt
    do 11 loop2=1,n
        cdf(loop,loop2)=urand(iy(loop))
        surf(loop,loop2)=1-cdf(loop,loop2)
11 continue
9 continue
print*, 'Enter the index parameter'
read*,knew

```

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```

print*, 'Enter the rate parameter'
read*, rho
print*, 'Enter the acceleration factor'
read*, a
rho2=rho*a
do 18 loop=1, trt
    if(loop.eq.1) call simulate(trt, loop, n, surf, t, kappa, rho)
    if(loop.eq.trt) call simulate(trt, loop, n, surf, t, kappa, rho2)
18 continue
stop
end

```

```

subroutine simulate(trt, tn, n, surf, t, kappa, rho)

```

This subroutine simulates the Weibull distribution with index (kappa) and rate (rho). It obtains the survivor, hazard and probability density functions as well as the integrated hazard.

Local variables are loop, hazard, pdf and ihazard  
tn is the treatment number

\*\*\*\*\*

Simulate the Weibull distribution using the two parameters to obtain the remission times

\*\*\*\*\*

Print the headings

\*\*\*\*\*

```

integer trt, n, loop, tn
real surf(trt, n), t(trt, n), kappa, rho
real hazard, pdf, ihazard

```

```

print*
print*, 'For treatment ', tn
print*, 'Simulation of the Weibull distribution with'
print*, 'Index = ', kappa, ' and rate = ', rho
print*
write(*, 25)
25 format(t3, 'time', t12, 'surv. fn', t32, 'h', t44, 'f', t55, 'H')
do 20 loop=1, n

```

```

    t(tn, loop)=(-log(surf(tn, loop))/(rho**kappa))**(1/kappa)
    hazard=(kappa*rho)*((rho*t(tn, loop))**(kappa-1))
    pdf=surf(tn, loop)*hazard
    ihazard=((rho*t(tn, loop))**(kappa))

```

\*\*\*\*\*

Output the survivor, hazard and density functions as well as the integrated hazard, together with its time.

\*\*\*\*\*

```

    write(*, 40) t(tn, loop), surf(tn, loop), hazard, pdf, ihazard
40 format(f7.3, t12, f7.4, t30, f7.4, t40, t7.4, t50, f7.4, t60)

```

```

20 continue
return
end

```

```

real function urand(iy)

```

```

integer iy

```

\*\*\*\*\*

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Urand is a uniform random number generator based on theory and suggestions given by KNUTH (1969). The integer iy should be initialised to an arbitrary integer prior to the first call to urand. The calling program should not alter the value of iy between subsequent calls to urand. Values of urand will be returned in the interval (0,1).

\*\*\*\*\*

Reference - Problem solving with Fortran 77  
 Brian D.Hahn 1987

\*\*\*\*\*

```
integer ia,ic,itwo,m2,m,mic
double precision halfm
real s
data m2/0/,itwo/2/
```

If first entry, compute machine integer word length

```
if(m2.eq.0) then
    m=1
10  if(m.gt.m2) then
        m2=m
        m=itwo*m2
        goto 10
endif
```

```
halfm=m2
```

Compute multiplier and increment for linear congruential method

```
ia=8*int(halfm*atan(1.d0)/8.d0)+5
ic=2*int(halfm*(0.5d0-sqrt(3.d0)/6.d0))+1
mic=(m2-ic)+m2
```

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```
c      s is the scale factor for converting to floating point  
      s=0.5/halfm  
      endif
```

```
c      Compute next random number  
      iy=iy*ia
```

```
c      The following statement is for computers which do not allow  
c      integer overflow on addition  
      if(iy.gt.mic) iy=(iy-m2)-m2  
      iy=iy+ic
```

```
c      The following statement is for computers where the word length  
c      is greater than for multiplication  
      if(iy/2.gt.m2) iy=(iy-m2)-m2
```

```
c      The following statement is for computers where integer overflow  
c      affects sign bit  
      if(iy.lt.0) iy=(iy+m2)+m2  
      urand=float(iy)*s  
      return  
      end
```

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Output from F77 Program 21

How many individuals per treatment

175  
Seed for treatment 1  
2  
Seed for treatment 2

-1  
Enter the index parameter

3  
Enter the rate parameter  
1.25

Enter the acceleration factor  
2

For treatment 1  
Simulation of the Weibull distribution with  
Index = .3000000E+01 and rate = .1250000E+01

time	surv. fn	h	f	H
1.431	.0033	11.9951	.0351	5.7208
.536	.7401	1.6841	1.2464	.3010
.589	.6714	2.0302	1.3631	.3983
.803	.3639	3.7771	1.3745	1.0109
.639	.6011	2.3906	1.4370	.5090
.485	.8006	1.3763	1.1019	.2224
.444	.8425	1.1570	.9748	.1714
.839	.3156	4.1239	1.3016	1.1532
.761	.4229	3.3932	1.4348	.8607
.538	.7372	1.6990	1.2524	.3049
.624	.6220	2.2825	1.4196	.4749
.703	.5073	2.8961	1.4691	.6787
.333	.9305	.6493	.6042	.0721
.678	.5437	2.6953	1.4655	.6093
.769	.4114	3.4649	1.4255	.8882
1.312	.0121	10.0888	.1223	4.4128
.745	.4461	3.2513	1.4503	.8073
1.162	.0468	7.9061	.3702	3.0612
.798	.3701	3.7353	1.3822	.9941
.812	.3510	3.8668	1.3571	1.0471
.347	.9219	.7036	.6487	.0813
.655	.5776	2.5139	1.4520	.5489
.807	.3578	3.8191	1.3665	1.0278
.662	.5675	2.5676	1.4570	.5665
.981	.1582	5.6390	.8920	1.8440
1.258	.0205	9.2681	.1904	3.8854
1.070	.0911	6.7144	.6116	2.3959
1.010	.1337	5.9768	.7991	2.0121
.623	.6235	2.2747	1.4182	.4724
.875	.2708	4.4810	1.2136	1.3062
.353	.9180	.7284	.6686	.0856
.259	.9666	.3931	.3800	.0339
.684	.5358	2.7383	1.4672	.6240
.618	.6309	2.2365	1.4110	.4606
1.030	.1184	6.2156	.7358	2.1339
.822	.3376	3.9619	1.3375	1.0859

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.806	.3592	3.8098	1.3683	1.0240
.960	.1777	5.3993	.9595	1.7277
1.007	.1364	5.3973	.8098	1.9922
.286	.9554	.4791	.4578	.0457
.797	.3725	3.7188	1.3852	.9875
.617	.6320	2.2312	1.4100	.4589
.604	.6500	2.1388	1.3903	.4307
1.407	.0044	11.5929	.0505	5.4355
.730	.4673	3.1254	1.4604	.7609
.519	.7607	1.5800	1.2019	.2735
.396	.8854	.9211	.8155	.1217
.764	.4192	3.4158	1.4320	.8694
.457	.8296	1.2255	1.0167	.1868
.443	.8442	1.1479	.9691	.1694
1.088	.0811	6.9299	.5620	2.5121
.961	.1769	5.4091	.9567	1.7324
.594	.6636	2.0696	1.3735	.4100
.902	.2384	4.7679	1.1369	1.4336
.702	.5095	2.8837	1.4692	.6744
.394	.8875	.9092	.8069	.1194
.631	.6121	2.3337	1.4284	.4909
.664	.5649	2.5815	1.4582	.5712
.274	.9605	.4405	.4231	.0403
.732	.4655	3.1359	1.4597	.7647
1.215	.0300	8.6530	.2600	3.5051
.668	.5580	2.7138	1.5144	.5833
1.064	.0951	6.6339	.6308	2.3529
.977	.1619	5.5914	.9053	1.8207
.512	.7692	1.5371	1.1823	.2624
1.052	.1030	6.4832	.6677	2.2732
.658	.5733	2.5366	1.4543	.5563
.537	.7394	1.6876	1.2478	.3019
.620	.6273	2.2551	1.4146	.4663
.713	.4930	2.9768	1.4675	.7072
.802	.3649	3.7701	1.3758	1.0080
1.107	.0709	7.1753	.5086	2.6468
1.027	.1204	6.1819	.7446	2.1166
.749	.4396	3.2902	1.4655	.8218
.993	.1473	5.7833	.8519	1.9152
.310	.9433	.5641	.5322	.0583
.541	.7366	1.7167	1.2594	.3097
.419	.8657	1.0311	.8927	.1442
.940	.1976	5.1755	1.0228	1.6214
.814	.3481	3.8872	1.3530	1.0554
.846	.3062	4.1959	1.2847	1.1836
1.305	.0130	9.9814	.1298	4.3425
.578	.6855	1.9591	1.3430	.3776
1.186	.0385	8.2412	.3170	3.2579
.561	.7080	1.8456	1.3067	.3453
.384	.8953	.8642	.7737	.1106
.510	.7722	1.5217	1.1751	.2585
.614	.6365	2.2080	1.4053	.4518
.733	.4635	3.1476	1.4589	.7690
.619	.6286	2.2483	1.4133	.4642
.761	.4229	3.3930	1.4348	.8607
.875	.2702	4.4861	1.2136	1.3084

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.723	.4784	3.0608	1.4641	.7374
.590	.6699	2.0380	1.3652	.4006
.822	.3377	3.9612	1.3376	1.0857
.627	.6173	2.3063	1.4238	.4823
.690	.5269	2.7871	1.4685	.6407
.712	.4945	2.9685	1.4678	.7043
.366	.9085	.7857	.7139	.0959
.810	.3548	3.8400	1.3624	1.0362
.601	.6548	2.1146	1.3846	.4235
.532	.7448	1.6603	1.2367	.2946
.634	.6075	2.3574	1.4321	.4984
.875	.2702	4.4861	1.2136	1.3084
.875	.2702	4.4861	1.2136	1.3084
.790	.3811	3.6610	1.3953	.9646
.558	.7127	1.8221	1.2986	.3387
.481	.8049	1.3544	1.0902	.2171
.875	.2702	4.4861	1.2136	1.3084
.420	.8648	1.0360	.8960	.1452
.504	.7791	1.4868	1.1583	.2497
.875	.2702	4.4861	1.2136	1.3084
.869	.2774	4.4257	1.2279	1.2821
.368	.9070	.7950	.7211	.0976
.521	.7587	1.5902	1.2065	.2761
.804	.3618	3.7916	1.3718	1.0167
.875	.2702	4.4861	1.2136	1.3084
.474	.8120	1.3177	1.0699	.2083
.875	.2702	4.4861	1.2136	1.3084
.846	.3070	4.1899	1.2862	1.1810
.869	.2782	4.4199	1.2294	1.2796
.300	.9484	.5290	.5017	.0530
.867	.2801	4.4037	1.2335	1.2726
.663	.5666	2.5724	1.4575	.5682
.452	.8349	1.1975	.9998	.1805
.793	.3781	3.6811	1.3919	.9726
.688	.5298	2.7714	1.4682	.6353
.875	.2702	4.4861	1.2136	1.3084
.495	.7887	1.4377	1.1339	.2374
.875	.2702	4.4861	1.2136	1.3084
.775	.4027	3.5206	1.4176	.9097
.875	.2702	4.4861	1.2136	1.3084
.815	.3471	3.8937	1.3517	1.0580
.733	.4627	3.1521	1.4585	.7706
.437	.8496	1.1188	.9506	.1630
.353	.9178	.7296	.6696	.0858
.875	.2702	4.4861	1.2136	1.3084
.561	.7086	1.8425	1.3057	.3444
.812	.3513	3.8642	1.3576	1.0460
.812	.3510	3.8666	1.3571	1.0470
.875	.2702	4.4861	1.2136	1.3084
.855	.2954	4.2801	1.2644	1.2194
.258	.9669	.3913	.3783	.0337
.875	.2702	4.4861	1.2136	1.3084
.850	.3012	4.2343	1.2755	1.1998
.362	.9112	.7698	.7014	.0930
.865	.2824	4.3847	1.2383	1.2644
.432	.8541	1.0946	.9349	.1577

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.589	.6707	2.0340	1.3642	.3995
.500	.7837	1.4630	1.1466	.2437
.592	.6670	2.0528	1.3692	.4050
.875	.2702	4.4861	1.2136	1.3084
.505	.7780	1.4924	1.1610	.2511
.857	.2920	4.3072	1.2577	1.2310
.536	.7405	1.6822	1.2456	.3004
.426	.8598	1.0634	.9144	.1510
.624	.6223	2.2806	1.4193	.4743
.195	.9857	.2221	.2189	.0144
.734	.4616	3.1586	1.4580	.7730
.820	.3409	3.9381	1.3425	1.0762
.574	.6905	1.9338	1.3353	.3703
.678	.5444	2.6915	1.4653	.6081
.536	.7404	1.6824	1.2457	.3005
.508	.7741	1.5123	1.1706	.2561
.875	.2702	4.4861	1.2136	1.3084
.562	.7075	1.8484	1.3077	.3461
.205	.9832	.2474	.2432	.0169
.875	.2702	4.4861	1.2136	1.3084
.475	.8110	1.3229	1.0728	.2095
.563	.7056	1.8578	1.3109	.3487
.725	.4746	3.0827	1.4630	.7453
.622	.6249	2.2676	1.4169	.4702
.657	.5751	2.5270	1.4533	.5532
.875	.2702	4.4861	1.2136	1.3084
.875	.2702	4.4861	1.2136	1.3084

For treatment 2  
 Simulation of the Weibull distribution with  
 Index = .3000000E+01 and rate = .2500000E+01

time	surv. fn	h	f	H
.478	.1814	10.7131	1.9431	1.7072
.355	.4959	5.9208	2.9360	.7014
.297	.6640	4.1361	2.7462	.4095
.417	.3226	8.1438	2.6268	1.1315
.468	.2014	10.2708	2.0683	1.6026
.491	.1571	11.3062	1.7761	1.8509
.241	.8041	2.7166	2.1845	.2180
.420	.3136	8.2784	2.5961	1.1597
.364	.4712	6.2042	2.9237	.7524
.344	.5289	5.5527	2.9366	.6370
.219	.8477	2.2579	1.9141	.1652
.263	.7528	3.2399	2.4391	.2839
.373	.4452	6.5125	2.8996	.8092
.378	.4304	6.6934	2.8807	.8431
.113	.9779	.5949	.5818	.0223
.304	.6458	4.3205	2.7903	.4372
.378	.4301	6.6963	2.8803	.8436
.301	.6519	4.2587	2.7762	.4279
.357	.4899	5.9890	2.9340	.7136
.408	.3458	7.8070	2.6993	1.0620
.547	.0776	14.0205	1.0882	2.5559
.237	.8118	2.6375	2.1411	.2085
.037	.9992	.0647	.0646	.0008



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.265	.7473	3.2957	2.4629	.2913
.396	.3785	7.3577	2.7845	.9747
.575	.0514	15.4905	.7961	2.9683
.318	.6048	4.7425	2.8684	.5028
.280	.7092	3.6796	2.6095	.3436
.474	.1900	10.5179	1.9984	1.6607
.119	.9743	.6586	.6417	.0260
.430	.2887	8.6672	2.5024	1.2423
.402	.3614	7.5886	2.7425	1.0178
.229	.8281	2.4665	2.0425	.1886
.270	.7357	3.4128	2.5108	.3070
.413	.3330	7.9898	2.6608	1.0996
.370	.4535	6.4134	2.9085	.7908
.262	.7548	3.2197	2.4303	.2813
.288	.6884	3.8892	2.6772	.3734
.597	.0359	16.7173	.5997	3.3278
.388	.4001	7.0740	2.8304	.9160
.194	.8928	1.7573	1.5689	.1134
.357	.4920	5.9648	2.9347	.7093
.351	.5075	5.7895	2.9383	.6782
.479	.1800	10.7457	1.9339	1.7150
.320	.5982	4.8117	2.8782	.5139
.535	.0911	13.4283	1.2234	2.3957
.230	.8276	2.4717	2.0456	.1892
.266	.7448	3.3213	2.4736	.2947
.232	.8229	2.5216	2.0750	.1949
.365	.4686	6.2351	2.9218	.7580
.408	.3452	7.8145	2.6978	1.0635
.533	.0939	13.3132	1.2234	2.3650
.355	.8276	2.4717	2.0456	.6983
.326	.5810	4.9916	2.9002	.5430
.388	.4025	7.0438	2.8348	.9102
.294	.6718	4.0562	2.7251	.3977
.296	.6659	4.1167	2.7412	.4067
.395	.3816	7.3153	2.7918	.9633
.440	.2634	9.0891	2.3940	1.3341
.449	.2432	9.4474	2.3979	1.4138
.387	.4039	7.0252	2.8376	.9066
.411	.3375	7.9244	2.6748	1.0861
.344	.5292	5.5486	2.9365	.6363
.186	.9037	1.6289	1.4721	.1012
.575	.0514	15.4908	.7960	2.9684
.408	.3474	7.7842	2.7040	1.0574
.233	.8210	2.5414	2.0865	.1973
.395	.3813	7.3202	2.7909	.9643
.247	.7906	2.8562	2.2580	.2350
.366	.4655	6.2718	2.9193	.7647
.660	.0111	20.4451	.2269	4.5008
.432	.2846	8.7344	2.4856	1.2568
.527	.1013	13.0278	1.3201	2.2894
.411	.3391	7.9024	2.6795	1.0815
.249	.7851	2.9123	2.2864	.2420
.369	.4555	6.3896	2.9105	.7863
.511	.7366	12.2317	1.5239	2.0828
.258	.7646	3.1211	2.3863	.2685
.236	.8144	2.6096	2.1254	.2052

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.544	.0809	13.8677	1.1222	2.5143
.366	.4651	6.2761	2.9190	.7655
.438	.2691	8.9911	2.4197	1.3126
.417	.3223	8.1473	2.6260	1.1322
.276	.7206	3.5643	2.5686	.3276
.366	.4651	6.2763	2.9190	.7655
.511	.1241	12.2481	1.5196	2.0870
.417	.3228	8.1407	2.6275	1.1308
.184	.9076	1.5823	1.4362	.0969
.361	.4797	6.1061	2.9291	.7346
.285	.6960	3.8122	2.6534	.3624
.420	.3153	8.2530	2.6019	1.1543
.362	.4769	6.1388	2.9274	.7405
.476	.1858	10.6130	1.9714	1.6833
.340	.5422	5.4066	2.9316	.6121
.278	.7156	3.6155	2.5871	.3347
.434	.2786	8.8316	2.4609	1.2778
.369	.4549	6.3966	2.9099	.7876
.492	.1564	11.3249	1.7709	1.8555
.241	.8039	2.7193	2.1860	.2183
.377	.4332	6.6581	2.8846	.8364
.232	.8225	2.5253	2.0771	.1954
.255	.7708	3.0574	2.3567	.2603
.363	.4722	6.1925	2.9244	.7503
.250	.7827	2.9370	2.2987	.2451
.542	.0835	13.7532	1.1481	2.4832
.513	.1220	12.3125	1.5026	2.1034
.336	.5518	5.3035	2.9263	.5946
.285	.6959	3.8134	2.6537	.3626
.582	.0462	15.8586	.7327	3.0747
.325	.5848	4.9522	2.8959	.5365
.758	.0011	26.9119	.0301	6.7971
.199	.8840	1.8575	1.6421	.1233
.116	.9762	.6257	.6108	.0241
.326	.5820	4.9810	2.8991	.5412
.269	.7378	3.3914	2.5022	.3041
.395	.3813	7.3194	2.7911	.9641
.260	.7601	3.1659	2.4065	.2743
.292	.6765	4.0095	2.7123	.3909
.391	.3932	7.1638	2.8166	.9335
.407	.3485	7.7682	2.7072	1.0541
.417	.3221	8.1503	2.6254	1.1328
.446	.2496	9.3312	2.3294	1.3878
.255	.7724	3.0414	2.3492	.2582
.216	.8547	2.1829	1.8657	.1570
.417	.3229	8.1388	2.6279	1.1304
.481	.1755	10.8498	1.9044	1.7400
.425	.3011	8.4714	2.5504	1.2004
.428	.2940	8.5831	2.5232	1.2243
.293	.6737	4.0372	2.7199	.3949
.390	.3944	7.1479	2.8191	.9304
.451	.2389	9.5264	2.2763	1.4315
.322	.5931	4.8649	2.8853	.5224
.192	.8959	1.7214	1.5421	.1100
.246	.7932	2.8289	2.2439	.2316
.155	.9430	1.1328	1.0682	.0587

APPENDIX 02 - Fortran 77 (F77) Programs

.209	.8663	2.0559	1.7810	.1435
.215	.8570	2.1574	1.8490	.1543
.426	.2992	8.5011	2.5432	1.2068
.138	.9602	.8868	.8514	.0407
.293	.6738	4.0359	2.7196	.3948
.178	.9160	1.4808	1.3565	.0877
.323	.5920	4.8762	2.8867	.5242
.454	.2316	9.6639	2.2384	1.4626
.340	.5401	5.4298	2.9326	.6160
.684	.0068	21.9108	.1486	4.9934
.409	.3421	7.8584	2.6887	1.0725
.474	.1896	10.5266	1.9959	1.6628
.197	.8878	1.8147	1.6111	.1190
.286	.6934	3.8387	2.6617	.3662
.396	.3801	7.3361	2.7882	.9674
.612	.0280	17.5384	.4909	3.5760
.584	.0445	15.9898	.7111	3.1129
.273	.7266	3.5045	2.5463	.3194
.282	.7039	3.7329	2.6275	.3511
.168	.9280	1.3303	1.2345	.0747
.362	.4775	6.1314	2.9278	.7392
.505	.1339	11.9473	1.6000	2.0105
.272	.7308	3.4615	2.5298	.3135
.347	.5204	5.6462	2.9382	.6532
.179	.9138	1.5075	1.3776	.0901
.398	.3741	7.4163	2.7742	.9833
.284	.6994	3.7785	2.6425	.3576
.401	.3647	7.5428	2.7512	1.0086
.354	.5007	5.8665	2.9372	.6918
.324	.5870	4.9285	2.8931	.5327
.310	.6276	4.5073	2.8287	.4659
.273	.7283	3.4875	2.5398	.3171
.297	.6637	4.1390	2.7469	.4100
.364	.4711	6.2061	2.9236	.7527
.270	.7349	3.4202	2.5137	.3080
.373	.4441	6.5262	2.8983	.8117
.234	.8183	2.5693	2.1025	.2005
.234	.8182	2.5703	2.1031	.2006
.271	.7328	3.4416	2.5221	.3109
.507	.1312	12.0278	1.5783	2.0309