m is the distance in trait value

e between optimal value and pop mean

σ is the standard dev of trait value distributions in the pop

k is the steepness of the trait to condition function

s is the survival parameter

a is max female fecundity

g is the strength of sexual selection

t is the size of competing groups of males

r is the number of repeted fitness measures for each male

d is the resolution of the condition to fitness function for males, i.e. how many focal individuals did we consider to draw that curve.

```
m = 0;
σ = 1;
k = 5;

a = 50;
g = 10;
t = 10;
r = 25;
d = 10;
```

Distribution of trait values, condition, condition after survival.

$$f[z\_, m\_, \sigma\_] := \frac{e^{\frac{-1}{2}\left(\frac{z-m}{\sigma}\right)^2}}{\sigma\sqrt{2\pi}}$$

$$cond[z\_, k\_] := e^{-(z)^2/k}$$

$$invcond1[c\_, k\_] := -\sqrt{k}\sqrt{Log\left[\frac{1}{c}\right]}$$

$$invcond2[c\_, k\_] := \sqrt{k}\sqrt{Log\left[\frac{1}{c}\right]}$$

$$fcond[c\_, m\_, \sigma\_, k\_] :=$$

$$(f[invcond1[c, k], m, \sigma] + f[invcond2[c, k], m, \sigma]) * \frac{\sqrt{k}}{2\,c\sqrt{Log\left[\frac{1}{c}\right]}}$$

$$surv[c\_, s\_] := c\,(s+1)\,/\,(s+c)$$

$$marginalsurv[c\_, m\_, \sigma\_, k\_, s\_] := fcond[c, m, \sigma, k] * surv[c, s]$$

$$fcad[c\_, m\_, \sigma\_, k\_, s\_] := \frac{marginalsurv[c, m, \sigma, k, s]}{NIntegrate[marginalsurv[cc, m, \sigma, k, s], \{cc, 0, 1\}]}$$

Male female covariance in fitness

```
covarmf[res_, rep_, g_, t_, m_, s_] := (
  Conditions = {};
  Densities = {};
  For[
   i = 1,
   i ≤ res - 1,
   i++,
   AppendTo[Conditions, (i + 0.5) / res];
   AppendTo[Densities, NIntegrate[fcond[c, m, σ, k], {c, i / res, (i + 1) / res}]];
  ];
  fc = ProbabilityDistribution[fcond[c, m, σ, k], {c, 0, 1}];

  malefit =
   Table[Mean[Table[Conditions[[i]]^g / (Conditions[[i]]^g + Total[RandomVariate[fc, t - 1]^g]) *
       t * surv[Conditions[[i]], s], rep]], {i, 1, res - 1}];


  femfit = Table[Conditions[[i]] * a * surv[Conditions[[i]], s], {i, 1, res - 1}];

  meanmalefitness = Densities.malefit;
  meanfemfitness = Densities.femfit;
  covar = Densities.((malefit - meanmalefitness) * (femfit - meanfemfitness));
  covarrelative = covar / (meanmalefitness * meanfemfitness);
  covarrelative)
```

Males variance in relative fitness

```
res = 50;
rep = 2;
g = 1;
m = 2;
t = 2;
```

```
varmales[res_, rep_, g_, t_, m_, s_] := (
  Conditions = {};
  Densities = {};
  For[
   i = 1,
   i ≤ res - 1,
   i++,
   AppendTo[Conditions, (i + 0.5) / res];
   AppendTo[Densities, NIntegrate[fcond[c, m, σ, k], {c, i / res, (i + 1) / res}]];
  ];
  fc = ProbabilityDistribution[fcond[c, m, σ, k], {c, 0, 1}];

  malefit = Table[Mean[Table[ (Conditions[[i]]^g /
        (Conditions[[i]]^g + Total[RandomVariate[fc, t - 1]^g]))   *
      t * surv[Conditions[[i]], s], rep]], {i, 1, res - 1}];



  meanmalefitness = Densities.malefit;
  varmalefitness = Densities. (malefit - meanmalefitness) ^2;
  varmalerelative = varmalefitness / (meanmalefitness) ^2;
  varmalerelative)
```

Females variance in relative fitness

```
varfem[res_, a_, b_, m_, s_] := (
  Conditions = {};
  Densities = {};
  For[
   i = 1,
   i ≤ res - 1,
   i++,
   AppendTo[Conditions, (i + 0.5) / res];
   AppendTo[Densities, NIntegrate[fcond[c, m, σ, k], {c, i / res, (i + 1) / res}]];
  ];

  femfit = Table[Conditions[[i]]^b * a * surv[Conditions[[i]], s], {i, 1, res - 1}];

  meanfemfitness = Densities.femfit;
  varfemfitness = Densities. (femfit - meanfemfitness) ^2;
  varfemrelative = varfemfitness / (meanfemfitness) ^2;
  varfemrelative)
```