

BIOLOGICAL CLOCK DECISION MODEL, SIMPLIFIED.

Guide to setting up the Excel model parameters.

The provided Excel model is simplified in the sense that it uses scenarios and parameterization techniques, which limit a decision maker’s flexibility in setting up the utility curves and importance coefficients. These techniques are described in detail in “Biological Clock Decision Problem” by Keeney and Vernik (2007).

Note: Familiarity with utility theory and decision analysis is necessary to assess the model components.

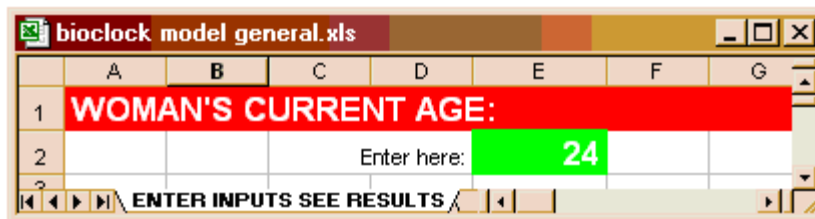
Also, it is simplified from an Excel usage perspective: Users can only enter certain parameters and can not modify the part of the model which performs the computations. However, advanced Excel users can look through the “technical” Excel sheets, look up formulas in the cells (without making any changes¹) and get a sense of how the model works.

Note: Please be aware that no error-checking is performed by the Excel model and parameters entered by the user that are inconsistent with the model (e.g. negative utility values) can yield meaningless results.

This guide contains a description of the parameters to enter into the Excel file. Please refer to the paper for a detailed explanation of how parameterization and scenarios are used to simplify the model, how to assess the utility curves, how to interpret relative utility scale values which range from 0 to 100, and how assess the importance coefficients.

CURRENT AGE

Enter in cell E2:



Independently of the woman’s current age, you need to assess all the utility curves starting at age 20. Estimating the utility curves for ages between 20 and the current age should be easier since it is retrospective and can be evaluated without uncertainty.

¹ These spreadsheets are protected.

PROFESSIONAL LIFE COMPONENT

Recall that $u_p(p_A|No)$ is the professional life utility curve given no child where A is the woman’s age. We will alter this curve based on a professional life adjustment function, denoted $g_p(t)$, for having a child of age t. Then the set of all professional life utility curves can be given by

$$u_p(p_A|t) = g_p(t) u_p(p_A|No)$$

where $g_p(t)$ is the proportion, scaled from 0 to 1, of the professional life utility without a child that the woman would experience with a child of age t.

Thus you need to set up two curves:

1. The expected professional life utility curve for the no-child case which reflects beliefs about the expected professional life utility changing with woman’s age, $u_p(p_A|No)$.
2. The child adjustment function which reflects beliefs about the impact of a child on the professional utility curve, changing with child’s age, $g_p(t)$.

Childless professional life utility curve, $u_p(p_A|No)$

Expected professional life quality starts at level $u_p(20)$ at age 20, and stays at this age until child is **X-1** years old.

At age **X** it jumps to level $u_p(X)$ and then gradually increases to level $u_p(Y)$ at age **Y**.

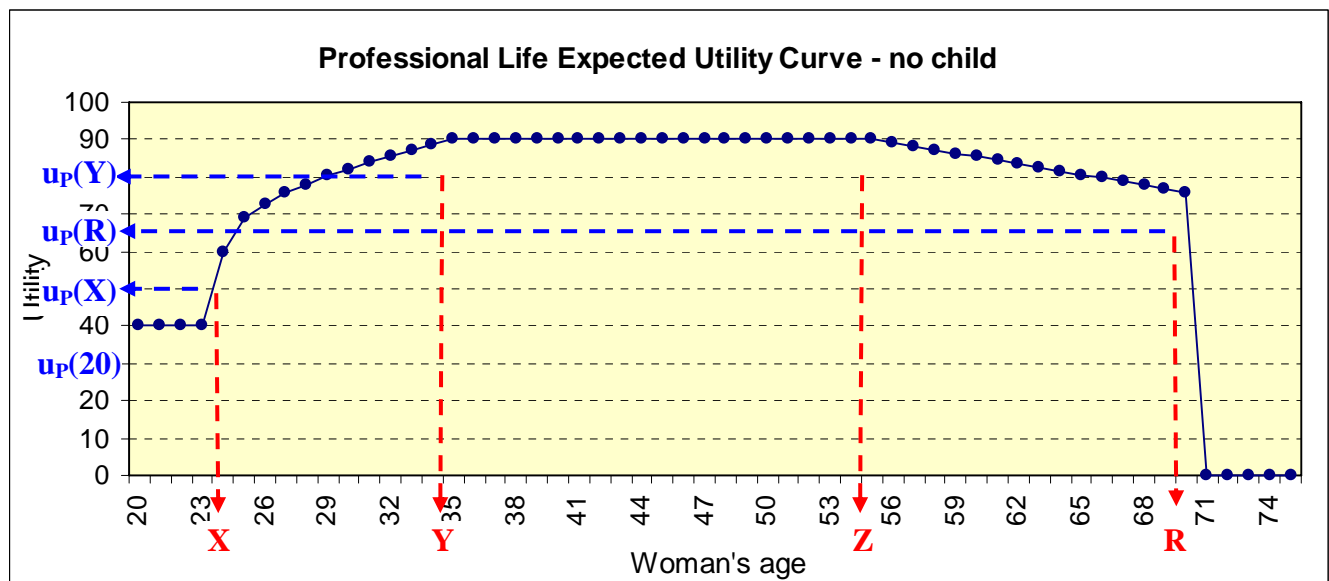
Between ages **Y** and **Z** the expected utility curve is flat at level $u_p(Y)$.

Note: Since you’re assessing the expected utility curve, it’s unlikely that this curve will ever reach 100 unless you either assess it retrospectively or you’re absolutely certain that under any scenario your professional life utility curve will reach 100.

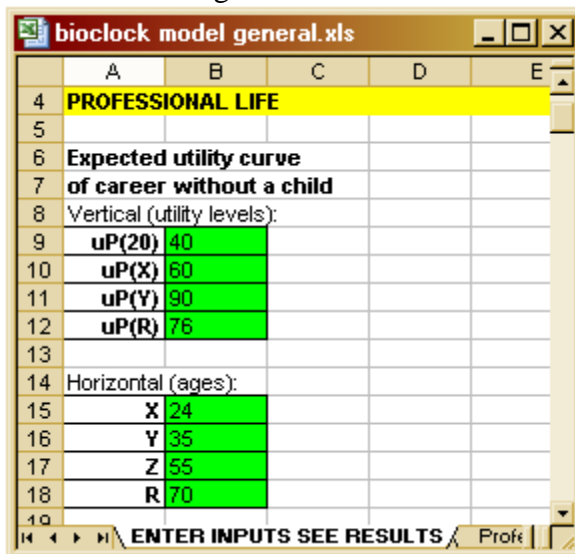
Starting at age **Z+1** it gradually decreases to reach level $u_p(R)$ at age **R**.

At age **R+1** and onwards the expected utility curve is zero. Age **R** is considered to be the age of retirement. If the woman does not plan on retiring set **R=75**.

*Note: This parameter **R** will be automatically used in social life utility curve assessments.*

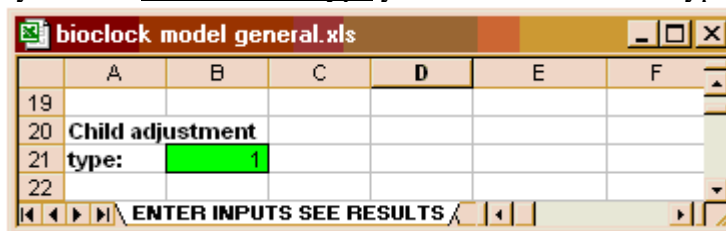


Enter utility levels in cells **B9:B12**. Enter the ages in cells **B15:B18** :



Child adjustment, $g_p(t)$

To provide some flexibility, there are three types of child adjustments, each is described in detail in the paper. In the model, first you need to choose the type you want to use. Enter type in cell **B21**:



The next step is to set up the parameters for the chosen type. You don't have to set up parameters for other types since they will not impact the model until the corresponding type is specified in cell **B21**. The graph will show the chosen type of child adjustment. Note, that instead of a **0 to 1** scale, the graph of $g_p(t)$ shows percentages (e.g. 10% instead of 0.1).

Type 1 parameters

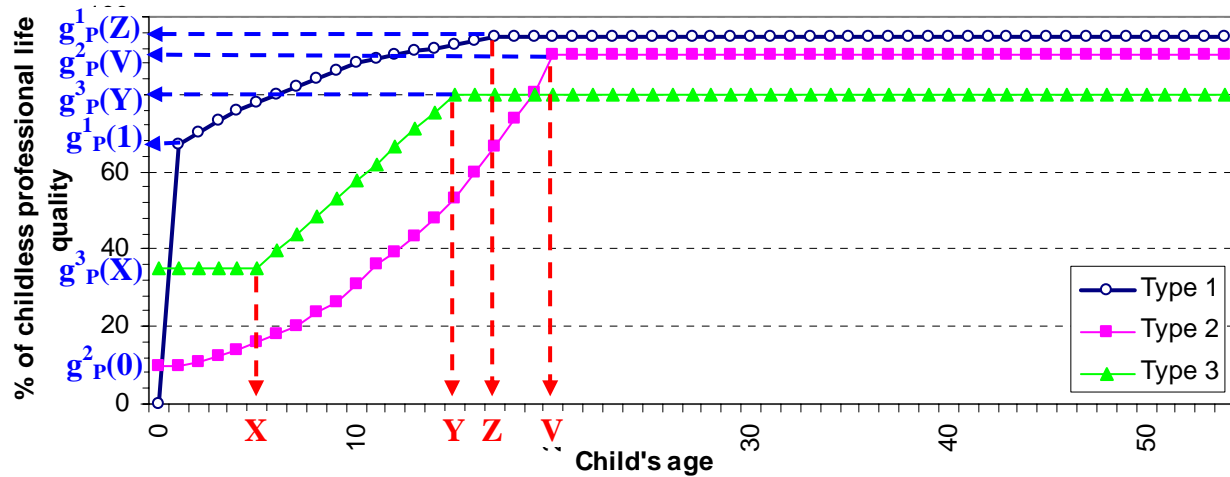
With this type, the professional life utility drops to **0** when the baby is born. Further, when the baby is 1y.o., the professional life utility jumps back to $g^1_p(1)\%$ of the childless one. In the following years, until the child is **Z** years old, the professional life utility increases from $g^1_p(1)\%$ to $g^1_p(Z)\%$ of what it could have been at this time without a child. Starting at the child's age **Z** and onwards, the professional life utility stays at level $g^1_p(Z)\%$ of that without a child.

Type 2 parameters

With this type, the professional life utility drops to $g^2_p(0)\%$ of the childless professional life utility when the baby is born, and then gradually increase until it reaches level $g^2_p(V)\%$ at child's age **V**. It stays flat at level $g^2_p(V)\%$ from age **V** onwards.

Type 3 parameters

With this type, professional life utility drops to $g^3_p(X)\%$ of the childless professional life utility when the baby is born and it stays at this level until the child is **X** years old. Then it starts increasing and reaches level $g^3_p(Y)\%$ when the child is **Y** years old.



Set up parameters for type 1 in cells C25:C27, for type 2 in cells C29:C31, and for type 3 in cells C33:C36:

	A	B	C	D
23	Parameters:			
24				
25	Type 1	gP(1)	60	
26		Z	5	
27		gP(Z)	95	
28				
29	Type 2	gP(0)	10	
30		v	15	
31		gP(V)	95	
32				
33	Type 3	gP(X)	25	
34		X	1	
35		Y	15	
36		gP(Y)	95	
37				

Attention: Input values on a scale 0-100, as percentages, but do not input “%” sign in the cells.

SOCIAL LIFE COMPONENT

Like the professional life component, the social life component is represented as a combination of a childless social life utility curve and the child adjustment:

$$u_S(s_A|t) = g_S(t) u_S(s_A|No)$$

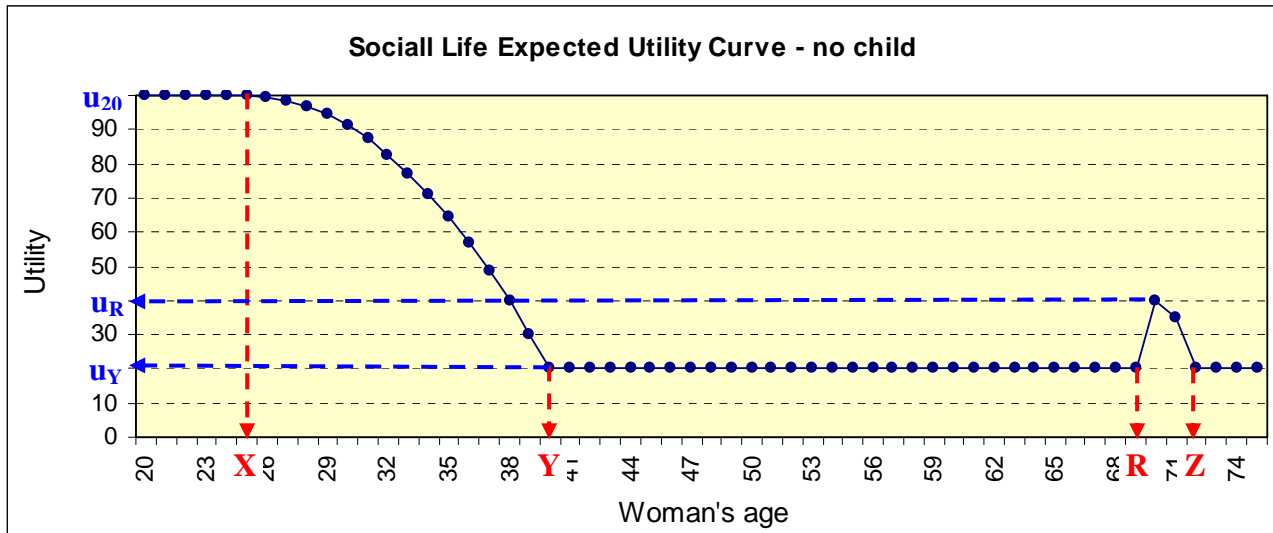
Thus you need to set up two curves:

1. The expected social life utility curve for the no-child case which reflects beliefs about the expected social life utility changing with the woman’s age.
2. The child adjustment function which reflects beliefs about the impact of a child on the social utility curve, changing with the child’s age.

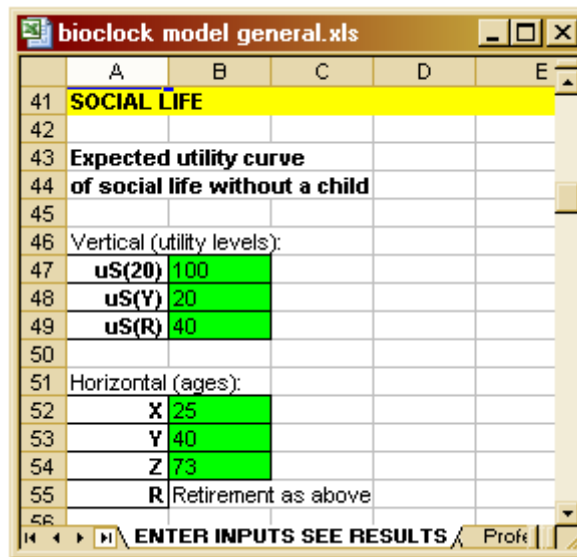
Childless social life utility curve, $u_S(s_A|No)$

The expected social life utility starts at level $u_S(20)$ at age 20 and stays at this level until the woman is X years old. Then the social life utility starts declining until it reaches level $u_S(Y)$ at woman’s age Y . It stays at that level until the retirement age R (defined above in the Professional life component section). When

the woman is $R+1$ years old, the social life utility equals to $u_S(R)$, and then by the woman's age Z it declines back to level $u_S(Y)$.

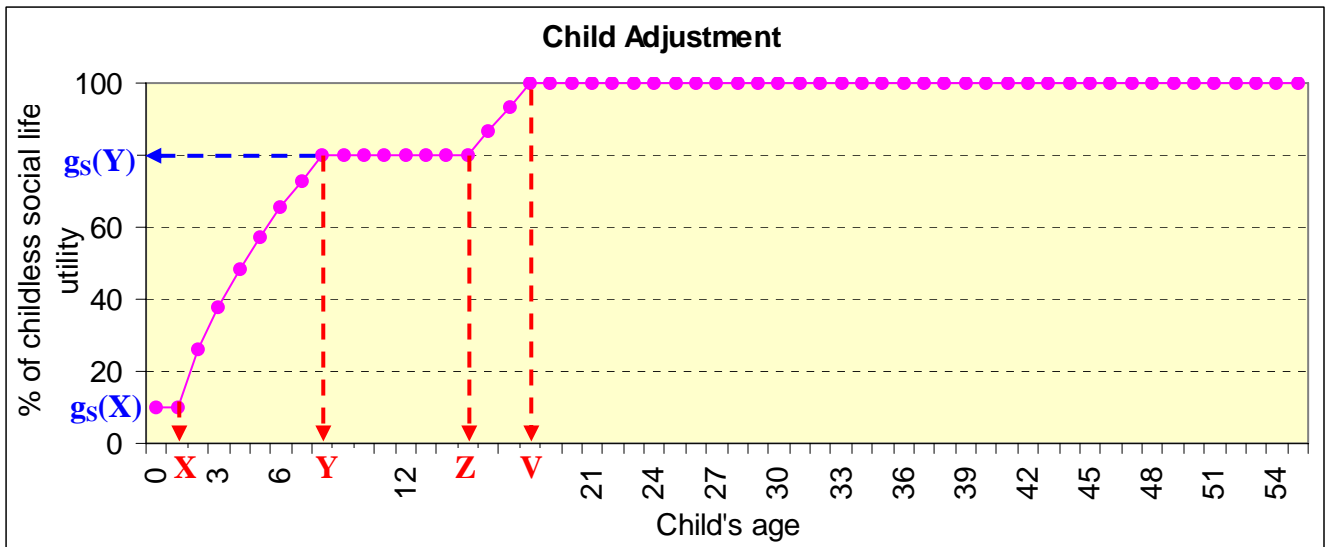


Enter utility levels in cells **B47:B49**. Set up ages in cells **B52:B54**:



Child adjustment, $g_s(t)$

The social life utility goes down to the level $g_s(X)$ % of the childless utility when the baby is born and stays at that level until the baby is X years old. Then at the child's age Y it increases to reach $g_s(Y)$ % of what the childless social life could have been at this point. It stays at this level until the child is X years old. Then it increases to 100% when the child is V years old, meaning that starting the age V the child does not impact the social life utility and it is the same as it would have been without the child at this age.



Enter the percentage levels in cells **B64:B65**. Enter child’s ages in cells **B68:B71**:

bioclock model general.xls					
	A	B	C	D	E
61	Child adjustment				
62					
63	Vertical (percentage)				
64	gS(X)	10			
65	gS(Y)	80			
66					
67	Horizontal (child's ages)				
68	X	1			
69	Y	8			
70	Z	15			
71	V	18			
72					

FAMILY LIFE COMPONENT

With no child, the family life utility is set to **0**. With a child, the family life utility $u_F(f_A|t)$ of a woman of age A having a child of age t is given by

$$u_F(f_A|t) = g_C(A)u_C(t)$$

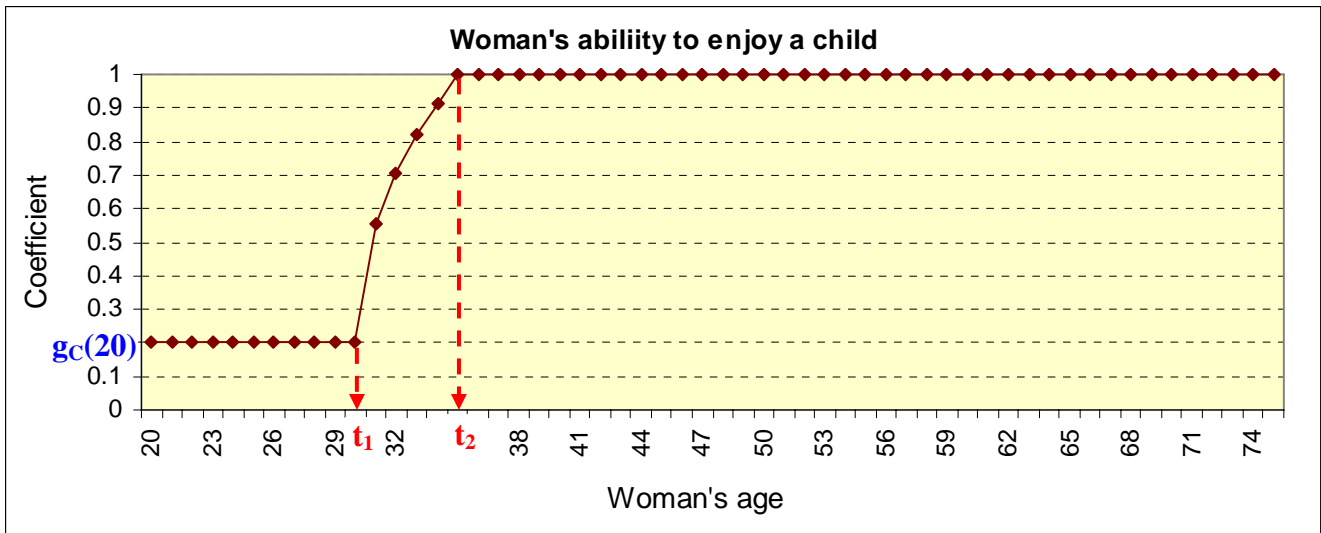
where $g_C(A)$ is the ability of a mother of age A to enjoy a child measured on the 0 to 1 interval, where 1 stands for full ability and 0 stands for not being able to enjoy a child at all, and $u_C(t)$ is the relative utility of having a child of a certain age on a 0 to 100 scale.

Here you need to assess and set up two curves:

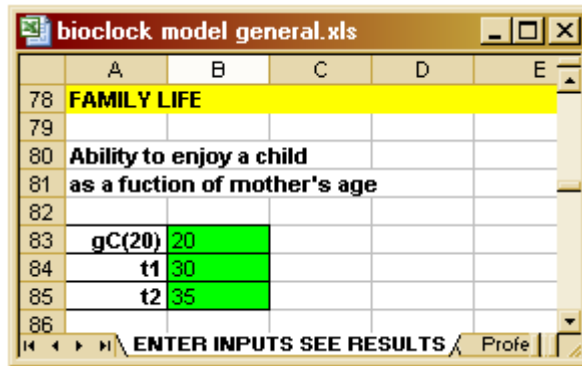
1. The mother’s ability to enjoy a child changing with woman’s age, $g_C(A)$.
2. The utility of having a child changing with child’s age, $u_C(t)$.

Ability to enjoy a child, $g_C(A)$

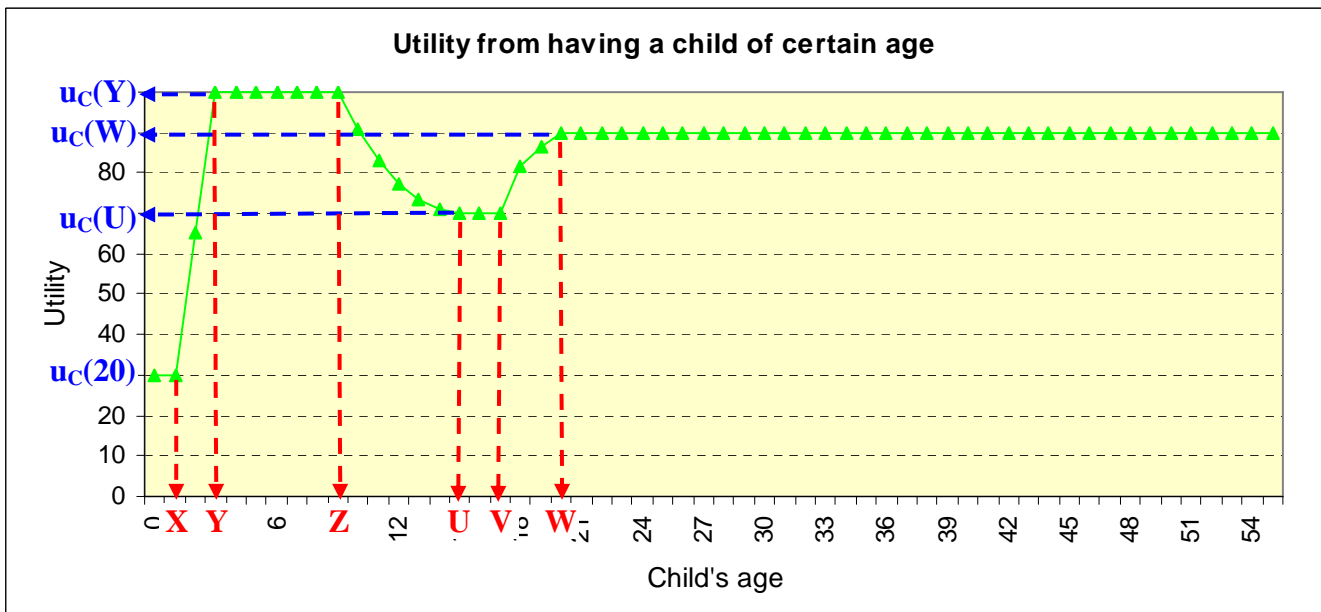
The woman’s ability to enjoy a child starts at level $g_C(20)$ and stays at that level until the woman is t_1 years old. Then it increases to reach the full ability level (equal to 1) at age t_2 .



Enter parameters in cells **B83:B85**

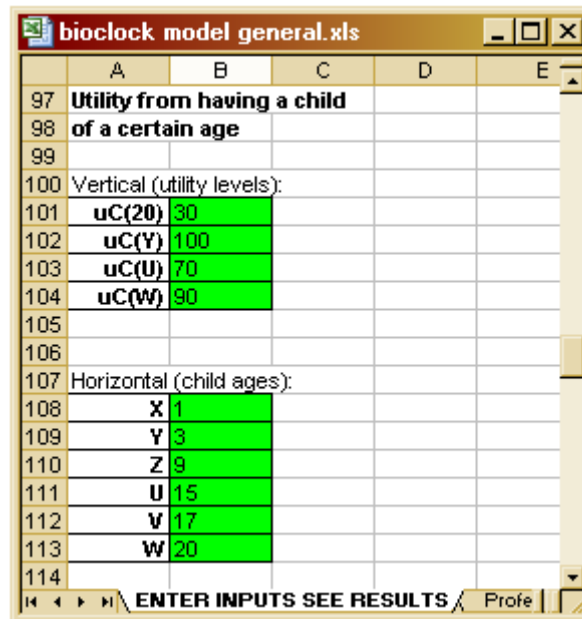


Utility of having a child, $u_C(t)$



The utility of having a child of a certain age starts at level $u_C(20)$ when the baby is born. It stays at this level until the child is X years old, and then starts increasing until it achieves level $u_C(Y)$ at the child's age Y . It stays at this level until the child is Z years old and then it declines until it reaches level $u_C(U)$ at the child's age U . It stays at this level until the child is V years old, and then gradually increases to reach level $u_C(W)$ at the child's age W . It stay at this level from the child's age W onwards.

Enter the utility levels in cells **B101:B104**. Enter the child’s ages in cells **B108:B113**.



IMPORTANCE COEFFICIENTS

Recall that the quality of life of a woman of age A is evaluated using an additive utility function U_A over the three attributes, so

$$U_A(p_A, s_A, f_A|t) = k_P(A)u_P(p_A|t) + k_S(A)u_S(s_A|t) + k_F(A)u_F(f_A|t)$$

where, u_P , u_S , and u_F are the utility curves defined above and k_P , k_S , and k_F are age dependent importance coefficients that sum to one in each year.

It suffices to enter values for only 2 out of 3 coefficients. In the Excel model you need to set up the professional life and family life importance coefficients, changing with woman’s age. The social life importance coefficient is computed automatically.

Like in the case with the woman’s utility curves, each coefficient $k_P(A)$ and $k_F(A)$ is defined by a parameterized curve, and you need only to set up the parameters defining the shape of the curve.

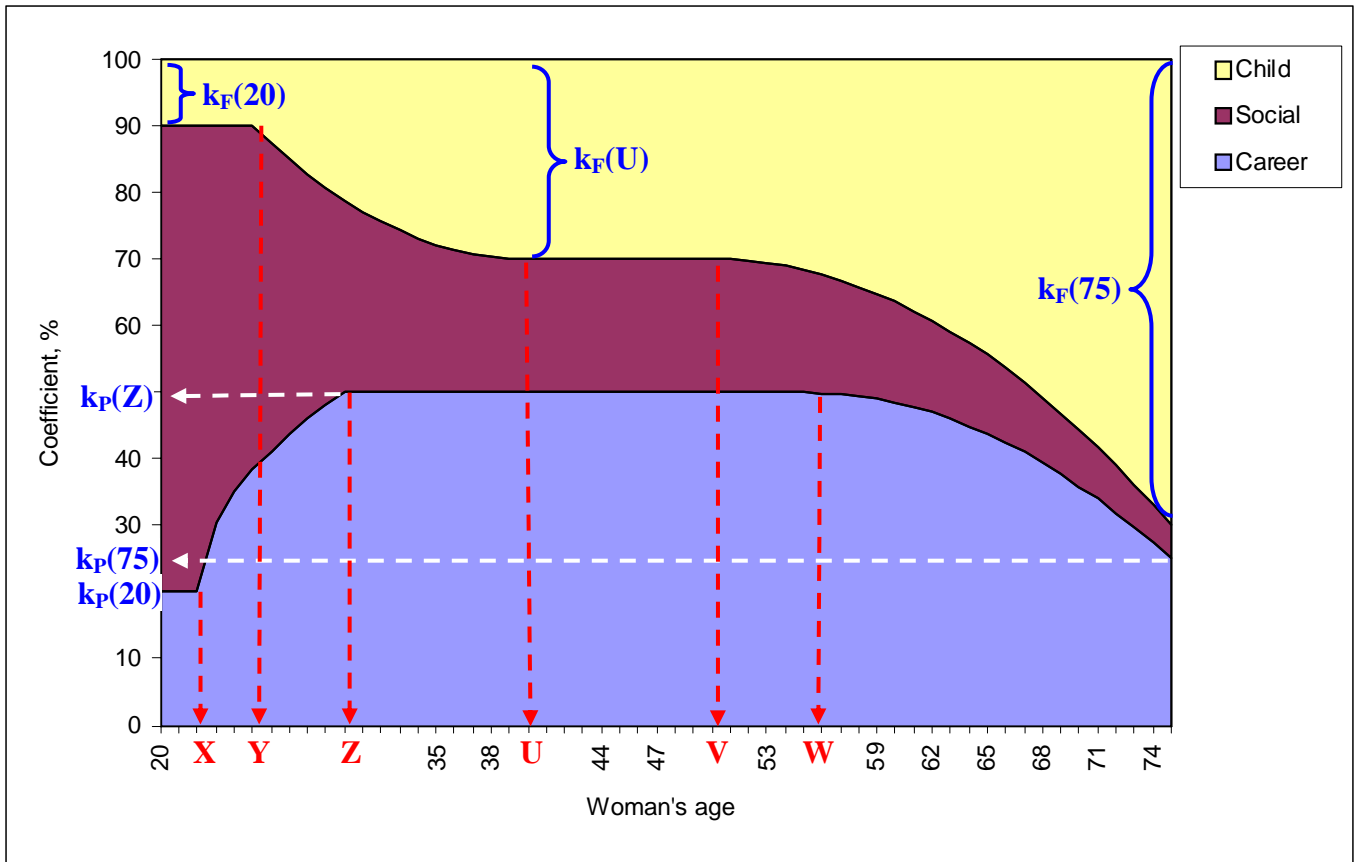
Note: The graph depicts the importance coefficients on a percentage scale 0% to 100% instead of 0 to 1 scale. You must enter parameters on a scale 0-100 as well, omitting the “%” sign.

Professional life importance coefficient, $k_P(A)$

The curve corresponding to $k_P(A)$ starts at the level $k_P(20)$ at the woman’s age 20. It stays flat at this level until the woman is X years old. Then the professional life importance coefficients starts increasing up to level $k_P(Z)$ which it reaches at the woman’s age Z . It stays at this level until the woman is W years old. Then it decreases until it reaches level $k_P(75)$ at woman’s age 75, i.e. at the end of the horizon.

Family life importance coefficients, $k_F(A)$

The curve corresponding to $k_F(A)$ starts at the level $k_F(20)$ at the woman’s age 20. It stays flat at this level until the woman is Y years old. Then the family life importance coefficient starts increasing to level $k_F(U)$ which it reaches at the woman’s age U . It stays at this level until the woman is V years old. Then it increases until it reaches level $k_F(75)$ at woman’s age 75, i.e. at the end of the horizon.



Enter family life importance coefficients and corresponding ages in cells **B120:B122** and **D120:D122** respectively.

Enter professional life importance coefficients and corresponding ages in cells **B125:B127** and **D125:D127** respectively.

	A	B	C	D
116	IMPORTANCE COEFFICIENTS			
117				
118	Vertical (k values):		Horizontal (ages):	
119	kF (family)			
120	kF(20)	10	X	25
121	kF(Y)	30	Y	40
122	kF(75)	70	Z	50
123				
124	kP (professional)			
125	kP(20)	20	U	22
126	kP(V)	50	V	30
127	kP(75)	25	W	55
128				