

# UVapp Documentation

*A. Nugent, Coursera data-products*

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## Description

‘UVapp’ is an interactive, web-based application for indicating maximum safe exposure times to solar UV radiation. Users can select various inputs, including skin type and UN index, and see the output as a pie-chart widget with a caption that displays the estimated time to onset of sunburn.

## Background

Sunburn is caused by prolonged exposure to UV. The duration of safe exposure before onset of reddening of the skin (erythema) depends on skin type as well as the intensity of ambient UV (“UV index”). Reflection from surfaces in the natural environs can augment the amount UV reaching the skin, so that burning occurs sooner.

Many public information services now routinely provide daily forecasts of the UV index. Some wearable devices now measure it directly (e.g. Microsoft Band, Samsung Gear S). However, most people do not know how to convert this data into personal guidelines for safe sun exposure.

## Usage

User inputs are found in the sidebar on the left of the application web page. The “UV index” slider is used to select a value between 2 and 12. The “Environs” drop-down is used to select the natural surface (grass, soil, sand, water, or snow) that dominates the user’s surroundings. The “Skin Type” drop-down is used to select the user’s skin type (I, II, III, IV), with reference to the table shown below the input controls.

The caption, which gives the estimated time to onset of sunburn, and the ‘clock’, which shows the safe exposure time in green, a 20% margin of error in yellow, and overexposure in red, are both updated in response to user input.

## Remarks on Usage

Users should note that safe exposure time is indicative only. Skin typing is a rough approximation, and the biological effects of UV cannot be modelled exactly. Furthermore, the data upon which the model was based originated from a European population, and it is not obvious how skin types in Asian or African populations, for example, would correlate.

## Details

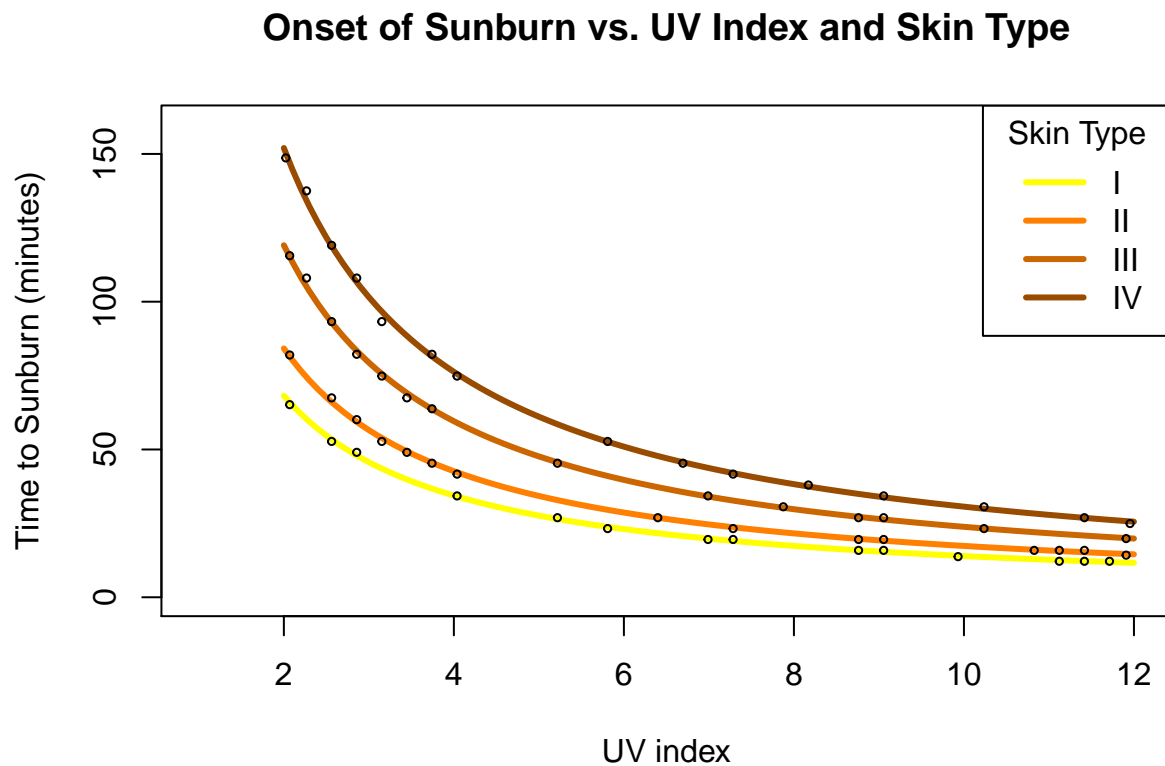
### Data

The raw data source was a published chart depicting erythema time versus UV index for the four skin types, published by the European Union (Ref: UV-Index for the Public – A guide for publication and interpretation of solar UV Index forecasts for the public prepared by the Working Group 4 of the COST-713 Action “UVB

Forecasting”. Karel Vanicek, Thomas Frei, Zenobia Litynska, Alois Schmalwieser. COST-713 Action, Brussels, 1999). The curves were scanned and digitised (using DigitizeIt), then read into R.

## Model

For each skin type, an approximating function was fitted to the data points to as to obtain a smooth line, by fitting a linear model to the logarithms of both the UV index and the time data. This enabled each skin type to be represented by an equation of the form  $y = ax^b$  where  $x$  = UV index,  $y$  = time to onset of sunburn (minutes), and  $a$ ,  $b$  ( $a > 0$ ,  $b < 0$ ) were the results of the modelling (and were different for each skin type). The following chart shows the original data as points with the fitted curves as coloured lines.



The reference publication also included a mention of UV transmittance and reflectance factors for various natural surfaces, ranging from 10% (soil) to 80% (fresh snow). These are used to augment the input value of UV index before obtaining the onset time from the model. This ‘correction’ is arguably crude, but it does provide an additional safety factor.

## Output

Although the displayed value of estimated time to onset of sunburn is sufficient for the user’s risk-mitigation planning, graphical output was included for visual impact. Using a clock symbol and scaling the onset time to 12 hours results in most of the dial being red, emphasising the narrow window of safe exposure. It is hoped that this will promote conscientious use of sun-proof clothing and sunscreen.