Equations

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There are two parts to the model: first, we fit a Gaussian on the subset of players with OVR at least 75 and age between 23 and 28 (inclusive). We exclude cross-correlation terms in the Gaussian for simplicity, so we have a strictly diagonal covariance matrix. Then, we fit a logarithmic curve whose inputs are the outputs of the Gaussian's pdf (ranging from 0 to .0253) and whose outputs are the desired contract lengths (2 to 5 years, ideally). We smush any values output from the log curve that are out of bounds, to the bounds.

The bi-variate Gaussian takes the form

$$\texttt{G\_pdf} = \frac{1}{2\pi\sigma_{age}\sigma_{ovr}} \exp\Big(-\frac{1}{2}\Big[\Big(\frac{age-\mu_{age}}{\sigma_{age}}\Big)^2 + \Big(\frac{ovr-\mu_{ovr}}{\sigma_{ovr}}\Big)^2\Big]\Big); \tag{1}$$

The Gaussian we fit has parameters:

- $\mu_{age} = 25.955128$
- $\mu_{ovr} = 79.384615$
- $\sigma_{age} = 1.524766$
- $\sigma_{ovr} = 4.125377$.

Next, we fit a logarithmic curve on the outputs of the Gaussian pdf. Our curve reflects our desire that most players will desire max length contracts, and only a select few great players in their primes will prefer shorter contracts. To avoid issues with taking the log of 0, we fit an exponential distribution on the inverse of the desired points, and then take the inverse of that exponential distribution. Since an exponential distribution takes the form

$$y = ae^{bx}, \tag{2}$$

where $x =$ `desired_years` is the desired contract length and $y =$ `G_pdf`, it follows from rearranging terms that the desired logarithmic distribution is

$$x = \frac{1}{b}\ln(y) - \frac{1}{b}\ln(a). \tag{3}$$

The curve we fit has parameters:

- $a = 278603$
- $b = -8.10721$.

We notice that we can actually combine equations (1) and (3) into a single equation. Let `normalization` denote the coefficient in front of the exp in equation (1), and let `exponent` denote the term in the exponent (after exp) in (1). Then, we see that

$$\texttt{desired\_years} = \frac{1}{b}(\ln(\texttt{normalization}) + \texttt{exponent}) - \frac{\ln(a)}{b}. \tag{4}$$

This is exactly what is implemented in the `get_desired_years` function.