Assignment 11: Gaussian Random Variates Using Acceptance-Rejection Methods

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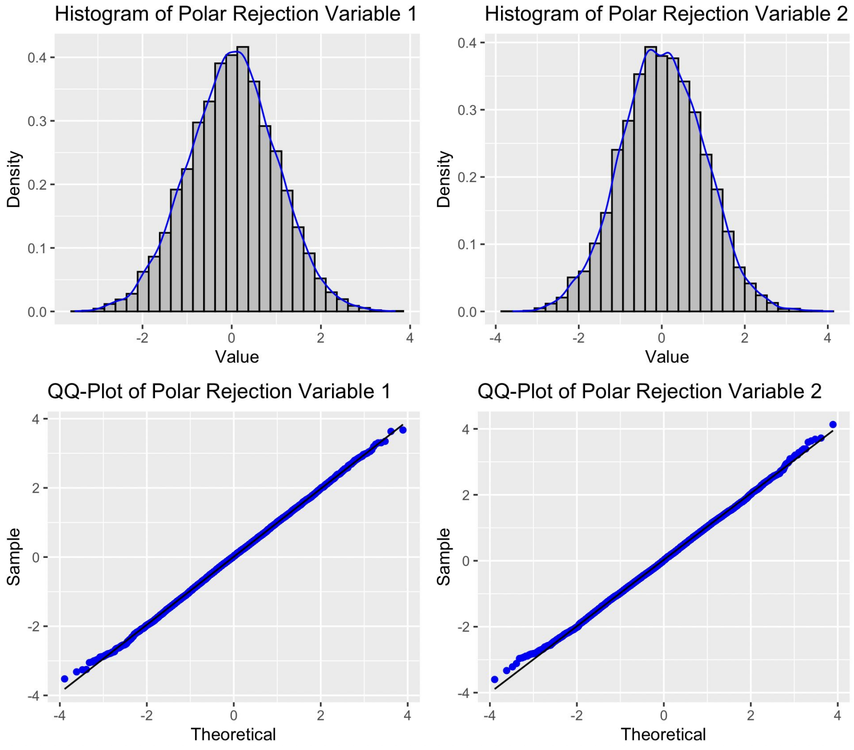
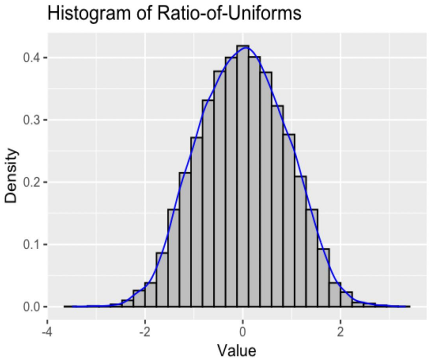
Polar Rejection

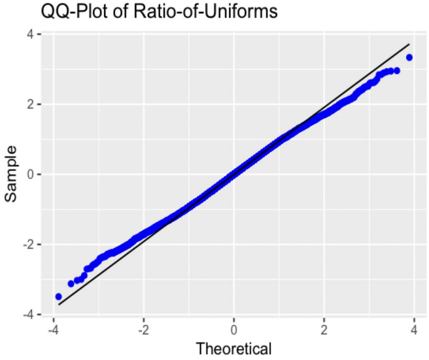


The polar rejection method produced two random variables, their histograms and qq plots are shown on the right. As the plots show, they appear normally distributed; their histograms are bell-curved with good symmetry and reasonable kurtosis, while the qq plots deviate barely from the normal line.

A Shapiro-Wilkins test for normality with the null hypothesis of normality produced p values of 0.1738 for the first variable and 0.3391 for the second, allowing for acceptance of the null hypothesis at all commonly tested significance levels.

Ratio-of-Uniforms

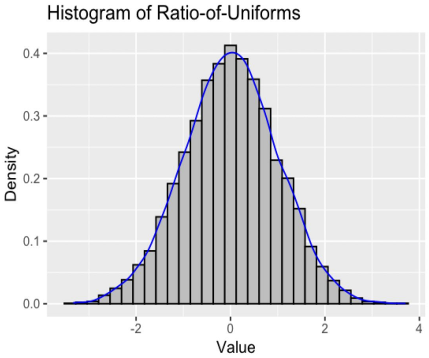


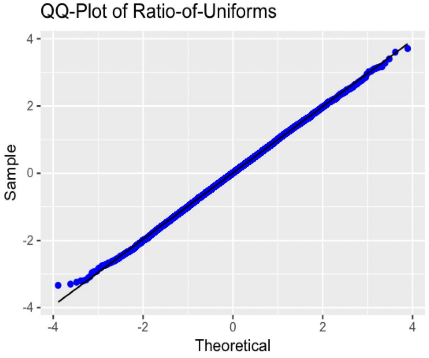


The ratio-of-uniforms function created a random variable, the histogram and qq plot for which are shown to the left. While still approximately normally distributed, the distribution is shorter and deviates more the normal line relative to the variables generated by polar rejection.

Similarly, the Shapiro-Wilkins for normality returned a p-value of 0.00002779, far below the critical value required to reject the null hypothesis at all commonly tested significance levels.

Leva’s Ratio-of-Uniforms





The Leva function produced a random variable, the histogram and qq plot of which are shown to the left. Compared to the ratio-of-uniform variable, Leva’s variable more closely approximates normal: the histogram has better kurtosis and the observations deviate less from the normal line in the qq plot. It is difficult to tell by eye whether this variable appears closer to normal than those produced by polar rejection.

However, a Shapiro-Wilkins test of the null hypothesis of normality returned a p-value of 0.8323, allowing us to accept the null hypothesis at all commonly tested significance levels. This p-value is larger than those for the variables produced by polar rejection, potentially indicating better approximation of normality.