Notebook

February 5, 2019

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In [2]: # Answer to 3c

        n = 1000
        p = 0.997

        k = np.arange(n + 1)                # array of possible values
        binomial_probs = stats.binom.pmf(k, n, p)   # array of exact binomial probabilities

        def poisson_approximation_pmf(j):
            """Returns the Poisson approximation to the
            exact binomial probability of j successes"""
            return stats.poisson.pmf(n - j, n*(1 - p))

        exact_binomial = Table().values(k).probabilities(binomial_probs)
        poisson_approximation = Table().values(k).probability_function(poisson_approximation_pmf)

        Plots('Binomial', exact_binomial, 'Poisson', poisson_approximation)
        plt.xlim(900, 1000)
```

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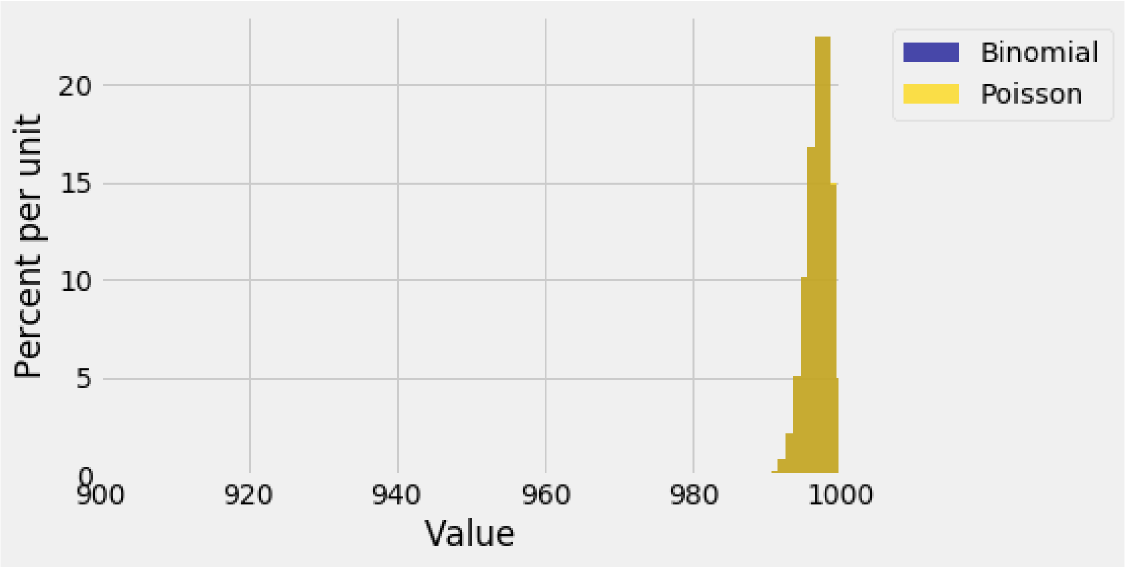
Out[2]: (900, 1000)
```



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In [3]: # Answer to 4a

        p_X_3_Y_7 = stats.binom.pmf(3, 12, 1/6) * stats.binom.pmf(4, 18, 1/6)
        p_X_3_Y_7

Out[3]: 0.03630084173970491
```

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In [4]: # Answer to 4b

        def joint_prob(x,y):
            if y < x:
                return 0
            else:
                return stats.binom.pmf(x, 12, 1/6) * stats.binom.pmf(y - x, 18, 1/6)

        xrange = np.arange(13)
        yrange = np.arange(31)

        joint_dist = Table().values('X', xrange, 'Y', yrange).probability_function(joint_prob)
        joint_dist

Out[4]:                X=0           X=1           X=2           X=3           X=4  \
        Y=30  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
        Y=29  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00  0.000000e+00
        ... Omitting 91 lines ...
        Y=2   0.000000e+00  0.000000e+00  0.000000e+00
        Y=1   0.000000e+00  0.000000e+00  0.000000e+00
        Y=0   0.000000e+00  0.000000e+00  0.000000e+00
```

```
In [9]: # Answer to 4c

        joint_dist.conditional_dist('X', 'Y')

Out[9]:                             X=0           X=1       X=2       X=3       X=4  \
        Dist. of X | Y=30  0.000000e+00  0.000000e+00  0.000000  0.000000  0.000000
        Dist. of X | Y=29  0.000000e+00  0.000000e+00  0.000000  0.000000  0.000000
        ... Omitting 94 lines ...
        Dist. of X | Y=1   0.000000e+00  0.000000e+00  0.000000e+00  1.0
        Dist. of X | Y=0   0.000000e+00  0.000000e+00  0.000000e+00  1.0
        Marginal of X      7.579995e-07  2.756362e-08  4.593937e-10  1.0
```

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In [8]: # Answer to 4d

        # P(X = 3 | Y = 7)

        p_X_3_Y_7 / stats.binom.pmf(7, 30, 1/6)

Out[8]: 0.3306808134394365
```

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In [10]: # Answer to 4g

         # Conditional distribution of X given Y=7

         x = np.arange(8)      # array of possible values of X given Y=7
         stats.hypergeom.pmf(x, 30, 7, 12)
```

```
Out[10]: array([0.01563218, 0.10942529, 0.27777188, 0.33068081, 0.19840849,
                0.05952255, 0.00816976, 0.00038904])
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