Problem 1

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% 5.14
% A power supply is connected to 20 independent loads. Each load is ON 30%
% of the time and draws a current of 0.75 amps. Let X be a current in the
% power supply at a particular moment.

% (a) if X exceeds 13 amps, the power supply is declared to be in a
% critical regime. What is the probability of this happening?
critical13amps = 1-binocdf(17, 20, 0.30);
% >=18 is complement of 17 (13/0.75 = 17), 20 total loads, each load on 30% of the
%     = 3.7731e-08

% (b) Find the probability that X is below 5 amps
sourcenum2 = floor(5/0.75); % 6
below5amps = binocdf(sourcenum2, 20, 0.30);
%     = 0.6080

% (c) Find the expectation and variance of X
X = 15; %20*0.75
p = 0.3;
q = 0.7;
EX = X * p; % 4.5
% VarX = n*p*q
VarX = X*p*q*0.75; % 2.3625
```

Problem 2

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% Emil du Bois-Reymond (1848) observed that the cornea of the eye is
% electrically positive relative to the back of the eye. This potential is
% not affected by the presence or absence of light, and it is not constant
% but randomly varying forming is the basis for the electro-oculogram
% (EOG). Eye movements thus produce a moving (rotating) dipole source and,
% accordingly, signals that are indicative of the movement may be obtained.

% Assume that corneoretinal potential is a random variable X = Y + 0.35 [mV]
% where Y is gamma distributed with shape parameter 3 and rate parameter
% 20 [1/mV] (or equivalently, scale parameter 1/20=0.05 [mV]).

% (a) What is the probability to observe corneoretinal potential X
% exceeding 0.5 [mV].

% P(X > 0.5)=P(Y+0.35 > 0.5)=P(Y > 0.15)
P1 = 1-gamcdf(0.15, 3, 1/20); %0.4232


% (b) If an observed corneoretinal potential exceeds x* it is recorded as
% significant. If, in the long run, we wish to record 5% of observed
% potentials as significant, how the threshold x? should be set?

% 0.05 = P(X > x*) = P(Y-0.35 > x*) = P(Y> x* - 0.35).
% x* - 35 is 0.95-quantile of gamma distribution with shape=3 and rate=20.
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xstar = 0.35 + gaminv(0.95, 3, 1/20); %0.6648
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