Continuous distributions

- Suppose $f(y)$ is a probability density function for a continuous random variable Y.
- Then $\int_{-\infty}^{\infty} f(y)dy = 1$ A) T B) F

Continuous distributions

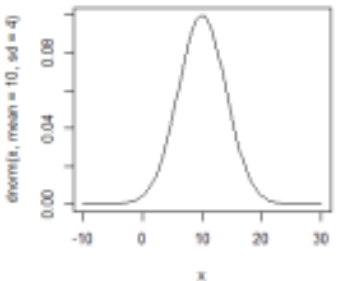
- Suppose $f(y)$ is a probability density function for a continuous random variable Y.
- Then: $P(Y = 2) = 0$ A) T B) F

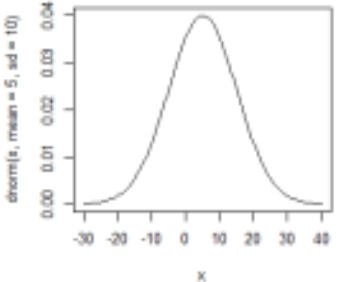
Continuous distributions

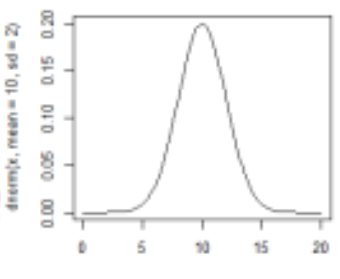
- Suppose $f(y)$ is a probability density function for a continuous random variable Y.
- Then: $f(y) \geq 0$ A) T B) F

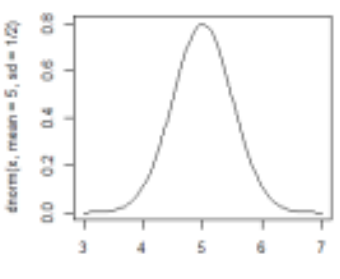
Which line is NOT plotted?

- A) curve(dnorm(x, mean=10,sd=4),xlim=c(-10,30))
- B) curve(dnorm(x, mean=10,sd=2),xlim=c(0,20))
- C) curve(dnorm(x, mean=5,sd=10),xlim=c(-30,40))
- D) curve(dnorm(x, mean=5,sd=1/2),xlim=c(4,7))



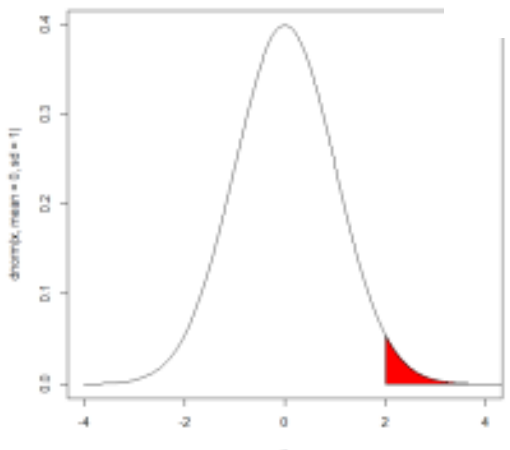






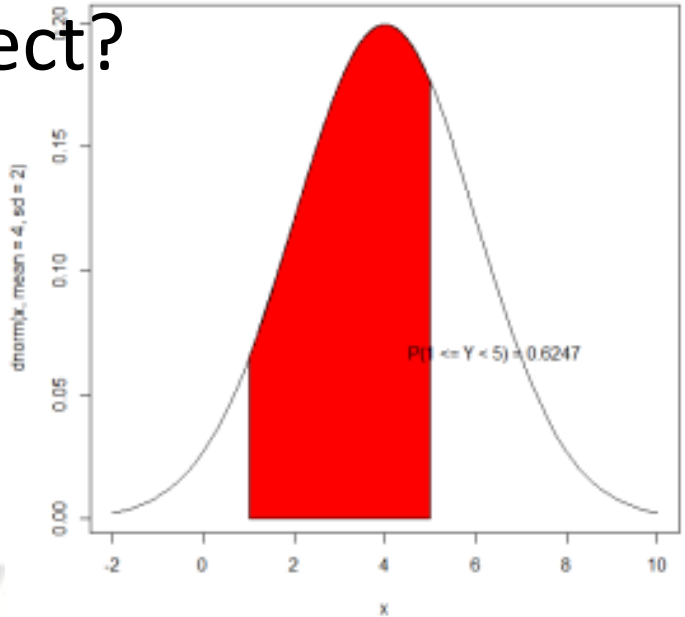
What is the size of the area shaded?

- A) 0.5
- B) 0.7
- C) < 0.5
- D) > 0.5



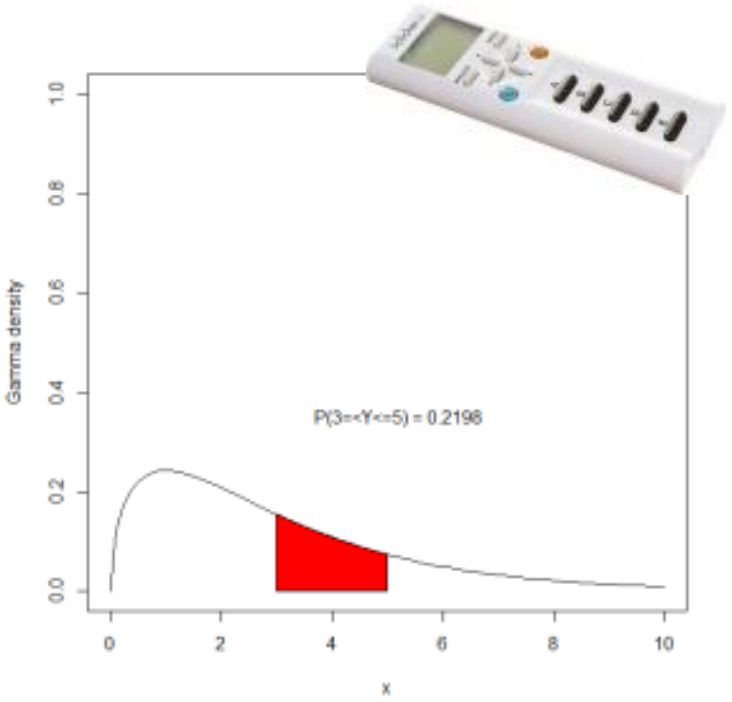
Which line is incorrect?

- A) curve(dnorm(x, mean=4,sd=2),xlim=c(-2,10))
- B) xcurve=seq(1,5,length=1000)
- C) ycurve=dnorm(xcurve,mean=4,sd=2)
- D)polygon(c(1,xcurve,6),c(0,ycurve,0),col="Red")
- E) text(locator(1),paste("P(1 <= Y < 5)","=",round(pnorm(5,mean=4,sd=2)-pnorm(1,mean=4,sd=2),4)))



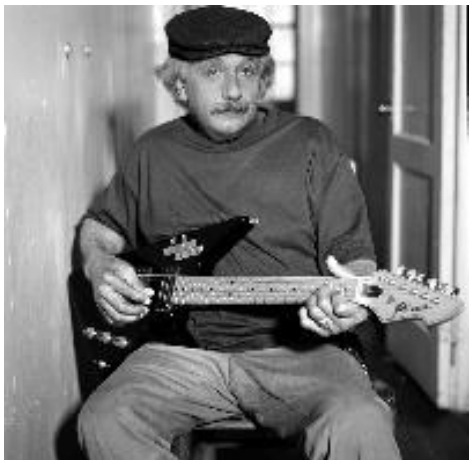
What line calculates the area?

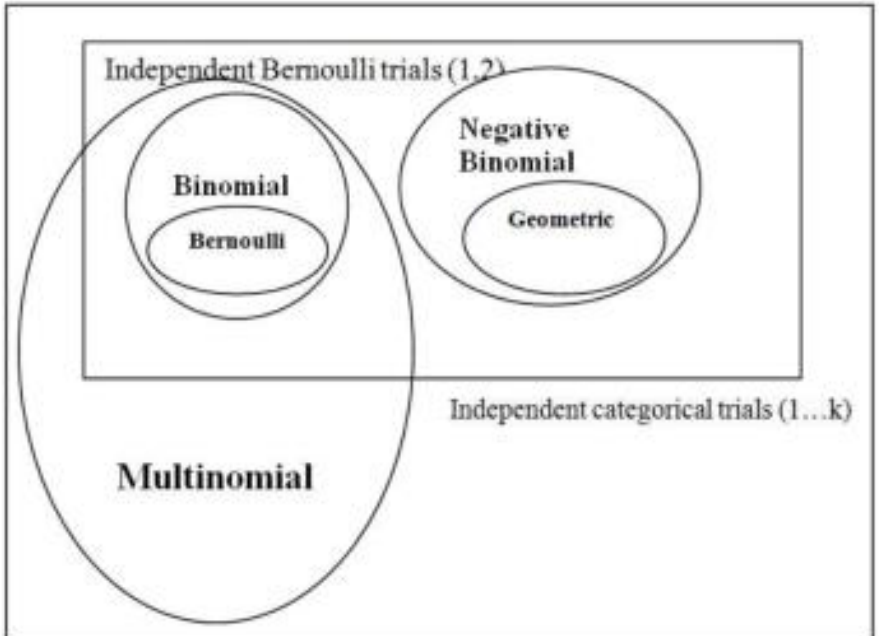
- A) curve(dchisq(x, df=3),xlim=c(0,10),ylim=c(0,1),ylab="Gamma density")
- B) xcurve=seq(3,5,length=1000)
- C) ycurve=dchisq(xcurve,df=3)
- D)polygon(c(3,xcurve,5),c(0,ycurve,0),col="Red")
- E)text(locator(1),paste("P(3=<Y<=5)","=",round(pchisq(5,df=3)-pchisq(3,df=3),4)))

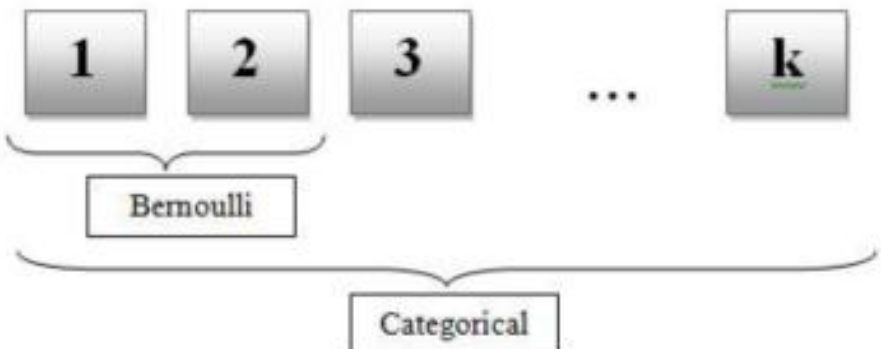


HWK due Wed

- Read Examples 6.1,2,3 page212



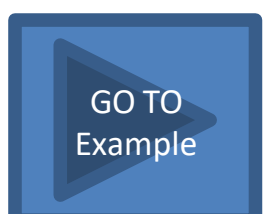

Independent Bernoulli trials (1,2)
Binomial
Bernoulli
Negative
Binomial
Geometric
Independent categorical trials (1…k)
Multinomial


1
2
3
...
k
Bernoulli
Categorical

Are there independent categorical trials?

a. Yes
    i. Is the number of trials fixed?
        1. Yes
            a. Are there more than two categories?
                i. Yes – Multinomial
                ii. No
                    1. Are there 2 or more trials
                        a. Yes – Binomial
                        b. No -- Bernoulli
        2. No
            a. Trials till first success?
                i. Yes – Geometric
                ii. No -- Negative Binomial

b. No
    i. Is there a constant rate?
        1. Yes – Poisson
        2. No – Hyper-geometric



Are there independent categorical trials?

- A) Yes
- B) No
- C) I don't know

25% of bottled water is just tap water packaged in a bottle. Consider a sample of five bottled water brands. Let Y = number of these brands that use tap water.

Are there independent categorical trials?

a. Yes
    i. Is the number of trials fixed?
        1. Yes
            a. Are there more than two categories?
                i. Yes – Multinomial
                ii. No
                    1. Are there 2 or more trials
                        a. Yes – Binomial
                        b. No -- Bernoulli
        2. No
            a. Trials till first success?
                i. Yes – Geometric
                ii. No -- Negative Binomial
b. No
    i. Is there a constant rate?
        1. Yes – Poisson
        2. No – Hyper-geometric

Is the number of trials fixed?

- A) Yes
- B) No
- C) I don't know

25% of bottled water is just tap water packaged in a bottle. Consider a sample of five bottled water brands. Let Y = number of these brands that use tap water.

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        1. Yes
            a. Are there more than two categories?
                i. Yes – Multinomial
                ii. No
                    1. Are there 2 or more trials
                        a. Yes – Binomial
                        b. No -- Bernoulli
        2. No
            a. Trials till first success?
                i. Yes – Geometric
                ii. No -- Negative Binomial
b. No
    i. Is there a constant rate?
        1. Yes – Poisson
        2. No – Hyper-geometric

Are there more than two categories?

- A) Yes
- B) No
- C) I don't know

25% of bottled water is just tap water packaged in a bottle. Consider a sample of five bottled water brands. Let Y = number of these brands that use tap water.

Are there independent categorical trials?

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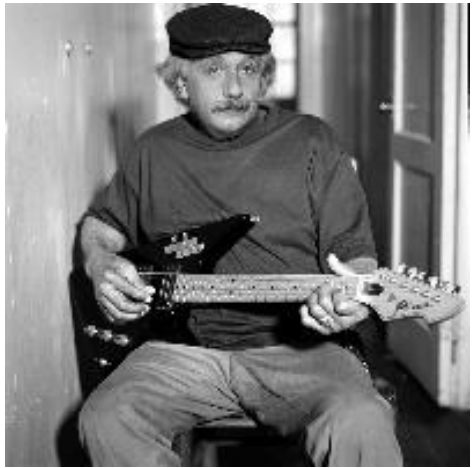
    i. Is the number of trials fixed?
        1. Yes
            a. Are there more than two categories?
                i. Yes – Multinomial
                ii. No
                    1. Are there 2 or more trials
                        a. Yes – Binomial
                        b. No -- Bernoulli
        2. No
            a. Trials till first success?
                i. Yes – Geometric
                ii. No -- Negative Binomial
b. No
    i. Is there a constant rate?
        1. Yes – Poisson
        2. No – Hyper-geometric

Are there 2 or more trials?

- A) Yes
- B) No
- C) I don't know

25% of bottled water is just tap water packaged in a bottle. Consider a sample of five bottled water brands. Let Y = number of these brands that use tap water.

BINOMIAL



Binomial

$$p(y) = \binom{n}{y} p^y q^{n-y}, (y = 0,1,...,n)$$

$$\mu = np, \sigma^2 = npq$$

1. N identical Bernoulli trials
2. Trials are independent
3. Y is the binomial random variable and stands for the number of successes in the n trials

Are there independent categorical trials?

- A) Yes
- B) No
- I don’t know

Suppose the number Y of cracks per concrete specimen is approximately 2.5 (We are interested in the number of cracks per Block)

Are there independent categorical trials?

a. Yes
    i. Is the number of trials fixed?
        1. Yes
            a. Are there more than two categories?
                i. Yes – Multinomial
                ii. No
                    1. Are there 2 or more trials
                        a. Yes – Binomial
                        b. No -- Bernoulli
        2. No
            a. Trials till first success?
                i. Yes – Geometric
                ii. No -- Negative Binomial
b. No
    i. Is there a constant rate?
        1. Yes – Poisson
        2. No – Hyper-geometric

Is there a constant rate?

- A) Yes
- B) No
- I don’t know

Suppose the number Y of cracks per concrete specimen is approximately 2.5

Are there independent categorical trials?

a. Yes
    i. Is the number of trials fixed?
        1. Yes
            a. Are there more than two categories?
                i. Yes – Multinomial
                ii. No
                    1. Are there 2 or more trials
                        a. Yes – Binomial
                        b. No -- Bernoulli
        2. No
            a. Trials till first success?
                i. Yes – Geometric
                ii. No -- Negative Binomial
b. No
    i. Is there a constant rate?
        1. Yes – Poisson
        2. No – Hyper-geometric

POISSON

Poisson

$$p(y) = \frac{\lambda^y e^{-\lambda}}{y!}, y = (0,1,2,\ldots)$$

$$\mu = \lambda, \sigma^2 = \lambda$$

1. Y is the number of times an event occurs within a unit of measurement (like time).

Are there independent categorical trials?

a. Yes
    i. Is the number of trials fixed?
        1. Yes
            a. Are there more than two categories?
                i. Yes – Multinomial
                ii. No
                    1. Are there 2 or more trials
                        a. Yes – Binomial
                        b. No -- Bernoulli
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            a. Trials till first success?
                i. Yes – Geometric
                ii. No -- Negative Binomial
b. No
    i. Is there a constant rate?
        1. Yes – Poisson
        2. No – Hyper-geometric

Are there independent categorical trials?

- A) Yes
- B) No
- C) I don't know

Assume hitting oil at one drilling location is independent of another and the probability of a success is 0.3. What is the probability that a driller will hit oil for the first time on the 10^{th} drilling?

Are there independent categorical trials?

a. Yes
    i. Is the number of trials fixed?
        1. Yes
            a. Are there more than two categories?
                i. Yes – Multinomial
                ii. No
                    1. Are there 2 or more trials
                        a. Yes – Binomial
                        b. No -- Bernoulli
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            a. Trials till first success?
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        1. Yes – Poisson
        2. No – Hyper-geometric

Is the number of trials fixed?

- A) Yes
- B) No
- C) I don't know

Assume hitting oil at one drilling location is independent of another and the probability of a success is 0.3. What is the probability that a driller will hit oil for the first time on the 10th drilling?

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    i. Is the number of trials fixed?
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                        a. Yes – Binomial
                        b. No -- Bernoulli
        2. No
            a. Trials till first success?
                i. Yes – Geometric
                ii. No -- Negative Binomial
b. No
    i. Is there a constant rate?
        1. Yes – Poisson
        2. No – Hyper-geometric

Trials to first success?

- A) Yes
- B) No
- C) I don't know

Assume hitting oil at one drilling location is independent of another and the probability of a success is 0.3. What is the probability that a driller will hit oil for the first time on the 10th drilling?

Are there independent categorical trials?

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            a. Trials till first success?
                i. Yes – Geometric
                ii. No -- Negative Binomial
b. No
    i. Is there a constant rate?
        1. Yes – Poisson
        2. No – Hyper-geometric

GEOMETRIC

Geometric

$$p(y) = pq^{y-1}, (y = 1,2,\ldots)$$

$$\mu = \frac{1}{p}, \sigma^2 = \frac{q}{p^2}$$

1. A sequence of identical Bernoulli trials
2. Each trial is independent
3. The random variable of interest is the number of trials Y until the first success.

Are there independent categorical trials?

a. Yes
    i. Is the number of trials fixed?
        1. Yes
            a. Are there more than two categories?
                i. Yes – Multinomial
                ii. No
                    1. Are there 2 or more trials
                        a. Yes – Binomial
                        b. No -- Bernoulli
        2. No
            a. Trials till first success?
                i. Yes – Geometric
                ii. No -- Negative Binomial
b. No
    i. Is there a constant rate?
        1. Yes – Poisson
        2. No – Hyper-geometric

Are there independent categorical trials?

- A) Yes
- B) No
- C) I don't know

An experiment is conducted to select a suitable catalyst for the commercial production of ethylene diamine (EDA – used in soap). Suppose a chemical engineer randomly selects 3 catalysts for testing from among a group of 10 catalysts, 6 of which have low acidity and 4 of which have high acidity

Are there independent categorical trials?

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    i. Is the number of trials fixed?
        1. Yes
            a. Are there more than two categories?
                i. Yes – Multinomial
                ii. No
                    1. Are there 2 or more trials
                        a. Yes – Binomial
                        b. No -- Bernoulli
        2. No
            a. Trials till first success?
                i. Yes – Geometric
                ii. No -- Negative Binomial
b. No
    i. Is there a constant rate?
        1. Yes – Poisson
        2. No – Hyper-geometric

Is there a constant rate?

- A) Yes
- B) No
- C) I don't know

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                        a. Yes – Binomial
                        b. No -- Bernoulli
        2. No
            a. Trials till first success?
                i. Yes – Geometric
                ii. No -- Negative Binomial
b. No
    i. Is there a constant rate?
        1. Yes – Poisson
        2. No – Hyper-geometric

HYPER-GEOMETRIC

Hypergeometric

$$p(y) = \frac{\binom{r}{y}\binom{N-r}{n-y}}{\binom{N}{n}}, y = Maximum[0, n-(N-r)]\ldots$$

$$Minimum(r, n)$$

$$\mu = \frac{nr}{N}, \sigma^2 = \frac{r(N-r)n(N-n)}{N^2(N-1)}$$

1. Randomly choose n elements from N, without replacement
2. The N objects are made up of two groups, r successes and (N-r) failures
3. Assume large sample size i.e. n/N>0.05
4. The random variable of interest is *Y* the number of successes in the n elements.