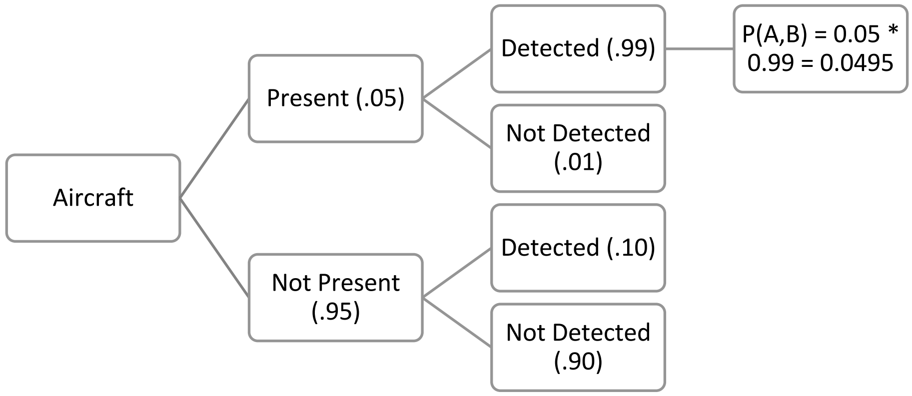
STA 309 – Homework 2

1. The radar registered the presence of an aircraft. What is the probability that an aircraft is actually present?



This problem can be solved using the multiplication rule:

$$P(A \cap B) = P(A)P(B|A)$$

Figuring out if an aircraft is present given the radar registered a presence is the same as the probability that an aircraft is both detected and present, thus the multiplication rule can be used.

P(A): The probability that an aircraft is present, given: 0.05
P(B|A): The probability that an aircraft is detected given that it is present, given: 0.99
P(A∩B) = 0.05 * 0.99 = 0.495

Thus, the probability that an aircraft is actually present with the radar registering the presence of an aircraft is 0.495 or 0.50 / 50% when rounded.

2. Creatinine Dataset
   a. What creatine clearance rate should we expect for a 55-year-old? Explain?

      Using R, it was determined that the linear regression coefficients were as follows:

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(Intercept)          age
147.8129158   -0.6198159
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      Thus we can form the equation $f(clear) = -0.6198x_i + 147.812$. By putting 55 in place of x_i, the predicted creatinine clearance rate is $113.72 {}^{ml}/_{min}$

   b. How does creatinine clearance rate change with age? (Units: ${}^{ml}/_{min/yr}$) Explain?

      Given that R provided the "age" coefficient as -0.6198159, the rate of change per year is $-0.62 {}^{ml}/_{min/yr}$ or 0.6198159 ${}^{ml}/_{min/yr}$

   c. Whose creatine clearance is healthier for their age: a 40-year-old with a rate of 135, or a 60-year-old with a rate of 112? Explain?

      Using R, a data frame was able to be created with the age and predictions vs. the actual creatinine release rate.

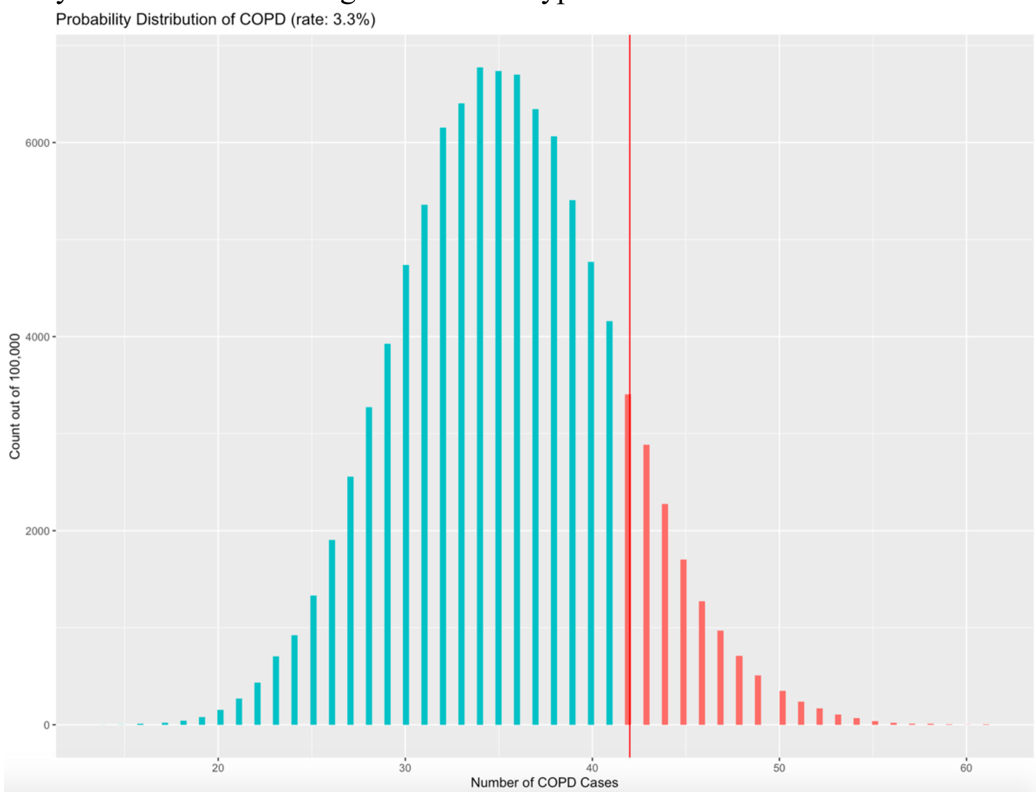
	age	creatclear	prediction
1	40	135	123.0203
2	60	112	110.6240

      For the 40-year-old, the actual level is 135 and their prediction is 123, thus their rate is +12; for the 60-year-old, the actual level is 112 and their prediction is 110, thus their rate is +2. The 40-year old's creatinine rate is healthier for their age, assuming that higher rates of release are higher.

3. Epidemiologists
    a. The null hypothesis:
        Elderly residents within 5 miles of the power plant experience COPD at the national background rate of 3.3%

    b. The test statistic used to measure evidence against the null hypothesis:
        The 49 cases out of 1072 elderly cases that were diagnosed within 5 miles of the powerplant

    c. Probability distribution assuming that the null hypothesis is true:



    d. The p-value itself:
        The p-value, as calculated in R, is .14754, rounded to .15, or 15%.

    e. Conclusion:
        Because the p-value is much larger than 0.05 (0.1475), the null hypothesis that the residents within 5 miles of the plant experience COPD at the normal rate (of 3.3% with 42 cases) is plausible

4. Capital Asset Pricing Model
   a. What is a "beta" value ~ 250 words:

      A beta value of a firm's stock is the measure of systematic risk related to the market as a whole. For a one percentage change in the "market" portfolio, the beta is the percentage change for the stock. For example, if Alcoa had a beta value of 0.28, and the market went up by one percentage point, Alcoa would go up by 0.28 percentage points. If a beta is less than one, there is less risk than the average firm. If a beta is higher than one, it has more systematic risk than the average firm. For example, if GE had a beta of 1.46, and the market went up by 1, it would go up by 1.46; however, when the market goes down, GE falls even further than the market. If a firm had a beta of 0, it would have no systematic risk. If a firm has negative beta, firm will have a negative risk premium; the return is less than the risk rate. The less risky stocks have a lower beta, due to their rate of return being indifferent to the activity of the market, while stock with higher beta are riskier due to their dependence on the activity of the market

   b. Table with caption:

	ticker	intercept	rate	Rsq	market_up	market_down
1	GOOG	0.000	0.650	0.648	0.0132	-0.0128
2	AAPL	0.001	0.013	0.013	0.0010	0.0005
3	MRK	0.001	0.678	0.484	0.0141	-0.0130
4	JNJ	0.000	0.741	0.502	0.0153	-0.0144
5	WMT	0.000	0.550	0.285	0.0113	-0.0107
6	TGT	0.000	0.350	0.248	0.0070	-0.0069

      This table shows each stock ticker with their respective intercept's and rates for a linear regression based on the rate of return for the S&P 500. For example, to predict the beta value for AAPL, you would use the following equation:

$$Y_t^{(K)} = B_0^{(K)} + (B_1^{(K)} \times X_t) + e_t^{(K)} =$$
$$0.001 + (0.013 \times \text{ROR for S\&P 500}) + \text{error}$$

      The "Rsq" column for each ticker shows R-squared value (on a scale of 0-1) or the fraction of variation that the beta value is predictable in terms of the S&P 500 ROR for the given day. For example, for AAPL, the Rsq column is 0.013, which means that 98.7% the stock is individual and not predictable by x, while 1.3% of the stock is.
      The market_up and market_down columns indicate the predicted beta values for the stock at either a 2% ROR for S&P (up) or a -2 ROR for S&P (down).

   c. Conclusion:

      Stock with lowest systematic risk: AAPL due to its low regression rate (0.013), it reacts indifferent when the market goes up or down, so there is less systematic risk. As seen when the market goes up by 2% AAPL rate of return is 0.0010, but when the market goes down, the rate of return is positive 0.0005; therefore, there is less systematic risk.

Stock with highest systematic risk: JNJ due to its high regression rate (0.741), it reacts dependent on market conditions, thus it has more systematic risk. As seen when the market goes up by 2%, it goes up by 0.015, but when it goes down by the same amount, it goes down -0.014.