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CS 2214 Assignment 5
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Problem 1: Relations

1. The relation $R = \{(x, y) | (x - y) \text{ is an even integer}\}$ is an equivalence relation if it is: reflexive, symmetric and transitive. That is, it is equivalent if:

Reflexive: R is reflexive iff (a,a,) is in R for every element a is in A. Note that (4 – 2) = is an even integer because $x \in A \longrightarrow (x,x) \in R$.

Symmetric: R is symmetric iff (b,a) ∈ R whenever (a,b) ∈ R for all a,b ∈ A. Note that, (4 – 2) is an even number, and (2 – 4) is also an even number. Therefore (b,a) ^ (a,b) ∈ R.

Transitive: R is transitive if whenever (a,b) ∈ R and (b,c) ∈ R, then (a,c) ∈ R, for all a,b,c ∈ A. That is, (4, 2) is an even integer and (6, 4) is an even number – therefore, (4, 4) is also an even number according to the relation: (4 – 4) = 0 = **even.**

Therefore, the relation is an equivalence relation.

2.

Problem 2: Basic Probability Calculations

1. There are 18 red numbers and 18 black numbers. The probability the wheel lands on a red number is 18/the total of red and black which is 39. Therefore it is 18/39 = 9/19.
2. Because there are 18 red and 18 black, then the first spin gives 18 options and the second spin gives 18 options as well. Therefore the probability the wheel lands on a black one twice in a row is simply $18^2 = 324$.
3. Either 0 or 00 is 2 favorable outcomes. The total outcomes are 38. Therefore, we divide 2/38 = 1/19. This is the probability it will be either 0 or 00.
4. The favorable outcomes here is NOT 0 or 00, therefore there are 36 possible outcomes because there's 18 red and 18 black. So, we note that subtracting 2 from 38 = 36, and total outcomes is 38. That means we have 36/38 = 18/19. However, we want to know the probability this will be the case for 5 turns, so we do $(18/19)^5$. This expands to 60466176/79235168.

Problem 3: Bayes Theorum

1. Bicyclists who use steroids = 8%.
   Bicyclists who use steroids and test positive = 96%.
   Therefore we have: 0.08 * 0.96 = 0.0768

   Bicyclists who don't use steroids = 92% (100-8).
   Bicyclists who do not use steroids and test positive = 9%.

Therefore we have: 0.92 * 0.09 = 0.0819
Therefore total bicyclists who test positive = 0.0768 + 0.0828 = 0.1596
Random cyclist who tests positive for steroids = 0.0768
So, required probability = 0.07680/15960.07680.1596 = 0.4812 = 48.12%

2. Total that doesn't use steroids is 92%. Total that tests negative is 99%. Therefore using Bayes Theorum we have P(doesn't use steroids ∩ tests negative) = P(0.92 ∩ 0.99) = 0.9108 = 91.08%.

Problem 4: Graphs

1. The first graph is not a Euler circuit because not all vertices have an even number of edges. Moreover, you can clearly tell it's not Euler circuit because you cannot leave from one and get back to the other with only using each edge ONCE.
2. The second one is a Euler circuit because there are all EVEN edges on each vertice.