Name _____ Score _____ Teacher _____ Date _____

Bayesian Prediction, Odds, and Bayes Factors

Use total probability for prior and posterior predictive mixtures. Convert probability and odds carefully. Posterior odds equal prior odds times the Bayes factor; the factor measures evidence direction and is not itself a posterior probability.

1. **The odds for H are 6:2. Convert to probability, then convert that probability back to decimal odds.**

Given: Odds a:b mean probability a/(a+b), not a/b as a probability.

2. **4 possible machines have success probabilities 1, 0.1, 0.4, 0.7 and exact prior weights 1/5, 3/10, 2/5, 1/10. Find the prior predictive success probability. After one success, find the posterior weights and posterior predictive probability for the next trial.**

Given: The machine identity stays fixed; trials are conditionally independent given it.

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Bayesian Prediction, Odds, and Bayes Factors

Use total probability for prior and posterior predictive mixtures. Convert probability and odds carefully. Posterior odds equal prior odds times the Bayes factor; the factor measures evidence direction and is not itself a posterior probability.

3. **A data set has Bayes factor BF_HK = 1.2. Interpret the evidence direction. Is 1.2 the posterior probability of H?**

Given: BF_HK=P(data|H)/P(data|K); posterior odds also require prior odds.

4. **Prior odds for H versus K are 3/4. 2 independent evidence item(s) have Bayes factors 1 and 1.3 for H versus K. Find posterior odds and probability of H.**

Given: Multiply odds by each likelihood ratio; a Bayes factor is not a probability.

Name _____ Score _____ Teacher _____ Date _____

Bayesian Prediction, Odds, and Bayes Factors

Use total probability for prior and posterior predictive mixtures. Convert probability and odds carefully. Posterior odds equal prior odds times the Bayes factor; the factor measures evidence direction and is not itself a posterior probability.

5. **The odds for H are 4:3. Convert to probability, then convert that probability back to decimal odds.**

Given: Odds a:b mean probability a/(a+b), not a/b as a probability.

6. **Prior odds for H versus K are 5/4. 1 independent evidence item(s) have Bayes factors 2 for H versus K. Find posterior odds and probability of H.**

Given: Multiply odds by each likelihood ratio; a Bayes factor is not a probability.

Name _____ Score _____ Teacher _____ Date _____

Bayesian Prediction, Odds, and Bayes Factors

Use total probability for prior and posterior predictive mixtures. Convert probability and odds carefully. Posterior odds equal prior odds times the Bayes factor; the factor measures evidence direction and is not itself a posterior probability.

7. **3 possible machines have success probabilities , 0.6, 0.1 and exact prior weights 3/8, 1/2, 1/8. Find the prior predictive success probability. After one success, find the posterior weights and posterior predictive probability for the next trial.**

Given: The machine identity stays fixed; trials are conditionally independent given it.

8. **A data set has Bayes factor BF_HK = 4. Interpret the evidence direction. Is 4 the posterior probability of H?**

Given: BF_HK=P(data|H)/P(data|K); posterior odds also require prior odds.

Name _____ Score _____ Teacher _____ Date _____

Bayesian Prediction, Odds, and Bayes Factors

Worked Answer Key

Use total probability for prior and posterior predictive mixtures. Convert probability and odds carefully. Posterior odds equal prior odds times the Bayes factor; the factor measures evidence direction and is not itself a posterior probability.

1. **The odds for H are 6:2. Convert to probability, then convert that probability back to decimal odds.**

Answer: P(H)=3/4=0.7500; odds=3

1. P(H)=6/(6+2).
2. Decimal odds=P(H)/(1-P(H))=3.
3. Converting back q/(1+q) gives 0.7500.

2. **4 possible machines have success probabilities 1, 0.1, 0.4, 0.7 and exact prior weights 1/5, 3/10, 2/5, 1/10. Find the prior predictive success probability. After one success, find the posterior weights and posterior predictive probability for the next trial.**

Answer: Prior predictive 0.3800; posterior predictive 0.4947

1. Prior mixture=sum w_i p_i=0.3800.
2. Update weights using the observed-success likelihoods to get (0.3158, 0.0789, 0.4211, 0.1842).
3. Mix the same success rates with posterior weights: 0.4947.

Name _____ Score _____ Teacher _____ Date _____

Bayesian Prediction, Odds, and Bayes Factors

Worked Answer Key

Use total probability for prior and posterior predictive mixtures. Convert probability and odds carefully. Posterior odds equal prior odds times the Bayes factor; the factor measures evidence direction and is not itself a posterior probability.

3. **A data set has Bayes factor BF_HK = 1.2. Interpret the evidence direction. Is 1.2 the posterior probability of H?**

Answer: supports H over K; no, it is a likelihood ratio

1. A factor above 1 favors H; below 1 favors K; 1 is neutral.
2. Here the factor supports H over K.
3. Posterior odds=prior odds x 1.2, so the factor alone is not posterior probability.

4. **Prior odds for H versus K are 3/4. 2 independent evidence item(s) have Bayes factors 1 and 1.3 for H versus K. Find posterior odds and probability of H.**

Answer: Posterior odds 0.7031; P(H|data)=0.4128

1. Posterior odds=3/4(1)(1.3)=0.7031.
2. Convert odds q to probability q/(1+q).
3. P(H|data)=0.4128.

Name _____ Score _____ Teacher _____ Date _____

Bayesian Prediction, Odds, and Bayes Factors

Worked Answer Key

Use total probability for prior and posterior predictive mixtures. Convert probability and odds carefully. Posterior odds equal prior odds times the Bayes factor; the factor measures evidence direction and is not itself a posterior probability.

5. **The odds for H are 4:3. Convert to probability, then convert that probability back to decimal odds.**

Answer: P(H)=4/7=0.5714; odds=1.3333

1. P(H)=4/(4+3).
2. Decimal odds=P(H)/(1-P(H))=1.3333.
3. Converting back q/(1+q) gives 0.5714.

6. **Prior odds for H versus K are 5/4. 1 independent evidence item(s) have Bayes factors 2 for H versus K. Find posterior odds and probability of H.**

Answer: Posterior odds 1.875; P(H|data)=0.6522

1. Posterior odds=5/4(2)=1.875.
2. Convert odds q to probability q/(1+q).
3. P(H|data)=0.6522.

Name _____ Score _____ Teacher _____ Date _____

Bayesian Prediction, Odds, and Bayes Factors

Worked Answer Key

Use total probability for prior and posterior predictive mixtures. Convert probability and odds carefully. Posterior odds equal prior odds times the Bayes factor; the factor measures evidence direction and is not itself a posterior probability.

7. **3 possible machines have success probabilities , 0.6, 0.1 and exact prior weights 3/8, 1/2, 1/8. Find the prior predictive success probability. After one success, find the posterior weights and posterior predictive probability for the next trial.**

Answer: Prior predictive 0.4250; posterior predictive 0.5059

1. Prior mixture=sum w_i p_i=0.4250.
2. Update weights using the observed-success likelihoods to get (0.2647, 0.7059, 0.0294).
3. Mix the same success rates with posterior weights: 0.5059.

8. **A data set has Bayes factor BF_HK = 4. Interpret the evidence direction. Is 4 the posterior probability of H?**

Answer: supports H over K; no, it is a likelihood ratio

1. A factor above 1 favors H; below 1 favors K; 1 is neutral.
2. Here the factor supports H over K.
3. Posterior odds=prior odds x 4, so the factor alone is not posterior probability.