# missing\_data\_type

September 23, 2020

The NA Type in R Paul Stey, Ph.D. 2020-09-16

## 1 1. NA Type

- Used to represent missing data
- Frequently occurs in "real" data sets

#### 1.1 1.1 Checking for NA

• Not necessarily obvious

#### 1.1.1 1.1.1 Correctly Checking for NA Values

```
In [9]: is.na(a)  # the `is.na()` funciton lets us check for missingness
   TRUE
In [10]: is.na(NA)  # yep
   TRUE
In [13]: is.na(42)  # nope
   FALSE
```

#### 1.2 Containers with NA Values

• Propagated NAs can lead to surprising behavior

#### 1.2.1 Finding NAs in vector

```
In [20]: w <- c(4, 5, 33, NA, 7)
    is.na(w)</pre>
```

1. FALSE 2. FALSE 3. FALSE 4. TRUE 5. FALSE

## 2 2. Applied Example

- We are given a large vector with many missing values
- We want to replace the missing values with the mean of the non-missings

### 2.1 2.1 Finding NA Values

• We can use is.na() to find our missing values

In [24]: print(x)

```
[1] -0.9567970841  0.5790187232  0.7770726178 -1.1768428857
                                                           0.9706907395
 [6] -1.6325974820 -2.5564692389 -0.6132367722 1.2200571644 -0.8608689466
[11] 0.7242786026 0.2786743861 -0.1195953412 0.0976578918
                                                           0.3351682084
[16] -0.0813928466 1.9986532931 -1.8018300727 -1.1543910947
                                                          0.7234624562
[21] -0.1685455494 0.0952096687 0.3769857343 -0.2327431911
                                                          0.5051146168
[26]
               NA 0.6234677604 -0.9710526960 0.9338689702 -0.1214318103
[31] -1.0313001207 -1.1698370196 -1.1023318733 -0.2514128798 -0.7392868648
[36] 0.8441845154 0.3447464168 1.4797166939 0.5372408897
                                                          0.6583285071
[41] -0.1653023163 2.0905956325 1.5096391170 0.0453731416
                                                          0.7660911021
[46] 0.1118427629 0.1595289056 1.2602812350 -0.2909843458
                                                          0.1416162166
[51] -1.2184524213 2.2678021280 1.2985946216 0.2876972414 1.3619375964
[56] -0.5253505944 -0.1673978592 0.0162475822 -0.4259452061
                                                          0.1643240506
[61] 0.2394389410 0.3876420922 -0.8983858970 0.3461135561 0.0314846830
[66] 1.2326589444 -0.3073016073 0.2156893025 -0.6753750273 0.4679179507
[71] -1.0006680161 -0.0925369821 -0.1642632060 -1.3188934617 1.2104715923
[76] 0.1060523140 0.6708463188 -1.3191283640 -0.8032869478
                                                          0.9237597202
[81] 0.6617724718 -0.3764802854 -0.2960191955 0.9403744797 -0.1175842951
[86] 1.4269505195 -1.3697479825 0.0855432251 0.7613245460 1.7201970024
[91] -0.5389849115 1.4469682602 0.9441090300 -2.0127736192
                                                          1.2569273930
[96] -0.0844383019 -0.2920513736 0.0218736426 -0.0592747555 -0.6483449744
[101] -0.6594563013 -0.2053896842 1.4237797902 2.4352596839
                                                          1.8456597263
[106] -0.7664906771 1.6990649528 0.0677989369 -2.0790316313 -1.1166881344
[111] 0.5391734992 0.0055429012 0.3618468917 0.1014576313 -1.2601648340
[116] -1.1833713004 -1.3980419806
                                [121] 0.3472057898 -0.3771992085 -0.0765163878 1.9918683951 2.8553997483
[126] 0.6279857863 0.8859555721 -0.7230073409 0.9060860727 -0.6212750357
[136] 0.5470467813 -1.7235894633 1.0483998771 -0.3117514069 -2.9396649055
[141] -0.3307390023 -2.1844282553 0.4357974817 -2.0389474676 -1.4961053801
[146] -0.7742682684 -1.6847067020 0.6300029929 -0.9413151436 -0.0441028935
[151]
    0.7648248749 -0.7004141112
                                1.6545975510 -0.2585274436 -1.0979065555
[156] -1.5656600791 0.2775362902 -1.1886375933 -0.5845123250 -0.4436422647
[161] 0.1141209795 -1.2807248992 -0.6611455316 0.5092278835 -0.0577577862
 \begin{bmatrix} 166 \end{bmatrix} \quad 0.9044838190 \quad -0.1441962747 \quad 0.7375475637 \quad -0.0307158103 \quad 0.2506815764 
[171] 0.7568386836 -0.0135257089 0.2191869738 -1.4539508092 0.4728531836
[176] 0.7382681923 0.0681782868 -0.1105412025 -0.8400459144 1.2602700971
     0.3365198429 -0.1785958837 1.0367476287 0.6066408021 -0.2219735228
[181]
[186]
      0.7256797787 1.4068949106 0.8344696802 -0.8886486517 -0.4268826188
[191] -1.6469481745 -0.1365240374 -0.6496170497 0.1596823220 -0.9401748681
[196] -0.0831400020 -0.9677327430 1.0291719958 0.3989284742 -0.0442961664
[206] 2.3071446046 -2.4455187156 -1.2576699954 -0.4676805000 -0.0283608997
[211] -0.3065989770 -0.9352831091 0.1873108788 -1.1142478065 1.4048048373
```

```
[216] -1.2773426364 0.6870477521 0.5886701920 -0.1721971288 1.2026419660
[221] 0.1420407443 0.5387876517 1.4118727069 -0.5383373774 -0.9227764165
[226] -0.0828877616 -0.3349668788 1.2946585851 -1.5560351062 -0.8903117958
[231] 1.5120860781 0.7758234828 -0.0193401847 -0.9655765592 0.5512948070
[236] -0.0118994827 -0.0718447532 -1.3189984528 0.0087846787 -0.8249375340
[241] 0.4123633252 -0.9645560694 0.0158589251 1.3122444162
[246] -0.0232129668  0.4817210184  1.0656951036  2.0406047763 -2.2463821622
[251] -1.3316615643 0.6280923153 0.4241651262 -1.5651796885 -0.9318593476
[256] 0.5084563994 -0.3222281287 -0.8498705002 -0.3272355875 1.9066100193
[261] -0.1801066232 0.4385325447
                                          NA 1.2650729315 0.2659760409
[266] 1.1947585267 0.8804059445 -0.9471393652 0.1892530788 -1.5269806381
[271] -0.6935863487 -0.6628811128 0.0001683154 -2.0290590521 -1.5126484485
[276] 2.0060697449 -1.6450578975 0.0644916324 -1.3487804557 0.0670050194
[281] 1.8400959909 1.2586120808 2.0989496597 -1.3711359141 -1.4362307962
[286] 1.0710612973 0.8734638544 -1.4432004785 0.9454229931 -0.0824533362
[296] 1.6819300681 1.2400753755 0.0100462259 0.4253890354 -1.5396784184
[301] 1.6519180224 0.7295054793 0.5389440318 -0.8473184981 -0.0356348932
[311] -0.9013165255 -0.4101736290 0.7604440346 -0.0322311368 0.4354839427
[316] 0.7209059413 1.0374407274 -0.0192515338 1.2801622622 0.2230469742
[321] -1.0443346404 -1.3513515076 -0.4359117819 -1.2340461005 0.2925053724
[326] 2.1140032765 0.6402858966 0.1422767261 0.6123965787 0.8204213376
[331] \quad 0.0874539742 \quad 0.7814250341 \quad -0.4154291506 \quad 0.7070122755 \quad -0.6412061162
[336] -0.6665164472 1.5422460504 0.3880523898 1.1070529574 0.8177027283
[341] -1.6178818352 -1.9421435921 1.9575635970 0.6847629034 0.7896386750
[346] -0.7707197965 -0.1538776486 0.9552704939 -0.5148771816 -1.8308451641
[351] -0.9701090435 0.4738698625 -0.3274900230 1.1600808063 1.2085085122
[356] 0.1507132203 -1.1036432938 -0.3691410150 0.6306244612 -1.8206100048
[361] -0.5104693957 -0.2538186052 -0.5710292941 0.3937718295 -0.4321582177
[366] 0.2916293798 1.8449224712 -1.1138310326 1.0813897995 0.7413142879
[376] -0.4296894957 -1.6020408509 -0.5158656132 0.8445501750 2.3966224161
[381] 0.3546665766 1.4165528295 1.2734145157 0.0021085625 0.2712009792
[386] -0.7268773202 -2.0739471236 -0.0028366632 -0.9781378072 -0.3116323418
[391] -0.1381116484  0.3401757130 -1.4930340236  0.5309739248  0.6091796724
[396] -0.4731890293 -0.3002746171 0.2416073138 -0.7336148831 -0.0386125182
[401] 1.5066006856 1.1210260051 -0.3955257740 -1.5785300874 -0.5149953585
 \left[ 406 \right] -0.8763510968 -0.0751874383 \quad 0.6153452401 -0.3202468918 -0.8461755601 
[411] 0.1497653076 -0.6397071552 1.2699596582 -0.0813290750 -0.0556707044
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[421] 0.8072864459 0.4665928087 0.8683025652 0.0220596424 -1.6728692097
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[431] -0.3707886580 0.0204602132 0.9672432906 0.2008306454 0.7518356837
[436] 1.8453588311 1.0826311497 -0.1634740593 -0.0042146117 -1.7022459610
 \begin{bmatrix} 441 \end{bmatrix} \quad 0.4116438615 \quad 0.1856635812 \quad 0.7998991453 \quad -1.3925783603 \quad -0.0625784928 
[446] 1.1380109756 0.6783886450 -0.3937796261 0.2864400342 0.7193686494
[451] -0.0433329296 -0.7772811052 -0.1228123212 0.9205961501 -0.1602606627
```

```
[461] -0.5958422603 2.0600161026 -0.4633373505 0.5506267525 0.5741402175
[466] 0.1817529612 -0.3394788045 -0.7860700745 1.1920534800
                                                       0.7253151681
[471] -3.3319884040 -1.4669574850 -1.3226828686 1.4291499866
                                                        1.3676285250
[476] 0.7537878688 -2.0487903108 2.4930891655 0.9559236129
                                                        0.1017406111
[481]
     0.7495229709 1.7176191656 0.4245151720 0.5864514373
                                                        1.0000890779
[486]
     2.3690653852 0.5054263959 -0.2229831901 0.3253366612 -1.3048383451
 \left[ 491 \right] -0.0742820161 -0.2913330281 -0.1586350129 -1.4723297684 -0.1958137754 
[496]
     1.6466665855 -2.0870806341 0.9595754562 -0.6397065514 0.7035362208
[501]
     1.3115536115 -1.0173467001 -0.8516167740 -1.1672448357
                                                        0.8366417935
[506] -0.6616822162 -0.9485208280 0.2098955182 2.5361787829 -0.1025679153
[511] -0.1580570940 1.2172729340 -0.8471603434 0.5460068196 -0.6001672710
[516] -0.4979131445 0.0561395726 -1.3949680426 -0.7660289547
                                                        0.2128814711
[521] -0.6792025144  0.8411656716  2.0716795011 -1.1816657820 -0.0022471173
[526]
     1.9943385952 -0.9149622995 -0.4055835368 -1.1813124222
                                                       1.2266470399
[531] -1.2583993835 -1.1341686812 0.5323034890 1.7139235003 -0.7340375348
[536] -0.6805755678 -1.3921844427 1.2434227557 -0.1327465054
                                                        2.3771444637
[541] -0.9652688091 -1.4134698089 0.1739005419 -0.9237311438 -0.6183144173
[546] -0.9403986146  0.3844269773 -1.3501340932 -0.5960438043
                                                       0.7609996286
     1.4125084942 0.9693751471 0.5233696279 -1.8287630903 -0.1426569928
[551]
[556]
     0.7045493711 0.7790257804 -1.5679245523 0.5576109456
                                                       0.2880786422
[561]
     1.7773328040 -1.8288616740 -0.1313642871 0.4222746509
                                                        0.8220153113
[566] 0.5771425622 0.0683386277 -2.3167441671 -0.3432316708 0.3523707430
[571] -0.1738912992 -1.0272350667 -0.4807291156 0.2513934136 -0.7105663101
[576] 0.0226319455 -1.4712261335 0.5173696014 2.3395238722 0.4443340716
[581] -0.4012638599 0.0568816704 1.4971348304 0.2549941655 0.7940582451
[586] 0.5235320975 -1.1913089103 -0.7769073330 -0.9604627842 -0.9275498153
[591] -1.4194698651 -0.8508464873 -0.6016162062 0.6640917221 0.0256094374
[596] -1.0180455957 -0.4832423714 0.2415386266 0.5879414397 0.7060075322
[606] -1.0073930281 1.7187151174 0.3212941524 -0.3963514671
                                                       1.2157600091
[616] -0.6850790731 1.0748860060 0.0143565942 1.0457971131 -1.1424096236
[621] 0.1706410778 -0.2070158692 -0.7386752614 1.0097164536 0.5523961832
[626]
     1.2424520908 0.7761291063 0.3269743371
                                                    NA -1.0399661095
[631] 0.0157823642 0.9169628999 -0.3185918262 0.6743410412 1.1897206985
[636] -1.9719657251 -0.3992339348 -0.5329793940 -1.1284076765 1.1716068270
 \begin{bmatrix} 641 \end{bmatrix} \quad 0.0693810693 \quad -0.1016756707 \quad 0.0610076999 \quad 0.6517881476 \quad -0.4576817905 
[651] -0.1831621825  0.3553556850  0.4574802927  0.6374292832  1.1855320170
 \begin{bmatrix} 656 \end{bmatrix} \quad 0.5404132277 \quad 0.6071368415 \quad -0.0885011097 \quad 2.0245394490 \quad 1.4793124505 
[661] -0.3367314728 -0.8245626514 0.0158731109 0.5124591695 -0.0379892486
    0.2998267025  0.5580149649  0.6297927022  -0.4023595500  -1.4669187032
[666]
[671] -0.8617820186  0.2538487431 -0.3291221286  2.1439617319 -1.0929186659
[681] 0.7392081992 -0.3242836043 -0.4265855968 -1.1500977238 -0.8695866649
[691] -0.3721588362 1.5181603388 0.5536763005 0.7418608001 0.2946146036
```

```
[696] -1.1641179867 1.3638566315 1.8971866252 0.5951287109 -0.1415512188
[706] 1.8109433290 1.1505031985 -0.0187803091 0.0378488679 -1.0028728561
[711] 0.4210156127 0.5648194219 0.7803628828 0.0282245723 0.0552260089
[716] 1.1101118660 -0.6379659715 -1.3099354258 -0.9104542083 0.7711042422
[721] -0.8851258664 0.9534370170 1.3148263485 2.1819925879 0.1271918737
 [726] \quad 0.4855519651 \quad -0.2962515401 \quad -1.2001635668 \quad 0.0349427478 \quad -0.5663684251 
[731] -0.0123820653 0.0122592742 -1.0420492604 -0.0433344943 0.7030402456
[736] -1.6123420456 -0.6438396418 1.8944332331 -0.2339270022 0.1483269756
[741] -0.6658586214 -0.6984302658 0.0067976611 -0.8947507391 0.2451220111
 \begin{bmatrix} 746 \end{bmatrix} \quad 0.6585365305 \quad -2.0224907020 \quad -1.3866097383 \quad 0.8871098447 \quad -0.4989989179 
[751] 0.8245169754 -0.3929163073 0.8042212306 0.7332761515 1.3716567741
[756] -0.2303581598 -0.0389248479 0.7550097577 0.8845797460 1.5429157605
[761] 0.5638495052 -0.8282781438 0.3522149389 0.4349659396
                                                              0.8796945814
[771] -0.6111611145 -0.1281827308 0.5860035021 -0.1220381990 0.1708052745
 [776] \ -1.2559328732 \ -0.6745731240 \ -0.9490183805 \ -0.2168970344 \ \ 0.1327129139 
[781] \quad 0.9932013658 \ -0.7431720533 \quad 1.2144870348 \ -1.2223388108 \quad 0.1740592046
 [786] \ -0.6981981027 \ \ 0.4012420608 \ -0.8249480999 \ \ 0.3704438974 \ -0.0515711719 
[791] 0.2828054669 1.5884946708 1.8017644344 0.6324905402 -2.3252357299
[796] 0.1672956632 1.3102306164 0.1815914280 1.0910888177 -0.1084812018
[801] 0.2246386269 -0.7223923860 -0.5795382590 -0.6451341885 -0.5482803775
[806] -1.5704906959 -2.2300832046 -0.1023436901 -0.4057882490 -0.5278459709
 \begin{bmatrix} 811 \end{bmatrix} \quad 0.3491029740 \quad -0.3464577255 \quad -0.0340906524 \quad -0.3296522674 \quad 0.5535747405 
[816] 2.2349620108 -0.4494178478 0.9230118874 -0.3234532092 2.0945533712
[821] -0.4822232146
                               NA -0.3752396310 -1.2379493675 0.8056387844
[826] 0.0370735100 1.2634885588 -1.8024202649 -1.6656158783 0.8693320880
[831] 0.5415189623 1.5097090721 0.8338654405 0.7018644992 1.6399805831
[836] 0.1467376369
                               NA 0.4416428322 -0.0143017933 -0.0470910032
[841] -1.1162641154 -0.1099329094 -0.8506951072 -0.1950709002 -1.4645741120
[846] 2.1142339448 -1.3872409363 0.0282524953 1.5127027670 1.6698992809
[851] 1.7072550789 1.1872645793 -1.2222576021 1.8362406012 -0.2786750289
[856] 0.4580205259 1.2870448201 -0.2724651588 -1.4785315557 -1.5620850599
[861] -1.7240207385 -1.5066370146 -1.0343912041 0.2561264861 1.8521201821
[866]
                NA -0.0989827416 -0.4225346544 0.9107036393 -0.3070134147
[871] -0.2807483172  0.3840271281 -1.9829671473 -1.5581442314  2.3840057537
[876] -2.0776744348 -0.5137337931 1.1943800350 0.5733518264 -0.3249543220
[881] -0.6089225324 -0.7516847571 -1.8875896524 -0.9572708184 0.6630989780
[886] -0.8000707934
                              NA 0.2645913163 0.5137324010 0.5047591456
[891] 1.0548182468
                              NA 2.4180229045 0.9069456538 1.0605646848
 \llbracket 896 \rrbracket \quad 0.6115742210 \quad 0.8410732180 \quad 0.4445317875 \quad -0.1676725173 \quad 0.0514895943 
[901] 0.2216823738 0.1382647760 1.3209743182 1.6375245221 -0.7348659718
[906] 0.1120834792 -1.8310062111 -0.3627764009 -0.3202175833 -0.7038175953
[911] 1.2870811472 2.1854161866 0.7438574456 -0.4220208507 -0.2199884752
[916] -0.6109445976 0.7952523165 -0.5907852111 0.4832687393 -0.0007516915
[921] 0.5136389223 -0.5735496373 -0.9539956800 0.0051622368 -0.1725936427
[926] -1.5256481799 -1.7702970817 -0.6697455913 1.1012995022 -0.5422849058
[931] 0.4706940490 0.5144895402 3.0130076859 0.4912098609 1.1379227635
```

```
[936]
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                                                        NA 0.7402049489
       0.7195497014 -0.1403035797 0.6003622886 -0.4590174362 -0.4476610029
[941]
[946] -2.0637082767 -0.0349306994 0.4717007648 -0.0145159772 0.8211954417
2.3048646527 -0.2673052356 -1.2362690193 -0.4527904362 0.3474454388
[956]
[961] -0.1695991567 -0.6727640414 -0.2304874900 -1.0423760740 -0.0253908862
      1.1233435035 -1.2334794712 0.1144477258 0.3558359456 -1.3317955525
[971] -0.9468821480 -1.2696676629
                                 1.0534020830 -1.2720315710 -2.4551403449
[976] -0.5804786968 1.1716330819 -0.5745054613 -1.3926687202 -0.5544304303
[981] 0.3961521582 -0.2070446840 0.9696727200 1.4668171044 0.5110595647
[986] -0.2877918616  0.5333211769 -0.6259085520  1.0920828520 -2.0817985479
                   1.3198742119 -1.1921084033 1.5037765807 -0.4965836484
[991] -0.4087189079
[996] -0.6938876699 0.7733210214
                                0.8862417292 -0.3871352323
                                                           0.7688160527
[1001] -0.2387526178 -1.0187077803
                                0.6779909087 -0.7162119894
                                                           1.3926012610
[1006] 0.6424452719
                    1.0375320660 -0.1529695934 0.2009461983 -0.3067492978
[1011] -1.1298700145 0.1718857535
                                           NA -0.1292964639 -1.2272348220
[1016] 0.0862970963 0.2127652467
                                 0.1212126354 0.9533315550
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[9996] -0.4785140085 0.4675084872 -0.2980299834 -0.1454882054 -1.2070721762
```

#### 2.1.1 2.1.1 Replace NAs with Mean

```
[46] 4834 4951 5139 5172 5210 5672 5739 5862 5948 6071 6080 6123 6161 6240 6383
[61] 6402 6410 6422 6436 6438 6459 6533 6551 6884 6929 7086 7120 7233 7296 7359
[76] 7543 7641 7647 7694 7758 7830 7839 7993 8294 8366 8397 8465 8519 8540 8626
[91] 8702 8971 8984 9008 9111 9259 9588 9806 9817 9920

In [26]: mean_obs <- mean(x, na.rm = TRUE)  # get mean of observed values

In [27]: x[idx_miss] <- mean_obs  # replace NAs with `mean_obs`

In [28]: mean_obs == mean(x)  # confirm that mean of `x` is same as `mean_obs`

TRUE

In [29]: any(is.na(x))  # confirm there are no longer NA values in `x`

FALSE
```